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Transmittal Acknowledgement

Environmental Resources Management

1701 Golf Road
Suite 1-700
Rolling Meadows, IL 60008
+1 847 258 8900
+1 847 258 8901 (fax)

To:	Stephanie Linebaugh, USEPA Doug Petroff, IDEM Jennifer Seaman, Jacobs
From:	Tim Barber, ERM
Date:	October 7, 2021
Subject:	USS Lead Superfund Site, Operable Unit 2 Revised RI Report

A copy of the Revised Remedial Investigation Report for the USS Lead OU2 Superfund Site is being submitted electronically to USEPA and IDEM.

This deliverable is being submitted pursuant to the Administrative Settlement Agreement and Order on Consent (ASAOC) between the U.S. Environmental Protection Agency - Region 5 (EPA) and USS Lead.

The initial RI Report was revised to incorporate new data and address comments from USEPA and IDEM.

Please contact me at 216-526-2965 or tim.barber@erm.com if you have any questions or require additional information. Thank you.

U.S. Smelter and Lead Refinery, Inc.
(USS Lead)

Remedial Investigation Report, Revised

USS Lead Superfund Site, Operable Unit 2,
5300 Kennedy Ave, East Chicago, IN

October 2021

Project No.: 0432213

The business of sustainability

ERM

Signature Page

October 2021

Remedial Investigation Report, Revised

USS Lead Superfund Site, Operable Unit 2, 5300 Kennedy Ave, East Chicago, IN

Daniel W. Petersen, Ph.D. Partner-in-Charge	Timothy R. Barber, PhD Technical Director, Project Coordinator

Environmental Resources Management, Inc.
1701 Golf Road, Suite 1-700
Rolling Meadows, IL 60008

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Acronyms and Abbreviations

Name	Description
°C	degrees Celsius
°F	degrees Fahrenheit
µg/L	Micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
ACL	Alternate Concentration Limit
amsl	above mean sea level
AOC	Administrative Order on Consent
ALM	Adult Lead Model
ARCO	Atlantic Richfield Company
ASAOC	Administrative Settlement Agreement and Order on Consent
AVS	Acid Volatile Sulfide
BAF	Bioaccumulation Factor
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BTOC	Below Top of Casing
CFR	Code of Federal Regulations
$CaCO_3$	Calcium carbonate
CAMU	Corrective Action Management Unit
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act
cfs	cubic feet per second
cm/sec	centimeters per second
COI	Chemicals of Interest
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
DAI	DAI Environmental, Inc.
DO	Dissolved Oxygen
DU	Decision Unit
ECHA	East Chicago Housing Authority
EJ	Environmental justice
ERC	Environmental restrictive covenant
ERM	Environmental Resources Management, Inc.
ETS	ETS Environmental & Associates
FS	Feasibility Study
FSP	Field Sampling Plan
ft	feet
HASP	Health and Safety Plan

HI/HQ	Hazard Index/Hazard Quotient
HHRA	Human Health Risk Assessment
IDEM	Indiana Department of Environmental Management
IEUBK	Integrated Exposure Uptake Biokinetic Model
IDNR	Indiana Department of Natural Resources
ILRC	International Lead Refining Company
ISM	Incremental sampling methodology
ITRC	Interstate Technology Regulatory Council
LAW	LAW Engineering and Environmental Services, Inc.
LL	Low Level
LOAEL	Lowest Observed Adverse Effect Leve
MCL	Maximum Contaminant Level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	millilitre
mph	miles per hour
MRFI	Modified RCRA Facility Investigation
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Unit
NWIS	National Water Information System
O&M	Operation and Maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PRB	Permeable reactive barrier
PRG	Preliminary Remediation Goal
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RISC	Risk Integrated System of Closure
RME	Reasonable Maximum Exposure

ROD	Record of Decision
RSL	Regional Screening Level
SC	Specific Conductivity
SEM	Simultaneously Extracted Metals
SHAARD	State Historic Architectural and Archaeological Research Database
SHPO	State Historic Preservation Office
SL	Screening Level
SM	Standard Method
SOW	Statement of Work
SPLP	Synthetic Precipitation Leaching Procedure
SVOC	Semi-volatile Organic Compound
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TRV	Toxicity Reference Value
TWA	Time-Weighted Average
µS/cm	Microsiemens per centimeter
USCS	Unified Soil Classification System
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USS Lead	U.S. Smelter and Lead Refinery, Inc.
VOC	Volatile Organic Compound
WP	Work Plan
XRF	X-ray Fluorescence

EXECUTIVE SUMMARY

Environmental Resources Management, Inc. (ERM) was retained by U.S. Smelter and Lead Refinery, Inc. (USS Lead) to conduct a Remedial Investigation (RI) for Operable Unit 2 of the USS Lead Superfund Site (Site or USS Lead Site) in East Chicago, Indiana. The former USS Lead Facility is located at 5300 Kennedy Avenue, East Chicago, Indiana. The work described in this RI Report was completed in accordance with an Administrative Settlement Agreement and Order on Consent (ASAOC) between the U.S. Environmental Protection Agency - Region 5 and USS Lead. The ASAOC was assigned Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) Docket No. V-W_17-C-013 and became effective on October 4, 2017.

The fieldwork for the RI was conducted in 2018 and 2019 and a RI Report, dated January 2020, was submitted to the USEPA. In response to comments from the agency, ERM prepared an RI/Feasibility Study (FS) Field Sampling Plan (FSP) Addendum, dated July 2020. After exchanging comments, the USEPA approved the FSP Addendum on December 2, 2020. ERM conducted additional sampling in March and June 2021 and prepared this revised RI Report, dated October 2021. The current revised RI Report includes historical data and sampling data generated by ERM between 2018 and 2021, and addresses comments provided by the USEPA on the January 2020 RI Report including the Human Health Risk Assessment (HHRA) and Baseline Ecological Risk Assessment (BERA).

The USS Lead Site is divided into two Operable Units (OU1 and OU2). OU1 includes the surface and subsurface soil in a 322-acre parcel bounded by East Chicago Avenue on the north, East 151st Street on the South, the Indiana Harbor Canal on the west, and Parrish Avenue on the east. OU1 has been subdivided into three zones: Zone 1, 2, and 3. OU2 consists of the surface and subsurface soil of the former USS Lead Facility and the groundwater beneath OU1 and OU2. Extensive site characterization and cleanup activities have occurred since its listing on the National Priorities List (NPL) in 2009 and also previously at the former USS Lead Facility under a Resource Conservation and Recovery Act (RCRA) Corrective Action during the 1990s through 2004. Removal and remedial actions taken by EPA and various responsible parties at both OUs are further summarized in later sections of this Report. Please note that while surface and subsurface soil in OU1 is not included in this RI Report, OU1 is mentioned throughout the report, because groundwater in OU1 is included in OU2.

The former USS Lead Facility ceased operations in 1985 and is currently a controlled site consisting of undeveloped land, a Corrective Action Management Unit (CAMU), wetlands, surface water bodies (five open water ponds and a former canal now detached from the Grand Calumet River), and a wooded area with remnants of the original dune and swale complex. No operations related to the former USS Lead Facility occurred in the dune and swale complex. Currently, the only activities taking place at the former USS Lead Facility are related to the Operation and Maintenance (O&M) of the CAMU, routine monitoring of groundwater and surface water, extraction system monitoring and maintenance, and inspections of site security, CAMU cover, vegetation, drainage, erosion, and subsidence, as described in the approved Post-Closure Permit (ETS 2010, 2016). The RCRA closure was completed between 1993 and 2004 and included the remediation of more than 70% of the developed surface area of the former USS Lead Facility. Excavated soil and sediments were placed in the CAMU. Groundwater monitoring at the former USS Lead Facility consists of biannual collection of groundwater samples from the six exterior CAMU monitoring wells (MW10, MW15, MW18, MW21, MW23, and MW25) and three downgradient wells (MW7, MW8, and MW12).

Soil, sediment, surface water, and groundwater sampling has been conducted at the former USS Lead Facility resulting in an extensive database of historical sampling results. During RI/FS planning, historical data were reviewed, and the metals antimony, arsenic, cadmium, lead, and selenium were identified as Chemicals of Interest (COIs) for this RI. At the request of USEPA, iron was added to the list of analytes to provide geochemical context for interpreting the results of the other metals. USEPA also requested analysis of Polycyclic Aromatic Hydrocarbons (PAHs) in groundwater sampled in OU1 during the 1st and 3rd quarters of RI sampling. After the first quarter of groundwater sampling, USEPA requested USS Lead sample three wells previously installed at the former East Chicago Housing Authority (ECHA) property in OU1 Zone 1as part of this RI.

Although groundwater at the former USS Lead Facility has been extensively characterized and monitored, only limited groundwater monitoring had been conducted at OU1 prior to this RI (AMERECO 2017). Eleven groundwater monitoring wells were installed in OU1 in 2018. USS Lead collected four quarters of groundwater data from these wells and three quarters of groundwater data from three existing ECHA wells between 2018 and 2019, and ETS continued to collect groundwater samples from OU2 monitoring wells in accordance with the Post-Closure Permit during this time. In March of 2021, at the request of USEPA, USS Lead installed and sampled three additional wells in OU1 Zone 1, four additional wells around OU1MW05, and two wells (MW21R and MW26) at the former USS Lead Facility. Between 2018 and 2021, USS Lead also collected soil, sediment, and biota samples at the former USS Lead Facility. The data collected between 2018 and 2021 were added to the historical database. The soil and sediment database for the COIs (0 to 2 feet and >2 feet below ground surface [bgs]) was used to evaluate nature and extent of contamination and the fate and potential transport of COIs at the Site. The soil, sediment, groundwater and biota data were used to complete the HHRA and BERA.

The main findings of this RI are:

Soil

- Elevated concentrations arsenic, lead, and antimony were detected near MW7 indicating a potential local source contributing to the elevated levels of these COIs in groundwater.

Sediment

- The concentrations of metals in the southern wetlands were elevated. The levels of arsenic were higher in Decision Unit 5 (DU5), levels of cadmium were higher in DU6 and DU8, and levels of lead were higher in DU8.
- The Acid Volatile Sulfide - Simultaneously Extracted Metals (AVS - SEM) results indicated limited bioavailability of divalent metals (i.e., cadmium and lead) in most parts of the southern wetlands.
- The highest concentrations of arsenic and lead in biota data were reported from DU8, indicating higher potential uptake of these COIs from sediment in DU8.

Surface Water

- Average concentrations of COIs in surface water in the ponds and former canal does not present a significant risk to human health and the environment.

Biota

- Arsenic and lead concentrations in invertebrate tissue samples collected from DU8 were elevated relative to the other DUs.
- The biota data is consistent with the alternative extraction data, indicating limited bioavailability of the COIs in most parts of the southern wetlands.

Groundwater

- Elevated concentrations of antimony and lead in some of the Zone 1 wells compared to the rest of OU1 (Zones 2 and 3) and OU2 suggest the presence of a separate source of these metals in Zone 1.
- Alkaline pH in OU1MW5 is likely the result of shallow groundwater being in direct contact with historic fill that includes slag/cinder material in that location. Monitoring wells installed to the north, south, east, and west of OU1MW5 are consistent with conditions observed throughout Zones 2 and 3.
- Higher arsenic concentrations in the deep wells of the three well pairs (OU1MW3/3D, OU1MW5/5D, and OU1MW6/6D) are related to changes in redox conditions, with deeper water being more reducing, thus resulting in increased dissolved iron and dissolved arsenic. These deep wells are installed in the same water-bearing zone as the shallow wells.
- Increasing concentrations of arsenic in groundwater samples collected from MW7 are likely related to increasing groundwater elevations and leaching from a localized source near MW7.
- Elevated arsenic concentrations in groundwater samples collected from MW21 are related to leaching from a very small source in this area; however, concentrations in groundwater have been decreasing since 2011 and a newly installed well immediately adjacent to MW21 (MW21R) shows much lower concentrations, indicating limited migration of arsenic from the area immediately surrounding MW21.

Human Health and Ecological Risks

- The results of the HHRA indicate that all increased cancer risks were within the acceptable range of 1×10^{-6} to 1×10^{-4}. Hazard indices exceeded unity for the future utility worker scenario. Incidental ingestion of arsenic in OU2 sediment was the primary chemical/pathway driver of this exceedance. These risk estimates are based on conservative assumptions and the predicted exposure concentrations are influenced by a few elevated samples. Potential exposure is limited by security fencing and the environmental covenant precluding development and requiring the use of PPE during any intrusive work.
- No unacceptable risks to human health were identified with potential exposure of COIs in OU1 groundwater. The risk assessment, using conservative exposure scenarios, evaluated exposure to groundwater leaking in basements during flood events or sump pump failures. Groundwater is not used as a drinking water source in OU1 or OU2 and an East Chicago Ordinance prohibits such use now and in the future.
- Lead risk modeling performed for adult receptors exposed to OU2 soil and sediment using USEPA's Adult Lead Model, and child receptors exposed to OU1 groundwater using USEPA's Integrated Exposure Uptake Biokinetic Model, showed that risks are below thresholds of concern for all receptors.
- The results of the BERA indicate that, with respect to the potential for adverse effects to plant and invertebrate receptors, there are exceedances of default literature-based toxicity thresholds (or site-specific tissue residue that rely on such thresholds) for COIs measured in soil, sediment, and biological tissue. Based on the results of the AVS - SEM and Synthetic Precipitation Leachate Procedure (SPLP) analyses, conditions are present in the southern wetlands that limit metal bioavailability and thus their potential to exert adverse effects to benthic invertebrates and plants. Site-wide, surface water does not present potential risk to aquatic biota.

- The BERA concluded that the uptake of arsenic from sediment or soil into plant and invertebrate tissue is occurring and underlies potential wildlife risk for invertivorous birds (American robin and red-winged blackbird) and herbivorous mammals, and that lead in terrestrial (riparian) soil is a risk-driver for the American robin. These risk estimates are based on conservative assumptions and the predicted exposure concentrations are influenced by a few elevated samples.
- The results of the BERA indicate arsenic is the primary driver of risks to wildlife with small home ranges that are assumed to satisfy the bulk of their metabolic requirements in the southern wetlands. Due to the limited habitat quality in the dense, monotypic stand of Phragmites, this area is not expected to support a diverse ecological community.

Recommended Remedial Action Objectives

Following approval of the revised RI Report by USEPA, USS Lead will prepare an FS for the Site to evaluate the following issues in accordance with the RI/FS ASAOC:

1. Elevated arsenic concentrations in groundwater samples from MW7 are related to increasing groundwater elevations and leaching from soluble forms of arsenic in this area. The presence of a local source was confirmed by additional soil data adjacent to MW7. Potential remedial alternatives for the area around MW7 will be evaluated in the FS.
2. Arsenic concentrations in groundwater from MW21 are elevated compared to other monitoring wells at the Site, but have been decreasing since 2011. MW21 was abandoned in March of 2021 and a new well (MW21R) was installed adjacent to the former location of MW21. Based on the low levels of arsenic reported in this well and the additional soil data, the source of arsenic was confirmed to be in the immediate area around MW21. The CAMU is immediately adjacent to this location preventing the removal of shallow soils around the former MW21 area. Arsenic and other COIs will continue to be monitored in MW21R under the RCRA Closure Permit as part of the ongoing CAMU maintenance and monitoring activities. No additional action is required under the RI/FS ASAOC.
3. A portion of the Site includes an undisturbed portion of the dune and swale complex. The dune and swale complex were formed by irregular cycles of high and low water levels of Lake Michigan over geologic time. Much of this covertype has been developed in northwest Indiana. Remaining remnants of the dune and swale complex are considered highly valuable habitat and are protected from development. This portion of the Site was not developed as part of the former USS Lead Facility. This area shows no overt signs of phytotoxicity and available soil data supports the conclusion that it is not directly impacted by former operations and disposal of waste materials. No additional action is required under the RI/FS ASAOC.
4. Other areas of the Site, excluding the southern wetlands, have been remediated under a RCRA Corrective Action. Except for the areas around MW7 and MW21, as discussed above, soil data do not indicate any additional action is required under the RI/FS ASAOC.
5. Levels of arsenic and lead in sediment in and around DU8 (southeast portion of the former USS Lead Facility) are elevated and more bioavailable compared to other portions of the southern wetlands. Biota data collected from DU8 confirm these metals are more bioavailable than other areas of the Site. Potential remedial alternatives around DU8 will be evaluated in the FS.
6. Although concentrations of metals in most parts of the southern wetlands are elevated with respect to background soils, alternative extraction analyses indicate these metals are not bioavailable. Ecological risks calculations based on total metals analyses (i.e., boiling concentrated acids) over-estimate the bioavailability of these metals and exaggerate potential

risks to wildlife with small home ranges. The presence of a dense stand of Phragmites and observations of wildlife in this area supports the conclusion of no unacceptable risk. No remedial alternatives for the southern wetlands, except for the area around DU8, will be evaluated in the FS.

7. Based on the results of the human health and ecological risk assessments, surface water at the Site does not present a potential risk to human health and the environment, and the surface water data do not require additional consideration under the RI/FS ASAOC.
8. Elevated concentrations of antimony and lead were detected in some parts of Zone 1. The distribution of groundwater contamination indicates the elevated levels are associated with a source in Zone 1. This area is being re-developed and USEPA is coordinating the cleanup of this area with the potentially responsible parties. No additional action is required under the RI/FS ASAOC.
9. High levels of pH in OU1MW5 are associated with the presence of slag/cinders in this area. Four monitoring wells were installed outside of the area with slag/cinders to the north, south, east, and west of OU1MW5. Sampling results confirm that conditions in this area, outside of the area with slag/cinders, are similar to other wells in Zones 2 and 3 of OU1. Potential remedial alternatives for this area will be evaluated in the FS.
10. Other than the area around OU1MW5, groundwater in Zones 2 and 3 does not present a potential risk to human health and the environment and does not require additional consideration under the RI/FS ASAOC.
11. Studies conducted in the RI have shown that the Site does not pose an unacceptable human health risk. The HHRA evaluated the reasonable maximum exposure scenario, and the underlying assumptions provided a conservative assessment that tends to overestimate risks. No unmanageable risk was identified. The main driver for the marginal risks estimated for the utility worker and trespasser scenarios is arsenic in sediment at the former USS Lead Facility. Risks to a hypothetical utility worker could be managed with PPE to mitigate exposure to COIs. In addition, access to most of the affected sediment is precluded by dense stands of Phragmites or deep water levels, which limits the potential for exposure by adult and adolescent trespassers likely below what was assumed in the HHRA. No unacceptable risks to human health were associated with subsurface groundwater intrusion into basements in Zones 2 and 3 of OU1. No additional action is required under the RI/FS ASAOC to address potential human health risks associated with any media.

1. INTRODUCTION

1.1 General

Environmental Resources Management, Inc. (ERM) was retained by U.S. Smelter and Lead Refinery, Inc. (USS Lead) to complete a Remedial Investigation and Feasibility Study (RI/FS) for Operable Unit 2 (OU2) of the USS Lead Superfund Site (Site or USS Lead Site). The former USS Lead Facility is located at 5300 Kennedy Avenue, East Chicago, Indiana and consists of a 79-acre parcel of land (**Figure 1.1-1**). The work described in this Remedial Investigation Report was completed in accordance with the Administrative Settlement Agreement and Order on Consent (ASAOC) between the U.S. Environmental Protection Agency - Region 5 and USS Lead. The ASAOC was assigned Comprehensive Environmental, Response, Compensation, and Liability Act (CERCLA) Docket No. V-W_17-C-013 and became effective on October 4, 2017. Specific requirements for the RI/FS work are described in the Statement of Work (RI/FS SOW) included in Appendix A of the ASAOC. The State of Indiana receives copies of all documents related to the project as directed in the ASAOC.

The fieldwork for the RI was conducted in 2018 and 2019 and a RI Report, dated January 2020, was submitted to the USEPA. In response to comments from the agency, ERM prepared an RI/Feasibility Study (FS) Field Sampling Plan (FSP) Addendum, dated July 2020. After exchanging comments, the USEPA approved the FSP Addendum on December 2, 2020. ERM conducted additional sampling in March and June 2021 and prepared this revised RI Report, dated October 2021. The current revised RI Report includes historical data and sampling data generated by ERM between 2018 and 2021, and addresses comments provided by the USEPA on the January 2020 RI Report including the Human Health Risk Assessment (HHRA) and Baseline Ecological Risk Assessment (BERA).

The USS Lead Site is divided into two Operable Units (OU1 and OU2). OU1 has been subdivided into three zones: Zone 1, 2, and 3 and includes the surface and subsurface soil in a 322-acre parcel bounded by East Chicago Avenue on the north, East 151st Street on the South, the Indiana Harbor Canal on the west, and Parrish Avenue on the east (**Figure 1.1-1**). Universal Services (formerly Howard Industries) is located southeast and Sims Metal Management (formerly Metal Recovery Technologies, Inc.) is located southwest of East 151st Street/149th Place, followed by the Indiana Harbor Belt Railroad and then the former USS Lead Facility. The DuPont Facility is located south of OU1 and east of the Site. The former Anaconda Lead Products and International Lead Refining Company (ILRC) Facility occupied the western portion of OU1. Currently, the property is owned by the City of East Chicago following a transfer from the East Chicago Housing Authority (ECHA). A petroleum products tank farm is located east of Parrish Avenue.

OU1 has been investigated and remediated for soil contamination under a Time-Critical Removal Activities Remedial Action Contract between USEPA and SulTRAC beginning in 2008. On September 3, 2014, USEPA entered into a Consent Decree with Atlantic Richfield Company and E. I. du Pont de Nemours to have a USEPA contractor excavate soil from Zones 1 and 3 with concentrations of lead above the established action level (400 mg/kg) in the remaining residential properties, and to transport and dispose of the excavated soil (Civil Action No. 2:14-CV-312 [N.D. Ind.]). In 2018, Atlantic Richfield Company, The Chemours Company FC, LLC, E. I. du Pont de Nemours and Company, Mueller Industries, Inc., United States Metals Refining Company, and U.S. Smelter and Lead Refinery, Inc. provided Notice of Intent to Comply with the Unilateral Administrative Orders for Interior Removal Actions in Zone 2 and 3 of OU1 (CERCLA Docket No. V-W-18-C-006) and for Soil Remedial Action in Zone 2 of OU1 (CERCLA Docket No. V-W-18-C-005).

OU2 includes soil, sediment, and surface water at the former USS Lead Facility and the groundwater under both OU1, Zones 1-3, and OU2 (the "Groundwater") (**Figure 1.1-1**). The former USS Lead Facility is bounded on the north by the Indiana Harbor Belt Railroad, followed by Universal Services on the northeast and Sims Metal Management on the northwest, and then by OU1; on the east by Kennedy Avenue and then by the DuPont plant; on the south and west by the East Branch of the Grand Calumet River; and on the northwest by the Indiana Harbor Canal.

A RCRA closure was completed at the USS Lead Facility between 1993 and 2004 that included establishing a CAMU at the Site to store excavated soil and sediments with elevated lead concentrations from the USS Lead Facility and adjacent areas. The RCRA closure included the remediation of more than 70% of the developed surface area of the former USS Lead Facility. Soil, sediment, surface water, and groundwater have been extensively sampled and analyzed for the chemicals of interest (COIs), and select samples were analyzed for a larger list of chemicals. The data collected after remediation or from areas not remediated were used to establish the Scope of Work for the RI.

The environmental media sampling work described in this RI Report was completed in accordance with a set of RI/FS planning documents prepared by USS Lead. The planning documents include the following:

- An RI/FS Work Plan (WP; ERM 2018a);
- An RI/FS Field Sampling Plan (FSP; ERM 2018b);
- An RI/FS Field Sampling Plan Addendum (FSP; ERM 2020a);
- An RI/FS Quality Assurance Project Plan (QAPP; ERM 2018c); and
- An RI/FS Health and Safety Plan (HASP; ERM 2018d).

The goals of the RI/FS process are as follows:

- Determine the nature and extent of the contamination at the former USS Lead Facility and in the groundwater;
- Evaluate the risks related to the remaining contamination via a HHRA and a BERA;
- Collect sufficient hydrogeological information and engineering data to allow the evaluation of remedial alternatives that can be used to mitigate unacceptable risks;
- Evaluate the need for treatability studies and conduct treatability studies, if necessary; and
- Identify and evaluate potential remedial alternatives to mitigate unacceptable risks.

1.2 Report Organization

This report consists of nine sections outlined below. The complete dataset is provided in the appendices by media and type of data. The HHRA and BERA are attached as appendices.

- Section 1. Introduction. This section provides the rationale for completing this investigation, an introduction to the Site, and describes the Site background including the regulatory history and brief description of previous operations, investigations, and interim measures.
- Section 2. Site Characteristics. This section describes the physiography, soils and sediments, geology, hydrology, hydrogeology, climate, meteorology, demography, land use, and ecological, cultural, and natural resource features of the Site.
- Section 3. Site Investigations. This section presents a detailed description of the historical investigations completed at the Site as well as a detailed description of the field procedures, laboratory analyses, and waste and data management activities performed as part of the current RI.

- Section 4. Nature and Extent of Contamination. This section provides a summary of the historical data review and selection of COIs, a description of the data used in this RI, and a summary of the current and historical data.
- Section 5. Human Health Risk Assessment. This section provides a summary of the results of the HHRA.
- Section 6. Ecological Risk Assessment. This section provides a summary of the results of the BERA.
- Section 7. Contaminant Fate and Transport. This section includes the conceptual site model, definitions of relevant chemical characteristics, general behavior of the COIs under different geochemical conditions, and a discussion of the abundance and distribution of the COIs at the Site.
- Section 8. Summary and Conclusions. This section provides the summary and conclusions of this RI Report.
- Section 9. References. This section lists the references used in preparing this RI report.

1.3 Site Background

The Site has been investigated and interim remedial activities implemented since the 1990s. Therefore, the background information presented in this RI Report was taken from plans and reports prepared to document these previous activities.

1.3.1 Site Setting

As previously indicated in **Section 1.1**, OU2 consists of (1) the former USS Lead Facility and (2) the Groundwater at the entire Site, which includes both the former USS Lead Facility and OU1. The former USS Lead Facility property includes the following features, shown on **Figure 1.3-1**:

- An approximately 10-acre RCRA CAMU and related infrastructure;
- A 39-acre wetland area located south and southeast of a former canal;
- Several surface water ponds to the north, west, and south of the CAMU; and
- A forested uplands area (undeveloped) that has remnants of the original dune and swale complex in the northwest corner of the former USS Lead Facility covering approximately 20 acres.

According to SulTRAC (2012), OU1 consists of 322 acres of mixed-use properties, with 1,271 properties with the following uses:

- Residences, including single and multi-family units some of which were public housing that was demolished in 2018 (in the southwest corner of OU1);
- Generally small commercial/industrial operations;
- Municipal and community offices and operations;
- Two schools (the Carrie Gosch Elementary School and the Carmelite School for Girls);
- Four municipal parks; and
- Numerous places of worship.

The area where both the Carrie Gosch Elementary School and the East Chicago Public Housing complex, immediately south of the school, were built between 1970 and 1973 (the southwest portion of

OU1) was occupied by the Anaconda Lead Products and International Lead Refining Company beginning in 1912. Anaconda Company was acquired by Atlantic Richfield Company (ARCO) in 1977 and subsequently purchased by BP Amoco PLC (now BP PLC).

East Chicago is located within one of the most heavily industrialized areas in the United States, which includes steel mills, oil refineries, heavy manufacturing, chemical processing plants, and heavy rail. The East Chicago area near OU2 has historically supported a variety of industries. USEPA considers East Chicago an environmental justice (EJ) community, based on a population with a minority percentage of 92% (more than twice the state minority percentage; USEPA Region 5 2008).

Both OU1 and former USS Lead Facility soils consist of the former natural dune and swale complex surrounding Lake Michigan, with the swale portions mostly having been filled by slag and other fill material at OU1. The former USS Lead Facility provides habitat to ecological populations because of the presence of wetlands and ponds within the property. A nesting pair of bald eagles is located at the former USS Lead Facility. Bald eagles were delisted as threatened/endangered species but retain special protection under federal laws. State endangered/threatened species have been sighted in the area where the former USS Lead Facility is located. However, there is no record of sighting of federal or State endangered/threatened species at the former USS Lead Facility.

1.3.2 Site Regulatory History

The Site regulatory history is provided in the ASAOC and summarized below:

a. Pursuant to Section 105 of CERCLA, 42 U.S.C. § 9605, USEPA placed the Site on the National Priorities List (NPL), set forth at 40 CFR 300, Appendix B, by publication in the Federal Register on April 9, 2009, 74 Fed. Reg., 16126–34.

b. The Site consists of two OUs: OU1 and OU2.

c. In response to a release or a substantial threat of a release of hazardous substances at or from OU1 of the Site, USEPA commenced, in June 2009, a Remedial Investigation and Feasibility Study (RI/FS) of OU1 of the Site pursuant to 40 CFR 300.430.

d. USEPA completed a RI/FS Report of OU1 in June 2012 (SulTRAC 2012).

e. The decision by USEPA on the remedial action to be implemented at OU1 of the Site is embodied in a final ROD, executed on November 30, 2012, on which the State has given its concurrence. The ROD includes a responsiveness summary to the public comments. Notice of the final plan was published in accordance with Section 117(b) of CERCLA, 42 U.S.C. § 9617(b).

f. OU1 consists generally of a residential neighborhood. In 2014, USEPA divided OU1 into Zones 1, 2, and 3. A map depicting the three Zones is attached as Appendix C [of the ASAOC].

g. Between approximately 1906 and 1985, the USS Lead Facility processed and refined significant quantities of lead and other metals and chemicals, including arsenic.

h. Between approximately 1912 and 1954, facilities in Zone 1 also processed and refined significant quantities of lead and other metals and chemicals, including arsenic and antimony.

i. Between approximately 1893 and 2000, the DuPont Facility, located immediately south of Zone 3 , processed a significant quantity of metals and other chemicals primarily in the production of various inorganic acids and organic and inorganic chemicals, including lead arsenate, and zinc chloride. For much of the time, the DuPont Facility was owned and operated by the E. I. DuPont de Nemours and Company (DuPont). The Chemours Company (Chemours) assumed ownership of the facility in 2015.

j. Lead has been identified in the soil, and arsenic has been identified in the soil and groundwater, at the facilities identified in Paragraphs 8.g–8.i of the ASAOC in RI paragraphs g to i above and in the surrounding area. Only a limited investigation into groundwater conditions has been performed in the residential neighborhood that comprises OU1.

k. On April 10, 1990, Respondent and the Indiana Department of Environmental Management (IDEM) entered into a Partial Interim Agreed Order for Cause No. N-296, for remediation and closure of the former USS Lead Facility.

l. On November 18, 1993, Respondent and USEPA entered into an Administrative Order on Consent (AOC) pursuant to Section 3008(h) of RCRA, 42 U.S.C. § 6928(h), which required Respondent to implement, inter alia, Interim Stabilization Measures at the former USS Lead Facility to relieve threats to human health or the environment.

m. On November 8, 1996, USEPA designated a CAMU at the former USS Lead Facility. The CAMU, construction of which was overseen by federal authorities, includes a perimeter subsurface slurry wall, an engineered final cover, an inwardly induced hydraulic gradient, and a long-term groundwater monitoring system. The designation included a response to comments submitted during the public notice period.

n. Pursuant to the Partial Interim Agreed Order and the Administrative Order on Consent (AOC), Respondent excavated lead-contaminated soils and point-source-discharge canal sediments from both on-site areas and limited off-site areas. Waste removed by these activities was consolidated in the onsite CAMU. Respondent also constructed a berm to isolate the canal from the Grand Calumet River to protect surface water and ecological receptors.

o. Residual contamination from lead and other metals may remain in soil, wetlands, and other areas within the former USS Lead Facility that may result in exposure of contaminants to human and ecological receptors. Groundwater samples hydraulically upgradient of the CAMU also show arsenic at levels above the USEPA Maximum Contaminant Level (MCL), indicating a possible off-site source of groundwater contamination.

p. On June 6, 2005, as part of a closure plan developed with and approved by IDEM, Respondent executed an environmental restrictive covenant that implemented institutional controls at the former USS Lead Facility. Those institutional controls prohibit, inter alia, any activity that will impact, damage or threaten the integrity of the CAMU, the subsurface slurry wall, or the monitoring wells installed around the CAMU.

q. On December 14, 2007, IDEM issued a Post-Closure Permit for the CAMU, which required the Respondent to establish a trust fund for continued maintenance of and monitoring at the former USS Lead Facility in perpetuity. In 2009, USEPA terminated its AOC with Respondent.

r. On February 15, 2017, ECHA finalized its Phase II Environmental Site Assessment for the West Calumet Housing Complex located in Zone 1. Groundwater sampling results from Phase II primarily show arsenic, lead, chromium, and benz(a)anthracene contamination present above IDEM Remediation Closure Guide residential tap screening levels and USEPA MCLs.

s. On June 17, 1997, DuPont and USEPA entered into a RCRA Corrective Action Administrative Order on Consent to determine the nature and extent of any releases of hazardous waste and/or hazardous constituents at or from the DuPont Facility, and to address such releases as appropriate. Contamination at the DuPont Facility is being addressed under this Corrective Action Order.

t. In 2002, DuPont installed a permeable reactive barrier (PRB) near the northern facility boundary to address arsenic-contaminated groundwater coming off the DuPont Facility. Nonetheless, groundwater sampling results from the northern edge of the DuPont Facility continue to show levels of arsenic above the MCL. Groundwater monitored at these wells is expected to be captured by the municipal sewer system; however, USEPA has not verified the extent of capture, and sampling results from the area north of the DuPont Facility (Zone 3) show arsenic in groundwater above the MCL.

u. On August 24, 2020, the City of East Chicago passed and adopted Ordinance No. 20-0013 that prohibits the use of groundwater as a potable water supply by the installation or use of potable water supply wells or by any other means. Lake Michigan is the source of drinking water for residents of the Site. A water well search by ERM identified seven unconsolidated wells and four significant withdraw wells located within one mile of the Site. The ordinance is included in Appendix P and the water well search is included in Appendix Q. USEPA has not identified a path for human exposure to unsafe amounts of lead and arsenic from the groundwater. USEPA anticipates additional corrective action by Chemours to address contaminated groundwater coming from the Former DuPont Facility.

1.3.3 Previous Site Operations, Investigations, and Interim Measures

Except as otherwise indicated via a different source, the information presented in the next three sections is reproduced from the Modified RCRA Facility Investigation (MRFI) (Geochemical Solutions 2004). According to the MRFI, the Historical USS Lead Facility Operations information (Section 1.3.3.1) was developed from the Facility operations history described by ENTACT in the MRFI QAPP, Revision 1, dated September 18, 1997, Section 1.3.1, pages 2-3 (ENTACT 1997). Similarly, the Historical USS Lead Waste Generation and Disposal information (Section 1.3.3.2) was taken from the waste generation and disposal history described by ENTACT in the MRFI QAPP, Revision 1, dated September 18, 1997; Section 1.3.2, page 3 (ENTACT 1997); and the Interim Stabilization Measures Work Plan, Volume 1, Revision 4, dated September 17, 1996, and Section 1.3.2, pages 3-4 (ENTACT 1996).

1.3.3.1 Historical USS Lead Facility Operations

The USS Lead Facility was constructed in the early 1900s by United States Metals Refining Company (USMR). The property was purchased by U.S. Smeltering, Refining, and Mining, the predecessor of USS Lead in 1920. USMR used an electrolytic process called the "Betts process" to refine pre-cast lead bullion anodes into high-purity lead that was free of bismuth. The bismuth dross was then treated to recover gold, silver, and metals of the platinum group. In the Betts process, 400-pound anodes of primary lead bullion were placed in tanks containing cathodes, anodes, and a solution of lead fluosilicate and free hydrofluosilicic acid. During electrolysis, impurities in the primary lead bullion remained on the anode and lead deposited on the cathode. The cathode was then removed, re-melted, and treated with compressed air to oxidize and float any remaining impurities, and the purified lead was cast into lead "pigs." The Betts process volatilized metals during the production process.

The USS Lead Facility buildings constructed in the early days of operation and their uses were as follows:

- The Tankhouse, where lead refining occurred via the Betts Process;
- The Store Building, a warehouse area plus an old boiler facility;
- The Club Building, a worker's cleaning area, lunchroom, locker area, and cafeteria;
- The Main Office and Laboratory Building;
- An "Old Silver Refinery'" building, located to the south of the western end of the Tankhouse;
- The Sulfuric Acid Building, later renamed the Battery Breaker Building;

- The Tellurium Building; and
- The Byproducts Building.

The Mixed Metals Building and Baghouse were constructed around 1926. A 50-ton blast furnace was installed to process the kettle dross but only operated on an intermittent basis due to the limited amount of kettle dross.

Between 1972 and 1973, the facility was converted to a secondary lead smelter, which recovered lead from scrap metal and automotive batteries. Some of the kettles from the Mixed Metals Building were moved to the eastern end of the Tankhouse, which became the new Alloying Department. During plant conversion, the Sulfuric Acid Building was converted for battery processing and renamed the Battery Breaker Building. A 100-ton furnace produced 1-ton lead blocks and smaller 12-pound pigs. The lead blocks and pigs were subsequently re-melted and refined to soft lead, antimony lead, and calcium lead. Metal alloys used in the refining process included silver, copper, tin, antimony, and arsenic. Operations ceased at the USS Lead Facility in December 1985. Additional information related to the locations of various buildings and operational areas at the USS Lead Facility can be found in Appendix B of the RI/FS WP (ERM 2018a).

1.3.3.2 Neighboring Industrial Operations

In addition to the USS Lead smelting operation, some other local industrial operations are known to have managed lead and other metals. For example, immediately east of the Facility, across Kennedy Avenue, is the former DuPont Facility, a portion of which is leased and operated by W.R. Grace & Co., Grace Davison. One of the processes that historically took place at the DuPont Facility was the manufacturing of the pesticide lead arsenate. Northwest of the USS Lead Facility, west of Gladiola Street and north of 151st Street and within Zone 1 of OU1, two smelter operations reportedly managed lead and other metals (Geochemical Solutions 2004). A 1930 Sanborn Map identifies the operations as Anaconda Lead Products and International Lead Refining Company (referred to in this RI/FS WP as the "former Anaconda site") (Geochemical Solutions 2004). According to the Sanborn Map, Anaconda Lead Products was a manufacturer of white lead and zinc oxide, and the International Lead Refining Company was a metal refining facility. These facilities consisted of a pulverizing mill, white lead storage areas, a chemical laboratory, a machine shop, a zinc oxide experimental unit building and plant, a silver refinery, a lead refinery, a baghouse, and other miscellaneous buildings and processing areas. Locations of these possible source facilities are presented in the RI Report for OU1 (SulTRAC 2012).

1.3.3.3 Interim Measures

USS Lead site remediation began under the interim status regulations and pursuant to IDEM Partial Interim Agreement Order in Cause Number N-296, dated April 10, 1990, and pursuant to the US EPA RCRA 3008(b) Administrative Order on Consent, Docket Number V-W-001-94, dated September 20, 1993 (Geochemical Solutions 2004). Remediation began during the fourth quarter of 1994 by ENTACT, Inc., TechLaw, and IT Corporation and generally progressed from the whole site with the Interim Stabilization Measures to specific areas with the MRFI such as the canal, former tank area, railroad sampling and off-site. Interim measures at the USS Lead Facility included removal of the baghouse dust and bags piles and off-site disposal, removal of the slag piles and disposal/storage at the CAMU, demolition and storage at the CAMU of the USS Lead Facility's production plant structures, and removal and storage at the CAMU of soil and sediments with lead concentrations greater than 1,200 mg/kg, which was the Indiana regulatory limit for industrial property uses in the 1990s. The estimated volume of lead-bearing waste contained in the CAMU is 284,000 cubic yards (DAI 2004). **Figure 1.3-2** of this RI Report shows the areas remediated and is based on information provided in Geochemical Solutions (2004). **Figure 1.3-3** of this RI shows the historical building footprints from 1915 to post 1949.

Other than the removal of potential sources via the soil and sediments excavation activities at the former USS Lead Facility and the targeted removal of the top 6 to 24 inches of soil in OU1 there have been no interim measures in OU1 and limited interim measures in OU2 related to groundwater. Historical investigations and the four major site-wide sampling events since 1993 are detailed in **Section 3**.

1.3.4 Current Conditions

USS Lead executed an environmental restrictive covenant (ERC; **Appendix A**) to implement institutional controls at the Facility on June 6, 2005 (Swidler Berlin LLP 2005). The ERC was part of the RCRA closure plan approved by IDEM, and among other provisions, includes prohibition of:

- Any activity that will impact, damage or threaten the integrity of the CAMU, the subsurface slurry wall, or the monitoring wells installed around the CAMU;
- Installation of drinking water wells;
- Use of the property for residences; and
- Off-site placement of surface or subsurface soil from the property unless it is properly sampled and characterized for appropriate use or disposal.

The former USS Lead Facility is currently a controlled site consisting of undeveloped land, the CAMU, wetlands, surface water bodies (three ponds and a former canal now detached from the Grand Calumet River), and a wooded area with remnants of the original dune and swale complex. The only activities taking place are related to the O&M of the OU2, CAMU, and monitoring of groundwater and surface water on a periodic basis, as described in the approved Post-Closure Permit (ETS 2010, 2016). O&M activities include periodic inspections of site security, CAMU cover, vegetation, drainage, subsidence, extraction system monitoring and maintenance, site photographs, CAMU groundwater elevations, and surface water elevations. As dictated in the approved permit, groundwater monitoring consists of the biannual collection of groundwater samples from the six exterior CAMU monitoring wells (MW10, MW15, MW18, MW21, MW23, and MW25), located outside and immediately adjacent to the CAMU and three monitoring wells (MW7, MW8, and MW12) located various distances hydraulically downgradient from the CAMU.

Groundwater samples are analyzed for the following parameters: lead, antimony, arsenic, selenium, and cadmium. In addition, four monitoring wells (MW10, MW18, MW23, and MW25) located outside and immediately adjacent to the CAMU are analyzed for volatile organic compounds (VOCs) annually. To date, no major issues have been encountered during O&M of the CAMU or groundwater monitoring, except that concentrations of dissolved arsenic at MW7 started to increase in 2008. Arsenic concentrations in groundwater are described in more detail in **Section 4.3.1** below.

Recently, a soil and groundwater investigation was conducted in Zone 1 at the ECHA property (AMERECO 2017). Three monitoring wells installed during this investigation were sampled in this RI (ECHA-MW35, MW09, and MW01). One well (ECHA-MW12) was scheduled to be sampled as part of the RI, but it could not be located and was presumed to have been destroyed during the demolition activities at the former ECHA property.

According the USS Lead Superfund Site Newsletter, Issue 05, May 2021 (USEPA 2021), two areas in Zone 1 near the former Carrie Gosch Elementary School were cleaned up. The contaminated soil was excavated from these areas, backfilled with clean soil and restored with grass sod. In Zones 2 and 3, all of the identified properties have been cleaned and restored. USEPA and contractors working on behalf of the potentially responsible parties completed the work during the 2021 construction season. Along with yard cleanups, indoor dust samples were collected with the landowners' permission after the outdoor work was completed. Dust inside the home was collected and tested for lead and arsenic. Houses above USEPA action levels were cleaned (USEPA 2021).

The RI/FS ASAOC indicates that Lake Michigan, instead of groundwater, is used as the source for drinking water for the OU1 residents and that USEPA has not yet identified a path for human exposure to unsafe amounts of lead and arsenic from the Site groundwater (see Paragraph “u” in **Section 1.3.2** of this RI Report). During the March 16, 2018 conference call to discuss USEPA comments on the January 2, 2018 RI/FS planning documents, USEPA mentioned that dermal contact to groundwater may potentially occur via basement flooding, sump pump operations, and seepage of groundwater into residential basements. This potential human exposure pathway was evaluated in the HHRA.

2. SITE CHARACTERISTICS

2.1 Physiography

The Site is located in the Calumet Lacustrine Plain physiographic province of northern Indiana (Schneider 1966) The Calumet Lacustrine Plain is a flat to gently undulating surface that slopes gently to Lake Michigan (USGS 2001). The upper portion of the Calumet Lacustrine Plain consists of dune, beach, and lacustrine sediments that may contain thin, discontinuous layers of muck, peat, and organic material (TechLaw 2004). Prior to the beginning of urbanization and industrialization that began in the early- to mid-1800s, the region consisted of dune and swale complex. This complex was developed from a post-glaciation receding glacial Lake Chicago shoreline, and the corresponding prevailing winds that swept across the lake and inland. Today, the elevation difference between the crest of the dunes and the trough of the swales is typically less than 15 feet (Thompson 1992; MSU 2017). Much of the original dune and swale complex has been altered by urbanization and industrialization in the area, though the northwestern area of the USS Lead Facility has remnants covering approximately 20 acres (Figure B3, Appendix B of the RI/FS WP, ERM 2018a; Geochemical Solutions 2004).

2.2 Soils and Sediments

ERM used the US Department of Agriculture (USDA) Web Soil Survey area-mapping tool to identify soil types present across the Site (**Figure 2.2-1**). According to the mapping tool, the soils at the Site include urban land (Ur) covered by pavement, buildings, other structures, and human-modified soil that does not resemble any mapped soil unit; Oakville-Adrian complex, 0 to 6 percent slopes; and Houghton muck, drained, 0 to 1 percent slopes.

According to Kay et al. (1997), isolated areas of fill less than 10-feet thick are scattered throughout East Chicago, and "these small, thin deposits are widespread in residential areas." Steel industry waste (mainly slag, foundry sand, and casting bricks) are the most widespread type of fill in the study area. The fill may also include dredging spoil, primarily sand and silt-sized sediment derived from the Indiana Harbor Canal, ash, and cinders. Slag is primarily composed of silica, lime, and metal oxides. According to Kay, et al. (1997) "each of the main fill types are composed of mixtures of materials capable of leaching constituents that could adversely affect surface and groundwater quality." According to Duwelius et al. (1996), groundwater in contact with slag can have a pH greater than 12. In addition, ash and cinder fill, which is widespread throughout East Chicago, is capable of leaching silica, sulfate, and metals to groundwater and increasing the pH (Le Seur-Spencer and Drake 1987).

2.3 Geology

Deposits of silt, sand, and gravel associated with glacial Lake Chicago and the later Lake Michigan shoreline and dune and swale sequences prevail across the region. These deposits have a maximum thickness of approximately 50 feet and are referred to as the Calumet aquifer (Fenelon and Watson 1993). The Calumet aquifer is hydraulically capable of providing an abundant supply of groundwater for local use (Geochemical Solutions 2004); however, because it is shallow (generally found to be saturated at 10 feet bgs or less) and has been contaminated by historical industrial activities, it is not utilized as a potable water source. Instead, municipalities near the Site obtain their water supply from Lake Michigan.

The Calumet aquifer extends from the water table (less than 10 feet bgs) to a depth of approximately 25 to 30 feet bgs near the Site. Beginning at 25 to 30 feet bgs, at an elevation of between 555 and 560 feet above mean sea level (amsl), the Calumet aquifer is underlain by the Wadsworth Till and underlying Lemont Formation, which act as a confining unit between the Calumet aquifer and the underlying Paleozoic limestone and dolomite bedrock (Berg, Kempton, and Cartwright 1984). Near the Site, the

Wadsworth Till is approximately 120 feet thick (560 to 440 feet amsl; Watson et al. 1989) and is estimated to have a hydraulic conductivity of 1×10^{-9} to 1×10^{-7} centimeters per second (cm/sec). Based on its very low hydraulic conductivity, the Wadsworth Till acts as an aquitard that restricts downward migration of groundwater from the overlying Calumet aquifer.

Of the 14 available lithologic logs for borings completed at the USS Lead Facility, nine soil borings reached depths of 30 feet bgs or more (Geochemical Solutions 2004). The site-specific geological profile described below coincides with the regional profile outlined in the paragraph above. The sand and gravel layers are part of the Calumet aquifer with very firm gray clay marking the top of the Wadsworth Formation, a lacustrine clay and till stratigraphic unit. No boring logs were identified for borings advanced to either the Lemont Formation or bedrock in the immediate vicinity of the Site. Lithologic logs for the 14 monitoring wells installed at the USS Lead Facility show the typical geological profile for the area (SulTRAC 2012):

- 1 - 2 feet bgs – Fill and sand
- 2 - 29 feet bgs – Fine sand, making up the greatest portion of the Calumet aquifer. Sand particles described as 80 to 90% fine-grained quartz with 10 to 20% other fines (silts/clay). Within this sand unit are thin (0.5- to 2-inch thick) peat lenses that are associated with thin zones of marine fossils ("micro-shells") and black streaking of the peat and/or sand matrix.
- 29 - 30 feet bgs – Layers of coarse sand and/or gravel.
- 30 - 130 feet bgs – Very firm gray calcareous clay unit defined as the top of the Wadsworth Formation, a lacustrine clay and till stratigraphic unit.

According to records of water wells drilled near the Site, the depth to the Silurian/Devonian-aged bedrock is approximately 130 feet bgs (Indiana Division of Water 2017).

Soil borings drilled within Zone 1 of OU1, reported by Amereco Engineering (2017), to a depth of 12 feet bgs indicated the presence of very fine to medium sand, with gravel, slag, and brick and concrete fill material found at depths up to 11 feet bgs. The top one foot had either 3 to 6 inches of topsoil or 6 to 12 inches of asphalt/gravel. In addition, at least two of the Amereco Engineering boring logs, SB-09 and SB-12, noted an "oily sheen" at five feet bgs. Three of the borings drilled by Amereco Engineering that were converted to monitoring wells are present on the former ECHA property and were monitored during this RI per USEPA's request. Those three monitoring wells are identified as ECHA-MW01, ECHA-MW09, and ECHA-MW35 on the groundwater sample location map (**Figure 2.3-1)**.

In November and December 2018 as part of the RI, ERM completed eight shallow borings (OU1MW1 through OU1MW8) and three paired deeper borings (OU1MW3D, OU1MW5D, and OU1MW6D) within OU1 (see locations on **Figure 2.3-1**). The eight shallow borings were completed to total depths of 15 feet bgs; the three deeper borings were completed to 30 feet bgs. At each boring, ERM installed a two-inch diameter PVC monitoring well. Boring logs and well construction diagrams for each boring location are included in **Appendix B**. Surveyed top-of well-casing elevation, ground elevation, spatial coordinates, and well construction details are provided in **Table 2.3-1**.

At each boring location, with the exception of OU1MW1, ERM observed black, dark brown, dark yellow-brown, and dark grayish brown surficial fill material with thicknesses ranging from 0.5 to 6-feet bgs. At the OU1MW5/5D well pair, the fill material appeared to be composed largely of black, gravel- and sand-sized slag/cinders.

In March 2021, four additional shallow monitoring wells were installed around the OU1MW5/MW5D well pair. OU1MW5N, OU1MW5S, OU1MW5E and OU1MW5W were installed north, south, east, and west of the OU1MW5/MW5D well pair. The additional shallow wells encountered brown to dark brown fine sand, thin zones of black organic matter, and gray and black fine sand at depth. Black slag/cinders was not present at any of the additional well locations.

Below the fill material at each boring location, ERM observed native fine to medium silty sand down to total depth. ERM did not observe clay representative of the top of the Wadsworth Formation at any of the boring locations, including at the three deeper borings, indicating that, within OU1, the bottom of the Calumet aquifer is greater than 30 feet bgs and has an elevation below 556 feet amsl.

During drilling activities, ERM observed continuously saturated conditions, believed to be the water table, starting at depths ranging from 3 to 5.5 feet bgs. At monitoring well pairs OU1MW5/5D and OU1MW6/6D, the static water level depth was less than the observed 6-foot fill thickness indicating that shallow groundwater in the uppermost part of the Calumet aquifer was in direct contact with fill material at those two locations.

2.4 Hydrology

The Site is situated within the Grand Calumet River watershed (Hydrologic Unit Code 071200030406), which is approximately 13 miles long and drains approximately 39 square miles of surface area to both Lake Michigan and the Calumet Sag Channel in Illinois (**Figure 2.4-1**).

Since 1909 when the Indiana Harbor Canal was completed, the Grand Calumet River has flowed westward to its junction with the Indiana Harbor Canal. From that junction, surface water from the Grand Calumet River flows northward in the Indiana Harbor Canal, eventually discharging into Indiana Harbor and Lake Michigan. The Site is located northeast of the junction of the Grand Calumet River and the Indiana Harbor Canal, with the Grand Calumet River forming the south and southwest boundary of the Site, and the Indiana Harbor Canal forming the western boundary of the Site. According to Cohen et al. (2002), Plate 1, there is no sheet piling lining the southern stretch of the Indiana Harbor Canal adjoining the Site to influence groundwater-surface water interaction.

The streamflow in the northward flowing Indiana Harbor Canal west of the Site derives from two sections of the Grand Calumet River:

(1) The approximately 10-mile-long east branch extending from just southwest of the Marquette Park Lagoons in Gary, IN to the Indiana Harbor Canal junction; and

(2) An approximately 3,300-ft-long eastward flowing stretch of the west branch extending from approximately the vicinity of the I-90 Indiana Toll Road bridge to the junction with the Indiana Harbor Canal.

Under dry conditions, flow within the west branch of the Grand Calumet River, east of the I-90 Indiana Toll Road Bridge, is derived primarily from treated wastewater discharged by the East Chicago Sanitary District wastewater plant. According to the USGS (Fenlon and Watson 1993), under dry conditions the plant treats and discharges approximately 23 cubic feet per second (cfs). West of the I-90 Indiana Toll Road bridge (the position of this surface water divide location may shift somewhat based on several factors, including the water levels in Lake Michigan), the west branch of the Grand Calumet River continues flowing westward into Illinois where it eventually joins with the Calumet River.

The USGS (Greeman 1995) noted that when Lake Michigan stage level is exceptionally high, for example, greater than 582 feet amsl as it was in early 1986, the Grand Calumet River rises sufficiently in response that its stage elevation crests the surface water divide near the I-90 Indiana Toll Road Bridge. According to the USGS, under these circumstances water from Lake Michigan, via the Indiana Harbor Canal, and the entire length of the Grand Calumet River may flow westward into Illinois (Greeman 1995).

The mean elevation of Lake Michigan recorded at Calumet Harbor (NOAA Station No. 9087044) for the 60-year period from 1 September 1969 through 1 September 2019 was 579.04 feet amsl. Over that 60-year period, the monthly average elevation of Lake Michigan exceeded 582 feet only twice, in May 1986 and again in August 2019 (**Figure 2.4-2**).

The USGS gauging station closest to the Site (No. 04092750) is located on the Indiana Harbor Canal near Canal St. approximately 2.5 miles north of the Site. Data from this station indicate that storms, wind, and barometric effects on Lake Michigan influence stage height within the Indiana Harbor Canal. Watson et al. (1989) observed that wind and/or barometric pressure changes in Lake Michigan caused estuary-like effects on the Indiana Harbor Canal that can be detected as far as four miles upstream from the Lake, which is the distance from Indiana Harbor to the junction of the Grand Calumet River and Indiana Harbor Canal. The Indiana Harbor Canal has a northward gradient of 0.2 feet per mile (Kay et al. 1996). According to available USGS National Water Information System (NWIS) data, from 1995 to 2012 the annual mean instantaneous discharge of the Indiana Harbor Canal at this gauging station ranged from 461.5 to 726.9 cfs.

An additional USGS gauging station (No. 04092677) is present on the east branch of the Grand Calumet River and is located at Industrial Highway in Gary, IN approximately 3.9 miles upstream from the Site. According to available USGS NWIS data, from 1995 to 2012 (the same period available for Station No. 04092750) the annual mean instantaneous discharge of the river at this gauging station ranged from 426.0 to 555.9 cfs. This gauge provides additional insight into river fluctuations.

Figure 2.4-3 provides daily average gauge height from December 2018 to March 2021 from the USGS gauging station closest to the Site (No. 04092750) and indicates the ERM groundwater gauging events. The river stage is lowest from November through March, which probably represents base flow conditions. The gauge height peaks between July and August, then declines back to base flow conditions in November, with a total average river fluctuation across the year of nearly 3.5 feet during a typical year. If this fluctuation reflects conditions adjacent to the Site, then during the wettest portion of the year, the wetlands experience river-flooding conditions.

According to the Post-Closure Permit Application (DAI 2004), the USS Lead Facility consists of approximately 30% low-lying wetlands adjacent to the Grand Calumet River (southeast portion of site), 30% forested uplands area (northwestern portion of the site), 15% CAMU, 5% roads and paved areas (northeast portion of the site), and 20% surface water. The results of the field wetland and waterbody assessment (described in **Sections 2.81** and **3.2.1**) indicated that the majority of the Site includes either wetlands, open water marshes, or dune/swale complex, where the upland forested areas are mixed with lineal depressions of scrub shrub wetlands. Within the central portion of the Site, the open water marshes surrounding the CAMU drain to the open water canal, which drains all surface waters to the wetland area. The canal is separated from the Grand Calumet River by a clay berm, which may be over-topped during periods of heavy rainfall. The open water marshes exhibit little vegetation above the water surface and are bordered by either Phragmites (*Phragmites australis*) or cattail (*Typha x glauca*) dominant emergent wetlands.

The excavations and sand borrow activities in Area A (south of the CAMU), Area B (west of the CAMU), and Area C (north of the CAMU) have resulted in ground surface elevations below typical groundwater levels so that surface water is now present in these areas of the Site. These areas are shown in **Figure 1.3-1**. The estimated area (acres) and depth of the surface water bodies are shown in **Table 2.4-1.** Other surface water bodies at the Site include a former canal and wetlands. Before remediation of the canal sediments, the canal was open to the Grand Calumet River. A clay berm was installed to isolate the canal from the Grand Calumet River before excavation of the canal sediments. Currently, direct drainage to the Grand Calumet River from the Site is impeded by the upland wooded area to the northwest, the canal berm, and the wetlands. Surface water elevations on the Site typically remain elevated several feet above the water level of the Grand Calumet River and tend to be higher in the northern portion of the Site (DAI 2004).

As indicated in **Section 2.1**, OU1 is a mixed-use area and does not have permanent surface water features that may drain to the Indiana Harbor Canal, located just west of Zone 1 of OU1.

2.5 Site Hydrogeology

2.5.1 Groundwater Elevations

Thirty-five groundwater elevation measurement events were conducted at the former USS Lead Facility between the first quarter of 2003 and the fourth quarter of 2016, during the post-closure period (DAI 2003 - 2004; and ETS 2005 – 2016). A table of historical groundwater elevations is provided in **Appendix C**. Following the installation of additional monitoring wells at OU1 in November and December 2018, four additional quarterly measurement events were completed by ERM and ETS at the Site in December 2018, March 2019, June 2019, and August 2019. An additional groundwater-monitoring event was performed in March 2021. The results of these events are summarized below, and a full list of the results is included in **Table 2.5-1.**

Summary of groundwater monitoring events.

Sampling Event	Area	Minimum Depth to Water (ft BTOC)	Maximum Depth to Water (ft BTOC)	Minimum Groundwater Elevation (ft AMSL)	Maximum Groundwater Elevation (ft AMSL)
December 2018	OU1, Z1	2.12	4.19	581.63	583.42
	OU1, Z2	5.08	5.33	580.57	581.81
	OU1, Z3	3.02	5.05	580.83	582.70
	OU2	1.90	15.53	576.73	584.86
March 2019	OU1, Z1	1.44	4.19	581.66	584.10
	OU1, Z2	5.20	5.38	580.62	581.52
	OU1, Z3	2.68	5.09	580.92	583.04
	OU2	1.92	15.47	576.79	585.19
June 2019	OU1, Z1	0.28	3.30	582.53	585.32
	OU1, Z2	4.07	4.84	581.01	582.43
	OU1, Z3	1.66	4.42	582.29	584.23
	OU2	1.49	15.43	576.83	585.82
August 2019	OU1, Z1	2.95	4.50	581.34	583.00
	OU1, Z2	5.55	5.88	580.30	581.02
	OU1, Z3	3.33	5.47	580.33	582.44
	OU2	1.30	15.40	576.86	584.25

The depth to the water table at the Site ranged from 0.28 to 15.53 feet below top of casing with elevations of the groundwater table ranging from 585.82 feet amsl in OU2 east of the CAMU to 576.73 feet amsl within the actively pumped CAMU slurry wall. The webpage of the US Department of Housing and Urban Development (1980) that shows the Flood Insurance Rate Map for this area indicates that the 100-year flood zone for the USS Lead Facility is at an elevation of 585 feet amsl, which implies that the East Branch of the Grand Calumet River may discharge to the Calumet aquifer in the area during a 100-year storm event.

2.5.2 Groundwater Flow

Site groundwater contour maps showing groundwater flow directions and water table potentiometric divides for the Calumet aquifer for gauging events completed in December 2018, March 2019, June 2019, August 2019 and March 2021 are presented on **Figure 2.5-1 to 2.5-5,** respectively. A graph showing the surface water elevation of the Indiana Harbor Canal at USGS gauging station No. 04092750 approximately 2.5 miles north of the Site during the same time is shown on **Figure 2.4-2**. Because the surface water flow direction is typically from the Grand Calumet River northward through the Indiana Harbor Canal to Lake Michigan, the elevations illustrated by the graph would be slightly lower than the surface water elevations of the base-level river and Indiana Harbor Canal bounding the Site to the south and west, respectively. The Indiana Harbor Canal elevations on the date of each measurement event are provided in the upper left corner of each contour map. .

The following observations were common to all of the groundwater contour maps:

- A water table divide extends west-northwest from the northeast corner of OU2 towards the raised railroad bed north of MW3 before curving northward beneath OU1 Zone 1.

- The east-west portion of that divide appears to be a westward extension of the same north-south Calumet aquifer groundwater divide documented repeatedly during previous work at the DuPont Facility east of Kennedy Ave (e.g., see Figure 1, Parsons 2013). South of the divide, groundwater flows to the Grand Calumet River; north of the divide, groundwater flows to Lake Michigan and/or is captured by infiltration into the sewer system serving nearby residential areas.

- The water table beneath OU1 Zones 2 and 3 appears to be depressed by infiltration of shallow groundwater into older, degraded sanitary sewers 8 to >60 inches in diameter located below the water table, a phenomenon previously documented near the Site by Fenlon and Watson (1993), Greeman (1995), and Cohen, et al. (2002). This dewatering is most clearly demonstrated by the potentiometric heads at OU1MW7 and OU1MW1, in the northern part of OU1 Zones 2 and 3, which were lower than the elevation of the Indiana Harbor Canal, the nearest base level surface water body, during each of the five measurement events.

- A sewer-induced potentiometric trough in the water table appears to extend southward from the area between OU1MW7 and OU1MW1, past OU1MW5, eventually truncating at the groundwater divide northwest of MW3. The groundwater flow direction is north-northeasterly along the axis of the trough toward the degraded sewer system 8 to >60 inches in diameter located under the older residential neighborhood within OU1 Zones 2 and 3.

- The north-south trending portion of the groundwater divide, through OU1 Zone 1, is an elongated narrow mound formed by the surface infiltration within OU1 Zone 1 being (1) dewatered on the east by the degraded sewer system beneath the older residential neighborhood, and (2) discharged westward to the Indiana Harbor Canal base-level surface water body.

- There is an engineered enclosed depression in the water table in the northeast corner of OU2 from active pumping of groundwater within the CAMU containment wall. Otherwise, groundwater flow within OU2 is south southwesterly, to the Grand Calumet River.

The following observations were made during the August 2019 measurement event, when infiltration rate was seasonably low and the Lake Michigan water level was near a historic high elevation.

- The north-south groundwater divide beneath OU1 Zone 1 shifted westward toward the Indiana Harbor Canal west of the Site, which was influenced by the record high lake level and began acting as a losing stream and groundwater divide. During this period, surface water from the Indiana Harbor Canal was infiltrating groundwater east of the Indiana Harbor Canal and was flowing northeastward towards the degraded sewer system within OU1 Zones 2 and 3.
- Groundwater elevations beneath the wetland areas in the southern portion of OU2 were lower than the elevation of the Grand Calumet River/Indiana Harbor Canal surface water system in August 2019. The same transient reversal phenomenon was reported in Grand Calumet River watershed by Fenlon and Watson (1993) and Greeman (1995) who attributed it to evapotranspiration by densely vegetated wetlands adjacent to the river during the summer growing season.

2.5.3 Groundwater Gradients

2.5.3.1 Horizontal Gradients

Ranges of groundwater gradients were determined for the four quarterly groundwater measurement events completed across the Site from December 2018 to August 2019 and additional groundwater monitoring conducted in March 2021, as follows:

1. For each of the groundwater contour maps, three representative groundwater flow direction lines were selected: one from OU1 Zone 1, one from OU1 Zone 2, and one from OU1 Zone 3.
2. The flow lines, identified on **Figures 2.5-1 to 2.5-5** as lines "-1-", "-2-", or "-3-", were placed in areas distant from the OU2 CAMU, to avoid biases caused by the slurry wall and associated active pumping.
3. The three flow lines terminated at either a monitoring well location or a potentiometric iso-contour line.
4. Horizontal distances along each of the three flow lines were scaled in feet.
5. Vertical head differences were calculated in feet between the two endpoints.
6. Horizontal gradient was determined by dividing the vertical head (in feet) by the horizontal difference (in feet).

The horizontal gradients are summarized on **Table 2.5-2**. Using the entirety of the data, the gradients across the Site differed by just one order of magnitude, from 0.001 to 0.006, and the average gradient was 0.002.

2.5.3.2 Vertical Gradients

Three vertical groundwater gradients were calculated for the paired monitoring wells, OU1MW3/OU1MW3D, OU1MW5/OU1MW5D, and OU1MW6/OU1MW6D, for each measurement event as follows:

1. The groundwater elevation recorded for the shallow well was subtracted from the groundwater elevation recorded in the deeper well to determine the potentiometric head difference in feet.

2. The distance from the midpoint of the saturated screened interval of each shallow well was subtracted from the midpoint of the fully saturated screened interval of the corresponding deeper well.

3. The vertical gradient was determined by dividing the head difference in feet between the two wells in each pair by the vertical distance between the two well midpoints in feet.

The vertical gradients are summarized on **Table 2.5-3.** An average upward gradient of 0.004 was observed at the OU1MW6/OU1MW6D monitoring well pair located in the northeastern part of OU1 Zone 1. The upward gradient at that location is most likely caused by dewatering of the upper part of the Calumet aquifer by the degraded sewer system. A consistent vertical gradient could not be discerned at the OU1MW3/OU1MW3D and OU1MW5/OU1MW5D well pairs.

Vertical hydraulic gradient was also calculated for two well pairs within OU2 using first quarter groundwater elevation data from 2004. The data for these two pairs, MW1/MW14 and MW9/MW10, were obtained from the Modified RCRA Facility Investigation (MRFI) (Geochemical Solutions 2004). The vertical hydraulic gradients at these locations for that date were as follows:

- The MW1/MW14 well pair just south of the Indiana Harbor Belt Railroad indicated a downward gradient of 0.004.

- The MW9/MW10 well pair located 600 feet west of Kennedy Avenue and 1,200 feet north of the Grand Calumet River had a downward gradient of 0.003.

2.5.4 Hydraulic Conductivity

On December 14 and December 17, 2018, ERM completed slug tests at the 11 monitoring wells installed in OU1 to evaluate hydraulic properties of the Calumet aquifer beneath OU1. The locations of the 11 wells that were tested (OU1MW-1 through OU1MW-8, plus OUMW3D, OUMW5D, and OUMW6D) are shown on **Figure 2.3-1**. All 11 wells were two inches in diameter. The eight shallow wells were screened from 3 to 13 feet bgs and the three deep wells were screened from approximately 25 to 30 feet bgs. A minimum of six tests were recorded at each location: a minimum of three rising head tests and a minimum of three falling head tests. A 3-foot-long, solid polyvinyl chloride (PVC) slug was used to initiate positive (“slug in”) and negative (“slug out”) displacement at each location. An In-Situ Troll 700 pressure transducer and data logger was used to measure and record changing water levels during each test. Each test was deemed complete once the water level returned to within 98% of the starting elevation.

The test data were analyzed using AQTESOLV Version 4.02 which incorporates the method developed by Bouwer and Rice (1976, 1989). In accordance with that method, where two straight-line segments were observed due to gravel pack drainage effects, the second straight line and corresponding y-intercept (initial displacement) value were used to determine the hydraulic conductivity. The hydraulic conductivity results in cm/s for each of the 11 monitoring wells tested are summarized in **Table 2.5-4**, and the graphed results of each test are included in **Appendix D**.

The geomean of the hydraulic conductivities for all OU1 wells tested in December 2018 was 2.09E-03 cm/s. The geomean of the eight shallow wells tested was 1.72E-03 cm/s, which was less than half the value of the 3.91E-03 cm/s value for the deeper wells.

The hydraulic conductivity values measured in the shallow and deep portions of the Calumet aquifer beneath OU1 were similar to the 3.5E-03 cm/s USGS-published horizontal hydraulic conductivity value for transect K-K' located 2.5 miles east of the Site (Kay et al. 1996).

2.5.5 Groundwater Velocity

Horizontal groundwater velocity, also known as seepage velocity, at the Site within the Calumet aquifer can be estimated as follows:

Velocity = (hydraulic conductivity x gradient)/effective porosity

- Between December 2018 and August 2019, the gradient at the Site ranged from 0.001 to 0.006.
- The geomean hydraulic conductivity is 2.09E-03 cm/s, or 5.93 ft /day.
- In Kay et al. (1996), the USGS assumed that the Calumet aquifer had an effective porosity of 30%. This value is confirmed by the information below.
- A grain size analysis of a sample of brown fine sand from OU1MW5W, 8-12 feet was 95.7% fine sand, 3.4% fines, 0.8% medium sand and 0.1% coarse sand. Aqtesolv.com reports fine sand has total porosity of 26-53% (median 39.5%) and effective porosity of 33% (Morris and Johnson 1967).

Therefore, the groundwater velocity at the Site ranges from 1.19E-02 ft/day (4.33 ft/year) to 1.21E-01 ft/day (44.0 ft/year). The USGS, in Kay et al. (1996), estimated that the groundwater velocity near the Site was 3.1E-02 ft/day (11.3 ft/year), which is within the range reported by ERM.

2.6 Climate and Meteorology

The climate in East Chicago, Indiana is considered humid continental, which is characterized by hot, wet summers and cold winters (INclimate 2019). The temperature ranges from minimums of 15 degrees Fahrenheit (°F) in January to maximums of 83°F in July. Prolonged severe hot and cold spells are not uncommon in Indiana. Average rainfall is around 37 inches per year with May being the wettest month. Average snowfall varies greatly from year to year with the average in the northcentral snow belt being about 76 inches per year. Lake-effect snow accounts for about half of the average snowfall due to its proximity to the moisture and warmth of Lake Michigan. The average wind speed is 10 miles per hour (mph). Indiana is prone to tornadoes with an average of 23 tornadoes per year (INclimate 2019).

2.7 Demography and Land Use

East Chicago's population in 2018 was 28,961, with a population density of 2,056 people per square mile, an unemployment rate of 7.1%, and a median household income of $27,264 (CivicDashboards 2018a). In comparison, the State of Indiana had a population density of 185 people per square mile, an unemployment rate of 3.3%, and a median household income of $50,433 in 2018 (CivicDashboards 2018b). According to the U.S. Census Bureau, there were 2.79 persons per household in East Chicago during the period 2013 to 2017 (U.S. Census Bureau 2018). In 2018, 57% of the population was Hispanic, 36.4% was African American, and 6.5% was White/non-Hispanic (U.S. Census Bureau 2018).

A zoning map issued by the planning department of the City of East Chicago is shown on **Figure 2.7-1** (City of East Chicago 2008). The East Chicago Comprehensive Plan indicated that 66.2% of the area consisted of industrial properties and 14.5% were residential properties, with the remaining 19.3% consisting of commercial, mixed use, institutional, and other uses (e.g., open space, right-of-way, vacant, and water; City of East Chicago 2008).

The USS Lead Facility is restricted to non-residential uses via an Environmental Restrictive Covenant (ERC) established in June 2005 (Swidler Berlin 2005). OU1 is expected to remain a mixed-use area in the future.

2.8 Ecological Features

2.8.1 Habitat Characterization

This section applies only to the former USS Lead Facility portion of the Site. Because only the groundwater at OU1 is being investigated in response to the ASAOC, this section only applies to OU2. As described in **Section 3.2.1** below, an ecological evaluation was conducted as part of this RI and included a wetland delineation and habitat assessment that were based on a desktop review and field survey. The following three land use covertypes were identified during the ecological evaluation:

- Emergent Wetland
- Open Water Wetland
- Dune and swale complex

The covertypes and their approximate boundaries are depicted on **Figure 2.8-1**, and the characteristics of these covertypes are described in more detail in the following sections. **Table 2.8-1** lists the various ecological receptors that were visually observed or otherwise noted to be present within the emergent wetland and open water wetland covertypes. The dune and swale complex were observed from the periphery, and therefore, no receptor species were noted for the dune and swale complex covertype. **Table 2.8-2** summarizes listed species identified during the desktop review.

2.8.1.1 Emergent Wetland

The emergent wetland covertype at the USS Lead Facility includes both aquatic and terrestrial components as described below. This covertype occupies approximately 22.83 acres across the USS Lead Facility. In general, this area is dominated by invasive species and shows evidence of past disturbance (e.g., excavating, filling, etc.). All decision units (DUs) investigated as part of the current RI field activities described in **Section 3.2** were located within the emergent wetland covertype.

Ubiquitous and dominant within the emergent wetland are Phragmites (*Phragmites australis*), which could rapidly colonize and subsequently thrive in disturbed areas. Areas within the emergent wetland that exhibited standing water (approximately 1-15 inches deep) were classified as aquatic habitat, and mucky substrates consisted of nearly all Phragmites with one select zone dominated instead by cattail (*Typha x glauca*). All DUs were in the portions of the emergent wetland covertype that exhibit aquatic characteristics.

Less saturated areas of the emergent wetland are characterized as terrestrial habitat. These areas exhibited sandy substrate and a larger variety of shrub and herbaceous wetland species. These species included red osier dogwood (*Cornus sericea*), black willow (*Salix nigra*), jewelweed (*Impatiens capensis*), dogbane (*Apocynum cannabinum*), glossy buckthorn (*Rhamnus cathartica*), purple loosestrife (*Lythrum salicaria*), and scouring rush (*Equisetum hyemale*). Trees were absent within this covertype except for a small patch of black willows and several dead snags.

Table 2.8-1 lists the various ecological receptors that were visually observed or otherwise noted to be present within the emergent wetland covertype. The majority of these observations were made at the margins of the emergent wetland due to access restrictions resulting from the density of Phragmites and the depth of standing water. The height (10-12 feet) and density of Phragmites also limited the ability to make visual observations while investigating the interior areas of this covertype. Receptor observations while investigating the interior of this covertype included dragonflies (*Anisoptera spp.*) and mosquitos (*Culicidae spp.*).

Many of the receptors observed in the emergent wetland covertype likely use the area periodically for some of their daily needs (i.e., hunting, grazing, resting, etc.) but do not wholly reside within or rely on this area to fulfill all of their needs. For example, outside of the red-winged blackbird (*Agelaius phoeniceus*), which can nest in Phragmites and cattail stands, all other insectivorous bird species observed within this covertype could potentially utilize the area above the Phragmites for hunting but would not be able to nest or breed in this area as there are no trees or shrubs. Bird species observed in this area, such as the American robin (*Turdus migratorius*), could potentially hunt or forage at the boundary of this covertype where vegetation was observed to be less dense, but would not be able to utilize interior areas. Similarly, white tailed deer (*Odocoileus virginianus*) and the eastern cottontail (*Sylvilagus floridanus*) may be able to use select locations at the fringe of this covertype for resting or grazing but would need to utilize other surrounding habitats to fulfill the majority of their needs. Snail and insect species observed in the area, outside of the monarch butterfly (*Danaus plexippus*), would be more likely to utilize this covertype to fulfill a majority of their daily needs.

Mammal trails were observed at several locations within the emergent wetland covertype in areas connecting an open water channel feature outside the covertype to the open water wetlands. Observations indicate that these features could be a result of American beaver (*Castor canadensis*) and/or muskrat (*Ondatra zibethicus*) activity. No structures associated with either of these species (e.g., huts, lodges) were observed. It is possible that other animals could use these trails as well in addition to beavers and muskrats.

2.8.1.2 Open Water Wetland

The open water covertype was observed in two distinct areas south of the CAMU and at three distinct locations west and north of the CAMU (**Figure 2.8-1**).This covertype occupies approximately 5.97 acres of the USS Lead Facility. The open water wetlands appeared to be a result of past excavation, and the steep drop offs in the open water wetlands areas support this conclusion. Standing water was present in all areas, but approximate depth was not determined due to access restrictions. Eurasian watermilfoil (*Myriophyllum spicatum*), a true aquatic plant and an invasive species, was observed throughout this covertype.

As above, ecological receptors identified in this covertype are listed in **Table 2.8-1**. Due to access restrictions, only a small portion of this covertype was assessed on foot; however, observations support the homogeneity of this covertype throughout the area of interest. Several aquatic macroinvertebrate species were noted within this covertype, as well as fish and amphibians. In addition, it is possible that the nesting pair of bald eagles (*Haliaeetus leucocephalus*) observed at the former USS Lead Facility could use this covertype for hunting fish. Little habitat structural diversity (e.g., coarse woody debris, mudflats, sandbars, undercut banks, shade) was observed in this covertype.

2.8.1.3 Dune and Swale Complex

The dune and swale complex was observed in the northwest portion of the USS Lead Facility (**Figure 2.8-1**). This covertype exhibited both upland and wetland areas, where the higher elevation dune portion of the covertype consisted of sandy, well drained soils and upland species. The dominant species in the tree stratum included black oak (*Quercus velutina*), while tartarian honeysuckle (*Lonicera tatarica*) and common buckthorn (*Rhamnus cathartica*) dominated the shrub stratum. Very few herbaceous plants were noted in the herbaceous stratum due to the thick tree and shrub overstory.

The linear wetland, or swale, portions of this covertype consisted of a mixed scrub-shrub and emergent wetlands that were dominated by common buckthorn and Phragmites.

Many of the species included in **Table 2.8-1** could utilize this covertype for shelter or a water and/or food source; however, none of the species noted were observed directly within the dune and swale complex.

2.8.2 Threatened & Endangered Species

Several federal and state listed threatened and endangered species are known to occur within Lake County, Indiana and within 0.5 miles of the Site as indicated in the US Fish and Wildlife Service (USFWS) Report and the Indiana Department of Natural Resources (IDNR) Division of Nature Preserves Report included in **Appendix E**. These species are listed in **Table 2.8-2**.

ERM reviewed all possible listed animal species known to occur near the Site and compared their likelihood of being present at the Site with the habitats noted during the field survey.

The focused USFWS and IDNR Division of Nature Preserves review indicated there was the potential for two species of bat, one squirrel species, four bird species, and one insect species to be located at the Site, as summarized in **Table 2.8-2**. One of the birds, the bald eagle, is known to be present at the Site and has an active nest along the southeast side of the dune/swale complex (**Figure 2.8-1**). **Table 2.8-2** includes an evaluation of the potential for these species to be found at the Site, based on the known habitat needs for each species. There is no record of sighting of federal or State endangered/threatened species at the former USS Lead Facility.

2.9 Cultural Features

Cultural resources are any prehistoric or historic remains or indicators of past human activities, including artifacts, sites, structures, landscapes, and objects of importance to a culture or community for scientific, traditional, religious, or other reasons. No cultural resources assessment was performed at the Site during the RI work because: (1) the potential for intact buried cultural resources is extremely low due to significant earth movement during the USS Lead Facility's RCRA closure, including partial excavation of lead-containing sediments from the wetlands; (2) no cultural resources were identified within the former USS Lead Facility during the excavation activities; (3) the portion of the Site outside the CAMU lacks stratigraphic integrity; (4) industrial parcels to the south and east of the Site are not considered historic properties; and (5) any potential indirect impacts to cultural resources within or near the former USS Lead Facility (including OU1) during the investigation activities are expected to be temporary. Future remediation activities are not expected to affect the view shed from OU1 or any other area around it.

To assess potential cultural resource management requirements, ERM conducted a desktop inventory review of recorded Historic Properties inventoried by the Indiana Division of Historic Preservation & Archaeology, which serves as the State Historic Preservation Office (SHPO), via their State Historic Architectural and Archaeological Research Database (SHAARD). This review considered all Historic Properties within one mile of the Site. This search radius both characterizes the local Historic landscape and exceeds any potential requirement of a regulatory agency. SHAARD has inventoried 79 Historic Properties within one mile of the Site (see Table 2-2; Figures 2-6 and 2-7 of the RI/FS WP [ERM 2018a]). There are 204 additional resources if the search is extended to include OU1.

The results of the review indicate that there are no previously recorded archaeological sites, archaeological areas, or areas within the former USS Lead Facility footprint or within one mile of either OU1 or the Site. The Grand Calumet River would have been a source of food, navigation, and other resources, making adjacent dry terraces attractive to both Prehistoric and Historic populations. However, the extensive deep disturbance to soil at the Site (to a depth of 15 feet in some areas), during the modern period (the past 50 years), has affected the natural soil column to a depth below which archaeological resources may be expected. If any cultural materials were identified within the former USS Lead Facility, the lack of contextual integrity would likely make them ineligible for listing on the National Register of Historic Places (NRHP) and thus not require management or mitigation efforts.

Inventoried resources surrounding the Site, however, do include one NRHP-listed property, approximately one mile northwest of the USS Lead Facility, the First National Bank & Trust Company (NR-1759) at 720 West Chicago Avenue. This neo-classical revival granite and limestone building is considered significant for both its roles in local commerce and its design. Given several intervening city blocks, it is not expected that this two-story building is visible from anywhere within the Site, nor is the Site visible from the structure. None of the remaining 78 historic structures are listed on the NRHP; however, SHAARD does provide assessment of their individual eligibility to NRHP. From a cultural resource management perspective, properties that are eligible or potentially eligible for NRHP are considered as listed NRHP properties.

Properties rated as "Outstanding" by SHPO have enough historic or architectural significance that they are considered eligible for listing on NRHP. There are four such properties in the area, including:

- The Indiana Harbor Belt Railroad Roundhouse (089-275-53001), approximately 0.7 miles south of the USS Lead Facility and the Grand Calumet River. This crescent-shaped building is one of the few like facilities still functioning in Indiana and is considered important to the transportation history of the region.
- Two other properties, a federal building on East Chicago Avenue (089-679-35098) and the Holy Trinity Hungarian Church (089-679-35102) are within OU1. Holy Trinity is the closest significant historic resource to the Site, approximately 0.6 miles to the north.
- Calumet Trust and Savings Bank (089-679-35094) is also just across East Chicago Avenue from OU1.

Properties rated as "Notable" by SHPO are considered potentially eligible for NRHP listing pending further research and assessment. There are seven Notable structures within a mile of the Site, including Indiana Harbor Belt Railroad offices (089-275-55001), two apartment buildings (089-679-35109 and 089-679-35091), two churches (089-679-35128 and 089-679-35110), a duplex (089-275-35156), and the East Chicago Public Library (089-679-35177).

A total of 63 structures are listed by SHPO as "Contributing;" meaning that the property met the basic SHPO age (pre-1970) and integrity requirements considered for historic inventory but was not considered individually eligible for NRHP listing; however, as the category indicates, such properties may be considered part of an NRHP-eligible Historic District if one is defined. Thirty-three of these have been defined within OU1, but no district has been proposed. The closest defined historic district, the Washington Park Historic District, is just over one mile from the Site.

Structures listed as demolished are generally not eligible for NRHP if their primary significance derives from architectural characteristics. One of these is Indiana State Highway Bridge Number 41-45-1739C (HB-00998), which formerly crossed the Grand Calumet River just west of the Site. A historic duplex (089-275-35161), an auditorium (089-275-35171), and a firehouse (089-679-35132) are listed as demolished.

The activities undertaken under this RI were temporary and investigative in advance of the remediation of the Site, and therefore, did not pose permanent adverse effects to the historic landscape. Further, the closest resources that are eligible, potentially eligible, or listed on NRHP are all over 0.6 miles from the USS Lead Facility, and given the intervening built environment, the USS Lead Facility is not likely within the view shed of these properties. The potential for intact buried cultural resources within the Site is extremely low. Therefore, no further inventory and/or assessment of historic properties regarding this RI were conducted.

2.10 Natural Resource Features

The Calumet Aquifer can produce water at a sufficient rate to serve as a water supply, but it is not used as a source of potable water because extensive regional industrial development above the shallow, unconfined aquifer has resulted in widespread contamination of the aquifer. As indicated in **Section 2.8**, remnants of the dune and swale complex that covered the area before it was developed are present in an area of approximately 20 acres in the northwestern portion of the USS Lead Facility. East Chicago considers this area to be a Natural Area as part of the natural resources features in the area (City of East Chicago 2008). The 39-acre wetland area is also considered by East Chicago to be a natural resources feature.

The Grand Calumet River, which borders the USS Lead Facility, was designated a Great Lakes Area of Concern under the 1987 Great Lakes Water Quality Agreement (USEPA 2017a). The East Branch of the Grand Calumet River is listed as impaired for restrictions on fish and wildlife consumption, eutrophication or undesirable algae, harming of fish and wildlife flavor, degradation of fish and wildlife populations, beach closings, fish tumors and other deformities, degradation of aesthetics, bird or animal deformities or reproduction problems, degradation of benthos, degradation of phytoplankton and zooplankton populations, restriction on dredging activities, and loss of fish and wildlife habitat (USEPA 2016).

As part of the Great Lakes Legacy Act cleanup of the Grand Calumet River, the dredging and capping of 385,000 cubic yards of contaminated sediments from the portion of the East Branch of the Grand Calumet River that covers a 1.8-mile stretch of the river from Cline Avenue to Kennedy Avenue, was completed in 2015 (Great Lakes Sediment Remediation LLC 2015). This effort also included deep pool restoration and the revival of shallow marginal wetlands.

Work on Zone E, which is located directly south of the former USS Lead Facility, has begun with plans for a remedial investigation, feasibility study, and remedial design (USEPA 2017b). The final zone is a collection of the remaining Grand Calumet River segments within East Chicago, Indiana. The project is expected to address parts of the Indiana Harbor Canal.

3. SITE INVESTIGATIONS

3.1 Historical Investigations

Soil, sediment, groundwater, and surface water sampling has been conducted at the USS Lead Facility since 1993 resulting in a historical database of sampling results. Four site-wide sampling events have been completed, as well as targeted sampling in areas where impacts were identified and remediated. The following sections briefly describe these historical investigation activities.

3.1.1 Site-Wide Soil Investigations

Investigations at the USS Lead Facility were initiated in 1993 with subsequent site-wide events conducted in 1998, 2001, and 2003. These investigations thoroughly evaluated USS Lead Facility conditions and delineated impacts requiring remediation. The site-wide investigations are discussed in the following sections.

3.1.1.1 1993 XRF Lead Investigation

IT Corporation collected 475 samples of surface soil for x-ray fluorescence (XRF) lead analysis in 1993 to identify the areas requiring soil excavation at the Site. The sample results were used to determine areas of soil requiring excavation due to lead impacts and included sampling in the areas later defined as Remediation Areas A, B, and C (Geochemical Solutions 2004). The pre-excavation XRF samples were not included in the historic database used for the RI.

3.1.1.2 1998 ENTACT Investigation

ENTACT conducted surface and subsurface soil sampling in 1998. They established a grid-like orientation and collected surficial soil samples on 100-foot centers for laboratory analysis of lead. ENTACT also collected subsurface soil samples for lead analysis to determine the vertical extent of contamination, and determined impacts appeared limited to the upper one foot of the soil column. Information was not available on the number of samples collected (Geochemical Solution 2004). Pre-excavation soil samples were excluded, but post-excavation soil samples were included in the historic database used for the RI.

3.1.1.3 2000 and 2001 Site-Wide Sampling

LAW Engineering and Environmental Services, Inc. (LAW) collected soil samples in 2000 and 2001 to verify that the USS Lead Facility met the IDEM's remediation goals and to identify areas that might require further remediation. A sampling grid with 100-foot spacing was established for the surface soil sampling, and samples were collected from 26 locations. Forty-four subsurface samples were collected from seven soil borings at depth intervals of one foot. Additionally, a total of 24 samples were collected from four background soil sample locations. All samples were analyzed for total lead, antimony, nickel, and zinc; seven samples were also analyzed for metals; and seven samples were analyzed for volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Six of the seven samples analyzed for VOCs and SVOCs were analyzed for total petroleum hydrocarbons (TPH). Results indicated the VOC, SVOC, nickel, zinc, cyanide, and sulfide concentrations were below IDEM Risk Integrated System of Closure (RISC) Tier 1 Industrial Closure Levels (Tier 1 Levels) in all samples; lead, antimony, and arsenic were identified at concentrations above the Tier 1 Levels; and TPH was detected in one sample and its duplicate. Soil excavation was conducted to address the areas with lead, antimony, and arsenic concentrations above the Tier 1 Levels. The excavation areas and subsequent confirmation sampling are described below and in Geochemical Solutions (2001). These post-excavation soil samples were included in the historic database of the RI.

3.1.1.4 2003 Modified RCRA Facility Investigation

In July 2003, 36 soil/sediment samples were collected from 24 locations and analyzed for metals, VOCs, SVOCs, PCBs, and dioxins to ensure that adequate sampling of the USS Lead Facility was completed. Six samples were analyzed for VOCs, SVOCs, and TPH; 31 samples for PCBs; 2 samples for dioxins; and 35 samples for metals (see Figure 13 of the *Draft Final USS Lead MRFI Report* from 2004; Geochemical Solutions 2004). Arsenic, antimony, and lead were identified above the IDEM RISC Tier 1 Levels in multiple samples. PCBs, dioxins, VOCs, and SVOCs were detected at the highest concentrations in samples near the Calumet River, which is the suspected source of the contamination. The organic concentrations were not compared to IDEM Tier 1 RISC Levels. The soil/sediment metals data from the MRFI was included in the historic database of the RI.

3.1.2 Focused Soil/Sediment Investigations

A number of focused investigations have been conducted to collect soil samples in specific areas of the Site to delineate USS Lead Facility impacts and confirm that soil impacts were removed (Geochemical Solutions 2004). These focused investigations are described in the following sections.

3.1.2.1 Remediation Area A - Lead Slag Pile South of the CAMU

Seventeen confirmation soil samples were collected in 2000 to confirm that lead impacts were removed in Remediation Area A. The results demonstrated that the average lead concentration remaining was 56.7 mg/kg, which was below the requirement of 5,000 mg/kg established in the Interim Stabilization Measures Work Plan, and below the Region 9 Preliminary Remediation Goal (PRG) for residential soils of 400 mg/kg in place in 2000. These post-excavation soil samples were included in the historic database used for the RI.

3.1.2.2 Remediation Area B - Battery Chips West of the CAMU

Thirty-eight confirmation soil samples were collected in 1997 following soil removal activities to document that lead removal activities in Remediation Area B were complete. Additional samples were collected as part of site-wide investigation activities in 2001 and 2003. Sample results demonstrated that the IDEM Tier 1 RISC Level for industrial properties were met. These post-excavation soil samples were included in the historic database used for the RI.

3.1.2.3 Remediation Area C - North of the CAMU

Thirty-seven confirmation soil samples were collected in 1997 following soil excavation activities to document lead removal activities in Remediation Area C were complete. The results demonstrated that lead concentrations were less than the Region 9 PRG for residential soils of 400 mg/kg at that time. Additional sampling conducted in 2000 confirmed lead has been remediated in the area. These post-excavation soil samples were included in the historic database used for the RI.

3.1.2.4 Canal, Canal Access Road, and Holding Ponds

Initial sampling of the former canal was conducted in 1997 followed by a detailed characterization in 2000. Four confirmation soil/sediment samples collected at each of ten canal locations in September and October 2000 demonstrated that concentrations of VOCs, SVOCs, TPH, PCBs, and metals all met the IDEM Tier 1 RISC Levels.

In 2001, eight soil samples were collected from the Canal Access Road and the holding ponds used to store water from the former canal during remediation. These samples were analyzed for antimony, arsenic, cadmium, lead, and SVOCs to confirm that these areas were not impacted during remediation activities. With the exception of arsenic in one sample from the road at the western end of the former canal, the concentrations of all analytes met the IDEM Tier 1 RISC Levels. These post-excavation soil samples were included in the historic database used for the RI.

3.1.2.5 Fuel Tank Storage Area

Three subsurface soil samples were collected in 1997 in the former fuel tank storage area west of the CAMU and analyzed for VOCs, SVOCs, TPH, PCBs and total lead. VOCs, SVOCs, TPH, and lead were detected in the samples, and soil excavation was subsequently conducted in the area to remove the impacts. Analytical results for a soil sample collected in this area during the 2000 Site-Wide Sampling Event demonstrated the lead, nickel, and zinc concentrations were all below the IDEM Tier 1 RISC Levels. VOCs and SVOCs were not detected in the sample.

3.1.2.6 Wetlands

Soil/sediment sampling in the wetlands in 1999 identified the presence of lead contamination requiring remediation. During pre-excavation sampling conducted in August and September 2002, 100 soil samples were collected for XRF lead analysis, and the results were used to establish the lateral extents of soil excavation. Soil contaminated with lead was removed from the wetlands and placed in the CAMU in the winter and spring of 2001. The CAMU was constructed in November 1998 and capped in November 2002. Following excavation, 246 soil samples were collected from 221 locations for XRF lead analysis and fifteen samples were sent to the laboratory for lead analysis to document remaining lead concentrations. Lead was detected in 193 of the final 221 samples, with an average of 302 mg/kg.

Additional sampling was conducted in the wetlands in 2007 between the remediated area and the river. Thirteen samples were collected for metals analysis, and sixty samples were analyzed for XRF lead. Antimony, arsenic, chromium, iron, lead, and mercury were detected in the samples above the IDEM screening levels (SLs) at that time. The mercury concentration was only above the IDEM SL in one sample close to the Calumet River. Since mercury has only been detected above its IDEM SL near the river and the river is impacted with mercury from non-site related sources, mercury was not attributed to the Site. These post-excavation sediment samples were included in the historic database used for the RI.

3.1.3 Groundwater Investigations

Groundwater monitoring wells were installed during several investigation phases at the Site. To assess groundwater quality and hydrogeology, wells MW1 through MW5 were installed in 1996 and wells MW6 through MW14 were installed in 2000. Two of the wells, MW9 and MW14, were installed deeper than the other wells at a total depth of 30.04 and 28.44 feet bgs, respectively. Wells MW15 through MW25 were installed around the CAMU in 2001. Monitoring well MW2 was destroyed and removed during site remediation activities.

Samples have been collected from all site wells three to four times a year from 2003 through 2007 and from selected wells twice a year 2008 through 2019. Specific information on the groundwater monitoring events since 2008 is presented in the Biannual Post Closure Monitoring Reports prepared by ETS Environmental and submitted to IDEM. Antimony and arsenic have been detected above the Alternate Concentration Limits (ACLs) established in the Post Closure Permit and are currently present at concentrations above the IDEM SLs. These groundwater samples were included in the historic database used for this RI.

A Phase II Environmental Assessment of the former West Calumet Housing Project, which is located on the western portion of OU1 (i.e., Zone 1), was conducted in February 2017 (Amereco 2017). Four permanent monitoring wells and ten temporary wells were installed as part of the investigation and sampled for VOCs, PAHs, RCRA metals, and PCBs. Benzo(a)anthracene, benzo(a)pyrene, naphthalene, arsenic, cadmium, chromium, lead, and mercury have been detected in one or more samples above the IDEM SLs identified in Table 4-27 in these wells. The ten temporary wells were unusable during the RI. Three of the four permanent wells were sampled as part of the RI (ECHA-MW-01, ECHA-MW-09, and ECHA-MW-35). The fourth well (ECHA-MW-12) could not be located by ERM. These groundwater samples were included in the historic database for this RI.

3.1.4 Surface Water Sampling

LAW collected surface water samples in 2000 at two locations, one in Remediation Area A and one in Remediation Area B, for laboratory analysis of VOCs, SVOCs, cyanide, sulfide, and metals. Only antimony, arsenic, and barium were detected. In 2003 as part of the MRFI sampling, surface water samples were collected and analyzed for selected metals and hardness. Antimony, barium, cadmium, copper, lead, mercury, nickel, thallium, and zinc were detected in one or more samples. Arsenic was the only analyte detected above the IDEM RISC Tier 1 Levels in place in 2003.

Surface water sampling was also conducted twice in 2007 and in 2012, 2015, 2016, and 2017 as part of the post-closure monitoring efforts. During the first four events, four samples were collected for analysis of lead, antimony, arsenic, cadmium, and selenium from the four principal water bodies at the Site: Area A, Area B, Area C, and the former canal. The samples were also analyzed for mercury in 2007 and 2015, thallium in 2007, and iron in 2015. Only the former canal was sampled in 2016 and the former canal and Area B were sampled in 2017. Arsenic, cadmium, lead, mercury, and zinc have been detected above the Region IV Ecological Screening Values (ESVs). Since 2015, only arsenic and cadmium have been detected above the Region IV ESVs. Arsenic was detected at 170 ug/l versus the ESL of 150 ug/l and cadmium was detected at 0.95 to 1.2 ug/l versus the ESV of 0.45 ug/l. These surface water samples were included in the historic database used for this RI.

3.1.5 Soil Gas

Soil samples collected at the USS Lead Facility during the RCRA Facility Investigation did not contain VOCs or SVOCs above human health screening levels (Geochemical Solutions 2004). Therefore, no soil gas samples were collected during the RI.

3.1.6 Air Monitoring

One baseline air sample was collected in September 1994, before the excavation activities began, to evaluate potential emissions during the excavation activities. The result was less than the Occupational Health and Safety Administration’s Time-Weighed Average (TWA) limit for lead of 50 micrograms per cubic meter ($\mu g/m^3$). No air monitoring is required at the Site because soil and groundwater samples collected at the former USS Lead Facility did not contain VOCs or SVOCs above the IDEM SLs, and the surficial soil has been excavated throughout the areas that contained lead concentrations above the USEPA Regional Screening Levels (RSLs), except for the southern portion of the former USS Lead Facility that consists mostly of wetlands.

3.1.7 Lead Speciation Study

In 2003, TechLaw, Inc. conducted a study of lead speciation at the Site. The results of the lead isotope ratio analysis suggested that the lead in the samples adjacent to the DuPont site was dissimilar from the lead isotope signature associated with the former USS Lead Facility. In addition, the results demonstrated that the lead in the fine fraction of the samples was diagnostic of the source rock (“common lead”) than the signature obtained from the bulk material.

3.1.8 Study of Lead and Arsenic Immobilization

Purdue University conducted a study in 2003 to determine the impact of various soil amendments on the bioavailability of lead and arsenic at the Site. Phosphate and manganese oxide, peat and iron oxide, and biosolids and iron oxide were used to immobilize the lead and arsenic in soil samples collected from the Site. The addition of phosphate and manganese oxide significantly reduced the bioavailability of lead but increased the bioavailability of arsenic. In the samples amended with peat and iron oxide, the bioavailability of both lead and arsenic was reduced. The addition of biosolids and iron oxide had little impact on the bioavailability of either lead or arsenic (Purdue 2003).

3.2 Remedial Investigation Activities

As reported in the RI/FS FSP (ERM 2018b), historical data collected at the Site were evaluated to identify the data gaps that existed at the time of RI/FS planning. Analytical results were compared to the then current regulatory screening levels, and the results were used to determine the RI activities conducted between 2018 and 2019. The objectives of the RI activities were to obtain additional data to support the HHRA and BERA and the evaluation of remedial technologies in the FS. In order to meet these objectives, the 2018-2019 field activities consisted of:

At the former USS Lead Facility:

1. Conduct an ecological evaluation, including identification of threatened or endangered species;
2. Collect samples of soil and sediment for analysis of selected metals; and
3. Conduct biota sampling for analysis of select metals.

At OU1:

Install monitoring wells;

Collect groundwater samples; and

Obtain hydrogeological information via slug tests and measurements of water elevation.

3.2.1 Ecological Evaluation

An ecological evaluation was conducted as part of the RI and included wetland and habitat assessments that were based on desktop review and field survey. The field survey was conducted at the Site between September 25 and 26, 2018. The purpose of the field survey was to qualitatively characterize land use covertypes, including wetlands; assess the value and function of potential ecological habitats; and observe wildlife. The field survey was conducted during the growing season for the area in question.

The field survey was performed from areas accessible by walking and did not cover the entire Site due to deep ponded water in some areas. The site was divided into Decision Units (DUs). DU1, DU2, and DU8 were accessed on foot and directly observed during the habitat assessment. All other DUs were observed remotely. The height (10-12 feet) and density of Phragmites also limited the ability to make visual observations while investigating the interior areas of the emergent wetland covertypes.

The approximate boundaries of the covertypes identified during the field survey are presented in **Figure 2.8-1**, and the results are discussed in **Section 2.8**. **Table 2.8-1** lists the various ecological receptors that were visually observed or otherwise noted to be present within the emergent wetland and open water marsh covertypes. The dune and swale complex was observed from the periphery, and therefore, no receptor species were noted for this covertype. **Table 2.8-2** summarizes listed species identified during the desktop review.

3.2.2 *Collection and Analysis of Discrete Soil Samples*

Soil samples were collected in three phases from OU2. These locations were selected to evaluate former dust pile locations; to provide additional arsenic data where arsenic data was not previously collected; and to evaluate the sources of increasing arsenic concentrations in monitoring well MW7 and the concentrations of arsenic in MW21 (an upgradient well).

During the first phase of soil sampling, in November 2018, the following seven locations were sampled:

- Two locations northeast of MW7 that were not previously remediated to identify upgradient sources (RI1, RI2);
- One location north of MW7 at the corner of the CAMU where historical figures indicate a dust pile was located (RI3);
- Two locations on the northeast and southwest sides of the pond in Area B where a dust pile was located (RI4, RI5); and
- Two samples near MW21 where a dust pile was located (RI6, RI7).

During the second phase, in September 2019, the following six locations were sampled to delineate concentrations of metals in soil near MW7 and MW21:

- Two locations southwest of RI2 near MW7 (RI8 and RI9);
- Two locations southwest and northeast of RI1 (RI10 and RI11); and
- Two locations west of RI6 and RI7 near MW21 (RI12 and RI13).

During the third phase in March and June 2021, the following 11 locations were sampled to delineate the horizontal and vertical extent of arsenic in soil near MW7 and MW21:

- Five locations near MW7
    - One location northeast of MW7, MW7(NE), at three depths (0-2 ft bgs, 2-4 ft bgs, 4-6 ft bgs);
    - One location north of MW7, MW7(N), at three depths (0-2 ft bgs, 2-4 ft bgs, 4-6 ft bgs);
    - One location northwest of MW7, MW7(NW), at one depth (0-2 ft bgs);
    - One location southwest of MW7, MW7(SW), at three depths (0-2 ft bgs, 2-4 ft bgs, 4-6 ft bgs); and
    - One location south-southwest of MW7, MW7(SSW), at one depth (0-2 ft bgs).
- Six locations near MW21
    - One location east of MW21R, MW21R(E), at three depths (0-2 ft bgs, 2-4 ft bgs, 4-6 ft bgs);
    - One location west of MW21R, MW21R(W), at three depths (0-2 ft bgs, 2-4 ft bgs, 4-6 ft bgs)
    - One location adjacent to MW26, MW26B, at three depths (0-2 ft bgs, 2-4 ft bgs, 4-6 ft bgs);
    - One location north of MW26, MW26N, at three depths (0-2 ft bgs, 2-4 ft bgs, 4-6 ft bgs);
    - One location west of MW26, MW26W, at three depths (0-2 ft bgs, 2-4 ft bgs, 4-6 ft bgs); and

- One location south of MW26, MW26S, at three depths (0-2 ft bgs, 2-4 ft bgs, 4-6 ft bgs).

Discrete samples were collected in two-foot intervals using a hand auger, and a representative sample from each interval was transferred to laboratory-supplied containers. All samples were described by a geologist in accordance with the Unified Soil Classification System (USCS), and the information was recorded in the field book or saved on the project server. If any of the locations were inaccessible due to high water levels at the time of sampling, field personnel relocated to an adjacent location. If the samples were intended to evaluate the effects of the dust piles on the groundwater arsenic concentrations, the samples were relocated within the footprint of the former dust piles. The sample locations were placed in areas outside the backfilled areas of the Site; therefore, if backfill was encountered during sampling, the location was relocated outside the backfilled area. **Figure 3.2-1** shows the final sample locations, which were approved by USEPA prior to sampling.

A total of 13 samples were collected on November 27, 2018 (7 samples) and September 19, 2019 (6 samples). Quality assurance / quality control (QA/QC) samples included one field duplicate, one equipment rinsate blank, and one matrix spike / matrix spike duplicate (MS/MSD) sample per sampling event. The equipment rinsate blanks were collected by pouring laboratory-supplied deionized water over the cleaned hand auger and collecting the water in a 250-mL bottle.

A total of 31 samples were collected on March 11, 2021 (16 samples) and June 6, 2021 (15 samples including two field duplicates). The arsenic concentrations exceeded the USEPA RSL of 3 mg/kg at MW7N, 0-2 ft, 2-4 ft and 4-6 ft; MW7NW, 0-2 ft; MW7SW, 0-2 ft, 2-4 ft and 4-6 ft; MW7SSW, 0-2 ft; MW21R(W), 0-2 ft, MW26W, 0-2 ft and MW26N, 0-2 ft, 2-4 ft and 4-6 ft. The arsenic results for the March and June 2021 samples are shown on **Figure 3.2-3** (MW7 location) and **Figure 3.2-4** (MW21R and MW26 locations).

Sample containers were labeled and placed on ice in a cooler prior to delivery to the laboratory. Samples were delivered under chain of custody to Eurofins TestAmerica in Pittsburgh, Pennsylvania. Samples were prepared for Synthetic Precipitation Leaching Procedure (SPLP) according to USEPA Method 1312, and samples were analyzed for total and SPLP antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A. Percent moisture was analyzed according to Standard Method (SM) 2540G. The equipment rinsate blank was analyzed for total antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A.

The hand auger and other non-disposable equipment were cleaned by scrubbing prior to and after sampling using a brush and an Alconox® wash followed by a deionized water rinse. Sampling personnel changed sampling gloves at the time each sample was collected and when handling sampling equipment.

The results for the soil samples collected between November 2018 and June 2021 are provided in **Table 3.2-1**.

3.2.3 Collection and Analysis of ISM Sediment Samples

Sediment samples were collected from the DUs in OU2 using the incremental sampling methodology (ISM) in accordance with the Interstate Technology Regulatory Council's (ITRC's) ISM guidance document (ITRC 2012). The ISM sampling was conducted in the southern, non-remediated portion of the wetlands to determine potential impacts from Area A, where the slag was piled upstream. The process used to select the DUs is described in the RI/FS FSP (ERM 2018b).

Figure 3.2-2 identifies the DU locations at the Site. All samples collected were characterized as sediments. Using the ISM approach, three surficial incremental sediment samples, each composed of 30 sample increments, was collected from each DU. Each of the 30 incremental locations was within a grid box in the DU. Systematic grid sampling methodologies were used to develop the grid, and systematic random sampling was used to identify the soil collection location in each grid box. Gridded sampling locations for each DU were generated using the software program VSP v7 (http://vsp.pnnl.gov/). The “pre-determined number of samples” module was used in conjunction with project Geographic Information System (GIS) files of DU boundaries to generate target sample coordinates. A systematic grid was used to identify the sampling locations.

To preserve the assumption of random sample placement, the coordinates of the starting node upon which the grid was projected were selected at random by VSP. The coordinates of each incremental sample location for the first sample were preloaded into a handheld Trimble GPS. Field personnel collected the first sediment sample increment for the first replicate. The sampler then moved 5-feet north and 5-feet west of center and collected the first sample increment for the second replicate, and again 5-feet north and 5-feet east of center to collect the first sample increment for the third replicate. The sampler continued to the location of the second sample increment for the first replicate in the next grid box and followed the same procedure to collect the second set of three incremental samples. Field personnel moved through each DU in an “S” pattern, until all 30 increments for each of the three sample replicates had been collected from each DU. If any of the sample locations were not accessible due to the density of the Phragmites, the Phragmites were cut to allow access to the sediment for sampling. An amphibious vehicle was used to access areas with high water. Waypoints for all sample increment locations were collected using the handheld Trimble GPS unit.

Sample increments were collected from the surface to approximately 15 centimeters bgs using a 5/8-inch inside diameter soil probe. The mass collected for each sample increment was approximately 60 grams. Sample increments were initially collected in 2-ounce glass jars, and all increments for each sample were combined into a single 32-ounce jar prior to shipment to the laboratory. For areas with dense vegetation, the upper layer of plant root matter was removed from the samples.

A total of 24 ISM samples (three samples per DU) were collected between November 27 and December 7, 2018. QA/QC samples included one equipment rinsate blank and three MS/MSD samples. Field duplicates were not collected for ISM samples because three replicate samples were collected for each DU as part of the sampling procedure.

The equipment rinsate blank was collected by pouring laboratory-supplied deionized water over the cleaned soil probe and collecting the water in a 250-milliliter bottle.

Sample containers were labeled and placed on ice in a cooler prior to delivery to the laboratory. Samples were delivered under chain of custody to Eurofins TestAmerica in Pittsburgh, Pennsylvania. Samples were processed by the lab according to USEPA protocols for incremental sampling prep, which included drying, disaggregating, and sieving. Sediment samples were analyzed for total antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A. Percent moisture was analyzed by SM 2540G. The equipment rinsate blank was analyzed for total antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A.

The soil probe and other non-disposable equipment were cleaned by scrubbing prior to and after sampling at each DU using a brush and an Alconox® wash followed by a deionized water rinse. Sampling personnel wore booties and disposable sampling gloves during sampling. Booties and gloves were changed when entering each new DU.

The results for the ISM sediment samples collected between November 2018 and December 2018 are provided in **Table 3.2-2**.

3.2.4 Collection and Analysis of Discrete Sediment Samples

Three discrete sediment samples were collected from each DU in OU2 for analysis of AVS, SEM, and total organic carbon (TOC). AVS/SEM/TOC samples were collected concurrently with the ISM samples described above for the purpose of estimating metal bioavailability. The AVS/SEM/TOC sample locations coincided with three of the incremental locations for the first sample collected in each DU and were randomly selected to provide spatial coverage of the DUs (**Figure 3.2-2**).

AVS/SEM/TOC samples were collected from the upper six inches of soil using a hand auger and were transferred to laboratory-supplied 4-ounce glass jars.

A total of 24 AVS/SEM/TOC samples (3 samples per DU) were collected between November 27 and December 7, 2018. QA/QC samples included three field duplicates and three samples designated for MS/MSD analysis.

Sample containers were labeled and placed on ice in a cooler prior to delivery to the laboratory. Samples were delivered under chain of custody to Eurofins TestAmerica in Pittsburgh, Pennsylvania. The samples were prepared according to USEPA AVS and SEM protocols. The SEM analytes included antimony, arsenic, cadmium, copper, lead, nickel, silver, and zinc and were analyzed according to USEPA Method 6010C. AVS analysis was performed according to USEPA Method 9034, and percent moisture was analyzed according to SM 2540G. TOC analysis was performed according to the USEPA Lloyd Kahn protocol. TOC analysis was requested after samples were submitted, and analysis was performed outside of the prescribed holding time.

The hand auger and other non-disposable equipment were cleaned by scrubbing prior to and after sampling using a brush and an Alconox® wash followed by a deionized water rinse. Sampling personnel changed sampling gloves at the time each sample was collected and when handling sampling equipment.

The results for the discrete sediment samples collected between November 2018 and December 2018 are provided in **Table 3.2-3**.

3.2.5 Collection and Analysis of Biota Samples

One plant and one invertebrate tissue sample were collected from each DU (**Figure 3.2-2**). Plant tissue samples were collected of new Phragmites shoots above the water level. Shoots were placed directly into sample bags until approximately 40 grams of shoots and stems were gathered from each DU.

After the plant sampling was completed, the sample plots that had been knocked down the previous winter were revisited. The RI/FS FSP (ERM 2018b) indicated that invertebrate samples would be collected by setting pitfall traps. However, pitfall traps could not be used, as the sites were inundated at the time of sampling. Instead of pitfall traps, aquatic invertebrates were collected by sweeping a D-frame net one or more times through portions of each plot. Material collected in the net was transferred to a bucket. Invertebrates were then isolated from the detritus by handpicking with disposable plastic forceps and placed into a clean glass jar to form one composite sample per DU. Given practical limitations, none of the invertebrate specimens were held to allow clearance of sediment for their digestive tracts.

A total of eight plant tissue samples (one sample per DU) were collected between May 21, 2018, and May 24, 2019. A total of eight invertebrate tissue samples (one sample per DU) were collected in two phases between May 22, 2019, and May 23, 2019, and between June 3, 2019, and June 5, 2019. The second round of invertebrate tissue sampling was conducted due to additional time required to collect sufficient biomass. QA/QC samples included one field duplicate of each type of biomass, one sample of each type of biomass designated for MS/MSD analysis, and one equipment rinsate blank collected during invertebrate tissue sampling.

The equipment rinsate blank was collected by pouring laboratory-supplied deionized water over the cleaned net used for collecting invertebrate samples. The water was then collected in a 250-milliliter bottle.

Sample containers were labeled and placed on dry ice in a cooler prior to delivery to the laboratory. Samples were delivered under chain of custody to Eurofins TestAmerica in Pittsburgh, Pennsylvania. Upon receipt by the laboratory, the samples were stored frozen and handled according to National Oceanic and Atmospheric Administration (NOAA) and USEPA protocols for tissue handling and preparation. Samples were analyzed for antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A, percent lipids according to TestAmerica's Lipid Standard Operating Procedure, and percent moisture according to SM 2540G.

The net and other non-disposable equipment used to collect invertebrate tissue samples were cleaned by scrubbing prior to and after sampling using a brush and an Alconox® wash followed by a deionized water rinse. Sampling personnel changed sampling gloves at the time each sample was collected and when handling sampling equipment. Plant tissue samples were collected with disposable equipment.

The results for the plant and invertebrate tissue samples collected between May and June 2019 are provided in **Table 3.2-4**.

3.2.6 Installation and Development of Groundwater Monitoring Wells

Eight shallow wells and three deeper wells were installed in OU1 to assess potential impacts from groundwater to the residential area north of the former USS Lead Facility. The locations (**Figure 2.3-1**) were selected in parks and other properties owned by the City of East Chicago to facilitate access agreements. Monitoring wells OU1MW1 and OU1MW2 were installed in an area anticipated to have lead concentrations less than 400 mg/kg based on the USEPA's online map of soil concentrations[1]. The other six shallow monitoring well locations (OU1MW3 through OU1MW8) were selected in areas with higher lead concentrations in soil (greater than 1,200 mg/kg) to evaluate contaminant distribution in groundwater. Deeper wells were installed at OU1MW3, OU1MW5, and OU1MW6, which provided one deeper well for each of the three OU1 zones. Monitoring wells OU1MW2 and OU1MW7 were relocated slightly during the subsurface clearance and access agreement process.

As part of the development of the access agreement for well installation and sampling with the City of East Chicago, ERM conducted further review of the parcel boundaries and property ownership of each proposed well location on the County Assessor's website. As a result of this review, ERM determined the proposed OU1MW7 location was on property that was no longer owned by the City of East Chicago. Therefore, the location was moved approximately 50 feet north to an alternate property owned by the City of East Chicago. Additionally, the lot on which ERM planned to install OU1MW2 had split ownership; the eastern portion was owned by Northern Indiana Public Service and the western portion was owned by the City of East Chicago. The well location was moved approximately 75 feet west so that it was within the portion owned by the City of East Chicago and was out of the utility corridor.

The 11 wells were installed during November and December 2018 using a Geoprobe Systems® rig equipped with 4¼ -inch-diameter hollow-stem augers. The shallow monitoring wells were constructed of 10-foot long, 2-inch-diameter PVC well screens with PVC risers. The shallow monitoring wells were screened from 3 to 13 feet bgs (**Table 2.3-1**). The top of the well screens in the shallow wells were set across the water table to account for potential seasonal variations. The deeper wells were constructed of 5-foot long, 2-inch-diameter PVC well screens with PVC risers. The deeper monitoring wells were

[1] https://epa.maps.arcgis.com/apps/MapSeries/index.html?appid=d45c8610b7364b8f931fdbb748d607c1

screened from 24.5 or 25 feet bgs to 29.5 or 30 feet bgs (**Table 2.3-1**). Boring logs for the wells installed in OU1 are provided in **Appendix B**.

A filter pack consisting of No. 5 sand was placed around the screen to approximately 1 to 2 feet above the top of the screen. Except for OU1MW6D, the monitoring wells were constructed to 1 to 2 feet less than the total depth of the soil borings due to heaving sands. A seal consisting of bentonite chips was placed above the filter pack to the ground surface. The wells were then finished at the ground surface with flush-mounted, steel, locking well vaults sealed in concrete.

Following installation, each well was developed by surging with a bailer to remove fines from the filter pack. At least three well casing volumes were then removed utilizing a peristaltic pump to complete well development. Gauging and sampling occurred after wells had stabilized for 48 hours after development, as specified in the RI/FS FSP (ERM 2018b).

Drilling equipment was cleaned prior to the first boring and in between borings by scrubbing with an Alconox® solution followed by a clean water rinse.

Soil cuttings, purge water, and cleaning water generated during well installation and development were temporarily containerized in labelled and secured 55-gallon steel drums over secondary containment. Waste management is discussed in more detail in **Section 3.2.10**.

In March 2021, nine shallow groundwater monitoring wells were installed at the Site to either fill data gaps in the Site conceptual model or replace potentially malfunctioning wells. Each of the nine wells were installed using similar construction methods as the 11 2018 groundwater wells described previously. These nine shallow wells were each screened from approximately 4 to 14 ft bgs. Boring and well logs for these monitoring wells are provided in **Appendix B**. Of the nine wells, three were installed at the former ECHA complex (OU1MW13, OU1MW14, OU1MW15), four were installed around OU1MW5 (OU1MW5N, OU1MW5E, OU1MW5S, OU1MW5W), and two were installed at the former USS Lead Facility (MW21R and MW26). The former ECHA complex wells and four wells surrounding OU1MW5 were installed to fill data gaps in the Site conceptual model. Well MW21R was installed as a replacement well for MW21 to alleviate potential heaving issues. Well MW26 was installed as an additional data point west of MW21R.

3.2.7 Collection and Analysis of Groundwater Samples

Groundwater samples were collected from the 11 new OU1-series wells on a quarterly basis for the following four consecutive quarters: December 2018, March 2019, June 2019, and August 2019. Nine additional Site groundwater monitoring wells were installed and 13 were sampled in March 2021. Three monitoring wells at the former ECHA complex (ECHA-MW-01, ECHA-MW-09, and ECHA-MW-35) were also included in the March 2019, June 2019, and August 2019 events per the USEPA's request. Groundwater samples were collected using a peristaltic pump and the low-flow technique. Field water quality parameters (dissolved oxygen, oxidation reduction potential, pH, specific conductivity [SC], temperature, and turbidity) were monitored during purging using a Horiba U-50 series, or YSI multi-parameter water quality measurement device and recorded in the field notebook or stored on the project server. Dedicated, disposable tubing was used at each well.

Monitoring wells were sampled after a minimum of three well volumes were extracted and three consistent measurements of pH, SC, and temperature (i.e., readings within 0.1 units, 10%, and 1 degree of each other, respectively) were obtained. Samples were obtained directly from the pump tubing after being disconnected from the flow-through multi-parameter water quality meter. The samples for total metals and hardness analyses were placed into laboratory-supplied 250-mL polyethylene bottles with nitric acid preservative, and samples for alkalinity analysis were collected in unpreserved 250-mL polyethylene bottles. Additionally, a sample for dissolved metals was field filtered using a dedicated 0.45-

micron filter. A minimum of 500 mL of water was passed through the filter prior to collection into the laboratory-supplied 250-mL polyethylene bottle preserved with nitric acid.

As stated in the RI/FS FSP (ERM 2018b), groundwater samples were scheduled to be analyzed for total and dissolved antimony, arsenic, cadmium, iron, lead, and selenium, hardness and alkalinity on a quarterly basis. Groundwater samples were only analyzed for PAHs during the first and third quarters.

A total of 11 groundwater samples were collected from OU1 monitoring wells on December 13-14, 2018. QA/QC samples included two field duplicates, one equipment rinsate blank, and one sample designated for MS/MSD analysis. Sample containers were labeled, placed on ice in a cooler, and delivered under chain of custody to Eurofins TestAmerica in Pittsburgh, Pennsylvania. Groundwater samples and the equipment blank were analyzed for total and dissolved antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A, hardness according to SM 2340C, alkalinity according to SM 2320B, and PAHs according to USEPA 8270D Low Level (LL). The field-filtered sample collected from OU1MW3D on December 13, 2018, was lost by the lab, and so OU1MW3D was resampled on December 21, 2018, for total and dissolved metals and hardness. QA/QC samples included one field duplicate sample.

A total of 14 groundwater samples were collected from OU1 monitoring wells on March 20-21, 2019. QA/QC samples included two field duplicates, one equipment rinsate blank, and one sample designated for MS/MSD analysis. Sample containers were labeled, placed on ice in a cooler, and delivered under chain of custody to Eurofins TestAmerica in Pittsburgh, Pennsylvania. Groundwater samples and the equipment blank were analyzed for total and dissolved antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A, hardness according to SM 2340C, and alkalinity according to SM 2320B. Per the RI/FS FSP (ERM 2018b) PAHs were not analyzed in the March 2019 groundwater samples.

A total of 14 groundwater samples were collected between June 3 and June 5, 2019. QA/QC samples included two field duplicates, one equipment rinsate blank, and one sample designated for MS/MSD analysis. Sample containers were labeled, placed on ice in a cooler, and delivered under chain of custody to Eurofins TestAmerica in Pittsburgh, Pennsylvania. Groundwater samples and the equipment blank were analyzed for total and dissolved antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A, hardness according to SM 2340C, alkalinity according to SM 2320B, and PAHs according to USEPA 8270D LL.

A total of 14 groundwater samples were collected from OU1 monitoring wells on August 12-13, 2019. QA/QC samples included two field duplicates, one equipment rinsate blank, and one sample designated for MS/MSD analysis. Sample containers were labeled, placed on ice in a cooler, and delivered under chain of custody to Eurofins TestAmerica in Pittsburgh, Pennsylvania. Groundwater samples and the equipment blank were analyzed for total and dissolved antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A, hardness according to SM 2340C, and alkalinity according to SM 2320B. Per the RI/FS FSP (ERM 2018b) PAHs were not analyzed in the August 2019 groundwater samples. The groundwater sample from OU1MW5 was also analyzed for pH according to USEPA Method 9040C, per USEPA's request.

A total of 13 groundwater samples were collected from groundwater monitoring wells March 16-18, 2021. From OU1, newly installed shallow wells OU1MW5N, OU1MW5S, OU1MW5E, OU1MW5W, OU1MW13, OU1MW14, and OU1MW15 were sampled. At the former USS Lead Facility, wells MW1, MW3, MW4, MW14, MW21R, and MW26 were sampled. QA/QC samples included one field duplicate, one equipment rinsate blank, and one sample designated for MS/MSD analysis. Sample containers were labeled, placed on ice in a cooler, and delivered under chain of custody to Eurofins TestAmerica in Pittsburgh, Pennsylvania. Groundwater samples and the equipment blank were analyzed for total and dissolved antimony, arsenic, cadmium, iron, lead, and selenium according to USEPA Method 6020A, hardness according to SM 2340C, and alkalinity according to SM 2320B. The March 2021 groundwater samples were not analyzed for PAHs as directed by USEPA.

The equipment rinsate blanks were collected by pouring laboratory-supplied deionized water over the cleaned water level meter and collecting the water in a 250-mL bottle.

Water level meters and other non-dedicated equipment was decontaminated with Liquinox (non-phosphate detergent) mixed with deionized water, followed by a deionized water rinse.

Purge and cleaning water generated during groundwater sampling were temporarily containerized in labelled and secured 55-gallon steel drums over secondary containment. Waste management is discussed in more detail in **Section 3.2.10**.

The field parameter results for groundwater samples collected between December 2018 and March 2021 are provided in **Table 3.2-5**. The total and dissolved metals, hardness, alkalinity, and laboratory pH results for groundwater samples collected between December 2018 and March 2021 are provided in **Table 3.2-6**. The PAH results for groundwater samples collected between December 2018 and August 2019 are provided in **Table 3.2-7**.

3.2.8 Collection of Hydrogeological Information from OU1 and OU2

In December 2018, the top of casing, ground elevation, and coordinates of each monitoring well in OU1 and OU2 were surveyed by a licensed professional. Survey data is included in **Table 2.3-1**.

Depths to groundwater were measured in feet below the top of casing (BTOC) during each quarter of groundwater monitoring using an electronic water level meter. Depths to groundwater and calculated groundwater elevations are provided in **Table 2.5-1**. Historical groundwater elevations are provided in **Appendix C**. Groundwater elevations were used to construct contour maps of the water table surface across the Site for December 2018, March 2019, June 2019, and August 2019 (**Figures 2.5-2 through 2.5-5**, respectively).

Calculated horizontal and vertical gradients are discussed in **Section 2.5.3** and presented in **Tables 2.5-2** and **2.5-3**, respectively.

Additionally, in December 2018, slug tests were performed of the 11 new monitoring wells to estimate the hydraulic conductivity of the water-table aquifer beneath OU1. The results of the slug tests and hydraulic conductivity calculations are discussed in **Section 2.5.4** and presented in **Table 2.5-4** and **Appendix D**.

Cross-sections are presented as **Figure 3.2-5 (A-A'), 3.2-6 (B-B') and 3.2-7 (C-C').** Cross-section A-A' is southwest to northeast across the former USS Lead facility. Cross-section B-B' is west to east across OU1, Zones 1-3. Cross-section C-C' is south to north across the former USS Lead facility and OU1. Depths to groundwater and COI concentrations at the screened intervals are shown on the cross-sections.

3.2.9 Total Petroleum Hydrocarbon (TPH) Investigation

In November 2018, during sediment sampling, a petroleum odor in sediment samples and a sheen on the water in DU8 was observed. Further investigation determined that the material was consistently observed between DU3 and DU8, adjacent to the river. To characterize the material, three surface sediment grab samples were collected from the USS Lead property. The first sample was collected north of DU8 and east of one of the ponds, the second sample was collected from the northeast corner of DU8, and the third sample was collected about halfway along the eastern boundary of DU8. All three samples were collected in the southeast corner of the former USS Lead Facility approximately 75 feet west of the railroad and approximately 125 feet west of Kennedy Avenue. Samples were analyzed for total petroleum hydrocarbons (TPH) gasoline range organics (GRO), diesel range organics (DRO), and residual range organics (RRO). TPH C10-C20 and C20-C40 were detected. The results of the analysis indicated that the material was likely a slightly weathered petroleum-based material. TPH is not believed to pose a significant risk to human health or the environment. Based on the geographic distribution of the material, it appears to be from an offsite source (e.g., Grand Calumet River) and not related to the former USS Lead Facility.

3.2.10 Waste Management

Monitoring well installation, development, and sampling at OU1 generated the following quantities of waste.

Summary of Investigative Derived Waste (2018 – 2019)

# Drums	Media	Source	Classification
13	Soil cuttings	OU1	Non-hazardous
20	Purge and cleaning water	OU1	Non-hazardous
2	PPE, disposable sampling equipment	OU1	Non-hazardous

Waste characterization samples were collected from the soil cuttings. Composite samples were collected by taking an aliquot (approximately 8 ounces) from four to five drums and homogenizing the aliquots in a 1-gallon bag. A total of three composite samples were collected in this manner. Two 4-ounce jars were then filled with the material from each 1-gallon bag.

Composite soil samples were shipped under chain of custody to Envision Laboratories, Inc. in Indianapolis, IN and analyzed for antimony, arsenic, cadmium, lead, and selenium according to USEPA Method 6010B. A sample was also collected and submitted for possible toxicity characteristic leaching procedure (TCLP) testing and placed on hold pending the results of the total metal concentrations. Total metal concentrations were low, and the disposal facility did not require a TCLP analysis as part of the waste characterization. Therefore, TCLP analysis was not performed.

Purge and cleaning water drums and PPE materials were not sampled for waste characterization. Laboratory reports from well sampling were provided to the disposal facility to characterize the liquid waste.

All the waste from OU1 was classified as non-hazardous waste. Waste was transported offsite on June 11, 2019, and October 28, 2019, by Veolia Environmental Services (Veolia). The waste was disposed of at Veolia's facility in Menomonee Falls, WI. The waste manifests are provided in **Appendix F**.

The March 2021 monitoring well installation and development, soil sampling, and groundwater sampling generated the following quantities of waste.

Summary of Investigative Derived Waste (2021)

# Drums	Media	Source	Classification
8	Soil cuttings	OU1/former USS Lead Facility	Non-hazardous
4	Purge and cleaning water	OU1/former USS Lead Facility	Non-hazardous

Waste characterization samples were collected from the soil cuttings. Composite samples were collected by taking an aliquot (approximately 8 ounces) from four to five drums and homogenizing the aliquots in a 1-gallon bag. A total of three composite samples were collected in this manner. Two 4-ounce jars were then filled with the material from each 1-gallon bag.

Composite soil samples were shipped under chain of custody to Envision Laboratories, Inc. in Indianapolis, IN and analyzed for antimony, arsenic, cadmium, lead, and selenium according to USEPA Method 6010B. A sample was also collected and submitted for possible toxicity characteristic leaching procedure (TCLP) testing and placed on hold pending the results of the total metal concentrations. Total metal concentrations were low, and the disposal facility did not require a TCLP analysis as part of the waste characterization. Therefore, TCLP analysis was not performed.

Purge and cleaning water drums and PPE materials were not sampled for waste characterization. Laboratory reports from well sampling were provided to the disposal facility to characterize the liquid waste.

The waste will be disposed of at Veolia's facility in Menomonee Falls, WI.

3.2.11 Data Management

Data collected during the RI activities were managed according to the RI/FS QAPP (ERM 2018c). Laboratory analytical results for the samples collected November 2018 through June 2021 were provided by Eurofins TestAmerica as electronic data deliverables (EDDs) and PDF lab reports. The ERM database manager performed a data quality check on each EDD and loaded the EDDs to the EQuIS project database. Verification was performed by comparing information from the database against the PDF lab reports to verify accuracy of the EDDs. Following verification, the EDDs were submitted along with the PDF lab reports to Laboratory Data Consultants (LDC) for third-party data validation. Ninety percent of data underwent Stage 2B validation, and 10 percent of data underwent full Stage 4 validation. After validation, LDC provided a revised EDD with data modifications and qualifiers that resulted from the validation process along with a validation report. ERM reviewed the validation report and results of the validation and loaded the updated EDDs to the EQuIS project database.

Field notes prepared during the activities conducted between November 2018 and June 2021 were scanned into electronic PDFs and saved to the project folder. Original hard copies of the field notes were stored in the ERM Rolling Meadows office. Field data (e.g., field parameters and groundwater elevations) were manually entered into EDDs and loaded to the EQuIS project database. Verification was performed by comparing information from the database against the field notes to verify accuracy of the EDDs.

4. NATURE AND EXTENT OF CONTAMINATION

4.1 Data Review and Selection of Chemicals of Interest

As described in the RI/FS FSP (ERM 2018b), historical data were reviewed to identify the COIs for the RI. Data collected at the former USS Lead Facility over the preceding 20 years were evaluated and compared to the then current regulatory SLs. Soil data were compared to the IDEM SLs and USEPA RSLs and Soil Screening Levels (SSLs). Groundwater data was compared to USEPA MCLs (if available) or RSLs. Surface water data were compared to the USEPA Region IV ESVs. The results of the historical data review are summarized below. More detail can be found in ERM (2018b). The Screening Levels for Nature and Extent of contamination are summarized in **Table 4.1-1.**

- VOCs, SVOCs, PCBs, dioxins/furans, and pesticides are not a concern at the former USS Lead Facility, and investigation of these parameters was deemed complete.
- While extensive metals soil/sediment sampling had been conducted at most areas of the former USS Lead Facility, the southern (wetlands) portion of the former USS Lead Facility had not been thoroughly investigated, and levels of arsenic in MW7 and MW21 above the IDEM SL required further evaluation. The Post Closure Permit requires analysis of the OU2 groundwater samples for antimony, arsenic, cadmium, lead, and selenium, so these metals were identified as COIs in the soil/sediment.
- While groundwater at the Site has been characterized and extensively monitored, only limited groundwater sampling had been conducted in OU1. Therefore, the RI included installation and sampling of monitoring wells in OU1 in 2018, 2019 and 2021. The COIs identified for OU1 groundwater were the same select metals identified as COIs at the former USS Lead Facility.
- At the request of USEPA, iron was added to the list of select metals to be analyzed in soil, sediment, and groundwater samples. While iron is not considered a COI, it was added to provide geochemical context for interpreting the results of the other metals.
- USEPA also requested analysis of PAHs in groundwater sampled in OU1 during the 1st and 3rd quarters of 2018 and 2019.

4.2 Data Considered in this Remedial Investigation

Soil, sediment, groundwater, and surface water sampling has been conducted at the former USS Lead Facility resulting in an extensive database of historical sampling results; see **Section 3.1** for descriptions of the historical site investigation activities. In addition to the data collected by ERM between 2018 and 2019, data used in this RI were collected between 2000 (at areas that were not subsequently remediated) and 2019 by Geochemical Solutions, Inc., DAI Environmental, Law Engineering and Environmental Services, Inc., ENTACT, LLC, Indiana Department of Environmental Management, US Environmental Protection Agency, and ETS Environmental. ERM collected soil, sediment, groundwater, and biota samples between November 2018 and September 2019. Additional soil samples were collected at select locations in March and June 2021 and select monitoring wells were sampled in March 2021.

The historical sampling result database was filtered to generate the RI database based on:

- Post excavation samples;
- COI (Antimony, Arsenic, Cadmium, Iron, Lead, and Selenium);
- Sample depth (shallow interval 0 to 2 ft bgs, deep interval >2 ft bgs);
- Sample date:

- Soil and sediment samples from 2000 to 2021;
- Groundwater from 2018 to 2021 except for wells MW11 and MW13 which did not have sufficient data so samples from 2005-2007 were used;
- Surface water from 2018 to 2021, except for MRFI-SW samples, SW-A, and SW-C which did not have sufficient data so 2007, 2012, and 2015 samples were used; and
- Biota, all samples were used.

A total of 89 soil samples, 372 discrete sediment samples, 24 ISM sediment samples, 38 surface water samples, 27 groundwater PAH samples, 836 groundwater metals samples, 9 plant tissue samples, and 9 invertebrate samples were used in this RI. For the purposes of statistical data analysis, sample results reported by the laboratory as not detected were set equal to the MDL. In the case the MDL was not available the sample results were set equal to the reporting limit. Twenty-nine lead sediment samples in the historical database did not have MDLs or reporting limits available and were subsequently excluded from analysis. **Table 4.2-1** presents a list of historical investigation studies used in the RI. **Table 4.2-2** is a summary of the historical and RI samples by media type, analysis and dates collected. The locations of the discrete soil samples collected by ERM between 2018 and 2021 are shown on **Figure 3.2-1**, and the locations of the soil samples used in this RI are shown on **Figure 4.2-1**. The locations of the DUs sampled for sediment and biota by ERM between 2018 and 2019 are shown on **Figure 3.2-2**, and the locations of the sediment samples used in this RI are shown on **Figure 4.2-2** and **Figure 4.2-2a**. The locations of the surface water samples used in this RI are shown on **Figure 4.2-3,** and the locations of the groundwater monitoring wells are shown on **Figure 2.3-1**.

4.3 Results and Statistical Summary

The results and statistical summary section are organized by media and depth interval.

4.3.1 Soil

The shallow and deep soil datasets used for this RI included historical and recent samples. The complete soil dataset used for this RI is provided in **Appendix G** and summarized below. The distribution of the soil data is evaluated in a series of histograms in **Appendix H**, and statistical summary tables for soil are provided in **Appendix I.** Soil results figures that show RSL exceedances are provided in **Appendix O.**

4.3.1.1 Shallow Soil Samples

The following provides a summary of the shallow soil dataset for each metal.

- A total of 24 surface soil locations were sampled and analyzed for antimony during this RI, and 25 surface soil samples were compiled from historical datasets. Concentrations of detected antimony in the 49 surface soil samples ranged from 1.9 mg/kg to 210 mg/kg. The mean concentration of antimony in surface soil was 29.9 mg/kg. Antimony was detected in 42 of the 49 samples.
- A total of 24 surface soil locations were sampled and analyzed for arsenic during this RI, and 28 surface soil samples were compiled from historical datasets. Concentrations of detected arsenic in the 52 surface soil samples ranged from 1.7 mg/kg to 630 mg/kg. The mean concentration of arsenic in surface soil was 51.9 mg/kg. Arsenic was detected in 51 of the 52 samples.
- A total of 24 surface soil locations were sampled and analyzed for cadmium during this RI, and 28 surface soil samples were compiled from historical datasets. Concentrations of detected cadmium in the 52 surface soil samples ranged from 0.1 mg/kg to 14 mg/kg. The mean concentration of cadmium in surface soil was 2.45 mg/kg. Cadmium was detected in 42 of the 52 samples.

- A total of 24 surface soil locations were sampled and analyzed for lead during this RI, and 54 surface soil samples were compiled from historical datasets. Concentrations of detected lead in the 78 surface soil samples ranged from 1.7 mg/kg to 1800 mg/kg. The mean concentration of lead in surface soil was 262.1 mg/kg. Lead was detected in 71 of the 78 samples.
- A total of 24 surface soil locations were sampled and analyzed for selenium during this RI, and 24 surface soil samples were compiled from historical datasets. Concentrations of detected selenium in the 78 surface soil samples ranged from 0.11 mg/kg to 5.8 mg/kg. The mean concentration of selenium in surface soil was 0.97 mg/kg. Selenium was detected in 22 of the 32 samples.

4.3.1.2 Deep Soil Samples

- A total of 18 subsurface soil locations were sampled and analyzed for antimony during this RI, and 3 subsurface soil samples were compiled from historical datasets. Concentrations of detected antimony in the 21 subsurface soil samples ranged from 0.97 mg/kg to 110 mg/kg. The mean concentration of antimony in subsurface soil was 11.5 mg/kg. Antimony was detected in 18 of the 21 samples.
- A total of 18 subsurface soil locations were sampled and analyzed for arsenic during this RI, and no subsurface soil samples were compiled from historical datasets. Concentrations of detected arsenic in the 18 subsurface soil samples ranged from 0.87 mg/kg to 130 mg/kg. The mean concentration of arsenic in subsurface soil was 12.64 mg/kg. Arsenic was detected in all 18 of the samples.
- A total of 18 subsurface soil locations were sampled and analyzed for cadmium during this RI, and no subsurface soil samples were compiled from historical datasets. Concentrations of detected cadmium in the 18 subsurface soil samples ranged from 0.032 mg/kg to 530 mg/kg. The mean concentration of cadmium in subsurface soil was 42.47 mg/kg. Cadmium was detected in all 18 of the samples.
- A total of 18 subsurface soil locations were sampled and analyzed for lead during this RI, and three subsurface soil samples were compiled from historical datasets. Concentrations of detected lead in the 21 subsurface soil samples ranged from 1.4 mg/kg to 1700 mg/kg. The mean concentration of lead in subsurface soil was 207.3 mg/kg. Lead was detected in 19 of the 21 samples.
- A total of 18 subsurface soil locations were sampled and analyzed for selenium during this RI, and no subsurface soil samples were compiled from historical datasets. Concentrations of detected selenium in the 18 subsurface soil samples ranged from 0.2 mg/kg to 0.22 mg/kg. The mean concentration of selenium in subsurface soil was 0.128 mg/kg. Selenium was detected in three of the 18 samples.

4.3.2 Sediment

The sediment dataset used for this RI included historical and recent samples. In the RI, sediment samples were collected from eight wetland DUs using ISM and analyzed for total antimony, arsenic, cadmium, iron, lead, and selenium. Three composite samples were collected from each DU. The results for each DU were averaged to represent conditions throughout each DU. The complete sediment dataset used for this RI is provided in **Appendix J** and summarized below. The distribution of the sediment data is evaluated in a series of histograms in **Appendix H**, and statistical summary tables for soil are provided in **Appendix I.** Sediment data distribution figures that show RSL exceedances are provided in **Appendix O.**

4.3.2.1 Shallow Sediment Samples

- A total of 105 discrete surface sediment samples were compiled from historical datasets. Concentrations of detected antimony in the 105 surface sediment samples ranged from 0.82 mg/kg to 3,710 mg/kg. The mean concentration of antimony in surface sediment samples was 124 mg/kg. Antimony was detected in 37 of the 105 samples.

- A total of 47 discrete surface sediment samples were compiled from historical datasets. Concentrations of detected arsenic in the 47 surface sediment samples ranged from 1.51 mg/kg to 5,700 mg/kg. The mean concentration of arsenic in surface sediment samples was 488.6 mg/kg. Arsenic was detected in all 47 of the samples.
- A total of 47 discrete surface sediment samples were compiled from historical datasets. Concentrations of detected cadmium in the 47 surface sediment samples ranged from 0.16 mg/kg to 160 mg/kg. The mean concentration of cadmium in surface sediment samples was 16.69 mg/kg. Cadmium was detected in 33 of the 47 samples.
- A total of 358 discrete surface sediment samples were compiled from historical datasets. Concentrations of detected lead in the 358 surface sediment samples ranged from 1.9 mg/kg to 20,000 mg/kg. The mean concentration of lead in surface sediment samples was 640.5 mg/kg. Lead was detected in 254 of the 358 samples.
- A total of 28 discrete surface sediment samples were compiled from historical datasets. Concentrations of detected selenium in the 28 surface sediment samples ranged from 1.1 mg/kg to 43.9 mg/kg. The mean concentration of selenium in surface sediment samples was 9.98 mg/kg. Selenium was detected in 15 of the 28 samples.

4.3.2.2 Deep Sediment Samples

- A total of 21 discrete subsurface sediment samples were compiled from historical datasets. Concentrations of detected antimony in the 105 subsurface sediment samples ranged from 1.3 mg/kg to 26.5 mg/kg. The mean concentration of antimony in subsurface sediment samples was 2.5 mg/kg. Antimony was detected in two of the 21 samples.
- A total of two discrete subsurface sediment samples were compiled from historical datasets. Concentrations of detected arsenic in the two subsurface sediment samples ranged from 5.2 mg/kg to 122 mg/kg. A 95% UCL and associated mean concentration could not be calculated.
- A total of two discrete subsurface sediment samples were compiled from historical datasets. . Cadmium was detected in one of two samples at 9.7 mg/kg. A 95% UCL and associated mean could not be calculated.
- A total of 21 discrete subsurface sediment samples were compiled from historical datasets. Concentrations of detected lead in the 10 subsurface sediment samples ranged from 5.3 mg/kg to 617 mg/kg. The mean concentration of lead in subsurface sediment samples was 45.57 mg/kg. Lead was detected in 10 of the 21 samples.
- No discrete subsurface sediment samples were compiled from historical datasets.

4.3.2.3 AVS/SEM/TOC

Three discrete sediment samples were collected from each DU in OU2 for analysis of AVS, SEM, and TOC. The AVS/SEM/TOC samples were analyzed for antimony, arsenic, cadmium, copper, lead, nickel, silver, sulfide, and zinc. **Table 3.2-3** presents the AVS/SEM/TOC results.

4.3.3 Surface Water

The surface water dataset used for this RI was compiled from historical data. The complete surface water dataset used for this RI is provided in **Appendix K** and summarized below. The distribution of the surface water data is evaluated in a series of histograms in **Appendix H**, and statistical summary tables for surface water are provided in **Appendix I.** Surface water exceedances of the ESVs are shown on **Figure 4.3-6.**

4.3.3.1 Dissolved Metals

- A total of 22 surface water samples for dissolved antimony were compiled from historical datasets. Concentrations of detected dissolved antimony in the surface water samples ranged from 7.4 µg/L to 130 µg/L. The mean concentration of antimony in surface water was 22.59 µg/L. Dissolved antimony was detected in 17 of the 22 surface water samples.
- A total of 24 surface water samples for dissolved arsenic were compiled from historical datasets. Concentrations of detected dissolved arsenic in the surface water samples ranged from 5.8 µg/L to 610 µg/L. The mean concentration of arsenic in surface water was 105.2 µg/L. Dissolved arsenic was detected in all 24 of the surface water samples.
- A total of 24 surface water samples for dissolved cadmium were compiled from historical datasets. Concentrations of detected dissolved cadmium in the surface water samples ranged from 0.56 µg/L to 1.2 µg/L. The mean concentration of cadmium in surface water was 0.50 µg/L. Dissolved cadmium was detected in seven of the 24 surface water samples.
- A total of 24 surface water samples for dissolved lead were compiled from historical datasets. Concentrations of detected dissolved lead in the surface water samples ranged from 1.7 µg/L to 41 µg/L. The mean concentration of lead in surface water was 5.95 µg/L. Dissolved lead was detected in 14 of the 24 surface water samples.
- A total of 21 surface water samples for dissolved selenium were compiled from historical datasets. Concentrations of detected dissolved selenium in the surface water samples ranged from 7.7 µg/L to 12 µg/L. The mean concentration of selenium in surface water was 3.65 µg/L. Dissolved selenium was detected in three of the 21 surface water samples.

4.3.3.2 Total Metals

- A total of 13 surface water samples for total antimony were compiled from historical datasets. Concentrations of detected total antimony in the surface water samples ranged from 7 µg/L to 46 µg/L. The mean concentration of antimony in surface water was 16.74 µg/L. Total antimony was detected in 10 of the 13 surface water samples.
- A total of 13 surface water samples for total arsenic were compiled from historical datasets. Concentrations of detected total arsenic in the surface water samples ranged from 9.9 µg/L to 300 µg/L. The mean concentration of arsenic in surface water was 69.53 µg/L. Total arsenic was detected in all 13 of the surface water samples.
- A total of 13 surface water samples for total cadmium were compiled from historical datasets. Concentrations of detected total cadmium in the surface water samples ranged from 0.95 µg/L to 1.2 µg/L. The mean concentration of cadmium in surface water was 0.84 µg/L. Total cadmium was detected in four of the 13 surface water samples.
- A total of 13 surface water samples for total lead were compiled from historical datasets. Concentrations of detected total lead in the surface water samples ranged from 2.9 µg/L to 19 µg/L. The mean concentration of lead in surface water was 4.37 µg/L. Total lead was detected in four of the 13 surface water samples.
- A total of 13 surface water samples for total selenium were compiled from historical datasets. Total selenium was detected in one of the 13 surface water samples at 4.6 ug/L.

4.3.4 Biota

The biota dataset used for this RI included only recent data. The results are provided in **Table 3.2-4** and summarized below. The distribution of the plant tissue data is evaluated in a series of histograms in **Appendix H**, and statistical summary tables for plant tissue are provided in **Appendix I.**

4.3.4.1 Plant Tissue

A total of eight plant tissue samples were collected and analyzed for antimony during this RI.

- Concentrations of antimony in the eight plant tissue samples were below the method detection limit of 0.065 mg/kg.
- Concentrations of arsenic in the eight plant tissue samples ranged from 0.051 mg/kg to 0.56 mg/kg. The mean concentration of arsenic in plant tissue was 0.16 mg/kg. Arsenic was detected in all eight of the plant tissue samples.
- Concentrations of cadmium in the eight plant tissue samples ranged from 0.017 mg/kg to 0.036 mg/kg. The median concentration of cadmium in plant tissue was 0.02 mg/kg. Cadmium was detected in two of the eight plant tissue samples.
- Concentrations of lead in the eight plant tissue samples ranged from 0.035 mg/kg to 0.85 mg/kg. The mean concentration of lead in plant tissue was 0.16 mg/kg. Lead was detected in all of the eight plant tissue samples.
- Concentrations of selenium in the eight plant tissue samples were all below the method detection limit of 0.13 mg/kg.

4.3.4.2 Invertebrate Tissue

A total of eight invertebrate tissue samples were collected and analyzed for antimony during this RI.

- Concentrations of antimony in the eight invertebrate tissue samples ranged from 0.18 mg/kg to 1.6 mg/kg. The mean concentration of antimony in invertebrate tissue was 0.763 mg/kg. Antimony was detected in all eight of the invertebrate tissue samples.
- Concentrations of arsenic in the eight invertebrate tissue samples ranged from 4.1 mg/kg to 170 mg/kg. The mean concentration of arsenic in invertebrate tissue was 35.34 mg/kg. Arsenic was detected in all eight of the invertebrate tissue samples.
- Concentrations of cadmium in the eight invertebrate tissue samples ranged from 0.021 mg/kg to 0.46 mg/kg. The mean concentration of cadmium in invertebrate tissue was 0.12 mg/kg. Cadmium was detected in all eight of the invertebrate tissue samples.
- Concentrations of lead in the eight invertebrate tissue samples ranged from 2.7 mg/kg to 17 mg/kg. The mean concentration of lead in invertebrate tissue was 8.65 mg/kg. Lead was detected in all eight of the invertebrate tissue samples.
- Concentrations of selenium in the eight invertebrate tissue samples ranged from 0.46 mg/kg to 0.79 mg/kg. The mean concentration of selenium in invertebrate tissue was 0.6 mg/kg. Selenium was detected in all eight of the invertebrate tissue samples.

4.3.5 Groundwater

The groundwater dataset used for this RI included historical and recent samples. The complete groundwater dataset used for this RI is provided in **Appendix L** and summarized below. The distribution of the groundwater data is evaluated in a series of histograms in **Appendix H**, and statistical summary tables for groundwater are provided in **Appendix I.** The groundwater isoconcentration figures are **Figure 4.3-1 to 4.3-5.**

4.3.5.1 OU1 Zone 1

Dissolved Metals

A total of 20 groundwater samples for OU1 Zone 1 were collected and analyzed for dissolved metals during this RI.

- Concentrations of detected dissolved antimony in the groundwater samples ranged from 1.9 µg/L to 1200 µg/L. The mean concentration of antimony in groundwater was 180.1 µg/L. Dissolved antimony was detected in 15 of the 20 groundwater samples.
- Concentrations of detected dissolved arsenic in the groundwater samples ranged from 0.6 µg/L to 440 µg/L. The mean concentration of arsenic in groundwater was 128.9 µg/L. Dissolved arsenic was detected in all 20 of the groundwater samples.
- Concentrations of detected dissolved cadmium in the groundwater samples ranged from 0.41 µg/L to 59 µg/L. The mean concentration of cadmium in groundwater was 7.78 µg/L. Dissolved cadmium was detected in seven of the 20 groundwater samples.
- Concentrations of detected dissolved lead in the groundwater samples ranged from 0.13 µg/L to 68 µg/L. The mean concentration of lead in groundwater was 9.60 µg/L. Dissolved lead was detected in 10 of the 20 groundwater samples.
- Concentrations of detected dissolved selenium in the groundwater samples ranged from 2.6 µg/L to 82 µg/L. The mean concentration of selenium in groundwater was 11.83 µg/L. Dissolved selenium was detected in nine of the 20 groundwater samples.

Total Metals

A total of 20 groundwater samples for OU1 Zone 1 were collected and analyzed for total metals during this RI.

- Concentrations of detected total antimony in the groundwater samples ranged from 0.42 µg/L to 1200 µg/L. The mean concentration of antimony in groundwater was 183.5 µg/L. Total antimony was detected in 17 of the 20 groundwater samples.
- Concentrations of detected total arsenic in the groundwater samples ranged from 0.69 µg/L to 440 µg/L. The mean concentration of arsenic in groundwater was 77.57 µg/L. Total arsenic was detected in all 20 of the groundwater samples.
- Concentrations of detected total cadmium in the groundwater samples ranged from 0.5 µg/L to 59 µg/L. The mean concentration of cadmium in groundwater was 8 µg/L. Total cadmium was detected in six of the 20 groundwater samples.
- Concentrations of detected total lead in the groundwater samples ranged from 0.14 µg/L to 89 µg/L. The mean concentration of lead in groundwater was 16.7 µg/L. Total lead was detected in 13 of the 20 groundwater samples.
- Concentrations of detected total selenium in the groundwater samples ranged from 2.3 µg/L to 82 µg/L. The mean concentration of selenium in groundwater was 11.77 µg/L. Total selenium was detected in nine of the 20 groundwater samples.

4.3.5.2 OU1 Zone 2 and Zone 3

Dissolved Metals

A total of 40 groundwater samples for OU1 Zone 2 and Zone 3 were collected and analyzed for dissolved metals during this RI.

- Concentrations of detected dissolved antimony in the groundwater samples ranged from 0.45 µg/L to 28 µg/L. The mean concentration of antimony in groundwater was 8.01 µg/L. Dissolved antimony was detected in 34 of the 40 groundwater samples.
- Concentrations of detected dissolved arsenic in the groundwater samples ranged from 0.33 µg/L to 53 µg/L. The mean concentration of arsenic in groundwater was 7.72 µg/L. Dissolved arsenic was detected in 35 of the 40 groundwater samples.
- Concentrations of detected dissolved cadmium were not detected in the groundwater samples.
- Concentrations of detected dissolved lead in the groundwater samples ranged from 0.25 µg/L to 230 µg/L. The mean concentration of lead in groundwater was 8.88 µg/L. Dissolved lead was detected in six of the 40 groundwater samples.
- Concentrations of detected dissolved selenium in the groundwater samples ranged from 0.96 µg/L to 4.6 µg/L. The mean concentration of selenium in groundwater was 1.23 µg/L. Dissolved selenium was detected in seven of the 40 groundwater samples.

Total Metals

A total of 41 groundwater samples for OU1 Zone 2 and Zone 3 were collected and analyzed for total metals during this RI.

- Concentrations of detected total antimony in the groundwater samples ranged from 0.48 µg/L to 28 µg/L. The mean concentration of antimony in groundwater was 7.73 µg/L. Total antimony was detected in 33 of the 41 groundwater samples.
- Concentrations of detected total arsenic in the groundwater samples ranged from 0.33 µg/L to 50 µg/L. The mean concentration of arsenic in groundwater was 8.41 µg/L. Total arsenic was detected in 40 of the 41 groundwater samples.
- Concentrations of detected total cadmium were not detected in the groundwater samples.
- Concentrations of detected total lead in the groundwater samples ranged from 0.10 µg/L to 220 µg/L. The mean concentration of lead in groundwater was 8.83 µg/L. Total lead was detected in 12 of the 41 groundwater samples.
- Concentrations of detected total selenium in the groundwater samples ranged from 1.3 µg/L to 4.4 µg/L. The mean concentration of selenium in groundwater was 1.20 µg/L. Total selenium was detected in seven of the 41 groundwater samples.

4.3.5.3 OU2

Dissolved Metals

- A total of 27 groundwater samples for OU2 were collected and analyzed for dissolved antimony during this RI and 22 groundwater samples were compiled from historical datasets. Concentrations of detected dissolved antimony in the groundwater samples ranged from 6.9 µg/L to 89 µg/L. The mean concentration of antimony in groundwater was 17.44 µg/L. Dissolved antimony was detected in 23 of the 49 groundwater samples.

- A total of 27 groundwater samples for OU2 were collected and analyzed for dissolved arsenic during this RI and 22 groundwater samples were compiled from historical datasets. Concentrations of detected dissolved arsenic in the groundwater samples ranged from 0.42 µg/L to 23,000 µg/L. The mean concentration of arsenic in groundwater was 755.8 µg/L. Dissolved arsenic was detected in 23 of the 49 groundwater samples.
- A total of 27 groundwater samples for OU2 were collected and analyzed for dissolved cadmium during this RI and 22 groundwater samples were compiled from historical datasets. Concentrations of detected dissolved cadmium in the groundwater samples ranged from 0.65 µg/L to 180 µg/L. The mean concentration of cadmium in groundwater was 7.08 µg/L. Dissolved cadmium was detected in 23 of the 49 groundwater samples.
- A total of 27 groundwater samples for OU2 were collected and analyzed for dissolved lead during this RI and 22 groundwater samples were compiled from historical datasets. Concentrations of detected dissolved lead in the groundwater samples ranged from 0.13 µg/L to 7 µg/L. The mean concentration of lead in groundwater was 0.66 µg/L. Dissolved lead was detected in five of the 49 groundwater samples.
- A total of 27 groundwater samples for OU2 were collected and analyzed for dissolved cadmium during this RI and 20 groundwater samples were compiled from historical datasets. Concentrations of detected dissolved selenium in the groundwater samples ranged from 2.2 µg/L to 5.6 µg/L. The mean concentration of selenium in groundwater was 2.95 µg/L. Dissolved selenium was detected in 11 of the 47 groundwater samples.

Total Metals

A total of 27 groundwater samples for OU2 were collected and analyzed for total metals during this RI.

- Concentrations of detected total antimony in the groundwater samples ranged from 0.45 µg/L to 170 µg/L. The mean concentration of antimony in groundwater was 45.48 µg/L. Total antimony was detected in 21 of the 27 groundwater samples.
- Concentrations of detected total arsenic in the groundwater samples ranged from 0.62 µg/L to 23,000 µg/L. The mean concentration of arsenic in groundwater was 1,803 µg/L. Total arsenic was detected in 25 of the 27 groundwater samples.
- Concentrations of detected total cadmium in the groundwater samples ranged from 0.83 µg/L to 210 µg/L. The mean concentration of cadmium in groundwater was 29.32 µg/L. Total cadmium was detected in 23 of the 27 groundwater samples.
- Concentrations of detected total lead in the groundwater samples ranged from 0.17 µg/L to 1,200 µg/L. The mean concentration of lead in groundwater was 139.1 µg/L. Total lead was detected in 23 of the 27 groundwater samples.
- Concentrations of detected total selenium in the groundwater samples ranged from 2.2 µg/L to 5.6 µg/L. The mean concentration of selenium in groundwater was 1.76 µg/L. Total selenium was detected in two of the 27 groundwater samples.

4.3.5.4 Polycyclic Aromatic Hydrocarbons

All OU1 groundwater PAH results were less than laboratory method detection limits except for phenanthrene and pyrene. There were J-flagged detections of phenanthrene and pyrene. The J-flag indicates an estimated/approximate concentration below the reporting limit.

5. HUMAN HEALTH RISK ASSESSMENT

The complete baseline HHRA is provided in Appendix M. The sections below provide a summary of the HHRA.

Specific requirements for the HHRA are described in the RI/FS SOW included in Appendix A of the ASAOC. This HHRA has been prepared in accordance with the four-step process detailed in USEPA's Risk Assessment Guidance for Superfund: Volume I – Human Health Evaluation Manual (USEPA 1989).

5.1 HHRA Objectives and Scope

The primary objective of the HHRA was to evaluate site-specific risk to human health, and to support one of two determinations: (1) the Site does not pose an unacceptable human health risk, and no further action is needed; or (2) the Site poses an unacceptable human health risk, and further action may be needed. The risk characterization is summarized below.

5.2 Risk Characterization

The HHRA presents an evaluation of potential risks to human health from COIs in surface soil, subsurface soil, and sediment in OU2 at the former USS Lead Facility and in groundwater under both OU1 and OU2, in accordance with the RI/FS SOW included in Appendix A of the ASAOC.

Based on the human health Conceptual Site Model (CSM), the following current and future potential human receptor populations and exposure pathways for soil, sediment, surface water, and/or groundwater were evaluated quantitatively in the HHRA:

- Adult utility workers at the former USS Lead Facility (OU2):
    - Surface and subsurface soil: incidental ingestion, dermal contact, and inhalation of particulate emissions in outdoor air
    - Sediment: incidental ingestion and dermal contact
    - Surface water: dermal contact
    - Groundwater: dermal contact
- Adult O&M workers at the former USS Lead Facility (OU2):
    - Surface soil: incidental ingestion, dermal contact, and inhalation of particulate emissions in outdoor air
- Adult and adolescent trespassers at the former USS Lead Facility (OU2):
    - Surface soil: incidental ingestion, dermal contact, and inhalation of particulate emissions in outdoor air
    - Sediment: incidental ingestion and dermal contact
    - Surface water: incidental ingestion and dermal contact
- Adult, adolescent, and child residents (OU1):
    - Groundwater seepage in basements: incidental ingestion and dermal contact

The estimated RME total cancer risks and total noncancer hazard indices for the receptors evaluated are summarized below. Note that results are reported separately based on whether using the discrete sediment dataset or the ISM sediment dataset to evaluate potential receptor risks. Results also are reported separately for OU1 Zone 1 groundwater and OU1 Zones 2-3 groundwater for the purposes of informing potential future risk management decision-making.

Summary of Site-Related Risks and Hazards

Receptor	Risk/Hazard	Value	Risk Driver/Medium
Utility Worker	CR	1E-05 (Discrete) / 5E-06 (ISM)	N/A
Utility Worker	HI	2 (Discrete) / 1 (ISM)	Arsenic / Sediment
O&M Worker	CR	3E-06	N/A
O&M Worker	HI	0.03	N/A
Adult Trespasser	CR	1E-04 (Discrete) / 3E-05 (ISM)	Arsenic / Sediment
Adult Trespasser	HI	0.9 (Discrete) / 0.3 (ISM)	N/A
Adolescent Trespasser	CR	1E-04 (Discrete) / 3E-05 (ISM)	Arsenic / Sediment
Adolescent Trespasser	HI	1 (Discrete) / 0.5 (ISM)	N/A
Adult OU1 Resident	CR	1E-06 (Z1) / 2E-07 (Z2-3)	N/A
Adult OU1 Resident	HI	0.2 (Z1) / 0.004 (Z2-3)	N/A
Adolescent OU1 Resident	CR	1E-06 (Z1) / 1E-07 (Z2-3)	N/A
Adolescent OU1 Resident	HI	0.3 (Z1) / 0.005 (Z2-3)	N/A
Child OU1 Resident	CR	1E-06 (Z1) / 1E-07 (Z2-3)	N/A
Child OU1 Resident	HI	0.5 (Z1) / 0.009 (Z2-3)	N/A
Lifetime OU1 Resident	CR	4E-06 (Z1) / 4E-07 (Z2-3)	N/A
Lifetime OU1 Resident	HI	1 (Z1) / 0.02 (Z2-3)	N/A

Notes:
CR = Cancer risk
HI = Hazard index
N/A = not applicable
O&M = Operation and Maintenance

Of all the OU2 receptor populations evaluated in this HHRA, none have estimated Reasonable Maximal Exposure (RME) cancer risks above USEPA's acceptable risk range, although the estimated RME cancer risk for adult and adolescent trespassers are at the upper bound limit of this acceptable range when using the discrete sediment dataset. The only receptor population with estimated RME non-cancer hazards above USEPA's acceptable HI threshold of one was the utility worker when using the discrete sediment dataset. The estimated RME non-cancer hazard for adolescent trespassers is at but does not exceed the acceptable threshold of one when using the discrete sediment dataset.

The incidental ingestion of arsenic in OU2 sediment was the primary COI/pathway responsible for the exceedance and near exceedances. When using the ISM sediment dataset or Central Tendency Exposure (CTE), all estimated cancer risks and non-cancer hazards are below thresholds of potential concern. The 95UCL exposure point concentrations for discrete sediment samples are higher than the ISM samples due to influence of a few elevated concentrations, resulting in a highly skewed dataset. The average concentrations of the discrete sediment data (i.e., the CTE scenario) provides a more comparable result to the 95UCL for the ISM samples.

There were no risks identified for OU1 residents exposed to OU1 groundwater seeping into basements for any age group (adults, adolescents, children, and lifetime residents). This HHRA employed conservative assumptions to evaluate OU1 residents through the groundwater intrusion pathway (significantly greater than the assumptions used by USEPA in defining screening levels for this exposure, see Section 8.2.3 of the HHRA). Therefore, there is a high degree of confidence in the conclusions drawn in this HHRA.

Adult lead modeling of potential exposure to lead in OU2 sediment and OU2 soil shows that risks are below thresholds of concern for all receptors. IEUBK modeling of potential exposure to lead in OU1 groundwater seeping into residential basements also shows that risks are below thresholds of concern for child receptors (the most sensitive potentially exposed receptor population).

The HHRA evaluated the reasonable maximum exposure scenario, and the underlying assumptions provided a conservative assessment that tends to overestimate risks. The main driver for the marginal risks estimated for the utility and trespasser scenarios is arsenic in sediment. Risks to a hypothetical utility worker could be managed with personal protective equipment (PPE) to mitigate exposure to COIs at the Site. In addition, access to most of the affected sediment is precluded by dense stands of Phragmites or deep water levels, which limits the potential for exposure by adult and adolescent trespassers likely below what was assumed in the HHRA.

5.3 Uncertainties

Uncertainties may arise at every step of a risk assessment and may influence conclusions about the nature and extent of the risks estimates, or general conclusions drawn in the HHRA. The uncertainties in the HHRA include uncertainties in environmental sampling and data representativeness; uncertainties related to assumptions in receptor exposures; and uncertainties in toxicity thresholds. These uncertainties are further discussed in the HHRA (Appendix M).

6. BASELINE ECOLOGICAL RISK ASSESSMENT

The complete BERA is provided in Appendix N and summarized below.

Specific requirements for the BERA are described in the RI/FS SOW included in Appendix A of the ASAOC. This BERA has been prepared in accordance with the eight-step process as established in USEPA's Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, June 5, 1997 (USEPA 1997) and related guidance.

6.1 BERA Objectives and Scope

The goal of the BERA process is to determine whether there are contaminants present in Site media that may pose unacceptable risk to ecological receptors, and if identified, provide the information necessary to support risk management decisions.

The BERA is focused on the 39-acre wetlands in the southern portion of OU2, which lies adjacent to the former canal and the Grand Calumet River. The COI list was developed based on prior work (RI/FS FSP and BERA Work Plan) and confirmed by screening these constituent maximum concentrations with ecological screening values. The Site-specific COIs are antimony, arsenic, cadmium, lead, and selenium.

The potential ecological receptor groups identified for OU2 included:

- Plants (aquatic and wetland/riparian)
- Benthic or litter invertebrates
- Amphibians and reptiles
- Semi-aquatic birds and mammals
- Wetland and riparian birds and mammals
- Carnivorous birds

Threatened & Endangered (T&E) species known to occur within Lake County, Indiana and within 0.5 miles of the Site includes two bats (Indiana bat and northern long-eared bat), one squirrel (Franklin's ground squirrel), four birds (black tern, marsh wren, Virginia rail, bald eagle), and one insect (moth). In all cases, sufficient habitat exists within OU2 that could be potentially utilized by these species; however, other than the bald eagle, none were observed during the field survey.

Details of the exposure assessment and toxicity assessment, including screening, conceptual site model, exposure concentrations, measurement endpoints, representative receptors, and toxicity values, and are provided in the BERA (Appendix N).

6.2 Risk Characterization

There are exceedances of default literature-based toxicity thresholds (or site-specific tissue residue that rely on such thresholds) for COIs measured in sediment, soil, and biological tissue; however, conditions are present in the southern wetlands that limit metal bioavailability and thus their potential to exert adverse effects to benthic invertebrates (and plants). Site-wide surface water does not present potential risk to aquatic biota.

Risks to birds and mammals were evaluated through food web modeling based on estimated exposure doses compared to No Observed Adverse Effect Level (NOAEL)-based and Lowest Observed Adverse Effect Level (LOAEL)-based Toxicity Reference Values (TRVs). Hazard quotients (HQs) calculated by dividing the intake doses by the NOAEL and LOAEL TRVs are summarized below.

COI	Wetland Receptor Species							
	Canada Goose		Red-Winged Blackbird		American Kestrel		Muskrat	
	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	NA	NA	NA	NA	NA	NA	2.08	0.428
Arsenic	0.0533	0.0265	13.4	6.68	0.085	0.0422	8.96	4.01
Cadmium	0.00175	0.000435	0.24	0.0595	0.0589	0.0146	0.458	0.0928
Lead	0.0153	0.00262	2.17	0.372	0.219	0.0376	1.07	0.274
Selenium	0.00247	0.00105	0.406	0.173	0.184	0.0786	1.19	0.569

Note: Sediment (Discrete) and Surface Water Exposure

COI	Wetland Receptor Species							
	Canada Goose		Red-Winged Blackbird		American Kestrel		Muskrat	
	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	NA	NA	NA	NA	NA	NA	0.287	0.059
Arsenic	0.013	0.00647	8.1	4.02	0.0277	0.0138	2.18	0.975
Cadmium	0.00161	0.0004	0.221	0.0549	0.0563	0.014	0.42	0.0853
Lead	0.00986	0.00169	1.45	0.249	0.179	0.0308	0.693	0.176
Selenium	0.00134	0.000571	0.255	0.109	0.136	0.058	0.627	0.301

Note: Sediment (ISM) and Surface Water Exposure

COI	Terrestrial (Riparian) Receptor Species					
	American Robin		American Kestrel		Short-Tailed Shrew	
	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{NOAEL}	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	NA	NA	NA	NA	0.385	0.0791
Arsenic	11.1	5.53	0.0109	0.0109	1.48	0.663
Cadmium	0.324	0.0803	0.0218	0.0218	0.0211	0.00428
Lead	8.55	1.47	0.136	0.136	0.174	0.0444
Selenium	0.746	0.318	0.0837	0.0837	0.294	0.141

Note: Soil and Surface Water Exposure

The uptake of arsenic from sediment or soil into invertebrate tissue is occurring and underlies potential wildlife risk for invertivorous receptors (American robin, muskrat, and red-winged blackbird). Lead in terrestrial (riparian) soil is also a risk-driver for the American robin. A more thorough discussion of potential risks to ecological receptors is presented in the BERA (Appendix N).

6.3 Uncertainties

Uncertainties may arise at every step of a risk assessment and may influence conclusions about the nature and extent of the risks estimates, or general conclusions drawn in the BERA. The uncertainties in the BERA include uncertainties in environmental sampling and data representativeness; uncertainties related to assumptions in receptor exposures; and uncertainties in toxicity thresholds. These uncertainties are further discussed in the BERA (Appendix N).

7. CONTAMINANT FATE AND TRANSPORT

This section will describe the conceptual site model, contaminant characteristics, chemical persistence, chemical fate and transport, and contaminant migration.

7.1 Conceptual Site Model

A CSM represents the relationship between the contaminants and human or ecological receptors through their potential or actual distribution and exposure pathways. This model provides a framework to understand the site and helps to support a remedial strategy based on the risks and uncertainties. A CSM helps identify sources, receptors, media of concern, and the interactions between them. The essential elements of an effective CSM are source or release profile, movement and extent of contaminants, physical factors that affect fate and transport, and human and ecological receptors.

The CSM for the Site is shown on **Figure 7.1-1**. Primary sources of COIs at the Site include USS Lead and possibly neighboring plant operations, waste storage activities, and disposal areas. Additionally, all of the Site COIs are naturally occurring metals found in the soil and bedrock beneath the Site that can be mobilized in the subsurface due to changes in geochemical conditions.

COI release may have occurred from dissolution of solid materials and infiltration of dissolved chemicals or deposition and/or burial of solid materials, both of which would affect groundwater and soil at the Site. Overland runoff may have occurred resulting in impacts to soil, sediments, and surface water. Additionally, the former USS Lead Facility formerly operated a National Pollutant Discharge Elimination System (NPDES) outfall, which may have contributed COIs to sediments and surface water. COIs may also have entered and been transferred through the food chain, resulting in impacts to the biota at the Site.

There are potential human and ecological receptors at the Site. Potential human receptors include OU1 residents, OU2 O&M workers, OU2 trespassers, and OU2 utility workers. Potential ecological receptors include aquatic plants, benthic organisms, birds, mammals, and amphibians/reptiles. The potential exposure routes for these receptors include ingestion, inhalation, and direct contact to groundwater, soil, sediment, and surface water, and ingestion of biota for the ecological receptors. These exposure routes were evaluated for the potential human receptors and potential ecological receptors in the HHRA and BERA, respectively. The results of the HHRA and BERA are summarized in **Sections 5** and **6** above, and they are integrated into the discussion of COI abundance and distribution in **Section 7.4** below.

7.2 Contaminant Characteristics

7.2.1 Aqueous Solubility

Aqueous solubility affects a contaminant's ability to transport via water. Aqueous solubility is the concentration of a contaminant dissolved in the aqueous phase when the solution is in equilibrium with the pure compound in its usual phase (e.g., gas, liquid, or solid) at a specified temperature and pressure (e.g., 25°C, 1 atm; Schwarzenbach et al. 1998). Whether a contaminant has a tendency to dissolve in water is a key characteristic in determining its environmental behavior. Contaminants with a higher aqueous solubility tend to dissolve more easily in water and are, therefore, typically more mobile in groundwater and surface water. The aqueous solubility, dissociation constant (Kd) and volatility of the COIs are provided in **Table 7.2-1**.

7.2.2 Geochemical Conditions

The geochemical conditions in an environment (e.g., pH, redox conditions, presence of other cations and anions, etc.) are an important determinant of contaminant speciation and mobility. pH and redox conditions typically drive the dominant form of a contaminant and determine whether the contaminant will be present in a soluble form. The pH also drives the stability and number of cation and anion adsorption sites on solid phase particles. Under neutral to alkaline conditions, there are more negatively charged adsorption sites available, which bind positively charged cations. Under acidic conditions, the reverse is true, and there are more positively charged adsorption sites, which bind negatively charged anions. Therefore, cations will be less mobile under neutral to alkaline conditions, while anions will be less mobile under acidic conditions. Other ions present in the soil may affect the speciation of a contaminant and may compete for the same adsorption sites, thus reducing or increasing the contaminant's mobility.

7.2.3 Adsorption

Adsorption is the process by which a contaminant binds to the surface of solid phase particles. The aqueous concentration of a contaminant substantially influences adsorption reactions, and certain contaminants have a tendency to adsorb more strongly to certain types of particles. As mentioned above, adsorption of contaminants is highly dependent upon the geochemical conditions of the soil. pH has a strong influence on the nature and quantity of adsorption sites, and competing ions influence adsorption of a contaminant. Adsorption is measured by a ratio of contaminant mass that partitions to the solid and liquid phases under equilibrium conditions and is quantified by the coefficient Kd.

7.2.4 Mineral Dissolution/Precipitation

Mineral dissolution is the process by which solid phase minerals dissolve into aqueous phase ions and compounds, and precipitation is the process by which aqueous phase ions and compounds form solid phase minerals. Whether a contaminant exists in its dissolved or mineral phase will depend on the geochemical conditions and degree of saturation.

7.2.5 Chemical Speciation

Chemical speciation is a form of an element defined by isotopic composition, electronic or oxidation state, and/or complex or molecular structure (Feldmann et al. 2014). Speciation denotes the distribution of an element across defined chemical species in a system. Speciation is crucial for understanding the bioavailability, chemical toxicity, fate, and transport of a contaminant. Contaminants in the environment undergo changes to their speciation depending on the pH, ionic strength, hardness, microbial activity, redox conditions, and other factors.

7.2.6 Bioaccumulation

Bioaccumulation is the increase in concentration of a contaminant in or on an organism or tissue following uptake from the ambient environmental medium. Bioaccumulation is the net process of all uptake and loss processes, such as direct uptake from the exposure media or indirect uptake from feeding and losses such as metabolism, diffusion, or transfer to offspring. Inorganics such as metals can be incorporated within biomass as a protection against metal toxicity. Bioaccumulation strongly depends on the organism and its affinity for a contaminant and the associated physiochemical conditions of the surrounding media.

7.3 General Behavior of COIs

The COIs at the Site cannot be destroyed in the environment; they can only change form. Metal contaminants change form by reacting with other molecules or by the action of bacteria that live in soil or sediment. Metals may be transported as fugitive dust by wind, in runoff, or leach into the subsurface soil or groundwater. The primary mechanisms that control the fate and transport of the COIs at the Site are described in the following sections.

7.3.1 Antimony

Antimony (Sb) is a naturally occurring metal sometimes considered a metalloid because it exhibits metal and nonmetal properties (Li 2011). Antimony can enter the environment during the mining and processing of antimony-containing ores and in the production of antimony metal, alloys, aluminum oxides, and combinations of antimony with other substances (Grund et al. 2012; Li et al. 2011). Small amounts of antimony enter the environment through the burning of coal and incinerators.

Antimony can exist in four oxidation states (-3, 0, +3, +5); however, the +5 oxidation state (Sb(V)) and +3 oxidation state (Sb(III)) are the most common in the environment. Under reducing conditions antimony exists as Sb(III) with the predominant species being antimony trihydroxide ($Sb(OH)_3$). Under oxidizing conditions antimony exists as Sb(V) with the predominant species being hexahydroxoantimonate ($Sb(OH)_6^-$; Bodek et al. 1988).

Antimony tends to be retained in the soil through adsorption and can sorb to clay minerals, oxides, and hydroxides in soil and aquatic sediment (Wilson et al. 2010). In soil, the antimony oxidation state and environmental reactions largely depend on pH, redox conditions, and concentrations of co-occurring reduction agents and oxidants within the system (Wilson et al. 2010). Antimony concentrations tend to have a positive correlation with iron and manganese in the soil. Under reducing conditions, antimony is likely to be highly adsorbed.

Microorganisms can reduce and methylate antimony in anaerobic sediment releasing volatile methylated antimony compounds into the water (Bentley and Chasteen 2002).This is most likely to happen in reducing environments, such as bed sediment. Antimony can be taken up by plants through the roots and via surface deposition from aerosols. Surface deposition is the major pathway for soil-to-plant transfer of antimony in field conditions (Tschan et al 2009).

7.3.2 Arsenic

Arsenic is a naturally occurring metal that is classified as a metalloid for having both metal and nonmetal properties. Arsenic is usually found with oxygen, chlorine, and sulfur. When arsenic is combined with these elements it is referred to as inorganic arsenic and when combined hydrogen and carbon it is referred to as organic arsenic. Inorganic arsenic is found in soil and many kinds of rock, especially in ores that contain copper or lead. When these ores are heated in smelters, most of the arsenic goes up the stack and enters the air as fine dust.

Arsenic exists in three oxidation states (-3, +3, or +5), and the most common forms in the environment are +3 (As(III)) and +5 (As(V)). Under reducing conditions, arsenic exists as As(III) with the predominant species being arsenite. Under oxidizing conditions, arsenic exists as As(V) with the predominant species being arsenate (Clifford et al. 2011, WQA 2013, Evanko et al. 1997).

Many arsenic compounds can dissolve into water, but they tend to partition into the soil or sediment. Arsenic has a high affinity for iron and manganese (hydr)oxides, and under oxidizing conditions, much of the arsenic will be bound strongly to these minerals. As(III) sorbs more to iron (hydr)oxides than As(V), but it also desorbs more readily (Tufano 2008); therefore, under reducing conditions, reduction of sorbed arsenic will result in higher dissolved arsenic concentrations. Simultaneously, iron reduction and dissolution of iron (hydr)oxides without re-precipitation, will release arsenic that is adsorbed to the iron (hydr)oxides resulting in increased dissolved iron and arsenic concentrations (Tufano 2008).

Since arsenic compounds partition into soil under oxidizing conditions, leaching usually does not transport arsenic to great depth. Downward migration has been shown to be greater is sandy soil than in clay loam (Sanok et al. 1995). Leaching of arsenic in polluted wetland soil is generally low and is correlated with the amount of dissolved organic matter in the soil. Terrestrial plants may accumulate arsenic by root uptake from the soil or by absorption of airborne arsenic deposited on the leaves, and certain species may accumulate substantial levels (USEPA 1982). Yet, even when grown on highly polluted soil or soil naturally high in arsenic, the arsenic level taken up by plants is comparatively low (Gebel et al. 1998, Pitten et al. 1999). Arsenic accumulation by plants is affected by arsenic speciation.

7.3.3 Cadmium

Cadmium is a naturally occurring metal that is associated with zinc, lead, and copper ores. Cadmium is emitted to soil, water, and air by high-temperature processes, such as metal mining and refining, manufacture of phosphate fertilizers, fossil fuel combustion, and waste incineration and disposal.

Cadmium exists in two oxidation states (+1 and +2). Under reducing conditions, cadmium exists in the +1 state (Cd(I)) and tends to form sulfide minerals. Under oxidizing conditions, cadmium exists in the +2 state (Cd(II)) and tends to form cadmium-hydroxide, -carbonate, and -sulfate complexes (Evanko et al. 1997).

Cadmium and its compounds may travel through soil, but its mobility depends on several factors such as pH and amount of organic matter, which will vary depending on the local environment. Generally, cadmium binds strongly to organic matter where it will be immobile in soil and be taken up by plant life, eventually, entering the food supply. Cadmium is expected to partition primarily to soil (80–90%) when released to the environment. Precipitation and sorption to mineral surfaces, hydrous metal oxides, and organic materials are the most important processes for removal of cadmium to bed sediments. Humic acid is the major component of sediment responsible for adsorption. Sorption increases as the pH increases. Cadmium is not known to form volatile compounds in the aquatic environment, so partitioning from water to the atmosphere does not occur (USEPA 1979). In soils, pH, oxidation-reduction reactions, and formation of complexes are important factors affecting the mobility of cadmium (Bermond and Bourgeois 1992). Cadmium can participate in exchange reactions on the negatively charged surface of clay minerals. In acid soils, the reaction is reversible. However, adsorption increases with pH and may become irreversible (Herrero and Martin 1993).

The mobility and plant availability of cadmium in wetland soils are substantially different from upland soils. Cadmium tends to be retained more strongly in wetland soils and is more available to plants under upland conditions (Gambrell 1994). A low pH in soil increases the intake of cadmium by plants (Elinder 1992). Aquatic and terrestrial organisms may bioaccumulate cadmium (Handy 1992).

7.3.4 Iron

Iron was added to the list of analytes to provide geochemical context for interpreting the results of the other metals. Iron is the second most abundant metal and is the fourth most common element in earth's crust. Mining and processing of iron ores may result in the release of large quantities of iron compounds into the environment. The major iron ores found in nature are hematite (Fe_2O_3), magnetite (Fe_3O_4), limonite (FeO(OH)), and siderite ($FeCO_3$).

The most common oxidation states for iron in the environment are +2 and +3, with the +3 state (Fe(III)) preferred under oxidizing conditions and the +2 state (Fe(II)) being preferred under reducing conditions.

Fe(III) is highly insoluble under oxidizing conditions; therefore, increasing concentrations of dissolved iron typically indicates a transition to a more reducing environment because of the higher solubility of Fe(II)). Fe(III) ions have been shown to strongly adsorb to humic and fulvic acid in soils and sediments, but the strength of adsorption depends on pH, soil organic matter, and redox potential, with iron being more mobile under reducing than under oxidizing conditions. Iron compounds do not volatilize.

7.3.5 Lead

Lead is an element that is usually found in readily accessible ore deposits that are widely distributed worldwide. The major source of lead emissions into the environment has been anthropogenic emissions.

Lead exists in two oxidation states (0 and +2). Under most environmental conditions, lead will exist in the +2 oxidation state (Pb(II)). Under reducing conditions, lead tends to form sulfide minerals. Under oxidizing conditions, lead tends to form lead-hydroxide, -oxide, -carbonate, and -sulfate complexes (Evanko et al. 1997).

Lead can be complexed by various ligands present in the environment (e.g., fulvic and humic acids). Despite forming complexes with organic matter, it is unlikely that it would be incorporated into organic compounds under environmental conditions. Lead is transferred continuously between air, water, and soil by natural chemical and physical processes such as weathering, runoff, precipitation, dry deposition of dust, and stream/river flow. Soil and sediments are important sinks for lead.

Lead adsorbs strongly to most soils, which limits the rate of leaching. Soil acidity (pH) and composition are the most important factors affecting solubility, mobility, and phytoavailability of lead in soil. Other conditions that increase lead mobility in soil are reducing conditions and high chloride content. While lead is relatively immobile in soil and has a long retention time in most soils, it has some capacity to leach through the soil column and potentially contaminate groundwater. Lead sorbs strongly to soil components and is only weakly soluble in pore water, making the leaching of lead in soil a slower process as compared to other contaminants. Various soil conditions and characteristics affect the sorbing capacity of the soil and the solubility of contaminants including hydraulic conductivity of the soils, composition of the soil solution, organic matter, clay and mineral content of the soil, pH, and microbial activity (USEPA 2006). The mobility of lead will increase in environments having low pH due to the enhanced solubility of lead under acidic conditions.

Plants and animals may bioconcentrate lead, but biomagnification is not expected. Although the bioavailability of lead in soil to plants is limited because of the strong adsorption of lead to soil organic matter, bioavailability increases with increased soil organic matter content and with decreased soil pH (more acidic). Lead content in plants is largely the result of atmospheric deposition. This is due to the strong retention of particulate matter on plant surfaces that is difficult to remove through washing (USEPA 1977). Uptake of lead into plant tissue appears to involve a combination of uptake from the leaf surface and uptake from roots, with the relative contribution of each pathway dependent on species and soil characteristics (Angelova et al. 2010).

7.3.6 Selenium

Selenium is a naturally occurring, solid substance that is widely but unevenly distributed in the earth's crust. It is also commonly found in rocks and soil. Much of the selenium in rocks is combined with sulfide minerals or with silver, copper, lead, and nickel minerals.

The behavior of selenium in the environment is influenced to a large degree by its oxidation state and the consequent differences in the behavior of its different chemical compounds (USEPA 1979; NAS 1976a). The oxidation state of selenium in the environment is dependent on ambient conditions, particularly on pH, redox conditions, and biological activity (Maier et al. 1988). Elemental selenium is essentially insoluble and may represent a major inert "sink" for selenium introduced into the environment under anaerobic conditions (NAS 1976b). Heavy metal selenides and selenium sulfides, which are insoluble, predominate in acidic (low pH) soils and in soils with high amounts of organic matter. Selenium in this form is immobile and will remain in the soil.

Selenium uptake by plants is influenced by many factors including soil type, pH, colloidal content, concentration of organic material, oxidation-reduction potentials in the root-soil environment, and total level of selenium in the soil (Fishbein 1983, Robberecht et al. 1982). In acidic soils (pH 4.5–6.5) and under high moisture conditions, selenium is in the form of selenite and is bound to colloids as iron hydroxide and selenium complexes. These complexes are insoluble and generally not bioavailable to plants (Galgan and Frank 1995). In basic soils (pH 7.5–8.5), selenium is present as soluble selenate. Soluble selenates (principally sodium selenate) appear to be responsible for most of the naturally occurring accumulation of high levels of selenium by plants, although much of the total selenium in soil may be present in other forms (NAS 1976a).

7.4 Abundance and Distribution of COIs

7.4.1 Soil

Soil data for this RI include both historical and recent samples. The soil data are discussed in **Section 4.3.1**. The ratio of SPLP to total metals in discrete soil samples at OU2 is shown in **Figure 7.4-1**. The distributions of the soil data generally show a lognormal distribution with a few outliers (see the histograms presented in **Appendix H**). These outliers influence the 95% UCLs used in the human health and ecological risk assessments, resulting in a conservative assessment of the baseline risks at the former USS Lead Facility. Figures O-1 to O-5 in Appendix O show the metals distribution and relative concentrations in soil at the former USS Lead Facility. All antimony concentrations in soil are below the RSL of 470 mg/kg (Figure O-1). Most arsenic concentrations in soil are above the RSL of 3 mg/kg in the 3-30 mg/kg range. The highest arsenic concentrations in the 300-3,000 mg/kg range are along the north side of the former canal (Figure O-2). All cadmium concentrations in soil are below the RSL of 980 mg/kg (Figure O-3). Most lead concentrations in soil are below the RSL of 800 mg/kg, but there are scattered elevated concentrations in the 800-1,600 mg/kg range at the south end of the site, on the north side of the former canal, and in the dune complex (Figure O-4). All selenium concentrations in soil are below the RSL of 5,800 mg/kg (Figure O-5).

A portion of the Site includes an undisturbed portion of the dune and swale complex. The dune and swale complex were formed by irregular cycles of high and low water levels of Lake Michigan over geologic time. Much of this covertype has been developed in northwest Indiana. Remaining remnants of the dune and swale complex are considered highly valuable habitat and are protected from development. This portion of the Site was not developed as part of the former USS Lead Facility. This area shows no overt signs of phytotoxicity and available soil data supports the conclusion that it is not directly impacted by former operations and disposal of waste materials (**Appendix O**).

Other areas of the Site, excluding the southern wetlands, have been remediated under a RCRA Corrective Action as described in **Section 1.3.3**. Except for the areas around MW7 and MW21, soil data do not indicate any hot spots requiring additional consideration under the RI/FS ASAOC.

7.4.2 Sediment and Surface Water

Sediment data for this RI include both historical and recent samples. The sediment data are discussed in **Section 4.3.2**. Discrete sediment sample results and bioavailability calculations are shown in **Figure 7.4-2.** The sediment in the southern wetlands was a focus of the RI. To fill potential data gaps in the historical dataset, ISM was used to characterize sediment concentrations in eight DUs in the southern wetlands. In addition, the chemical bioavailability of the COIs was evaluated using AVS - SEM methodology, and benthic invertebrate and plant samples were collected to assess the uptake of the COIs in biota. The southern wetlands were not fully addressed in the RCRA Corrective Action and may have been impacted by former operation and disposal practices.

The ISM sampling consisted of the collection of three sets of 30 sediment samples in each DU. The samples were composited, and the averages of the three sample results were used to represent the entire area of the DU. However, the calculation of the 95% UCLs used for the human health and ecological risk assessments did not consider a spatially weighted average concentration, so like the soil dataset, the predicted exposure concentrations for sediment were influenced by outliers in the historical dataset. The distributions of the sediment data generally show a lognormal distribution with a few outliers (see the histograms presented in **Appendix H**).

Sediment concentrations measured in the DUs are presented in **Table 3.2-2**. ICM sediment sample results and the ratio of SEM to total metals concentrations at OU2 are shown in **Figure 7.4-3.** The concentrations were fairly consistent across each DU, except levels of arsenic were higher in DU5, levels of cadmium were higher in DU6 and DU8, and levels of lead were higher in DU8. The AVS - SEM results indicate the divalent metals (i.e., cadmium and lead) are unlikely to be bioavailable (**Table 3.2-3**). See bioavailability calculations in **Figure 7.4-2**. The highest concentrations of arsenic and lead in biota data were reported from DU8, indicating higher potential uptake of these COIs in DU8. Further consideration of the historical data shows higher concentrations of COIs adjacent to DU8 (**Appendix O**). This area, along the southeast portion of the Site, was not addressed in the RCRA Corrective Action and may have been impacted by past operations and disposal practices. In addition, an oily sheen was observed in this area during the ISM sampling (**Section 3.2.9**).

Figures O-6 to O-10 in Appendix O show the discrete metals distribution and relative concentrations in sediment at the former USS Lead Facility. All antimony concentrations in sediment are below the RSL of 470 mg/kg (Figure O-6). Arsenic concentrations in sediment are above the RSL of 3 mg/kg, in the 3-30 mg/kg range, north of the former canal but >3,000 mg/kg at the south end of the site (Figure O-7). All cadmium concentrations in sediment are below the RSL of 980 mg/kg (Figure O-8). Lead concentrations in sediment are below the RSL of 800 mg/kg except at the south end of the site where they are above 3,200 mg/kg (Figure O-9). All selenium concentrations in sediment are below the RSL of 5,800 mg/kg (Figure O-10).

Surface water data for this RI was compiled from historical data, and included samples collected from the various impoundments at the former USS Lead Facility and the former canal. The canal was formerly used to convey discharge from the former USS Lead Facility to the Facility's NPDES outfall and was remediated under the RCRA Corrective Action. The surface water data are discussed in **Section 4.3.3**. Based on the results of the human health and ecological risk assessments, surface water at the Site does not present a potential risk to human health and the environment, and the surface water data do not require additional consideration under the RI/FS ASAOC.

7.4.3 Biota

Benthic macroinvertebrate samples were collected from each of the eight DUs sampled in the southern wetlands. The wetlands were dominated by a dense, monotypic stand of Phragmites. These samples were collected to support the wildlife risk assessment by quantifying the concentrations of COIs in potential prey items for birds and mammals. Although no attempt was made to assess the quality of the invertebrate community, numerous taxa were represented in each sample. The dominant invertebrate taxa identified were physid snails, amphipods, isopods, and planorbid snails. Less prominent taxa included leeches, spiders, chironomids, Coleoptera, and Odonata. In addition, samples of aboveground biomass of Phragmites were collected and analyzed for the COIs, and below ground biomass concentrations were estimated from literature-based extrapolation values.

Biota concentrations were consistent across each DU, except levels of arsenic and lead were significantly higher in DU8. Arsenic levels in the invertebrate samples ranged between 4 and 170 mg/kg, and lead concentrations ranged between approximately 3 and 17 mg/kg (**Table 3.2-4**). The highest concentrations of arsenic and lead were reported from DU8. As expected, there were no indications of biomagnification. Concentrations of COIs in Phragmites were less than 1 mg/kg in all DUs. The biota and alternative extraction data (i.e., AVS/SEM) indicated limited bioavailability of the COIs in sediment.

The results of the ecological risk assessment indicate arsenic is the primary driver of risks to wildlife with small home ranges that are predicted to satisfy the bulk of their metabolic requirements in the southern wetlands. Due to the limited habitat quality in the dense, monotypic stand of Phragmites, this area is not expected to support a diverse ecological community.

7.4.4 Groundwater

The general distributions of COIs in groundwater at the Site between December 2018 and August 2019 are summarized below. Minimum, maximum, and average concentrations for each COI in each area of the Site are provided in **Section 4.3.6**. While not a COI, iron concentrations in groundwater provide geochemical context for interpreting the results of the other metals; therefore, iron results are summarized as well. Anomalous results identified in the general distributions are discussed in more detail in the following sections.

- Antimony concentrations in groundwater are generally higher in OU2 and ECHA wells as compared to the rest of the OU1 wells. Concentrations of antimony in ECHA-MW-01 are the highest measured at the Site. Recent concentrations of dissolved antimony (2015 – 2019) are greater than 100 µg/L only in ECHA-MW-01, ECHA-MW-09, MW21, and MW-23.
- Arsenic concentrations are highest in some areas of OU2, particularly at MW7 and MW21, and at ECHA-MW-01 in OU1. Concentrations of arsenic are generally higher in the deeper wells of the OU1 well pairs.
- Cadmium concentrations are generally higher in OU2 wells than in the ECHA wells. Cadmium concentrations are less than the MDL in all other OU1 wells.
- Iron concentrations are variable across the Site, but generally within a similar magnitude in OU1 and OU2. Iron concentrations are generally higher in the deeper wells of the OU1 well pairs. Dissolved iron concentrations are correlated with antimony and arsenic ($p<0.05$).
- Lead concentrations are generally higher in the ECHA wells than the other OU1 wells. Lead concentrations in the other OU1 wells (Zone 2 and 3) are generally less than the MDL, with the exception of OU1MW5 where lead concentrations are similar to the ECHA wells. Lead concentrations in the OU2 wells generally are not detected with only a few exceptions.
- Selenium concentrations are generally higher in the ECHA wells than in the OU2 wells. Selenium concentrations in the other OU1 wells are similar to concentrations measured in OU2.

7.4.4.1 Elevated Antimony and Lead Concentrations in ECHA Wells

Concentrations of total and dissolved antimony measured in samples collected from the ECHA wells (ECHA-MW-01, ECHA-MW-09, and ECHA-MW-35) were higher than concentrations of total and dissolved antimony measured in the rest of the OU1 wells (OU1MW1 through OU1MW8). The maximum concentration of total and dissolved antimony in the ECHA wells was 1,200 µg/L, and the average concentrations of total and dissolved antimony in the ECHA wells were 401 µg/L and 394 µg/L, respectively. In contrast, the maximum concentration of total and dissolved antimony in the rest of the OU1 wells was 18 µg/L, and the average concentrations of total and dissolved antimony in the rest of the OU1 wells were 5.0 µg/L and 5.2 µg/L, respectively. Between December 2018 and June 2019, total and dissolved antimony concentrations in the OU2 wells ranged from non-detect to 170 µg/L and 89 µg/L, respectively. In OU2, antimony levels are >100 µg/L in MW21 and MW23.

Elevated antimony in the ECHA wells as compared to the OU2 wells is driven primarily by concentrations measured in ECHA-MW-01, while antimony concentrations in ECHA-MW-09 and ECHA-MW-35 are generally similar to concentrations measured in OU2 wells. Total antimony concentrations in OU1MW1 ranged from 920 µg/L to 1,200 µg/L, and dissolved antimony in ECHA-MW-01 ranged from 960 µg/L to 1,200 µg/L. In contrast, total antimony in ECHA-MW-09 and ECHA-MW-35 ranged from 5.9 µg/L to 120 µg/L, and dissolved antimony in ECHA-MW-09 and ECHA-MW-35 ranged from 5.3 µg/L to 120 µg/L.

In contrast to the other OU1 Zone 2 and Zone 3 monitoring wells, concentrations of total and dissolved lead were also elevated in ECHA-MW-01 and ECHA-MW-09, located in OU1 Zone 1. Concentrations of total and dissolved lead in ECHA-MW-01 and ECHA-MW-09 ranged from 15 µg/L to 89 µg/L and from 8.4 µg/L to 68 µg/L, respectively. All three monitoring wells with elevated lead (OU1MW5, ECHA-MW-01, ECHA-MW-09) are located in the southwest corner of OU1 near or on the former Anaconda Lead Products and ILRC Facility property, which currently is owned by the City of East Chicago (formerly ECHA).

Elevated concentrations of antimony and lead in the ECHA wells compared to the rest of OU1 and in ECHA-MW-01 relative to OU2 may indicate a separate source of antimony near this well. As mentioned previously, the ECHA wells are located on the former Anaconda Lead Products and ILRC Facility property, which currently is owned by the City of East Chicago (formerly ECHA). Amereco conducted Phase II Environmental Site Assessment (ESA) at the former ECHA property in 2017 (Amereco 2017). While antimony was not analyzed during the Phase II ESA, Amereco did analyze RCRA 8 metals and determined that concentrations of several metals, including arsenic, and PAHs exceeded relevant screening levels (Amereco 2017). Arsenic and selenium are also elevated in groundwater samples collected from ECHA-MW-01, and the presence of metals and PAHs above relevant screening levels suggests a distinct source of COIs at the former ECHA property.

7.4.4.2 Elevated Arsenic Concentrations in MW7 and MW21

Overall, arsenic concentrations in groundwater samples collected from MW7 and MW21 are the highest measured at the Site. Between 2000 and 2019, total arsenic concentrations in samples collected from MW7, located north of the former canal and midway along its length, have ranged from 224 µg/L to 24,000 µg/L, with the maximum concentration measured in December 2016. Between 2001 and 2019 total arsenic concentrations in samples collected from MW21, located north of the CAMU and midway along its length, have ranged from 85 µg/L to 3,290 µg/L, with the maximum concentration measured in November 2011.

In general, total arsenic concentrations in samples collected from MW7 have increased over time, with concentrations between 20,000 µg/L and 23,000 µg/L between December 2018 and June 2019 (**Figure 7.4-1)**. An evaluation was conducted in 2008 that concluded the arsenic concentrations observed at MW7 were associated with elevated groundwater levels. Data collected since 2008 show a slight relationship between changes in groundwater elevation and groundwater concentrations of arsenic at MW7, with changes in arsenic concentration lagging slightly behind changes in groundwater elevation. Increasing groundwater elevations may be causing leaching from a localized source near MW7, thus resulting in increasing concentrations of arsenic as groundwater elevations increase. The increase in arsenic concentration also coincided with beaver activity that caused an increase in groundwater elevations near MW7. Rising groundwater levels associated with rising lake levels and beaver activity have likely exposed more contaminated surface soil to groundwater resulting in the increasing levels of arsenic in MW7.

Soil samples collected from the vicinity of MW7 in 2018 and 2019 were subjected to SPLP (**Table 7.4-1**), and the concentrations of arsenic in the aqueous SPLP extracts ranged from 61 µg/L at the location southwest of MW7 to 850 µg/L at the one of the locations northeast of MW7. The concentrations in SPLP extracts of soil collected near MW7 are higher compared to the concentrations measured in SPLP extracts from other soil samples collected at the former USS Lead Facility. However, the concentrations in SPLP extracts from soil near MW7 are much lower than the 20,000 µg/L to 23,000 µg/L measured in groundwater samples collected from MW7. The soil samples were collected from surficial soil (0 to 24 inches bgs), and therefore, may not represent localized sources present at depth near the water table.

Total arsenic concentrations in samples collected from MW21 have decreased over time, with concentrations ranging between 210 µg/L and 310 µg/L between December 2018 and June 2019 (**Figure 7.4-2**). Soil samples collected near MW21 in 2018, 2019, and 2021 were also subjected to SPLP (**Table 3.2-1**), and the concentrations of arsenic in the aqueous SPLP extracts ranged from 6.2 µg/L to 350 µg/L. The upper end of arsenic concentrations measured in the aqueous SPLP extracts of soil samples collected near MW21 are comparable to arsenic concentrations measured in groundwater. However, it is anticipated that arsenic concentrations will continue to decrease in MW21. The CAMU is under hydraulic control; therefore, the CAMU is not the source of elevated arsenic concentrations observed at MW21.

7.4.4.3 Higher Arsenic Concentrations in Deep OU1 Wells

It was noted that concentrations of total and dissolved arsenic in samples collected from the deep wells of the three well pairs (OU1MW3/3D, OU1MW5/5D, and OU1MW6/6D) were higher than total and dissolved arsenic concentrations in samples collected from the shallow wells of the well pairs. The minimum, maximum, and average concentration of total and dissolved arsenic in the shallow and deep wells of the well pairs are provided in the table below.

Summary statistics of total and dissolved arsenic in the paired monitoring wells.

Calculation	Arsenic, Total (µg/L)		Arsenic, Dissolved ((µg/L)	
	Shallow Wells	Deep Wells	Shallow Wells	Deep Wells
Minimum	0.39	13	0.50	14
Maximum	6.5	56	6.5	55
Average	3.0	40	3.0	40

Minimum, maximum, and average for shallow wells based on data from: OU1MW3, OU1MW5, and OU1MW6
Minimum, maximum, and average for deep wells based on data from: OU1MW3D, OU1MW5D, and OU1MW6D

The same observation was made for iron, where concentrations of total and dissolved iron in samples collected from the deep wells of the three well pairs (OU1MW3/3D, OU1MW5/5D, and OU1MW6/6D) were higher than total and dissolved iron concentrations in samples collected from the shallow wells of the well pairs. The minimum, maximum, and average concentration of total and dissolved iron in the shallow and deep wells of the well pairs are provided in the table below.

Summary statistics of total and dissolved iron in the paired monitoring wells.

Calculation	Iron, Total (µg/L)		Iron, Dissolved ((µg/L)	
	Shallow Wells	Deep Wells	Shallow Wells	Deep Wells
Minimum	14 U	5,700	14	5,600
Maximum	7,700	34,000	7,600	27,000
Average	3,289	17,994	3,276	17,319

Minimum, maximum, and average for shallow wells based on data from: OU1MW3, OU1MW5, and OU1MW6
Minimum, maximum, and average for deep wells based on data from: OU1MW3D, OU1MW5D, and OU1MW6D

As discussed in **Section 7.3.4**, iron exists predominantly as Fe(III) under oxidizing conditions and as Fe(II) under reducing conditions. Fe(III) is much more insoluble than Fe(II). Increasing concentrations of dissolved iron typically indicate a transition to a more reducing environment as iron is reduced to Fe(II) and becomes more soluble. Therefore, higher concentrations of dissolved iron in the deep wells suggests that deeper groundwater is more reducing than shallow groundwater.

This interpretation is supported by differences in dissolved oxygen (DO) and oxidation-reduction potential (ORP) between the shallow and deep wells of the well pairs. Minimum, maximum, and average measurements of DO and ORP in the deep and shallow wells of the well pairs are provided in the table below. Overall, DO is lower and ORP is more negative in the deep wells, indicating more reducing conditions in deeper groundwater.

Summary statistics of dissolved oxygen and ORP in the paired monitoring wells.

	Dissolved Oxygen (mg/L)		Oxidation-Reduction Potential (mV)	
	Shallow Wells	Deep Wells	Shallow Wells	Deep Wells
Minimum	0.00	0.00	-135	-195
Maximum	6.86	2.47	-55	-134
Average	1.68	0.46	-95	-155

Minimum, maximum, and average for shallow wells based on data from: OU1MW3, OU1MW5, and OU1MW6
Minimum, maximum, and average for deep wells based on data from: OU1MW3D, OU1MW5D, and OU1MW6D

As described in **Section 7.3.2**, arsenic has a high affinity for iron (hydr)oxides, and under oxidizing conditions, much of the arsenic will be bound strongly to these minerals. As(III) sorbs more to iron (hydr)oxides than As(V), but it also desorbs more readily (Tufano 2008). Therefore, under reducing conditions, reduction of sorbed arsenic will result in increased dissolved arsenic concentrations. Simultaneously, iron reduction and dissolution of iron (hydr)oxides without reprecipitation, will release sorbed arsenic resulting in increased dissolved iron and arsenic concentrations (Tufano 2008). Due to the more reducing conditions in the deeper groundwater, it is likely that reduction of iron and arsenic is driving the increased arsenic concentrations observed at depth. This conclusion is corroborated by a strong correlation between dissolved iron and dissolved arsenic concentrations ($p<0.05$; data not shown).

7.4.4.4 Elevated pH in OU1MW5

Overall, field pH measurements from the groundwater monitoring wells were between 5.58 and 7.95; however, field pH measurements taken at OU1MW5 in OU1 Zone 2 ranged from 12.75 S.U. to 13.90 S.U., and the lab pH analyzed in August 2019 was 10.7 S.U. The majority of total and dissolved metal concentrations in samples collected from OU1MW5 were similar to concentrations in other OU1 Zone 2 and Zone 3 monitoring wells, with the exception of lead. Concentrations of total lead in samples collected from OU1MW5 ranged from 11 µg/L to 220 µg/L, and concentrations of dissolved lead in samples collected from OU1MW5 ranged from 2.3 µg/L to 230 µg/L. Maximum concentrations of total and dissolved lead in samples from the other OU1 Zone 2 and Zone 3 monitoring wells were 0.22 µg/L to 0.30 µg/L, respectively, with most lead concentrations less than MDLs.

As described in Section 2.3, fill material is widespread at the Site, and at the OU1MW5/5D well pair, the fill material appeared to be composed largely of black, gravel- and sand-sized slag/cinders. The boring log for ECHA-MW-09 also indicates the presence of slag and fill at that location (Amereco 2017); however, no slag was noted in the boring log for ECHA-MW-01 (Amereco 2017). Static water level depths at OU1MW5, ECHA-MW-01, and ECHA-MW-09 are less than the observed fill thickness, therefore, shallow groundwater in the uppermost part of the Calumet aquifer is in direct contact with fill material at these locations and all three wells are screened across this interval of the shallow aquifer.

According to Duwelius et al. (1996), groundwater in contact with slag can have a pH greater than 12. In addition, ash and cinder fill, widespread throughout East Chicago, is capable of leaching silica, sulfate, and metals to groundwater and increasing the pH (Le Seur-Spencer and Drake 1987). Therefore, the elevated pH observed at OU1MW5 and the elevated lead observed at OU1MW5, ECHA-MW-01, and ECHA-MW-09 are likely the result of shallow groundwater in contact with historic fill that includes slag in some locations. The lack of elevated pH and lead concentrations in samples collected from OU1MW5D is likely because the well is screened deeper (24.50 to 29.50 feet bgs), and therefore, is influenced by groundwater not in direct contact with the fill material.

Due to the black gravel fill observed at OU1MW5, offset wells were installed to the north, south, east and west. Black gravel fill was not observed at the offset well locations. The pH concentrations in groundwater ranged from 7.19 to 7.32 SU. The dissolved metals sample results are summarized below by well location.

- OU1MW5N – The antimony concentration was 5.7 ug/l, which was below the MCL of 6 ug/l. Arsenic (<1 ug/l), cadmium (<1 ug/l), lead (<1 ug/l) and selenium (<5 ug/l) were non-detect.
- OU1MW5S - The antimony concentration was 1.1 ug/l, which was below the MCL of 6 ug/l. The arsenic concentration was 1.1 ug/l, which was below the MCL of 10 ug/l. Cadmium (<1 ug/l), lead (<1 ug/l) and selenium (<5 ug/l) were non-detect.
- OU1MW5E - The antimony concentration was 1.6 ug/l, which was below the MCL of 6 ug/l. Arsenic (<1 ug/l), cadmium (<1 ug/l), lead (<1 ug/l) and selenium (<5 ug/l) were non-detect.
- OU1MW5W - The antimony concentration was 23 ug/l, which was above the MCL of 6 ug/l. The arsenic concentration was 0.33 ug/l, which was below the MCL of 10 ug/l. Cadmium (<1 ug/l), lead (<1 ug/l) and selenium (<5 ug/l) were non-detect.

7.4.4.5 Extent of Groundwater Contamination above MCLs

- **Antimony** – Antimony contamination above the MCL (6 ug/l) is widespread in OU1 and OU2. Most of OU2 exceeds the MCL. The highest concentration detected was 1,200 ug/l in ECHA-MW01 at the southwest corner of OU2 where the former Anaconda Lead Products and International Lead Refining Company Facility and south adjoining Sims Metal Management (former Metal Recovery

Technologies) were previously located. Most of OU2 also exceeds the MCL, but the maximum concentration detected in OU2 was 89 ug/l. There does not appear to be a plume of antimony groundwater contamination between OU2 and OU1.

- **Arsenic** - The only exceedance of the arsenic MCL (10 ug/l) in OU1 was at the southwest corner of Zone 1 where a concentration of 440 ug/l was detected in ECHA-MW01. This was the same location that the highest concentration of antimony was detected in OU1. The central and northeast areas of OU2 exceeded the MCL for arsenic. The highest concentration detected at OU2 was 23,000 ug/l at MW7. There does not appear to be a plume of arsenic groundwater contamination between OU2 and OU1.
- **Cadmium** - The only exceedance of the cadmium MCL (5 ug/l) in OU1 was at the southwest corner of Zone 1 where a maximum concentration of 59 ug/l was detected in ECHA-MW01. There were three exceedances of the MCL in OU2 at MW7 (180 ug/l), MW21 (60 ug/l) and MW23 (9.7 ug/l). There does not appear to be a plume of cadmium groundwater contamination between OU2 and OU1.
- **Lead** - There were only two exceedances of the lead MCL (15 ug/l) in OU1 at the southwest corner of Zone 1 in ECHA-MW09 (68 ug/l) and at OU1MW5 (250 ug/l) in Zone 2. There was only one exceedance of the MCL in OU2 at MW7 (140 ug/l). There does not appear to be a plume of lead groundwater contamination between OU2 and OU1.
- **Selenium** - There was only one exceedance of the MCL (50 ug/l) at the southwest corner of Zone 1 in ECHA-MW01 (82 ug/l). There were no exceedances of the MCL in OU2 and there does not appear to be a plume of selenium groundwater contamination between OU2 and OU1.

8. SUMMARY AND CONCLUSIONS

8.1 Nature and Extent of Contamination

Soil

- Elevated concentrations arsenic, lead, and antimony were detected near MW7 indicating a potential local source contributing to the elevated levels of these COIs in groundwater.

Sediment

- The concentrations of metals in the southern wetlands were elevated. The levels of arsenic were higher in Decision Unit 5 (DU5), levels of cadmium were higher in DU6 and DU8, and levels of lead were higher in DU8.
- The Acid Volatile Sulfide - Simultaneously Extracted Metals (AVS - SEM) results indicated limited bioavailability of divalent metals (i.e., cadmium and lead) in most parts of the southern wetlands.
- The highest concentrations of arsenic and lead in biota data were reported from DU8, indicating higher potential uptake of these COIs from sediment in DU8.

Surface Water

- Average concentrations of COIs in surface water in the ponds and former canal does not present a significant risk to human health and the environment.

Biota

- Arsenic and lead concentrations in invertebrate tissue samples collected from DU8 were elevated relative to the other DUs.
- The biota data is consistent with the alternative extraction data, indicating limited bioavailability of the COIs in most parts of the southern wetlands.

Groundwater

- Elevated concentrations of antimony and lead in some of the Zone 1 wells compared to the rest of OU1 (Zones 2 and 3) and OU2 suggest the presence of a separate source of these metals in Zone 1.
- Alkaline pH in OU1MW5 is likely the result of shallow groundwater being in direct contact with historic fill that includes slag/cinder material in that location. Monitoring wells installed to the north, south, east, and west of OU1MW5 are consistent with conditions observed throughout Zones 2 and 3.
- Higher arsenic concentrations in the deep wells of the three well pairs (OU1MW3/3D, OU1MW5/5D, and OU1MW6/6D) are related to changes in redox conditions, with deeper water being more reducing, thus resulting in increased dissolved iron and dissolved arsenic. These deep wells are installed in the same water-bearing zone as the shallow wells.
- Increasing concentrations of arsenic in groundwater samples collected from MW7 are likely related to increasing groundwater elevations and leaching from a localized source near MW7.
- Elevated arsenic concentrations in groundwater samples collected from MW21 are related to leaching from a very small source in this area; however, concentrations in groundwater have been decreasing since 2011 and a newly installed well immediately adjacent to MW21 (MW21R)

shows much lower concentrations, indicating limited migration of arsenic from the area immediately surrounding MW21.

8.2 Human Health and Ecological Risks

- The results of the HHRA indicate that all increased cancer risks were within the acceptable range of 1×10^{-6} to 1×10^{-4}. Hazard indices exceeded unity for the future utility worker scenario. Incidental ingestion of arsenic in OU2 sediment was the primary chemical/pathway driver of this exceedance. These risk estimates are based on conservative assumptions and the predicted exposure concentrations are influenced by a few elevated samples. Potential exposure is limited by security fencing and the environmental covenant precluding development and requiring the use of PPE during any intrusive work.
- No unacceptable risks to human health were identified with potential exposure of COIs in OU1 groundwater. The risk assessment, using conservative exposure scenarios, evaluated exposure to groundwater leaking in basements during flood events or sump pump failures. Groundwater is not used as a drinking water source in OU1 or OU2 and an East Chicago Ordinance prohibits such use now and in the future.
- Lead risk modeling performed for adult receptors exposed to OU2 soil and sediment using USEPA's Adult Lead Model, and child receptors exposed to OU1 groundwater using USEPA's Integrated Exposure Uptake Biokinetic Model, showed that risks are below thresholds of concern for all receptors.
- The results of the BERA indicate that, with respect to the potential for adverse effects to plant and invertebrate receptors, there are exceedances of default literature-based toxicity thresholds (or site-specific tissue residue that rely on such thresholds) for COIs measured in soil, sediment, and biological tissue. Based on the results of the AVS - SEM and Synthetic Precipitation Leachate Procedure (SPLP) analyses, conditions are present in the southern wetlands that limit metal bioavailability and thus their potential to exert adverse effects to benthic invertebrates and plants. Site-wide, surface water does not present potential risk to aquatic biota.
- The BERA concluded that the uptake of arsenic from sediment or soil into plant and invertebrate tissue is occurring and underlies potential wildlife risk for invertivorous birds (American robin and red-winged blackbird) and herbivorous mammals, and that lead in terrestrial (riparian) soil is a risk-driver for the American robin. These risk estimates are based on conservative assumptions and the predicted exposure concentrations are influenced by a few elevated samples.
- The results of the BERA indicate arsenic is the primary driver of risks to wildlife with small home ranges that are assumed to satisfy the bulk of their metabolic requirements in the southern wetlands. Due to the limited habitat quality in the dense, monotypic stand of Phragmites, this area is not expected to support a diverse ecological community.

8.3 Recommended Remedial Action Objectives

Following approval of the revised RI Report by USEPA, USS Lead will prepare an FS for the Site to evaluate the following issues in accordance with the RI/FS ASAOC:

1. Elevated arsenic concentrations in groundwater samples from MW7 are related to increasing groundwater elevations and leaching from soluble forms of arsenic in this area. The presence of a local source was confirmed by additional soil data adjacent to MW7. Potential remedial alternatives for the area around MW7 will be evaluated in the FS.

2. Arsenic concentrations in groundwater from MW21 are elevated compared to other monitoring wells at the Site, but have been decreasing since 2011. MW21 was abandoned in March of 2021 and a new well (MW21R) was installed adjacent to the former location of MW21. Based on the low levels of arsenic reported in this well and the additional soil data, the source of arsenic was confirmed to be in the immediate area around MW21. The CAMU is immediately adjacent to this location preventing the removal of shallow soils around the former MW21 area. Arsenic and other COIs will continue to be monitored in MW21R under the RCRA Closure Permit as part of the ongoing CAMU maintenance and monitoring activities. No additional action is required under the RI/FS ASAOC.
3. A portion of the Site includes an undisturbed portion of the dune and swale complex. The dune and swale complex were formed by irregular cycles of high and low water levels of Lake Michigan over geologic time. Much of this covertype has been developed in northwest Indiana. Remaining remnants of the dune and swale complex are considered highly valuable habitat and are protected from development. This portion of the Site was not developed as part of the former USS Lead Facility. This area shows no overt signs of phytotoxicity and available soil data supports the conclusion that it is not directly impacted by former operations and disposal of waste materials. No additional action is required under the RI/FS ASAOC.
4. Other areas of the Site, excluding the southern wetlands, have been remediated under a RCRA Corrective Action. Except for the areas around MW7 and MW21, as discussed above, soil data do not indicate any additional action is required under the RI/FS ASAOC.
5. Levels of arsenic and lead in sediment in and around DU8 (southeast portion of the former USS Lead Facility) are elevated and more bioavailable compared to other portions of the southern wetlands. Biota data collected from DU8 confirm these metals are more bioavailable than other areas of the Site. Potential remedial alternatives around DU8 will be evaluated in the FS.
6. Although concentrations of metals in most parts of the southern wetlands are elevated with respect to background soils, alternative extraction analyses indicate these metals are not bioavailable. Ecological risks calculations based on total metals analyses (i.e., boiling concentrated acids) over-estimate the bioavailability of these metals and exaggerate potential risks to wildlife with small home ranges. The presence of a dense stand of Phragmites and observations of wildlife in this area supports the conclusion of no unacceptable risk. No remedial alternatives for the southern wetlands, except for the area around DU8, will be evaluated in the FS.
7. Based on the results of the human health and ecological risk assessments, surface water at the Site does not present a potential risk to human health and the environment, and the surface water data do not require additional consideration under the RI/FS ASAOC.
8. Elevated concentrations of antimony and lead were detected in some parts of Zone 1. The distribution of groundwater contamination indicates the elevated levels are associated with a source in Zone 1. This area is being re-developed and USEPA is coordinating the cleanup of this area with the potentially responsible parties. No additional action is required under the RI/FS ASAOC.
9. High levels of pH in OU1MW5 are associated with the presence of slag/cinders in this area. Four monitoring wells were installed outside of the area with slag/cinders to the north, south, east, and west of OU1MW5. Sampling results confirm that conditions in this area, outside of the area with slag/cinders, are similar to other wells in Zones 2 and 3 of OU1. Potential remedial alternatives for this area will be evaluated in the FS.

10. Other than the area around OU1MW5, groundwater in Zones 2 and 3 does not present a potential risk to human health and the environment and does not require additional consideration under the RI/FS ASAOC.
11. Studies conducted in the RI have shown that the Site does not pose an unacceptable human health risk. The HHRA evaluated the reasonable maximum exposure scenario, and the underlying assumptions provided a conservative assessment that tends to overestimate risks. No unmanageable risk was identified. The main driver for the marginal risks estimated for the utility worker and trespasser scenarios is arsenic in sediment at the former USS Lead Facility. Risks to a hypothetical utility worker could be managed with PPE to mitigate exposure to COIs. In addition, access to most of the affected sediment is precluded by dense stands of Phragmites or deep water levels, which limits the potential for exposure by adult and adolescent trespassers likely below what was assumed in the HHRA. No unacceptable risks to human health were associated with subsurface groundwater intrusion into basements in Zones 2 and 3 of OU1. No additional action is required under the RI/FS ASAOC to address potential human health risks associated with any media.

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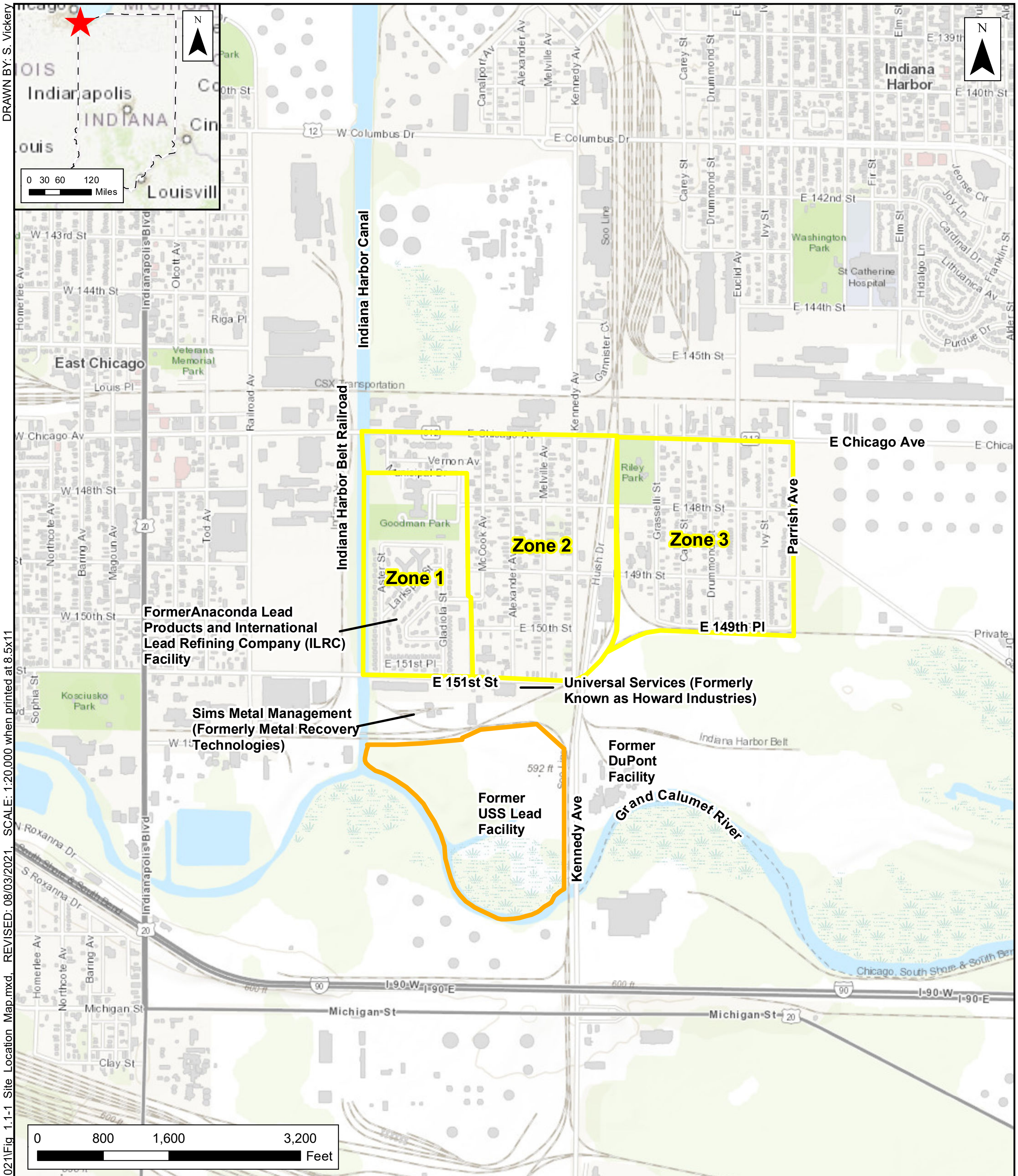
FIGURES



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Legend

- Approximate Boundary of OU1
- USS Lead Facility Boundary

Figure 1.1-1
Site Location Map
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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ERM

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

Legend

- Wetlands
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Figure 1.3-1
USS Lead Facility Features
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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J:\Projects\USS Lead\ MXD\2021\RI 2021\Fig 1.3-1 USSL Facility Features.mxd, REVISED: 08/03/2021, SCALE: 1:4,800 when printed at 8.5x11

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

DRAWN BY: S. Vickery

J:\Projects\USS Lead\ MXD\2021\RI 2021\Fig 1.3-2 Previously Remediated Areas.mxd, REVISED: 08/03/2021, SCALE: 1:4,800 when printed at 8.5x11

Legend

USS Lead Facility Boundary	Canal (Backfilled 4-8')
Approximate CAMU Boundary	Fuel Tank Area (Backfilled 4-8')
Remediated Area	Howard Industries (Backfilled 1-2')
Area A (Backfilled 4-5')	Indiana Harbor Belt Triangle (Backfilled 1-4')
Area B (No Backfill)	Kennedy Avenue (Backfilled 1-2')
Area C (No Backfill)	Railroad Area (Backfilled 1-2')
CAMU East Side (No Backfill)	Wetland (Partially Backfilled 2-3')

Figure 1.3-2
Previously Remediated Areas
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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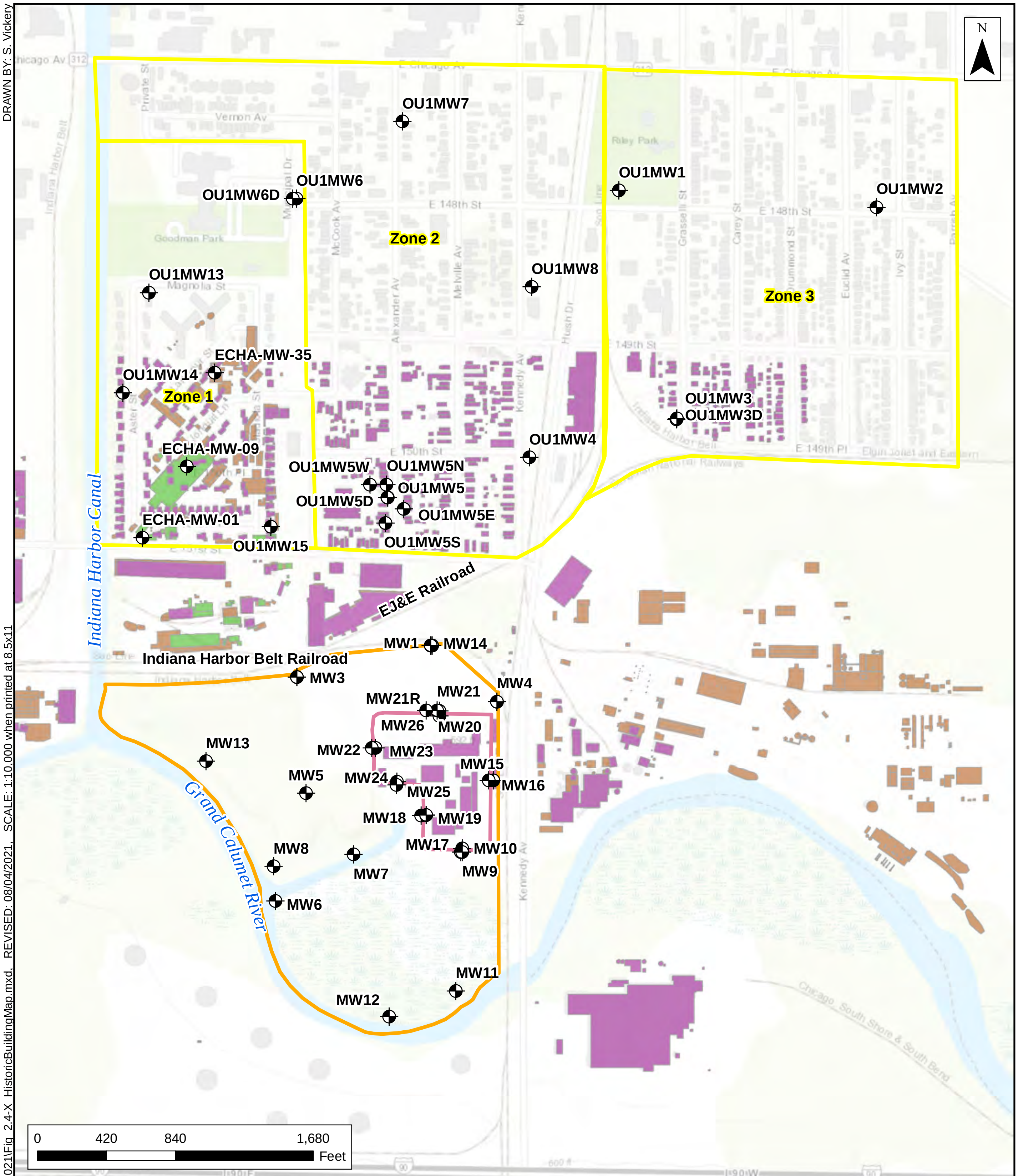
ERM

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



Legend

- Groundwater Monitoring Well
- Building Footprints (1915)
- Building Footprints (1949)
- Building Footprints (Post-1949)
- Approximate Boundary of OU1
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Figure 1.3-3
Historic Building Footprints
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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J:\Projects\USS Lead\ MXD\2021\RI 2021\Fig 2.4-X HistoricBuildingMap.mxd, REVISED: 08/04/2021, SCALE: 1:10,000 when printed at 8.5x11 DRAWN BY: S. Vickery

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

USDA Soil Map Survey Unit Description	
Lake County, Illinois	
Soil Map Unit Boundary	Descirption
Ca	Houghton muck, drained, 0-1% slopes
OkB	Oakville-Adrian complex, 0-6% slopes
Ur	Urban land
W	Water

Legend

- Soil Map Unit Boundary
- USS Lead Facility Boundary
- Approximate CAMU Boundary

Notes:
1. Lake County GIS, 2019
2. United States Department of Agriculture (USDA) web soil survey, Lake County, Indiana (April 26, 2021).

Figure 2.2-1
USDA Web Soil Survey Map
Remedial Investigation Report – OU2
USS Lead Superfund Site
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J:\Projects\USS Lead\ MXD\2021\RI 2021\Fig 2.2-1-SoilSurveyMap 20210527.mxd, REVISED: 08/27/2021, SCALE: 1:6,000 when printed at 8.5x11 DRAWN BY: S. Vickery

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

J:\Projects\USS Lead\ MXD\2021\RI 2021\Fig 2.3-1 GroundwaterSampleLocationMap2021.mxd, REVISED: 08/27/2021, SCALE: 1:10,500 when printed at 8.5x11 DRAWN BY: S. Vickery

Legend

- Groundwater Monitoring Well
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Notes:
1. Lake County GIS, 2019

Figure 2.3-1
Groundwater Sample Location Map
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USS Lead Superfund Site
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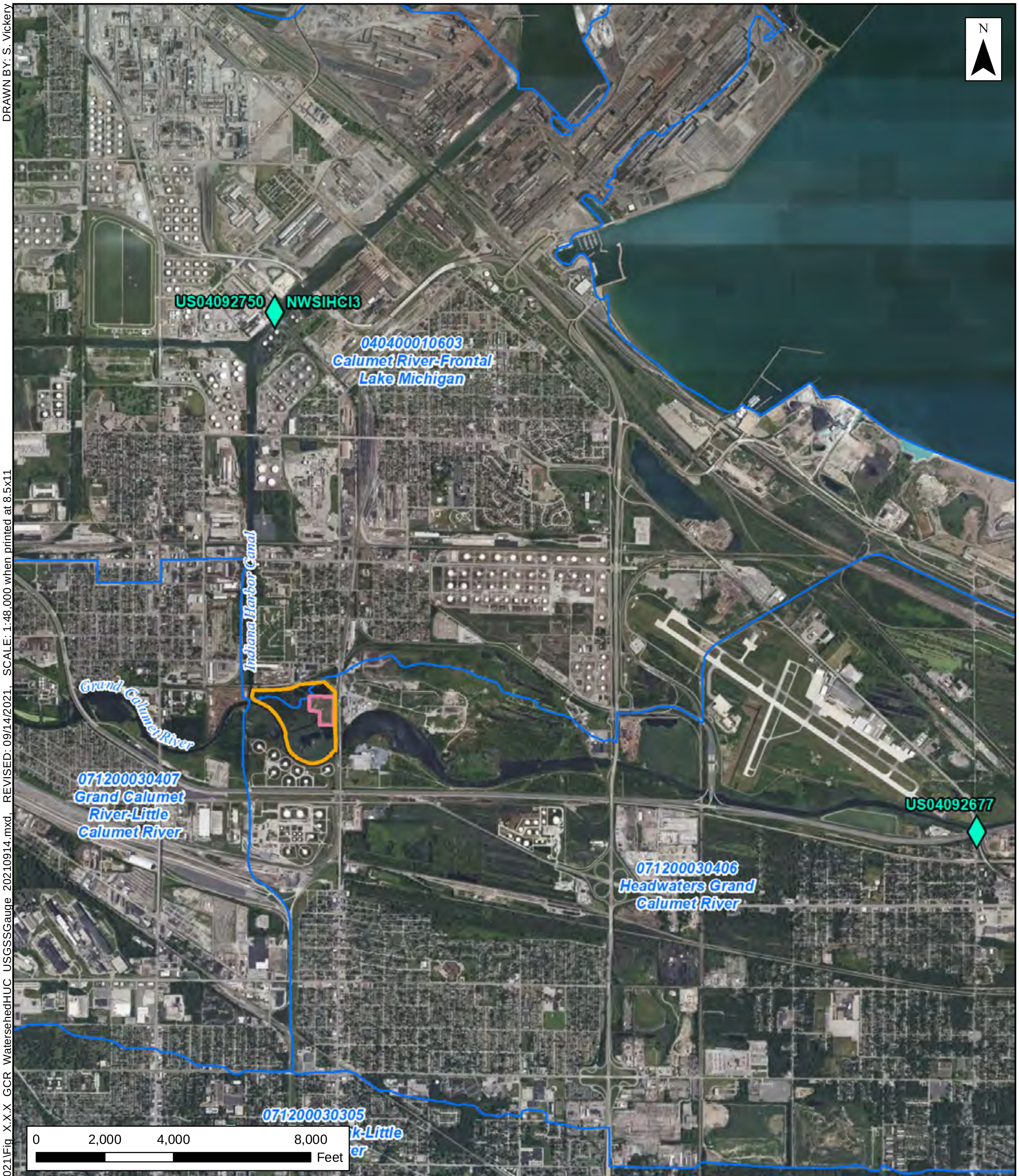
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



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J:\Projects\USS Lead_MXD\2021\RI_2021\Fig_X.X.X_GCR_WaterhedHUC_USGSSGauge_20210914.mxd, REVISED: 09/14/2021, SCALE: 1:48,000 when printed at 8.5x11

Legend

- USGS Stream Gauge
- HUC12 Watershed Boundary
- USS Lead Facility Boundary
- Approximate CAMU Boundary

Figure 2.4-1
Grand Calumet River Watershed
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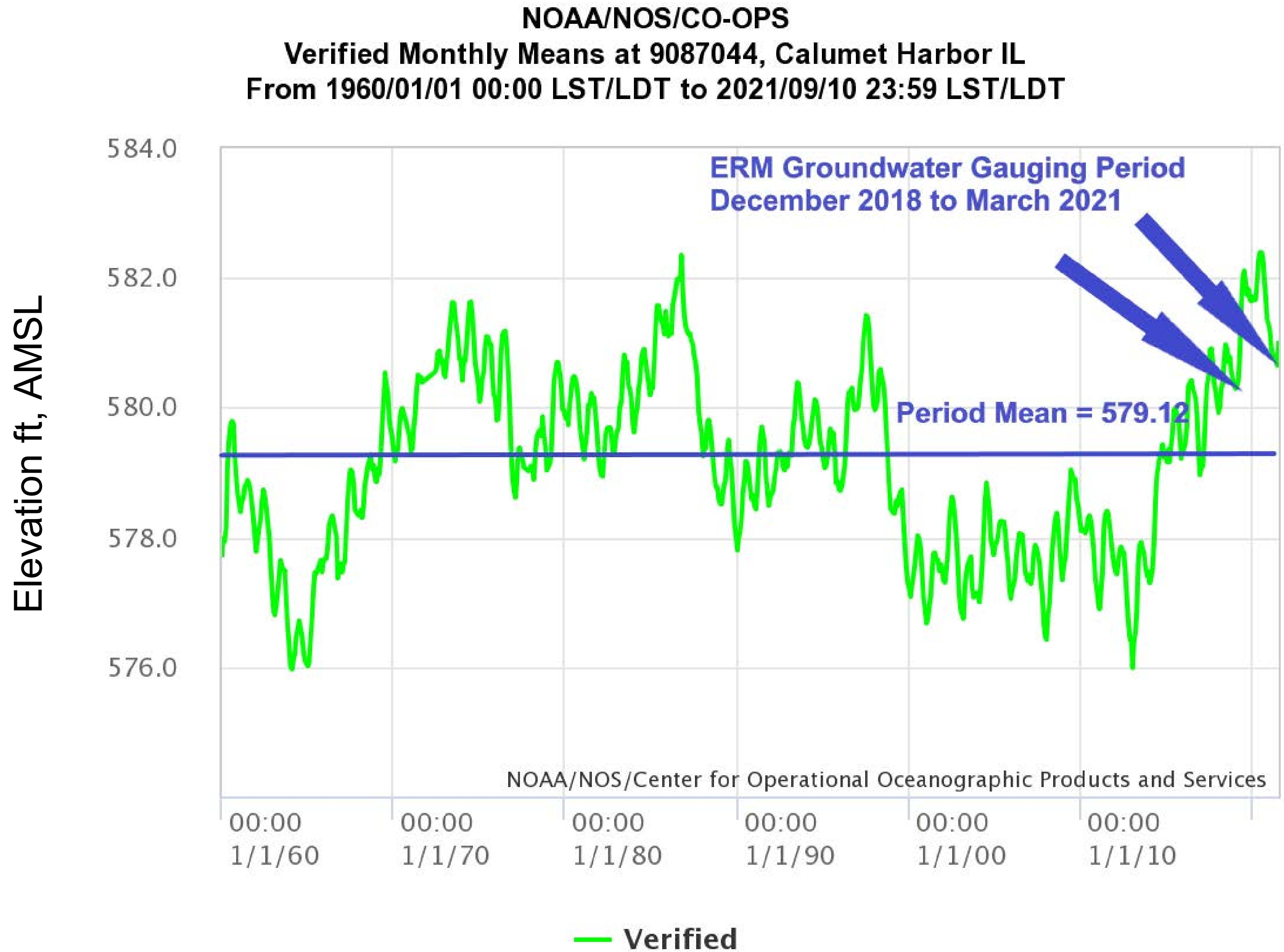
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



This information is for environmental review purposes only.

Figure 2.4-2
Surface Water Elevation of Lake Michigan
January 1960 to September 2021
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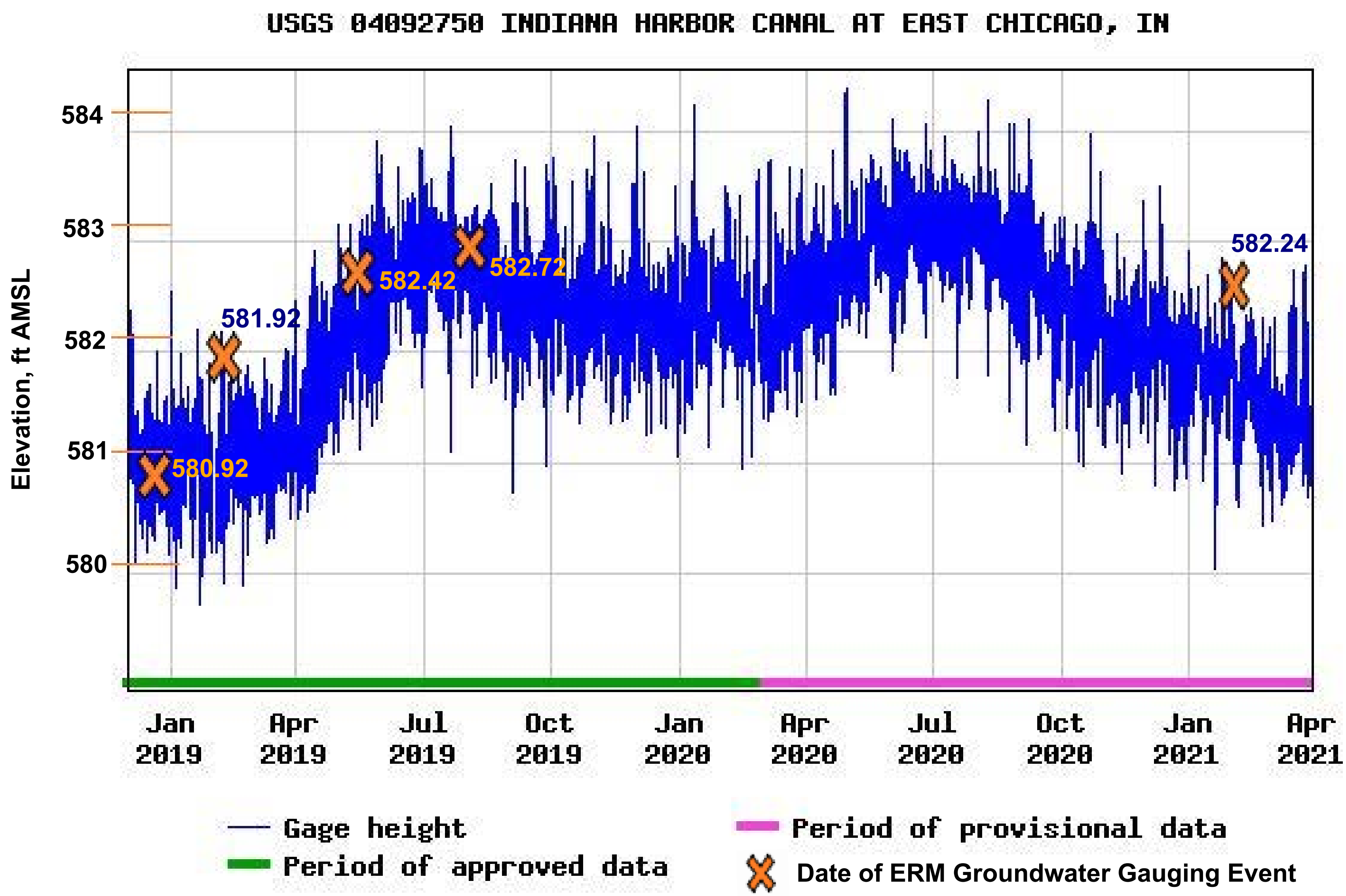
MPLS M:\Clients\S-U\USL_ArcGIS\2019\12\16_RI_Rpt_OU2_Figs\Fig_2.4-1_SW_Elev_Lake_Michigan.mxd | REVISED: 9/10/2021

DRAWN BY: MPLS GIS



This information is for environmental review purposes only.

Figure 2.4-3
Surface Water Elevation at Indiana Harbor Canal
December 2018 to April 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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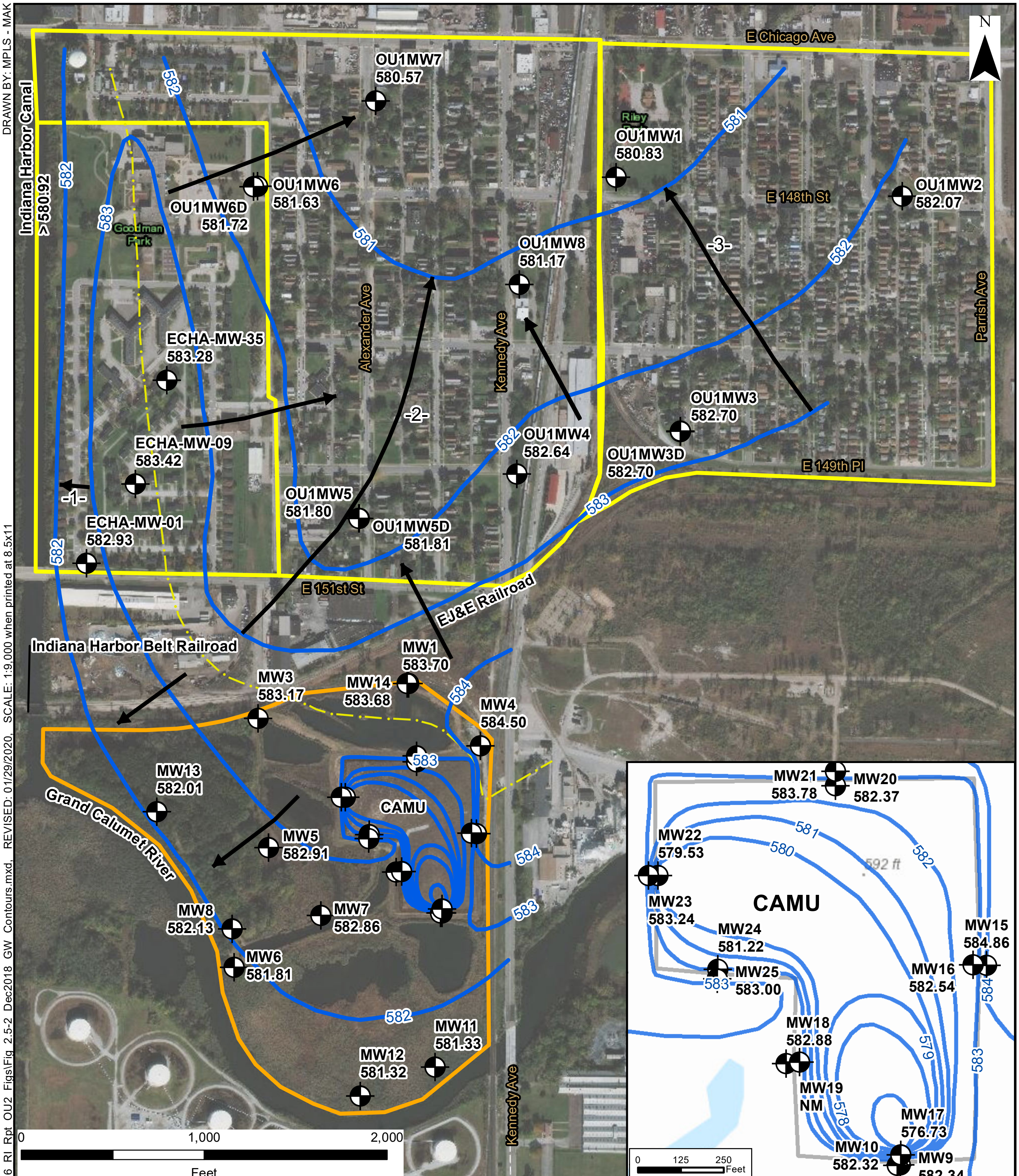
MPLS M:\Clients\S-U\USL_ArcGIS\2019\12\16_RI_Rpt_OU2_Figs\Fig_2.4-2_SW_Elev_IHC.mxd | REVISED: 9/10/2021

DRAWN BY: MPLS GIS



Groundwater Monitoring Well

Groundwater Contour (1 foot Interval)

Local Groundwater Flow Direction

Approximate Water Table Divide

Approximate Slurry Wall Location

Approximate Boundary of OU1

Approximate USS Lead Facility Boundary

-1- Flow Line Used to Estimate Potentiometric Gradient

Figure 2.5-1
Groundwater Contour Map - December 2018
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Note:
1. Groundwater measurements collected on December 12, 2018.
2. Stage reading of Indiana Harbor Canal from USGS Gauging Station No. 04092750 on December 12, 2018, located 1.65 mi north of East Chicaco Avenue.
3. CAMU has an induced inward gradient.

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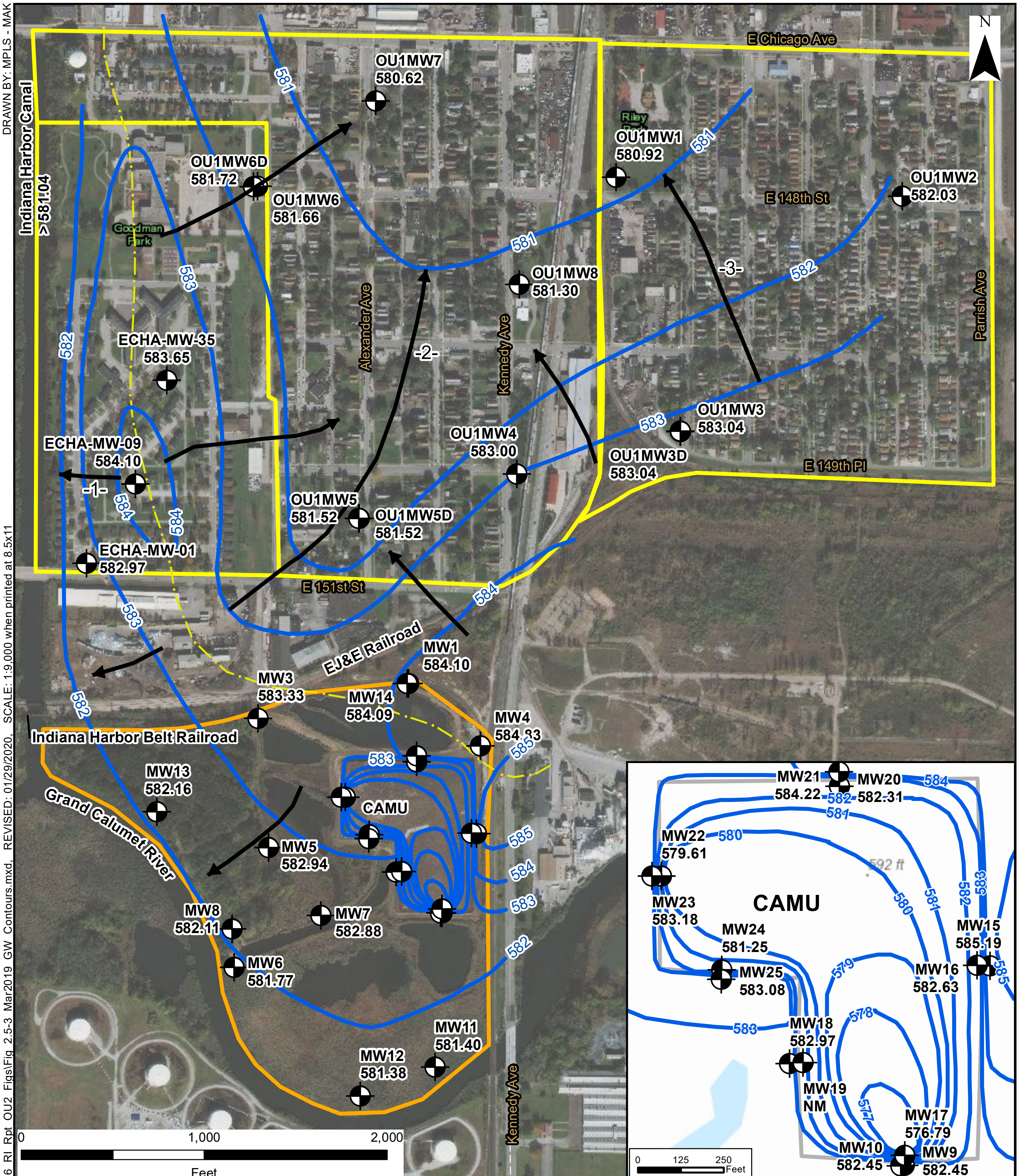
Source: Esri - World Topographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet; Imagery Date: March 2018



Groundwater Monitoring Well

Groundwater Contour (1 foot Interval)

Local Groundwater Flow Direction

Approximate Water Table Divide

Approximate Slurry Wall Location

Approximate Boundary of OU1

Approximate USS Lead Facility Boundary

-1- Flow Line Used to Estimate Potentiometric Gradient

Figure 2.5-2
Groundwater Contour Map - March 2019
Remedial Investigation Report - OU2 USS Lead Superfund Site
East Chicago, Indiana

Notes:
1. Groundwater measurements collected within 24 hours between March 19 and March 20, 2019.
2. NM indicates not measured; well contains free product.
3. Stage reading of Indiana Harbor Canal from USGS Gauging Station No. 04092750 on March 20, 2019, located 1.65 mi north of East Chicaco Avenue.
4. CAMU has an induced inward gradient.

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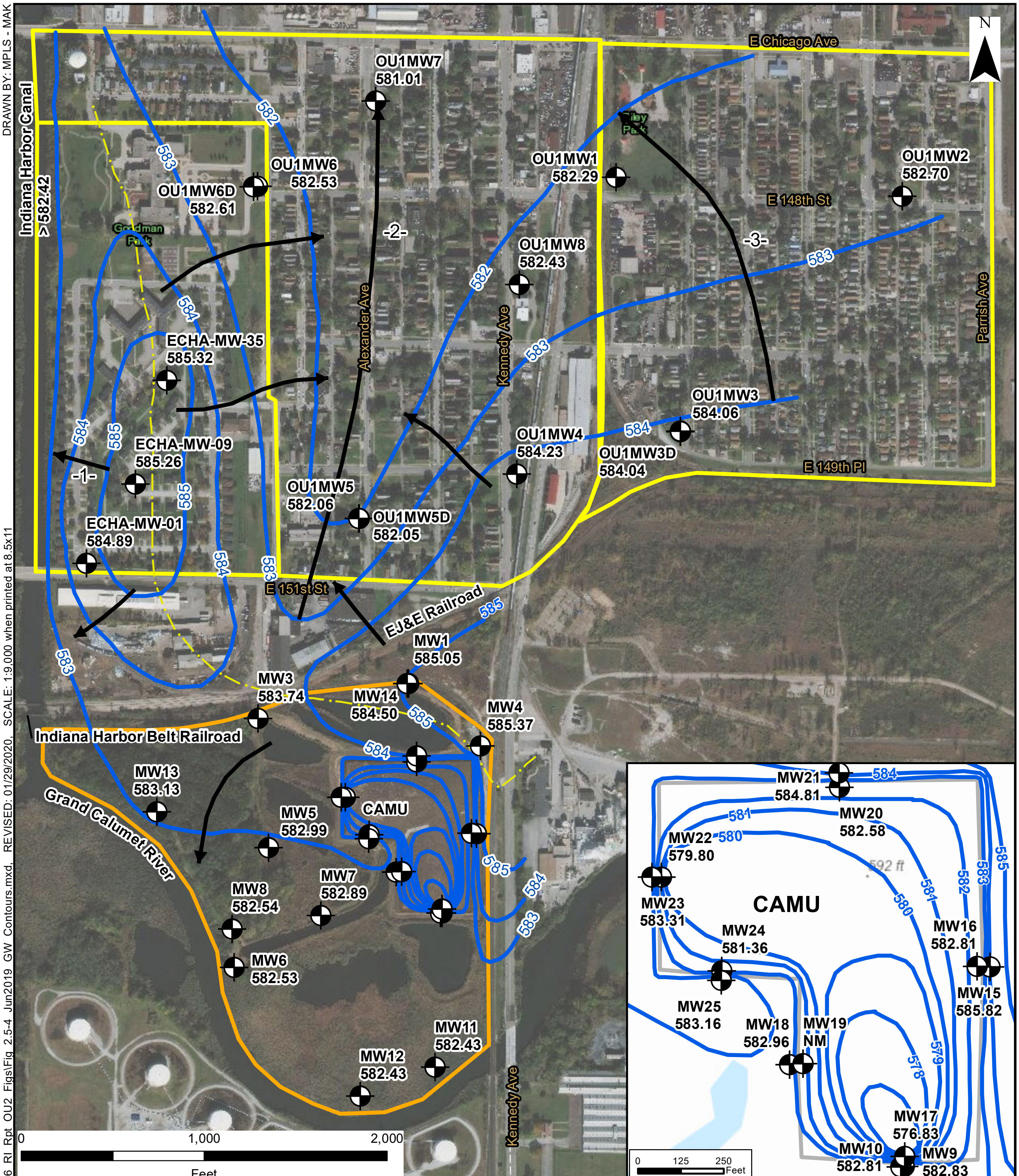
Source: Esri - World Topographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet; Imagery Date: March 2018

M:\Clients\S-U\USL_ArcGIS\2019\12\16_RI_Rpt_OU2_Figs\Fig_2.5-3_Mar2019_GW_Contours.mxd, REVISED: 01/29/2020, SCALE: 1:9,000 when printed at 8.5x11 DRAWN BY: MPLS - MAK



Groundwater Monitoring Well

Groundwater Contour (1 foot Interval)

Local Groundwater Flow Direction

Approximate Water Table Divide

Approximate Slurry Wall Location

Approximate Boundary of OU1

Approximate USS Lead Facility Boundary

-1- Flow Line Used to Estimate Potentiometric Gradient

Figure 2.5-3

Groundwater Contour Map - June 2019

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Notes:
1. Groundwater measurements collected between June 3 and June 5, 2019.
2. NM indicates not measured; well contains free product.
3. Stage reading of Indiana Harbor Canal from USGS Gauging Station No. 04092750 on June 4, 2019, located 1.65 mi north of East Chicaco Avenue.
4. CAMU has an induced inward gradient.

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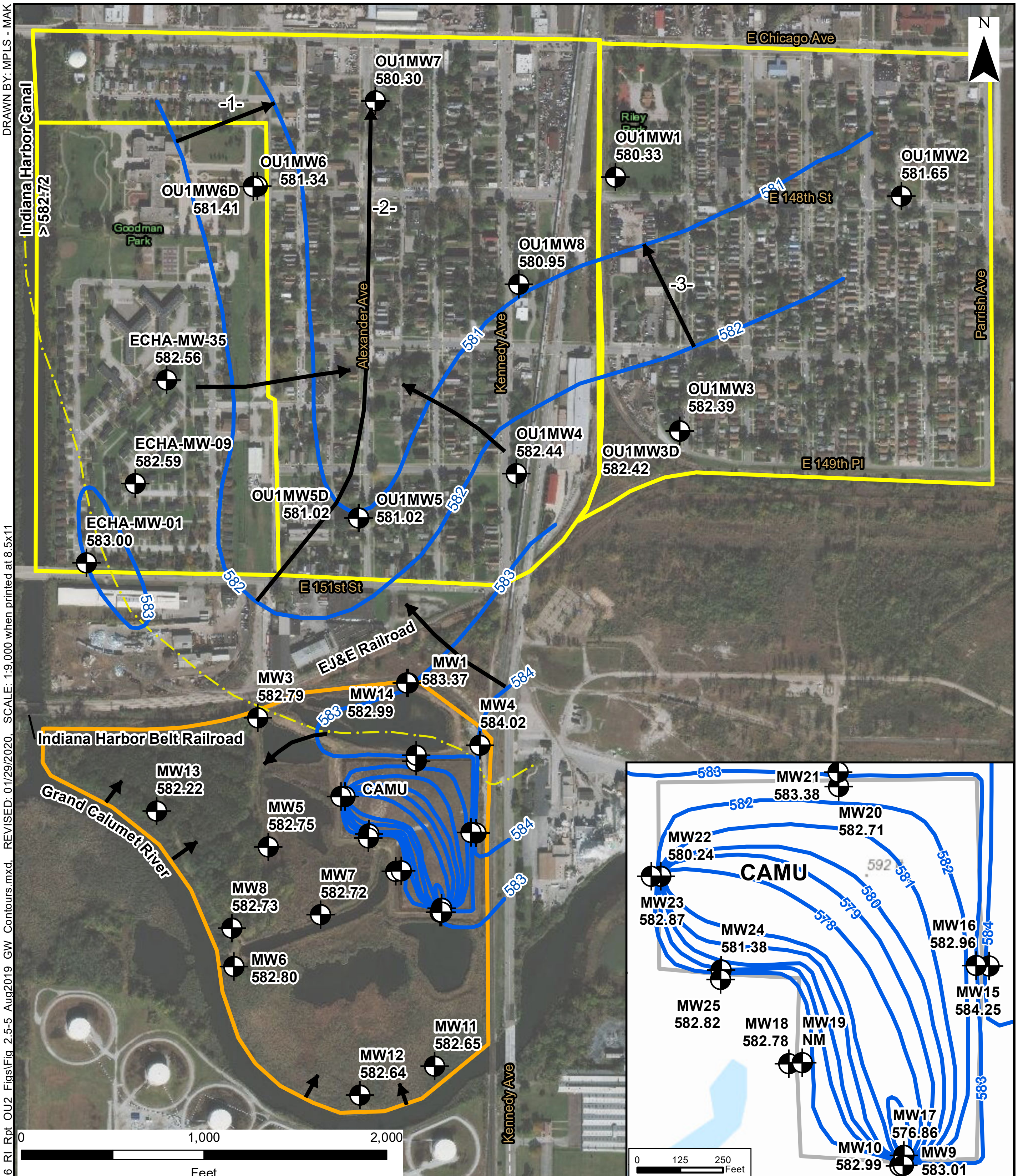
Source: Esri - World Topographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet; Imagery Date: March 2018

M:\Clients\S-U\USL\ ArcGIS\2019\12\16 RI Rpt OU2 Figs\Fig 2.5-4 Jun2019 GW Contours.mxd, REVISED: 01/29/2020, SCALE: 1:9,000 when printed at 8.5x11 DRAWN BY: MPLS - MAK



Groundwater Monitoring Well

Groundwater Contour (1 foot Interval)

Local Groundwater Flow Direction

Approximate Water Table Divide

Approximate Slurry Wall Location

Approximate Boundary of OU1

Approximate USS Lead Facility Boundary

-1- Flow Line Used to Estimate Potentiometric Gradient

Figure 2.5-4

Groundwater Contour Map - August 2019

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

Notes:

1. Groundwater measurements collected on August 12, 2019.
2. NM indicates not measured; well contains free product.
3. Stage reading of Indiana Harbor Canal from USGS Gauging Station No. 04092750 on August 12, 2019, located 1.65 mi north of East Chicaco Avenue.
4. CAMU has an induced inward gradient.

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Source: Esri - World Topographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet; Imagery Date: March 2018

M:\Clients\S-U\USL_ArcGIS\2019\1216_RI_Rpt_OU2_Figs\Fig_2.5-5_Aug2019_GW_Contours.mxd, REVISED: 01/29/2020, SCALE: 1:9,000 when printed at 8.5x11

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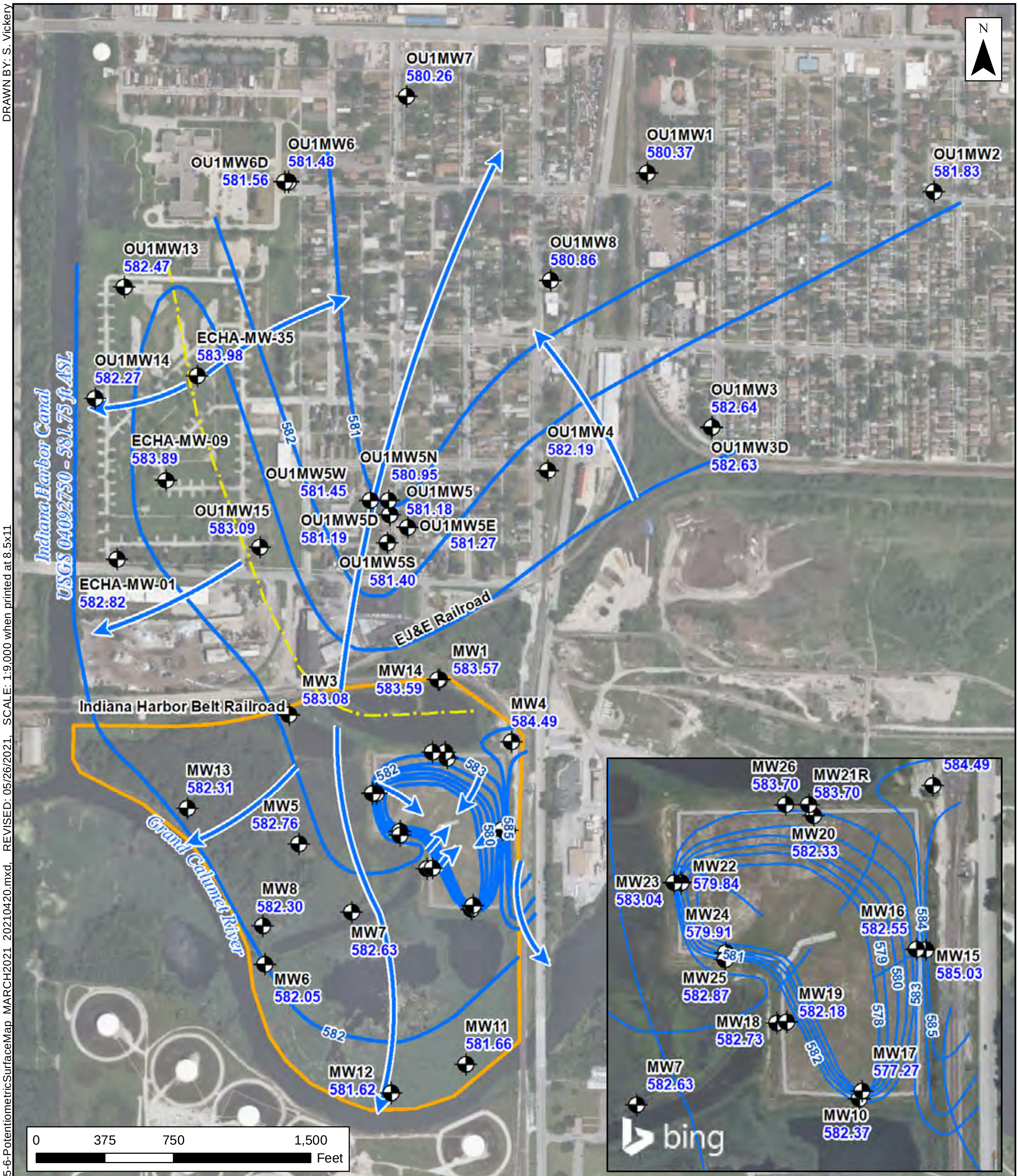

DRAWN BY: S. Vickery

J:\Projects\USS Lead_MXD\2021\Fig2.5-6-PotentiometricSurfaceMap_MARCH2021_20210420.mxd, REVISED: 05/26/2021, SCALE: 1:9,000 when printed at 8.5x11

Legend

- Groundwater Monitoring Well
- Groundwatar Flow Direction
- Groundwater Contour (1 Ft. Interval)
- Approximate Water Table Divide
- Approximate Slurry Wall Location
- Approximate USS Lead Facility Boundary

Notes:
1. Lake County GIS, 2019
2. 581.62 - Groundwater Elevation
2. Ft AMSL - Feet above mean sea level
1. Groundwater measurements collected between March 16, 2021.
2. NM indicates not measured; well contains free product.
3. Stage reading of Indiana Harbor Canal from USGS Gauging Station No. 04092750 on March X 2021, 581.75 ft. AMSL NAVD88 located 1.65 mi north of East Chicaco Avenue.
4. CAMU has an induced inward gradient.

Figure 2.5-5
Groundwater Contour Map-March 2021

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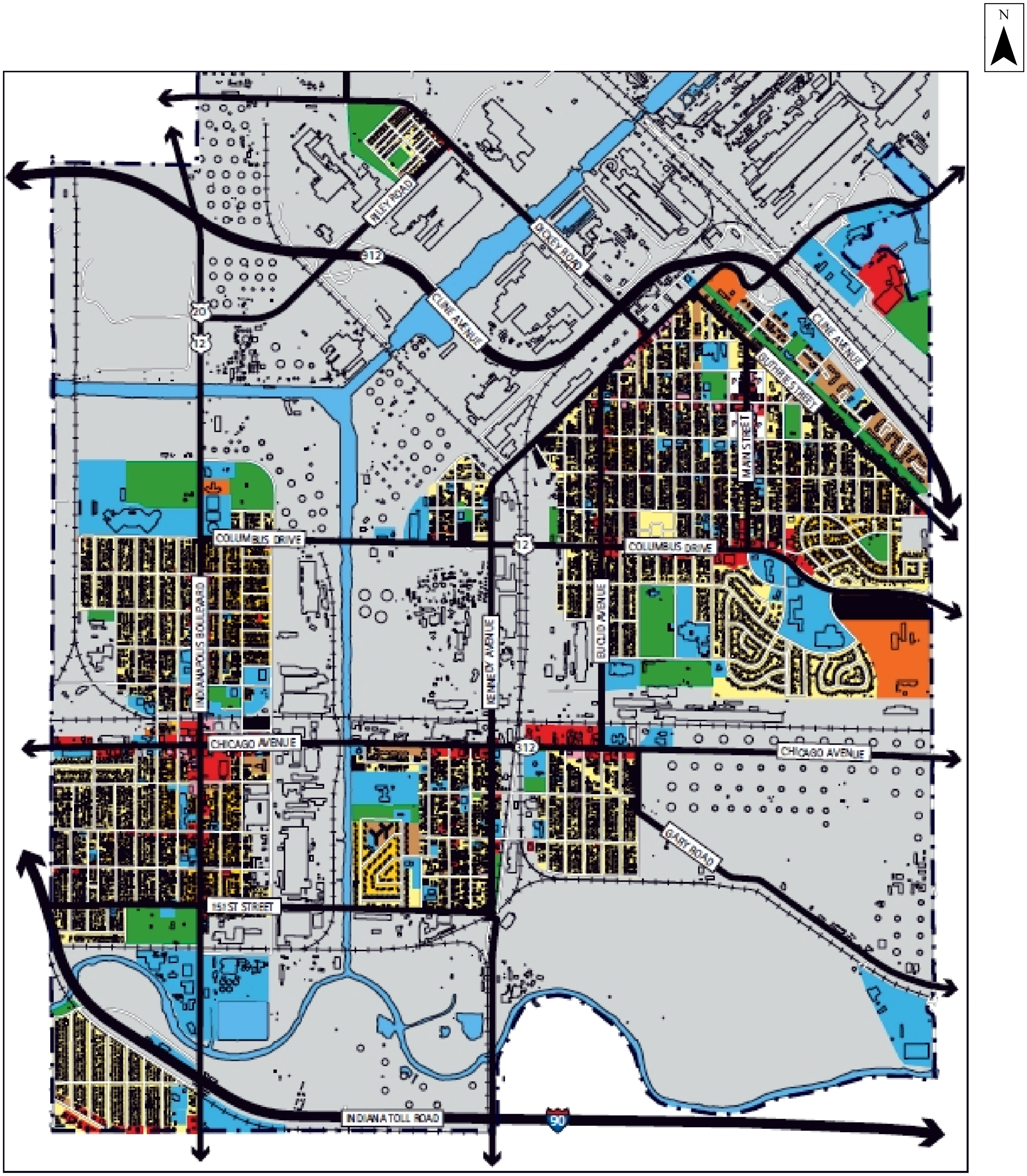
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



Notes:
1.Adapted from East Chicago Comprehensive Plan
City of East Chicago, Indiana
November 2008

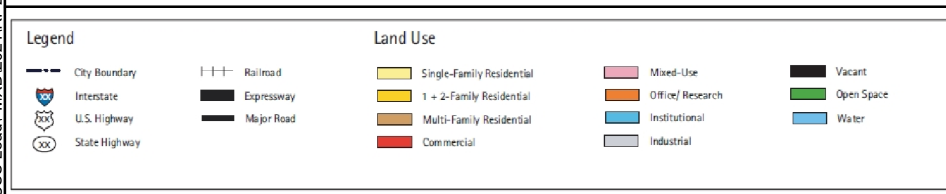


Figure 2.7-1
Zoning Map
Remedial Investigation Report - OU2
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East Chicago, Indiana

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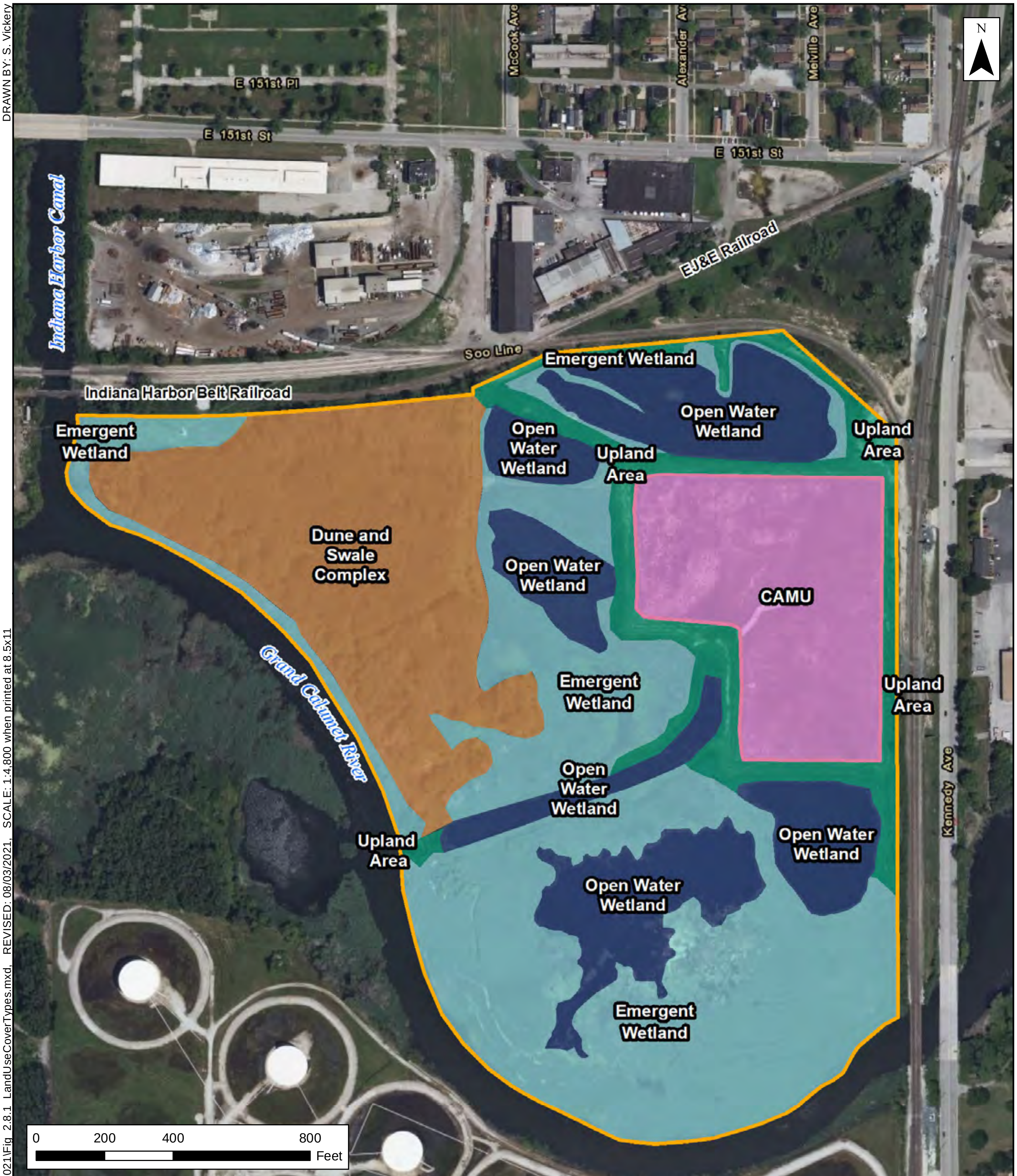
J:\Projects\USS Lead\ MXD\2021\RI_2021\Fig_2.7-1_Zoning_Map.mxd, REVISED: 08/03/2021, SCALE: 1:1,049 when printed at 8.5x11 DRAWN BY: MPLS - MAK

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



Legend

- Approximate CAMU Boundary
- USS Lead Facility Boundary

Land Use:

- Emergent Wetland
- Upland Area
- Open Water Wetland
- CAMU
- Dune and Swale Complex

Figure 2.8-1
Landuse Covertype Map
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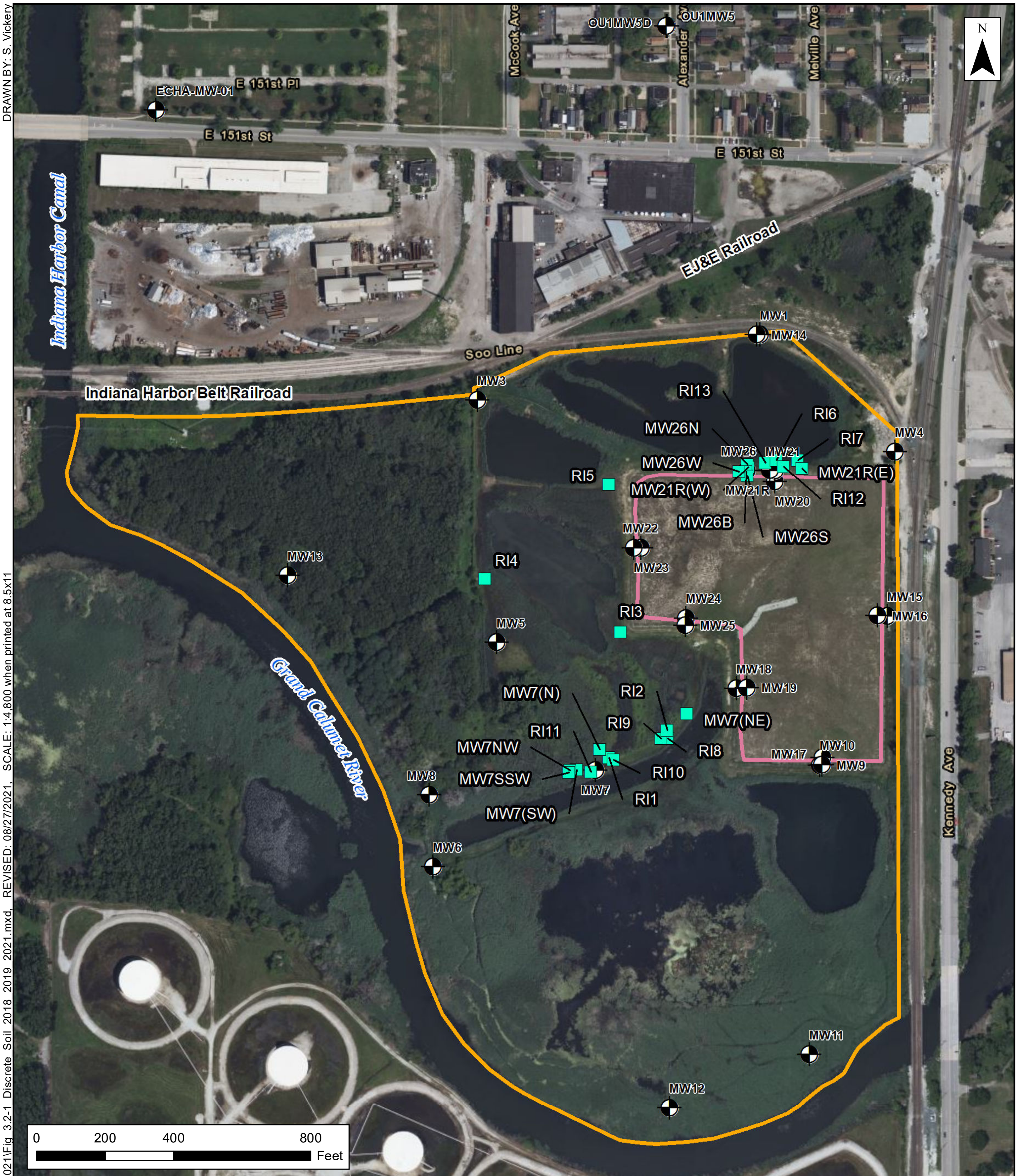
J:\Projects\USS Lead_MXD\2021\RI_2021\Fig_2.8.1_LandUseCoverTypes.mxd, REVISED: 08/03/2021, SCALE: 1:4,800 when printed at 8.5x11

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



Legend

- Discrete Soil Sample Location
- Groundwater Monitoring Well
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Figure 3.2-1
Locations of Discrete Soil Samples Collected in 2018, 2019, and 2021
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East Chicago, Indiana

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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

J:\Projects\USS Lead\ MXD\2021\RI 2021\Fig 3.2-1 Discrete Soil 2018 2019 2021.mxd, REVISED: 08/27/2021, SCALE: 1:4,800 when printed at 8.5x11 DRAWN BY: S. Vickery

DRAWN BY: S. Vickery

J:\Projects\USS Lead_MXD\2021\RI_2021\Fig3.2-2_DU_Location_20210602.mxd, REVISED: 08/03/2021, SCALE: 1:2,892 when printed at 8.5x11

Legend

Decision Unit

USS Lead Facility Boundary

Figure 3.2-2
Locations of Decision Units Sampled in 2018 and 2019
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East Chicago, Indiana

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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Wisconsin North FIPS 4801 Feet

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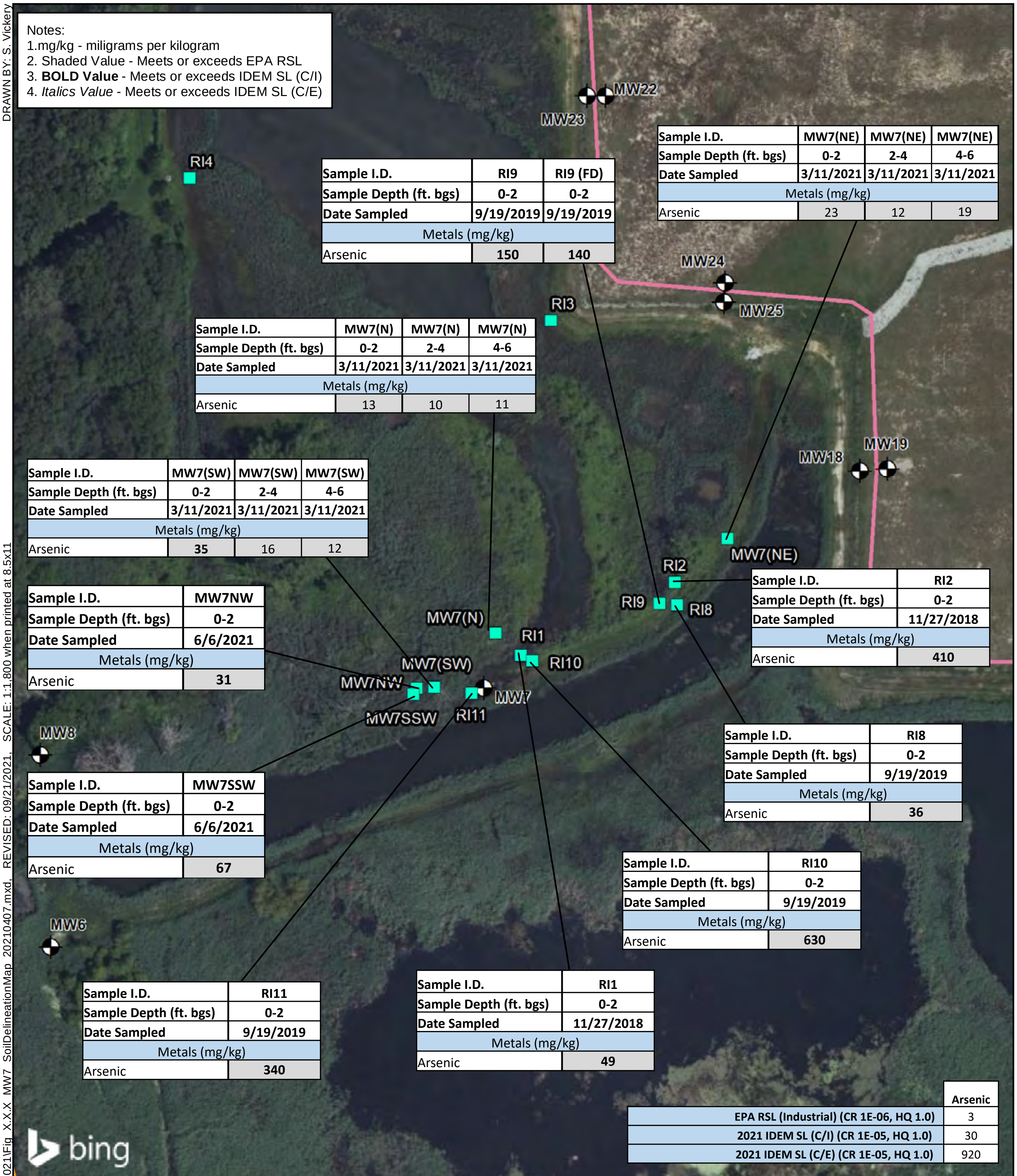
J:\Projects\USS Lead\ MXD\2021\RI 2021\Fig X.X.X MW7 SoilDelineationMap 20210407.mxd, REVISED: 09/21/2021, SCALE: 1:1,800 when printed at 8.5x11

Notes:
1.mg/kg - miligrams per kilogram
2. Shaded Value - Meets or exceeds EPA RSL
3. **BOLD Value** - Meets or exceeds IDEM SL (C/I)
4. *Italics Value* - Meets or exceeds IDEM SL (C/E)



Sample I.D.	RI9	RI9 (FD)
Sample Depth (ft. bgs)	0-2	0-2
Date Sampled	9/19/2019	9/19/2019
Metals (mg/kg)		
Arsenic	**150**	**140**

Sample I.D.	MW7(NE)	MW7(NE)	MW7(NE)
Sample Depth (ft. bgs)	0-2	2-4	4-6
Date Sampled	3/11/2021	3/11/2021	3/11/2021
Metals (mg/kg)			
Arsenic	23	12	19

Sample I.D.	MW7(N)	MW7(N)	MW7(N)
Sample Depth (ft. bgs)	0-2	2-4	4-6
Date Sampled	3/11/2021	3/11/2021	3/11/2021
Metals (mg/kg)			
Arsenic	13	10	11

Sample I.D.	MW7(SW)	MW7(SW)	MW7(SW)
Sample Depth (ft. bgs)	0-2	2-4	4-6
Date Sampled	3/11/2021	3/11/2021	3/11/2021
Metals (mg/kg)			
Arsenic	**35**	16	12

Sample I.D.	MW7NW
Sample Depth (ft. bgs)	0-2
Date Sampled	6/6/2021
Metals (mg/kg)	
Arsenic	**31**

Sample I.D.	RI2
Sample Depth (ft. bgs)	0-2
Date Sampled	11/27/2018
Metals (mg/kg)	
Arsenic	**410**

Sample I.D.	RI8
Sample Depth (ft. bgs)	0-2
Date Sampled	9/19/2019
Metals (mg/kg)	
Arsenic	**36**

Sample I.D.	MW7SSW
Sample Depth (ft. bgs)	0-2
Date Sampled	6/6/2021
Metals (mg/kg)	
Arsenic	**67**

Sample I.D.	RI10
Sample Depth (ft. bgs)	0-2
Date Sampled	9/19/2019
Metals (mg/kg)	
Arsenic	**630**

Sample I.D.	RI11
Sample Depth (ft. bgs)	0-2
Date Sampled	9/19/2019
Metals (mg/kg)	
Arsenic	**340**

Sample I.D.	RI1
Sample Depth (ft. bgs)	0-2
Date Sampled	11/27/2018
Metals (mg/kg)	
Arsenic	**49**

	Arsenic
EPA RSL (Industrial) (CR 1E-06, HQ 1.0)	3
2021 IDEM SL (C/I) (CR 1E-05, HQ 1.0)	30
2021 IDEM SL (C/E) (CR 1E-05, HQ 1.0)	920

Legend

- Discrete Soil Sample Location
- Groundwater Monitoring Well
- Approximate CAMU Boundary
- USS Lead Facility Boundary

N

0 45 90 180 Feet

Figure 3.2-3
MW7 Discrete Sample Locations for Arsenic
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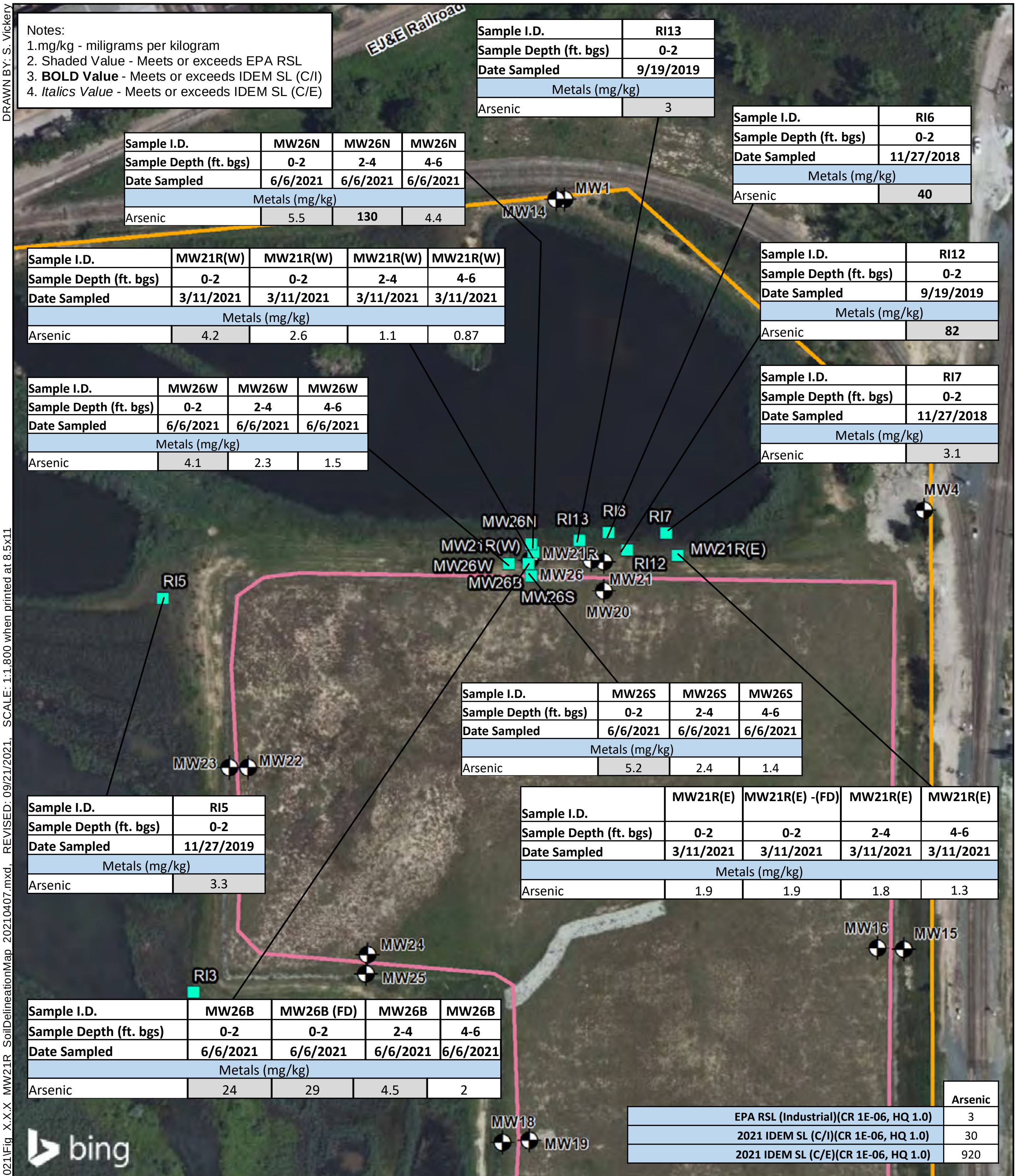
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



Notes:
1.mg/kg - miligrams per kilogram
2. Shaded Value - Meets or exceeds EPA RSL
3. **BOLD Value** - Meets or exceeds IDEM SL (C/I)
4. *Italics Value* - Meets or exceeds IDEM SL (C/E)

Sample I.D.	RI13
Sample Depth (ft. bgs)	0-2
Date Sampled	9/19/2019
Metals (mg/kg)	
Arsenic	3

Sample I.D.	RI6
Sample Depth (ft. bgs)	0-2
Date Sampled	11/27/2018
Metals (mg/kg)	
Arsenic	**40**

Sample I.D.	MW26N	MW26N	MW26N
Sample Depth (ft. bgs)	0-2	2-4	4-6
Date Sampled	6/6/2021	6/6/2021	6/6/2021
Metals (mg/kg)			
Arsenic	5.5	**130**	4.4

Sample I.D.	MW21R(W)	MW21R(W)	MW21R(W)	MW21R(W)
Sample Depth (ft. bgs)	0-2	0-2	2-4	4-6
Date Sampled	3/11/2021	3/11/2021	3/11/2021	3/11/2021
Metals (mg/kg)				
Arsenic	4.2	2.6	1.1	0.87

Sample I.D.	RI12
Sample Depth (ft. bgs)	0-2
Date Sampled	9/19/2019
Metals (mg/kg)	
Arsenic	**82**

Sample I.D.	MW26W	MW26W	MW26W
Sample Depth (ft. bgs)	0-2	2-4	4-6
Date Sampled	6/6/2021	6/6/2021	6/6/2021
Metals (mg/kg)			
Arsenic	4.1	2.3	1.5

Sample I.D.	RI7
Sample Depth (ft. bgs)	0-2
Date Sampled	11/27/2018
Metals (mg/kg)	
Arsenic	3.1

Sample I.D.	MW26S	MW26S	MW26S
Sample Depth (ft. bgs)	0-2	2-4	4-6
Date Sampled	6/6/2021	6/6/2021	6/6/2021
Metals (mg/kg)			
Arsenic	5.2	2.4	1.4

Sample I.D.	RI5
Sample Depth (ft. bgs)	0-2
Date Sampled	11/27/2019
Metals (mg/kg)	
Arsenic	3.3

Sample I.D.	MW21R(E)	MW21R(E) -(FD)	MW21R(E)	MW21R(E)
Sample Depth (ft. bgs)	0-2	0-2	2-4	4-6
Date Sampled	3/11/2021	3/11/2021	3/11/2021	3/11/2021
Metals (mg/kg)				
Arsenic	1.9	1.9	1.8	1.3

Sample I.D.	MW26B	MW26B (FD)	MW26B	MW26B
Sample Depth (ft. bgs)	0-2	0-2	2-4	4-6
Date Sampled	6/6/2021	6/6/2021	6/6/2021	6/6/2021
Metals (mg/kg)				
Arsenic	24	29	4.5	2

	Arsenic
EPA RSL (Industrial)(CR 1E-06, HQ 1.0)	3
2021 IDEM SL (C/I)(CR 1E-06, HQ 1.0)	30
2021 IDEM SL (C/E)(CR 1E-06, HQ 1.0)	920

Legend

- Discrete Soil Sample Location
- Groundwater Monitoring Well
- Approximate CAMU Boundary
- USS Lead Facility Boundary

N

0 45 90 180 Feet

Figure 3.2-4
MW21R & MW26 Discrete Sample Locations for Arsenic
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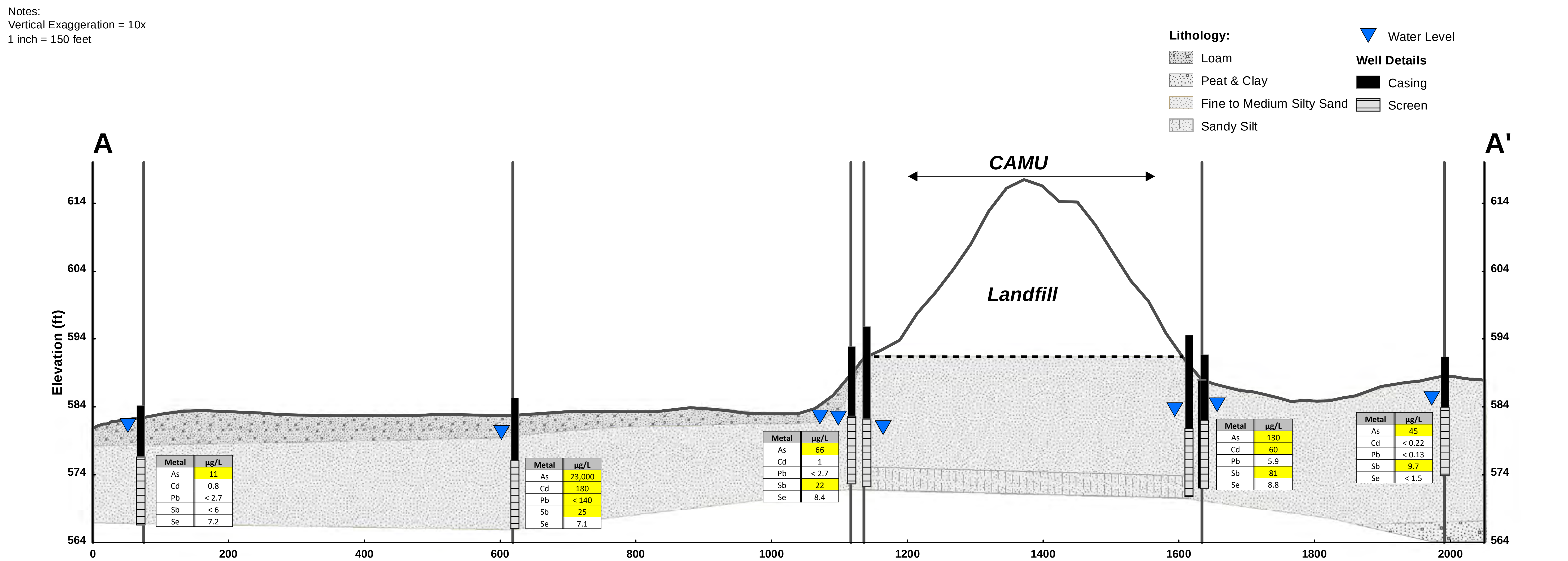
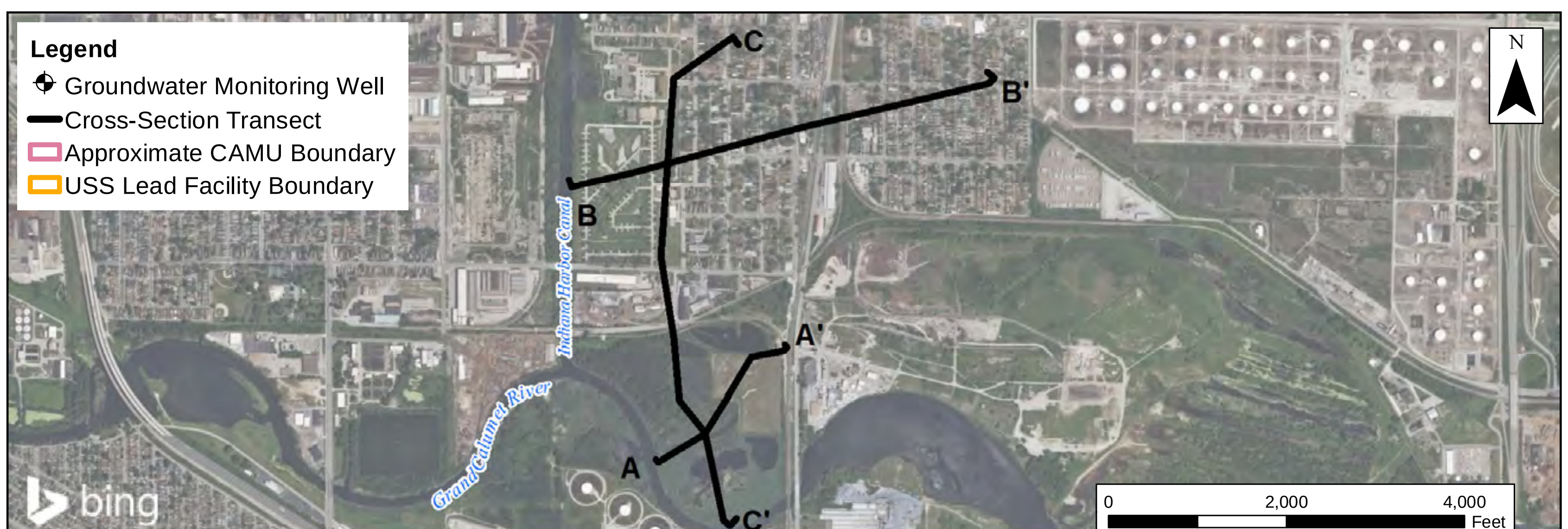
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet





Notes:
1. Maximum Dissolved Metal Concentrations
2. All Concentrations are µg/L
3. Yellow Box - Indicates RSL Exceedance
4. Lake County LiDAR Elevation used for Profile

RSLs:

Metal	µg/L
As	10
Cd	5
Pb	15
Sb	6
Se	50

Figure 3.2-5
Cross Section A-A'
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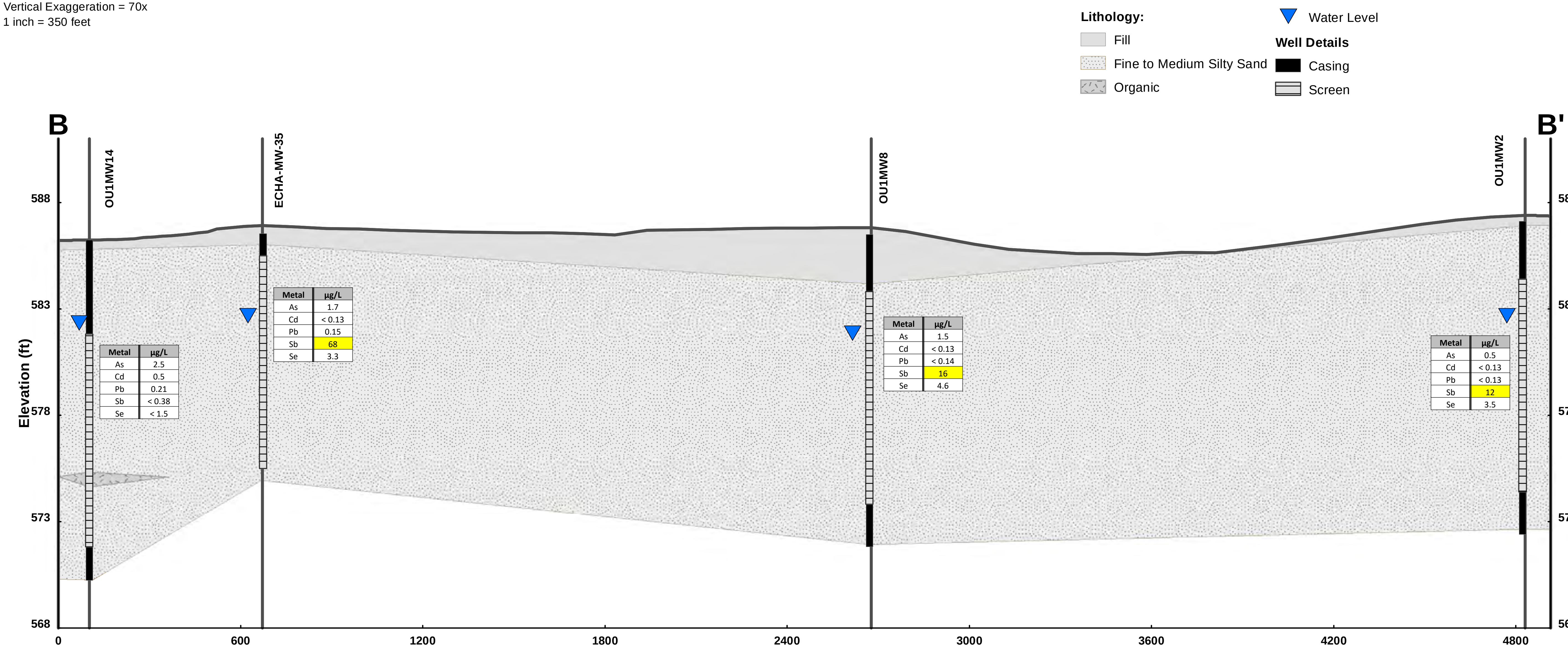
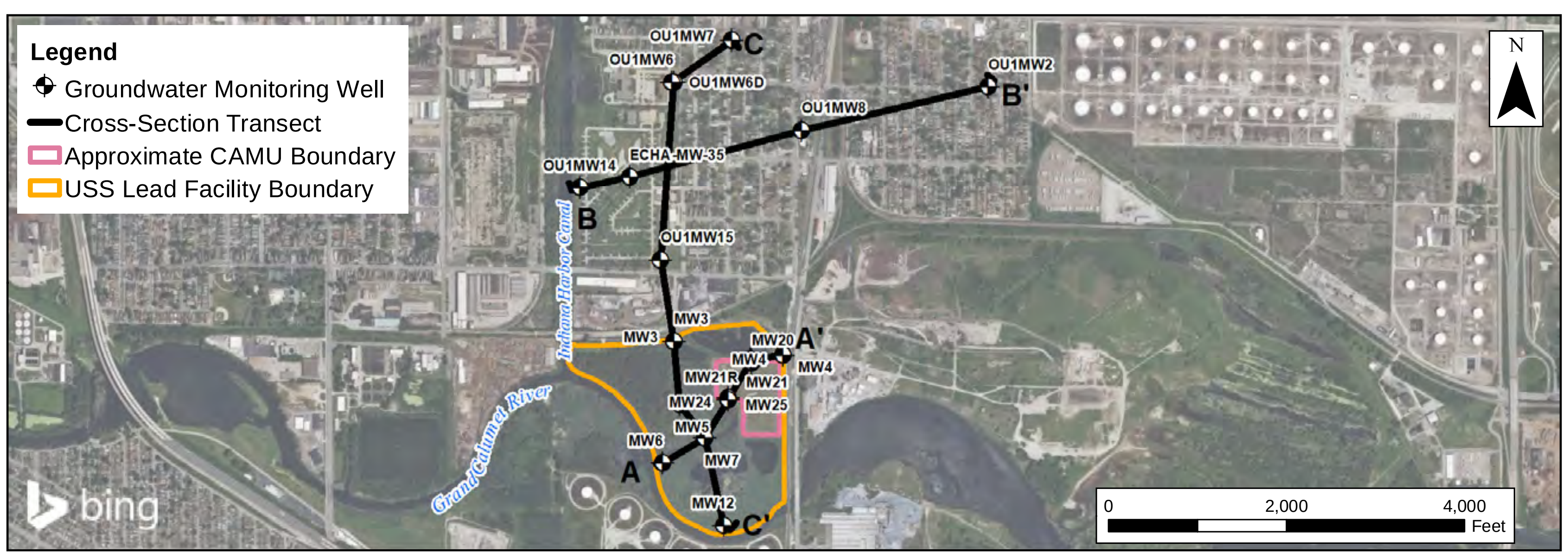
FILE: J:\Projects\USS Lead_MXD\EnviroInsite\Cross Section A-A\FigX_A-A_XSec_LiDAR_20211007.mxd, REVISED: 10/07/2021, SCALE: 1:24,000 when printed at 11x17, DRAWN BY: steven.vickery

Source: © 2021 Microsoft Corporation © 2021 Maxar ©CNES (2021) Distribution Airbus DS

Coordinate System: NAD 1983 StatePlane Indiana West FIPS 1302 Feet

Notes:
Vertical Exaggeration = 70x
1 inch = 350 feet





Notes:
1. Maximum Dissolved Metal Concentrations
2. All Concentrations are µg/L
3. Yellow Box - Indicates RSL Exceedance

RSLs:

Metal	µg/L
As	10
Cd	5
Pb	15
Sb	6
Se	50

Figure 3.2-6
Cross Section B-B'
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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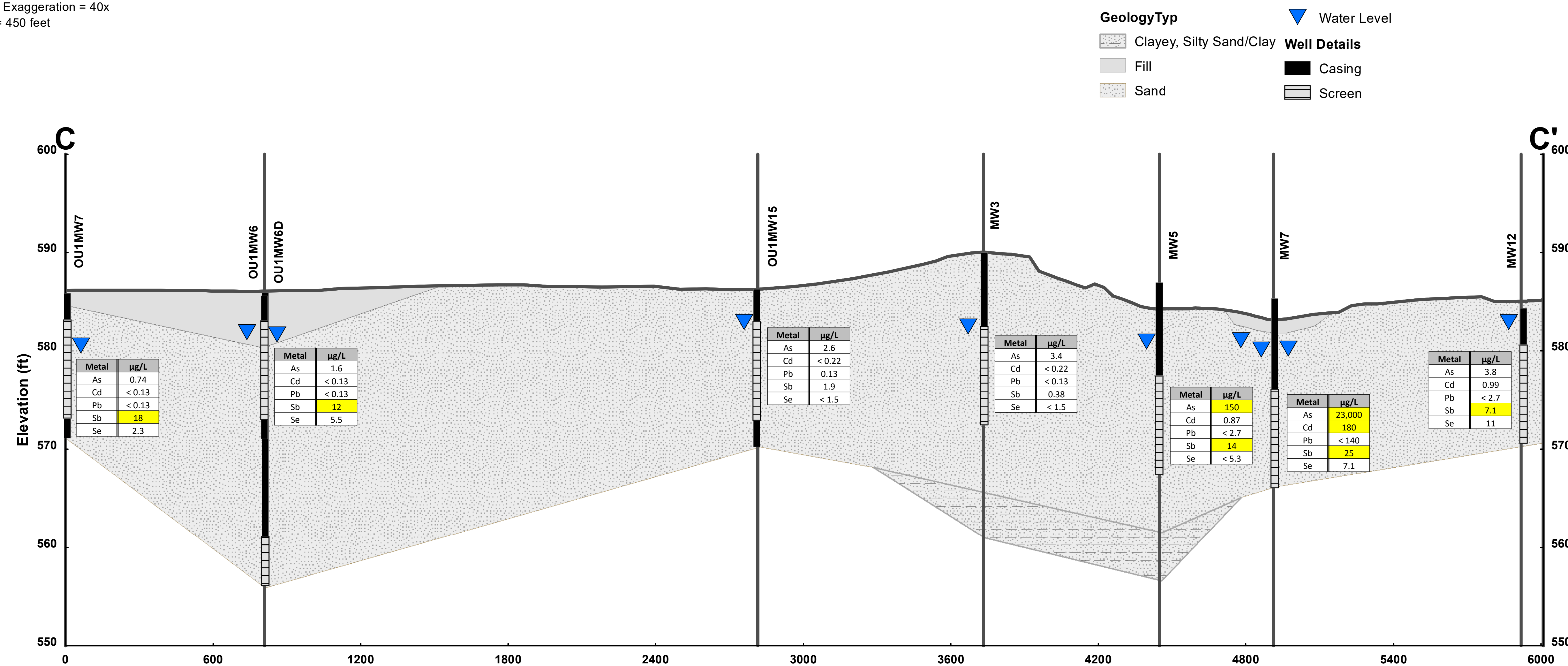
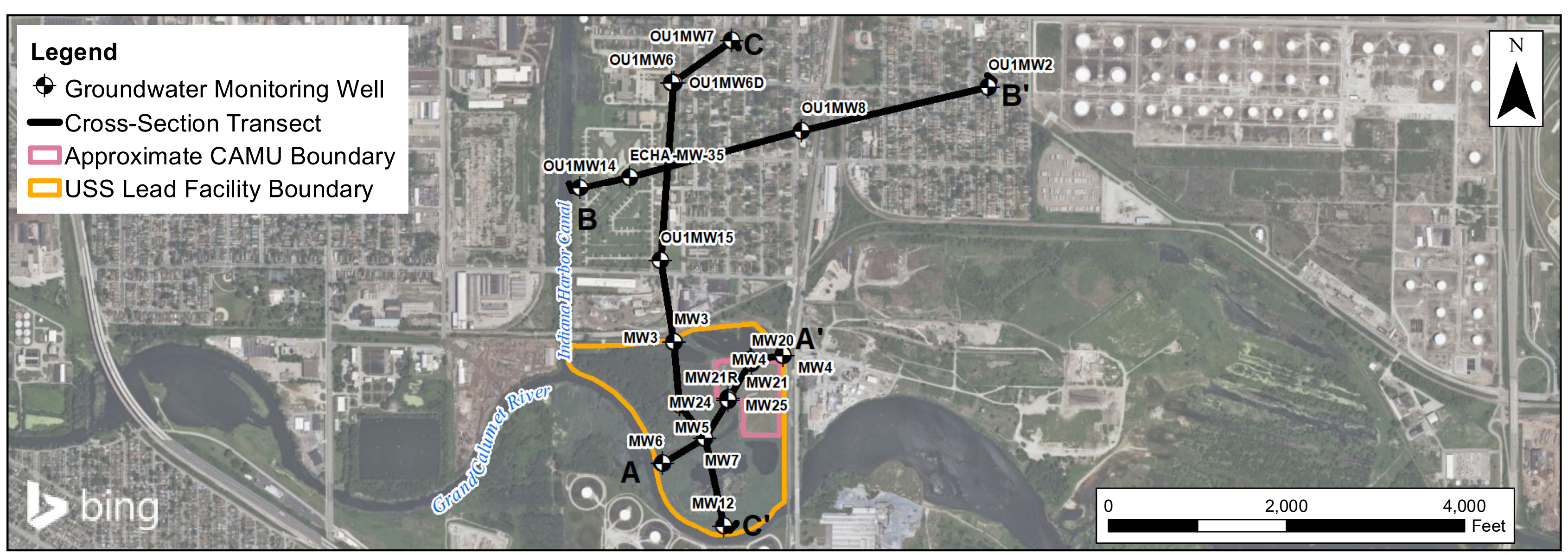
FILE: J:\Projects\USS Lead_MXD\EnviroInsite\Cross Sectio B-B\FigX_B-B_XSec.mxd, REVISED: 08/24/2021, SCALE: 1:24,000 when printed at 11x17

Coordinate System: NAD 1983 StatePlane Indiana West FIPS 1302 Feet

Notes:
Vertical Exaggeration = 40x
1 inch = 450 feet





Notes:
1. Maximum Dissolved Metal Concentrations
2. All Concentrations are µg/L
3. Yellow Box - Indicates RSL Exceedance

RSLs:

Metal	µg/L
As	10
Cd	5
Pb	15
Sb	6
Se	50

Figure 3.2-7
Cross Section C-C'
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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Source: © 2021 Microsoft Corporation © 2021 Maxar ©CNES (2021) Distribution Airbus DS

Coordinate System: NAD 1983 StatePlane Indiana West FIPS 1302 Feet

DRAWN BY: steven.vickery

FILE: J:\Projects\USS Lead_MXD\EnviroInsite\Cross Section C-C\FigX_C-C_XSec.mxd.. REVISED: 08/24/2021 . SCALE: 1:24,000 when printed at 11x17

DRAWN BY: MPLS - MAK

J:\Projects\USS Lead_MXD\2021\RI_2021\Fig_4.2-1_Soil_Sample_Locations.mxd, REVISED: 08/23/2021, SCALE: 1:4,800 when printed at 8.5x11

Legend

- Soil Sample Location
- USS Lead Facility Boundary
- Approximate CAMU Boundary

Figure 4.2-1
Locations of Soil Samples Used in the RI
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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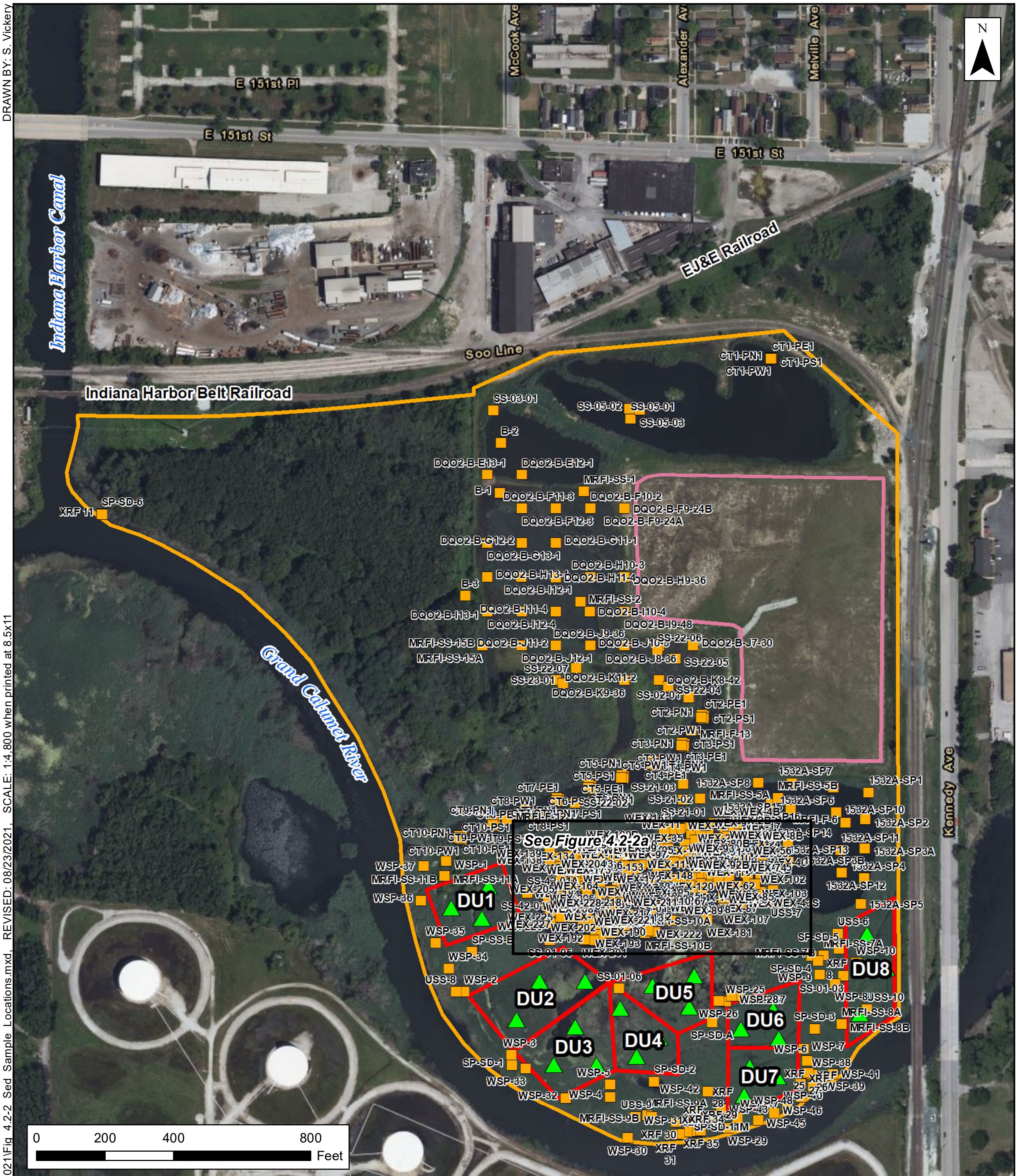
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



Legend

- Historical Sediment Sample Locations
- 2019 AVS/SEM Sample Locations
- Decision Unit (Refer to Figure 3.2-2)
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Figure 4.2-2
Locations of Sediment Samples Used in the RI
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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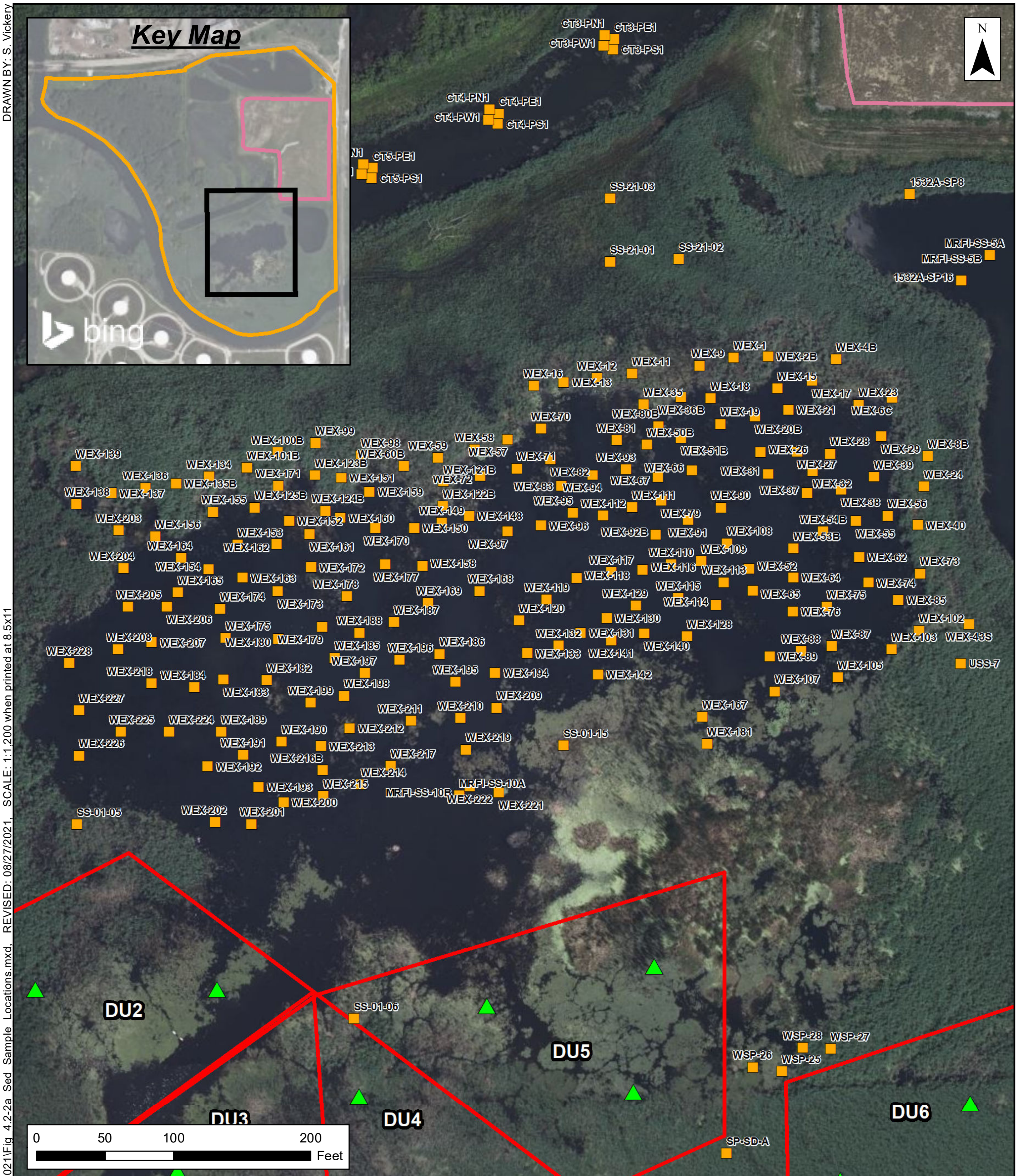
J:\Projects\USS Lead_MXD\2021\RI_2021\Fig_4.2-2_Sed_Sample_Locations.mxd, REVISED: 08/23/2021, SCALE: 1:4,800 when printed at 8.5x11

Source: Esri - World Topoogpraphic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



Legend

- Sediment Sample Location
- AVS/SEM Sample Location
- Decision Unit (Refer to Figure 3.2-2)
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Figure 4.2-2a
Locations of Sediment Samples Used in the RI
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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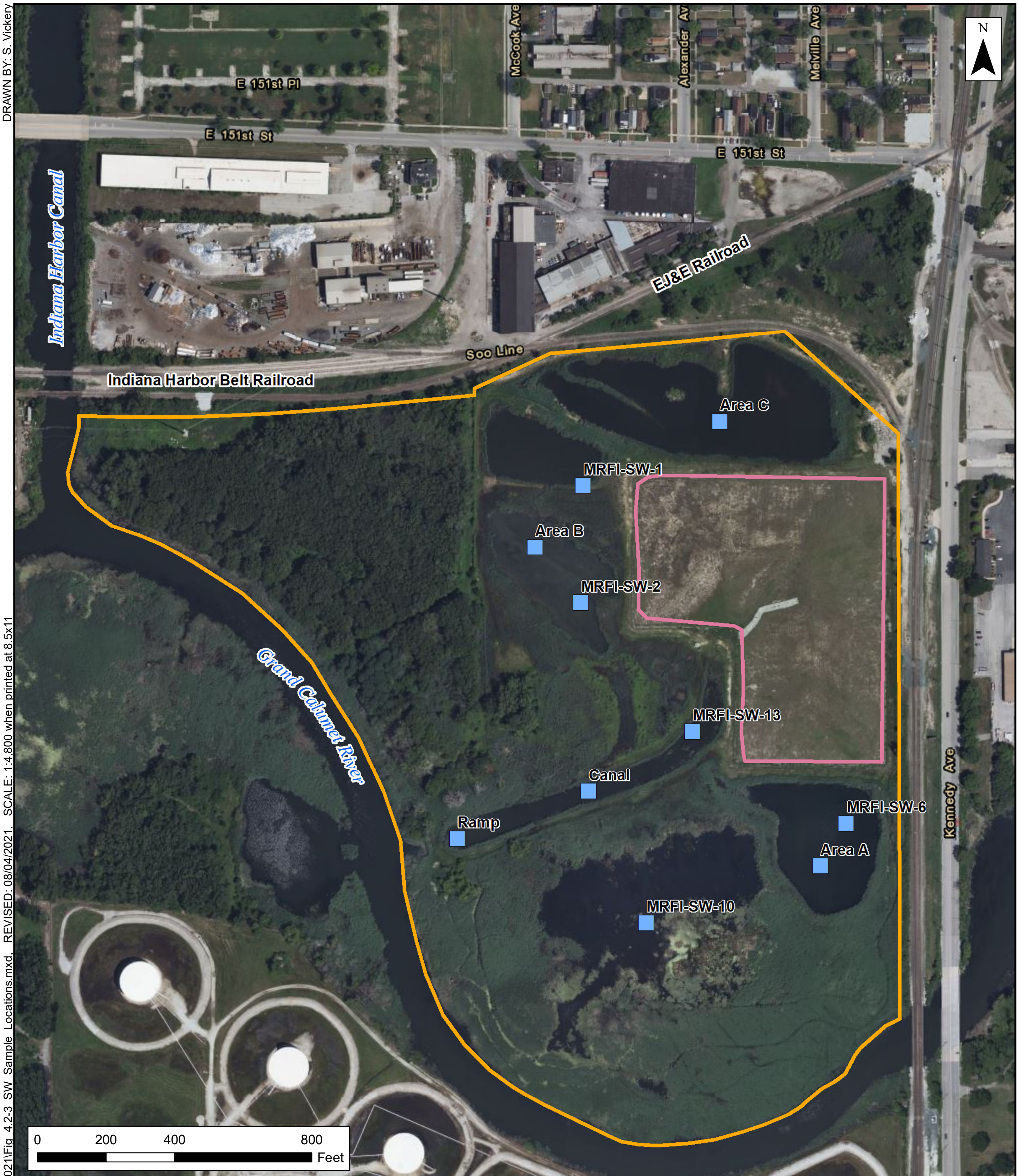
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

J:\Projects\USS Lead\ MXD\2021\RI 2021\Fig 4.2-2a Sed Sample Locations.mxd, REVISED: 08/27/2021, SCALE: 1:1,200 when printed at 8.5x11 DRAWN BY: S. Vickery



DRAWN BY: S. Vickery

J:\Projects\USS Lead_MXD\2021\RI_2021\Fig_4.2-3_SW_Sample_Locations.mxd, REVISED: 08/04/2021, SCALE: 1:4,800 when printed at 8.5x11

Legend

- Surface Water Sample Location
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Figure 4.2-3
Locations of Surface Water Samples Used in the RI
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

J:\Projects\USS Lead_MXD\2021\RI_2021\Fig_4.3-5-1_GW_MetalMaxConcentration_Antimony_20210818.mxd. REVISED: 09/17/2021. SCALE: 1:10,500 when printed at 8.5x11 DRAWN BY: S. Vickery

Legend

- Groundwater Monitoring Well
- 6 µg/L USEPA MCL (Antimony)
- Approximate Boundary of OU1
- USS Lead Facility Boundary
- Approximate CAMU Boundary

Notes:
1. Results reported in µg/L
2. Lake County GIS, 2019

Figure 4.3-1
Maximum Groundwater Antimony Isoconcentration Map
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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Source: Esri - World Topoogpraphic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

J:\Projects\USS Lead_MXD\2021\RI_2021\Fig_4.3-5-2_GW_MetalMaxConcentration_Arsenic_20210818.mxd, REVISED: 08/25/2021, SCALE: 1:10,500 when printed at 8.5x11 DRAWN BY: S. Vickery

Legend

- Groundwater Monitoring Well
- 10 µg/L USEPA MCL (Arsenic)
- Approximate Boundary of OU1
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Notes:
1. Results reported in µg/L
2. Lake County GIS, 2019

Figure 4.3-2
Max Groundwater Arsenic Isoconcentration Map
Remedial Investigation Report - OU2 USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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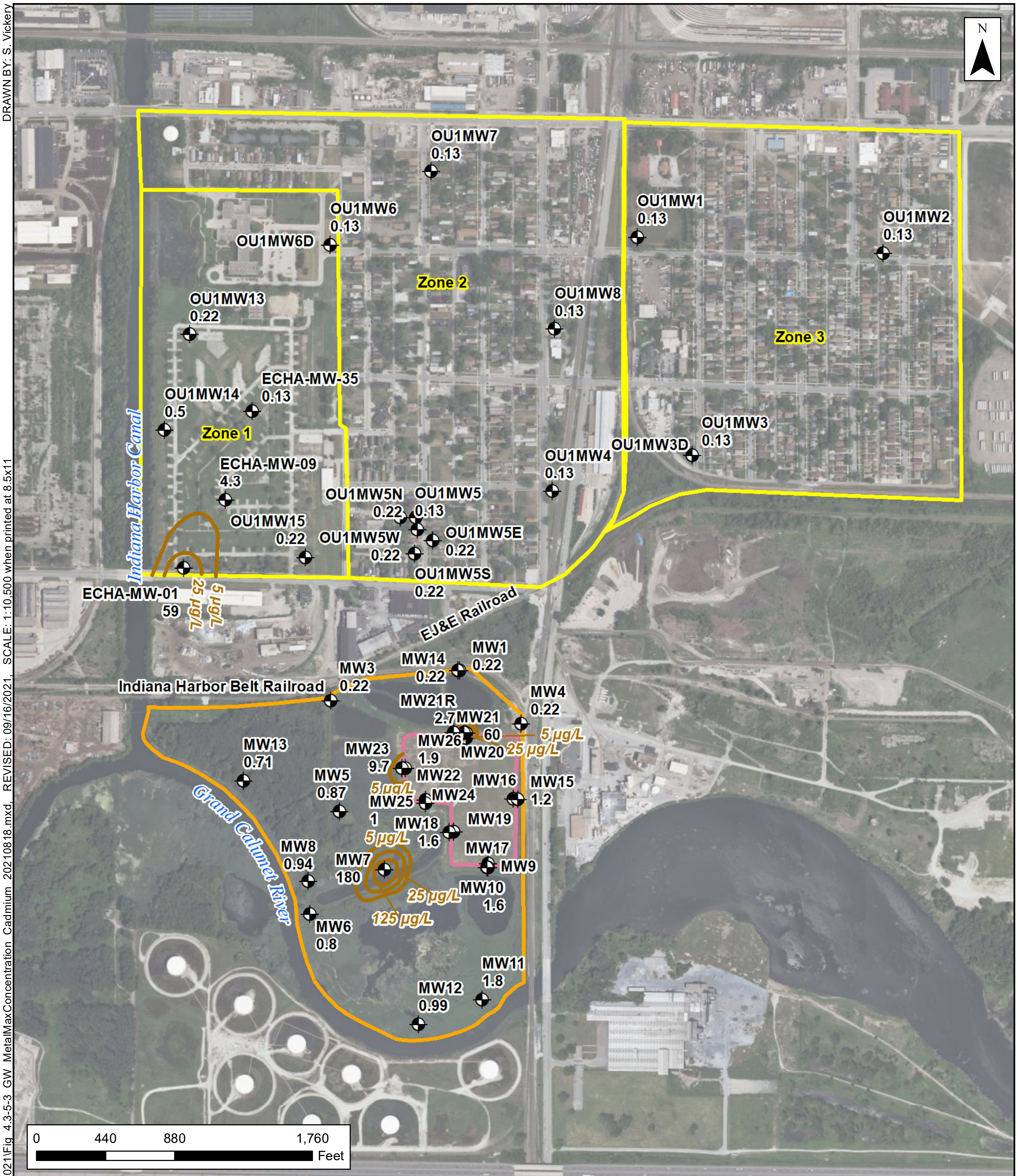
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



DRAWN BY: S. Vickery

J:\Projects\USS Lead_MXD\2021\RI_2021\Fig_4.3-5-3_GW_MetalMaxConcentration_Cadmium_20210818.mxd, REVISED: 09/16/2021, SCALE: 1:10,500 when printed at 8.5x11

Legend

- Groundwater Monitoring Well
- 5 µg/L USEPA MCL (Cadmium)
- Approximate Boundary of OU1
- USS Lead Facility Boundary
- Approximate CAMU Boundary

Notes:
1. Results reported in µg/L
2. Lake County GIS, 2019

Figure 4.3-3
Max Groundwater Cadmium Isoconcentration Map
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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ERM

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

Legend

- Groundwater Monitoring Well
- 15 µg/L USEPA MCL (Lead)
- Approximate Boundary of OU1
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Notes:
1. Results reported in µg/L
2. Lake County GIS, 2019

Figure 4.3-4
Maximum Groundwater Lead Isoconcentration Map
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

J:\Projects\USS Lead_MXD\2021RI_2021\Fig_X.X-X_GW_MetalMaxConcentration_Lead_20210818.mxd, REVISED: 08/23/2021, SCALE: 1:10,500 when printed at 8.5x11 DRAWN BY: S. Vickery

DRAWN BY: S. Vickery

J:\Projects\USS Lead_MXD\2021\RI_2021\FigX.X-X_GW_MetalMaxConcentration_Selenium_20210818.mxd, REVISED: 08/23/2021, SCALE: 1:10,500 when printed at 8.5x11

Legend

- Groundwater Monitoring Well
- 50 µg/L USEPA MCL (Selenium)
- Approximate Boundary of OU1
- USS Lead Facility Boundary
- Approximate CAMU Boundary

Notes:
1. Results reported in µg/L
2. Lake County GIS, 2019

Figure 4.3-5
Maximum Groundwater Selenium Isoconcentration Map
Remedial Investigation Report - OU2 USS Lead Superfund Site
East Chicago, Indiana

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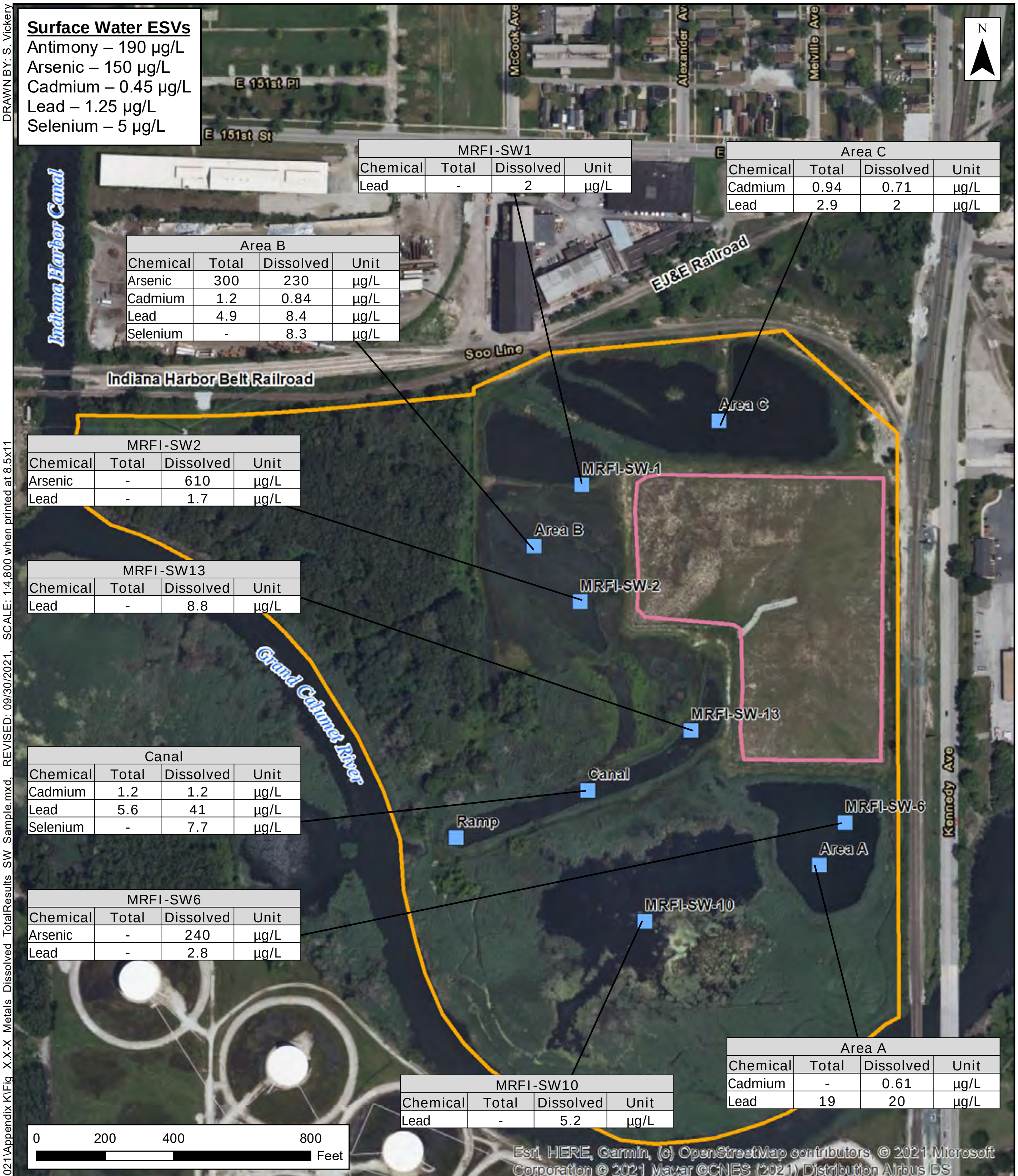
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



MRFI-SW1

Chemical	Total	Dissolved	Unit
Lead	-	2	µg/L

Area C

Chemical	Total	Dissolved	Unit
Cadmium	0.94	0.71	µg/L
Lead	2.9	2	µg/L

Area B

Chemical	Total	Dissolved	Unit
Arsenic	300	230	µg/L
Cadmium	1.2	0.84	µg/L
Lead	4.9	8.4	µg/L
Selenium	-	8.3	µg/L

MRFI-SW2

Chemical	Total	Dissolved	Unit
Arsenic	-	610	µg/L
Lead	-	1.7	µg/L

MRFI-SW13

Chemical	Total	Dissolved	Unit
Lead	-	8.8	µg/L

Canal

Chemical	Total	Dissolved	Unit
Cadmium	1.2	1.2	µg/L
Lead	5.6	41	µg/L
Selenium	-	7.7	µg/L

MRFI-SW6

Chemical	Total	Dissolved	Unit
Arsenic	-	240	µg/L
Lead	-	2.8	µg/L

MRFI-SW10

Chemical	Total	Dissolved	Unit
Lead	-	5.2	µg/L

Area A

Chemical	Total	Dissolved	Unit
Cadmium	-	0.61	µg/L
Lead	19	20	µg/L

Legend

- Surface Water Sample Location
- Approximate CAMU Boundary
- USS Lead Facility Boundary

Notes:
1. Exceedances of max concentrations to Ecological Screening Values (ESV) are shown.
2. EPA Region 4, Ecological Screening Value (ESV), March 2018, freshwater screening values, chronic (table 1a).

Figure 4.3-6
Surface Water Maximum Concentrations Total and Dissolved Metals (2000-2021)
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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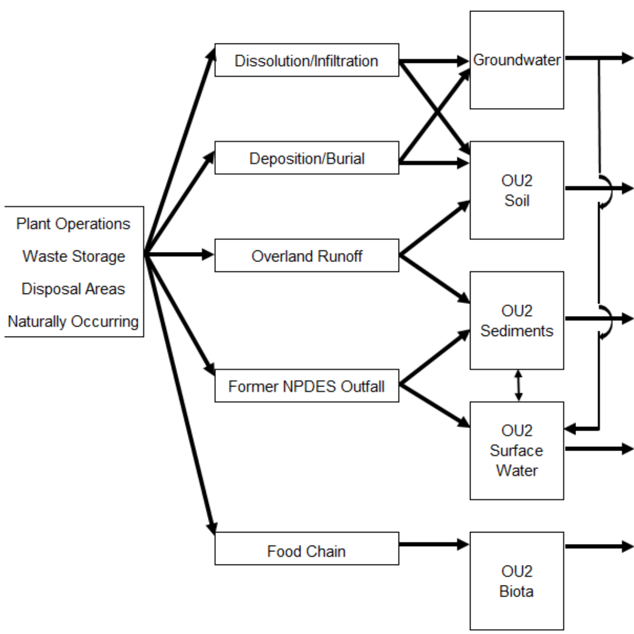
J:\Projects\USS Lead\ MXD\2021\RI 2021\Appendix K\Fig X.X-X Metals Dissolved TotalResults SW Sample.mxd REVISED: 09/30/2021, SCALE: 1:4,800 when printed at 8.5x11 DRAWN BY: S. Vickery

Source: Esri - World Topoogrpahic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet



Exposure Media	Exposure Route	Potential Human Receptors: OU1 Residents[1]	OU2 Adult O&M Workers	OU2 Trespassers[2]	OU2 Adult Utility Workers	Potential Ecological Receptors: Aquatic Plants	Benthic Organisms	Lower Trophic Level Fish	Birds	Mammals	Amphibians Reptiles[3]
Groundwater	Ingestion	●	○	○	○	-	-	-	-	-	-
	Inhalation	-	-	-	-	-	-	-	-	-	-
	Direct Contact	●	○	○	●	-	-	-	-	-	-
OU2 Soil	Ingestion	-	●	●	●	-	○	○	●	●	●
	Inhalation	-	●	●	●	-	-	-	-	-	-
	Direct Contact	-	●	●	●	●	●	●	○	○	●
OU2 Sediments	Ingestion	-	-	●	●	-	○	○	●	●	●
	Inhalation	-	-	-	-	-	-	-	-	-	-
	Direct Contact	-	-	●	●	●	●	●	○	○	●
OU2 Surface Water	Ingestion	-	-	●	○	-	●	●	●	●	●
	Inhalation	-	-	-	-	-	-	-	-	-	-
	Direct Contact	-	-	●	●	●	●	●	○	○	●
OU2 Biota	Ingestion	○	-	○	-	-	●	●	●	●	●

Legend

○ Pathway evaluated and found incomplete or insignificant
● Pathway complete
- Pathway not applicable

(1) OU1 Residents included children (0 to 6 years), adolescents (7 to 18 years), adults (>18 years), and lifeimte residents. Groundwater seeping into basements may result in the deposition of residuals onto basement floors after the groundwater seeps recede. This exposure medium is not quantifiable, nor distinguishable from other potential sources of residuals in residential basement settings, thus is discussed qualitatively only.
(2) Trespassers included both adolescents (7 to 18 years old) and adults engaging in recreational activities such as hiking in upland areas, or wading in open water or wetland areas of the Site. This population would include nearby residents or workers trespassing on the Site for recreational purposes. Otherwise, off-Site (nearby) populations are not expected to contact or be exposed to impacted media on-Site.
(3) Not all complete pathways for amphibians/reptiles are quantitatively evaluated due to a lack of appropriate toxicity benchmarks.

NPDES = National Pollutant Discharge Elimination System
O&M = Operation and Maintenance

Notes:

Figure 7.1-1
Conceptual Site Model
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

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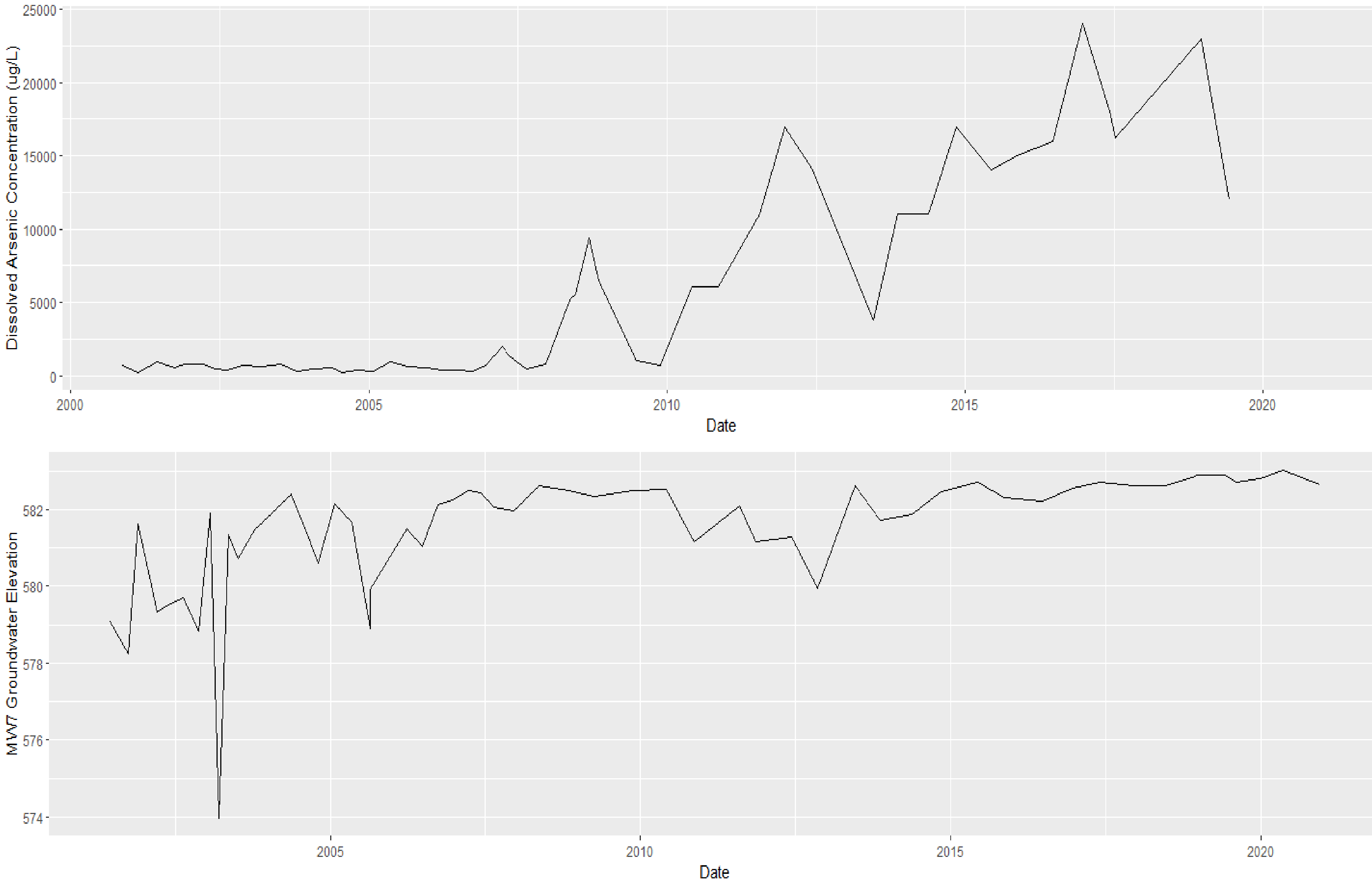

Figure 7.4-1
MW7 Time Concentration Curve and Hydrograph
Remedial Investigation Report-OU2
USS Lead Superfund Site
East Chicago, Indiana

ERM

REVISED: 09/13/2021 AED

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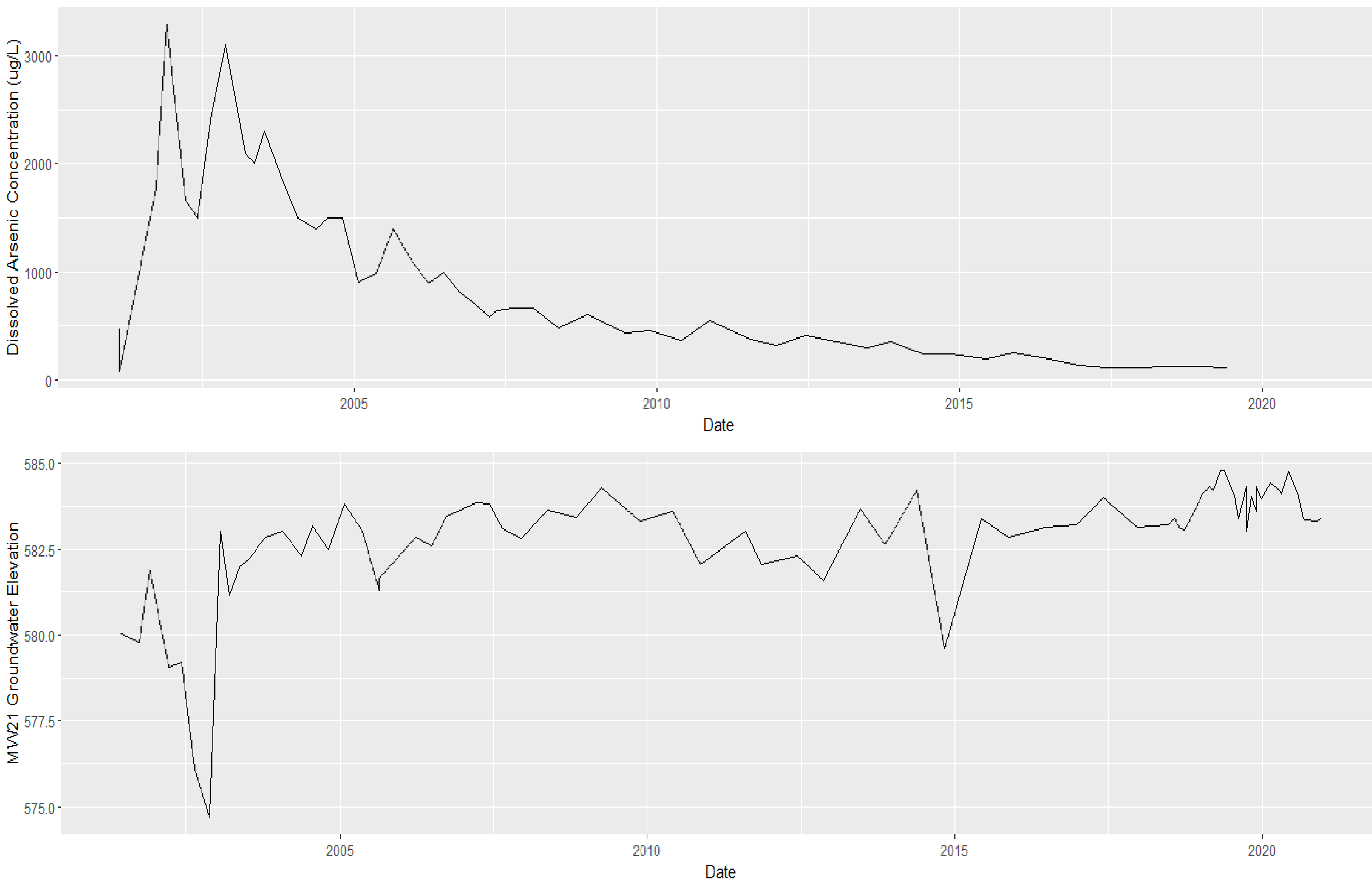

Figure 7.4.-2
MW21 Time Concentration Curve and Hydrograph
Remedial Investigation Report-OU2
USS Lead Superfund Site
East Chicago, Indiana

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TABLES

Table 2.3-1
OU1 and OU2 Well Construction Information
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Northing[1]	Easting[1]	Ground Elevation (feet AMSL)	TOC Elevation (feet AMSL)	Measured Total Depth[2] (feet BTOC)	Total Depth[3] (feet BGS)	Top of Screen[3] (feet BGS)	Bottom of Screen[3] (feet BGS)
OU1MW1	OU1, Zone 3	2323748.990	2849920.604	584.49	584.12	12.17	13.00	3.00	13.00
OU1MW2	OU1, Zone 3	2323646.631	2851487.801	587.40	587.12	12.65	13.00	3.00	13.00
OU1MW3	OU1, Zone 3	2322357.690	2850272.677	586.20	585.72	10.74	13.00	3.00	13.00
OU1MW3D	OU1, Zone 3	2322361.455	2850273.074	586.07	585.84	28.38	29.50	24.50	29.50
OU1MW4	OU1, Zone 3	2322126.058	2849377.876	587.22	587.00	12.47	13.00	3.00	13.00
OU1MW5	OU1, Zone 2	2321882.519	2848516.648	587.10	586.90	12.58	13.00	3.00	13.00
OU1MW5N	OU1, Zone 2	2321958.663	2848506.489	587.062	586.672	12.78	14.00	4.00	14.00
OU1MW5E	OU1, Zone 2	2321812.509	2848614.008	586.742	586.289	13.55	14.00	4.00	14.00
OU1MW5S	OU1, Zone 2	2321727.34	2848501.344	586.465	585.894	13.55	14.00	4.00	14.00
OU1MW5W	OU1, Zone 2	2321958.671	2848408.51	587.127	586.61	13.48	14.00	4.00	14.00
OU1MW5D	OU1, Zone 2	2321882.571	2848513.721	587.12	586.89	26.75	29.50	24.50	29.50
OU1MW6	OU1, Zone 1	2323698.686	2847960.586	586.04	585.56	12.78	13.00	3.00	13.00
OU1MW6D	OU1, Zone 1	2323698.306	2847939.088	586.15	585.91	28.03	30.00	25.00	30.00
OU1MW7	OU1, Zone 2	2324166.874	2848605.522	586.14	585.85	12.95	13.00	3.00	13.00
OU1MW8	OU1, Zone 2	2323162.474	2849391.308	586.82	586.50	12.84	13.00	3.00	13.00
OU1MW13	OU1, Zone 1	2323127.231	2847063.497	586.874	586.597	12.94	14.00	4.00	14.00
OU1MW14	OU1, Zone 1	2322517.928	2846904.338	586.591	586.241	13.35	14.00	4.00	14.00
OU1MW15	OU1, Zone 1	2321703.496	2847805.189	586.727	586.249	12.38	15.00	5.00	15.00
ECHA-MW-01[4]	OU1, Zone 1	2321637.384	2847025.336	587.31	586.83	NM	11.42	1.42	11.42
ECHA-MW-09[4]	OU1, Zone 1	2322071.491	2847292.951	585.79	585.54	NM	11.42	1.42	11.42
ECHA-MW-12[5]	OU1, Zone 1	NA	NA	NA	NA	NA	NA	NA	NA
ECHA-MW-35[4]	OU1, Zone 1	2322639.420	2847464.107	586.92	586.55	NM	11.42	1.42	11.42

Table 2.3-1
OU1 and OU2 Well Construction Information
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Northing[1]	Easting[1]	Ground Elevation (feet AMSL)	TOC Elevation (feet AMSL)	Measured Total Depth[2] (feet BTOC)	Total Depth[3] (feet BGS)	Top of Screen[3] (feet BGS)	Bottom of Screen[3] (feet BGS)
MW1	OU2	2320981.537	2848786.397	587.60	590.23	NM	17.95	7.95	17.95
MW3	OU2	2320790.842	2847963.074	587.00	590.01	NM	17.56	7.56	17.56
MW4	OU2	2320641.298	2849180.109	589.13	591.37	NM	17.52	7.52	17.52
MW5	OU2	2320083.430	2848019.867	584.24	586.94	NM	16.79	6.79	16.79
MW6	OU2	2319428.948	2847832.866	582.14	584.15	NM	15.52	5.52	15.52
MW7	OU2	2319711.948	2848307.129	583.12	585.30	NM	17.04	7.04	17.04
MW8	OU2	2319638.721	2847821.713	582.27	584.03	NM	14.76	4.76	14.76
MW9	OU2	2319727.343	2848968.191	588.29	592.09	NM	30.03	20.03	30.03
MW10	OU2	2319726.465	2848960.781	588.43	592.17	NM	23.59	13.59	23.59
MW11[6]	OU2	2318882.701	2848930.745	NM[7]	584.71	NM	15.83	5.83	15.83
MW12[6]	OU2	2318726.334	2848523.321	NM[7]	584.31	NM	16.92	6.92	16.92
MW13	OU2	2320279.524	2847409.187	587.14	590.83	NM	17.25	7.25	17.25
MW14	OU2	2320981.324	2848777.618	587.36	589.95	NM	28.44	18.44	28.44
MW15	OU2	2320161.021	2849157.908	589.14	592.74	NM	18.13	8.13	18.13
MW16[8]	OU2	2320162.388	2849129.410	591.74	593.51	NM	18.17	8.17	18.17
MW17[8]	OU2	2319748.829	2848969.085	590.16	592.26	NM	24.67	14.67	24.67
MW18	OU2	2319949.610	2848718.931	588.98	591.99	NM	20.91	10.91	20.91
MW19[8,9]	OU2	2319952.001	2848748.370	591.68	594.17	NM	24.28	14.28	24.28
MW20[8]	OU2	2320553.169	2848830.013	589.97	594.53	NM	19.15	9.15	19.15
MW21	OU2	2320584.488	2848829.842	587.64	591.67	NM	15.65	5.65	15.65
MW21R	OU2	2320586.444	2848815.951	585.30	587.98	16.44	16.00	6.00	16.00
MW22[8]	OU2	2320359.901	2848440.547	591.39	594.29	NM	19.61	9.61	19.61

Table 2.3-1
OU1 and OU2 Well Construction Information
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Northing[1]	Easting[1]	Ground Elevation (feet AMSL)	TOC Elevation (feet AMSL)	Measured Total Depth[2] (feet BTOC)	Total Depth[3] (feet BGS)	Top of Screen[3] (feet BGS)	Bottom of Screen[3] (feet BGS)
MW23	OU2	2320359.712	2848419.757	588.86	592.56	NM	16.98	6.98	16.98
MW24[8]	OU2	2320154.960	2848571.165	591.93	595.82	NM	19.72	9.72	19.72
MW25	OU2	2320134.036	2848569.605	589.84	592.87	NM	17.21	7.21	17.21
MW26	OU2	2320586.485	2848748.838	585.35	584.80	12.55	14.00	4.00	14.00

Notes:
TOC = top of casing
AMSL = above mean sea level (using NAVD 88 datum)
BTOC = below top of casing
BGS = below ground surface
NA = not applicable
NM = not measured

[1] *All coordinates are Indiana West Zone 1983 Datum US Survey Foot*
[2] *Total depth measurements only collected for the newly installed OU1 wells during the December 2018 event*
[3] *Total depth and screen interval as recorded on the boring logs*
[4] *Total depth and screen interval recorded on the boring logs in feet below top of casing*
[5] *Well not found (presumed destroyed)*
[6] *Well accessed with a boat or all-terrain vehicle*
[7] *Ground elevation not measured due to interference from surrounding vegetation*
[8] *Corrective Action Management Unit (CAMU) monitoring well*
[9] *Well contains free product*

Table 2.4-1
OU2 Surface Water Summary
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Location	Estimated Area (acres)[1]	Estimated Maximum Depth (feet)[2]
Area A	2.51	8 to 10
Area B	1.95	8 to 10
Area C	4.57	12 to 16
Former Canal	1.20	12 to 16

Notes:

[1]Area estimated from ArcGIS

[2]As cited in:
Geochemical Solutions, Inc. 2004. Draft Final USS Lead Modified RCRA Facility Investigation (MRFI) Report, March 1, 2004.

Table 2.5-1
OU1 and OU2 Groundwater Elevations, December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (feet BTOC)	Calculated Groundwater Elevation (feet AMSL)
OU1MW1	OU1, Zone 3	12-Dec-2018	3.29	580.83
		19-Mar-2019	3.20	580.92
		3-Jun-2019	1.83	582.29
		12-Aug-2019	3.79	580.33
		16-Mar-2021	3.75	580.74
OU1MW2	OU1, Zone 3	12-Dec-2018	5.05	582.07
		19-Mar-2019	5.09	582.03
		3-Jun-2019	4.42	582.70
		12-Aug-2019	5.47	581.65
		16-Mar-2021	5.29	582.11
OU1MW3	OU1, Zone 3	12-Dec-2018	3.02	582.70
		19-Mar-2019	2.68	583.04
		3-Jun-2019	1.66	584.06
		12-Aug-2019	3.33	582.39
		16-Mar-2021	3.08	583.12
OU1MW3D	OU1, Zone 3	12-Dec-2018	3.14	582.70
		19-Mar-2019	2.80	583.04
		3-Jun-2019	1.80	584.04
		12-Aug-2019	3.42	582.42
		16-Mar-2021	3.21	582.86
OU1MW4	OU1, Zone 3	12-Dec-2018	4.36	582.64
		19-Mar-2019	4.00	583.00
		3-Jun-2019	2.77	584.23
		12-Aug-2019	4.56	582.44
		16-Mar-2021	4.81	582.41
OU1MW5	OU1, Zone 2	12-Dec-2018	5.09	581.81
		19-Mar-2019	5.38	581.52
		3-Jun-2019	4.84	582.06
		12-Aug-2019	5.88	581.02
		16-Mar-2021	5.71	581.39

Table 2.5-1
OU1 and OU2 Groundwater Elevations, December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (feet BTOC)	Calculated Groundwater Elevation (feet AMSL)
OU1MW5N	OU1, Zone 2	16-Mar-2021	5.72	580.95
OU1MW5E	OU1, Zone 2	16-Mar-2021	5.02	581.27
OU1MW5S	OU1, Zone 2	16-Mar-2021	4.49	581.40
OU1MW5W	OU1, Zone 2	16-Mar-2021	5.16	581.45
OU1MW5D	OU1, Zone 2	12-Dec-2018	5.08	581.81
		19-Mar-2019	5.37	581.52
		3-Jun-2019	4.84	582.05
		12-Aug-2019	5.87	581.02
		16-Mar-2021	5.70	581.42
OU1MW6	OU1, Zone 1	12-Dec-2018	3.93	581.63
		19-Mar-2019	3.90	581.66
		3-Jun-2019	3.03	582.53
		12-Aug-2019	4.22	581.34
		16-Mar-2021	4.08	581.96
OU1MW6D	OU1, Zone 1	12-Dec-2018	4.19	581.72
		19-Mar-2019	4.19	581.72
		3-Jun-2019	3.30	582.61
		12-Aug-2019	4.50	581.41
		16-Mar-2021	4.35	581.80
OU1MW7	OU1, Zone 2	12-Dec-2018	5.28	580.57
		19-Mar-2019	5.23	580.62
		3-Jun-2019	4.84	581.01
		12-Aug-2019	5.55	580.30
		16-Mar-2021	5.59	580.55
OU1MW8	OU1, Zone 2	12-Dec-2018	5.33	581.17
		19-Mar-2019	5.20	581.30
		3-Jun-2019	4.07	582.43
		12-Aug-2019	5.55	580.95
		16-Mar-2021	5.64	581.18

Table 2.5-1
OU1 and OU2 Groundwater Elevations, December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (feet BTOC)	Calculated Groundwater Elevation (feet AMSL)
OU1MW13	OU1, Zone 1	16-Mar-2021	4.13	582.47
OU1MW14	OU1, Zone 1	16-Mar-2021	3.97	582.27
OU1MW15	OU1, Zone 1	16-Mar-2021	3.16	583.09
ECHA-MW-01	OU1, Zone 1	12-Dec-2018	3.90	582.93
ECHA-MW-01	OU1, Zone 1	20-Mar-2019	3.86	582.97
ECHA-MW-01	OU1, Zone 1	3-Jun-2019	1.94	584.89
ECHA-MW-01	OU1, Zone 1	12-Aug-2019	3.83	583.00
ECHA-MW-01	OU1, Zone 1	16-Mar-2021	4.01	583.30
ECHA-MW-09	OU1, Zone 1	12-Dec-2018	2.12	583.42
ECHA-MW-09	OU1, Zone 1	20-Mar-2019	1.44	584.10
ECHA-MW-09	OU1, Zone 1	3-Jun-2019	0.28	585.26
ECHA-MW-09	OU1, Zone 1	12-Aug-2019	2.95	582.59
ECHA-MW-09	OU1, Zone 1	16-Mar-2021	1.64	584.15
ECHA-MW-12[1]	OU1, Zone 1	12-Dec-2018	NM	NM
ECHA-MW-12[1]	OU1, Zone 1	20-Mar-2019	NM	NM
ECHA-MW-12[1]	OU1, Zone 1	3-Jun-2019	NM	NM
ECHA-MW-12[1]	OU1, Zone 1	12-Aug-2019	NM	NM
ECHA-MW-12[1]	OU1, Zone 1	16-Mar-2021	NM	NM
ECHA-MW-35	OU1, Zone 1	12-Dec-2018	3.27	583.28
ECHA-MW-35	OU1, Zone 1	20-Mar-2019	2.90	583.65
ECHA-MW-35	OU1, Zone 1	3-Jun-2019	1.23	585.32
ECHA-MW-35	OU1, Zone 1	12-Aug-2019	3.99	582.56
ECHA-MW-35	OU1, Zone 1	16-Mar-2021	2.57	584.35
MW1	OU2	12-Dec-2018	6.53	583.70
MW1	OU2	19-Mar-2019	6.13	584.10
MW1	OU2	3-Jun-2019	5.18	585.05
MW1	OU2	12-Aug-2019	6.86	583.37
MW1	OU2	16-Mar-2021	6.66	583.57

Table 2.5-1
OU1 and OU2 Groundwater Elevations, December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (feet BTOC)	Calculated Groundwater Elevation (feet AMSL)
MW3	OU2	12-Dec-2018	6.84	583.17
		19-Mar-2019	6.68	583.33
		3-Jun-2019	6.27	583.74
		12-Aug-2019	7.22	582.79
		16-Mar-2021	6.93	583.11
MW4	OU2	12-Dec-2018	6.87	584.50
		19-Mar-2019	6.54	584.83
		3-Jun-2019	6.00	585.37
		12-Aug-2019	7.35	584.02
		16-Mar-2021	6.88	584.49
MW5	OU2	12-Dec-2018	4.03	582.91
		19-Mar-2019	4.00	582.94
		4-Jun-2019	3.95	582.99
		12-Aug-2019	4.19	582.75
		16-Mar-2021	4.18	580.06
MW6	OU2	12-Dec-2018	2.34	581.81
		19-Mar-2019	2.38	581.77
		3-Jun-2019	1.62	582.53
		12-Aug-2019	1.35	582.80
		16-Mar-2021	2.10	580.04
MW7	OU2	12-Dec-2018	2.44	582.86
		19-Mar-2019	2.42	582.88
		3-Jun-2019	2.41	582.89
		12-Aug-2019	2.58	582.72
		16-Mar-2021	2.67	580.45
MW8	OU2	12-Dec-2018	1.90	582.13
		19-Mar-2019	1.92	582.11
		3-Jun-2019	1.49	582.54
		12-Aug-2019	1.30	582.73
		16-Mar-2021	1.73	580.54

Table 2.5-1
OU1 and OU2 Groundwater Elevations, December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (feet BTOC)	Calculated Groundwater Elevation (feet AMSL)
MW9	OU2	12-Dec-2018	9.75	582.34
		19-Mar-2019	9.64	582.45
		3-Jun-2019	9.26	582.83
		12-Aug-2019	9.08	583.01
		16-Mar-2021	NM	NM
MW10	OU2	12-Dec-2018	9.85	582.32
		19-Mar-2019	9.72	582.45
		3-Jun-2019	9.36	582.81
		12-Aug-2019	9.18	582.99
		16-Mar-2021	9.80	578.63
MW11[2]	OU2	12-Dec-2018	3.38	581.33
		19-Mar-2019	3.31	581.40
		5-Jun-2019	2.28	582.43
		12-Aug-2019	2.06	582.65
		16-Mar-2021	3.05	581.05
MW12[2]	OU2	12-Dec-2018	2.99	581.32
		19-Mar-2019	2.93	581.38
		5-Jun-2019	1.88	582.43
		12-Aug-2019	1.67	582.64
		16-Mar-2021	2.69	581.02
MW13	OU2	12-Dec-2018	8.82	582.01
		19-Mar-2019	8.67	582.16
		3-Jun-2019	7.70	583.13
		12-Aug-2019	8.61	582.22
		16-Mar-2021	8.52	578.62
MW14	OU2	12-Dec-2018	6.27	583.68
		19-Mar-2019	5.86	584.09
		3-Jun-2019	5.45	584.50
		12-Aug-2019	6.96	582.99
		16-Mar-2021	6.36	583.59

Table 2.5-1
OU1 and OU2 Groundwater Elevations, December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (feet BTOC)	Calculated Groundwater Elevation (feet AMSL)
MW15	OU2	13-Dec-2018	7.88	584.86
		19-Mar-2019	7.55	585.19
		3-Jun-2019	6.92	585.82
		12-Aug-2019	8.49	584.25
		16-Mar-2021	7.71	581.43
MW16[3]	OU2	12-Dec-2018	10.97	582.54
		19-Mar-2019	10.88	582.63
		3-Jun-2019	10.70	582.81
		12-Aug-2019	10.55	582.96
		16-Mar-2021	10.96	580.78
MW17[3]	OU2	12-Dec-2018	15.53	576.73
		19-Mar-2019	15.47	576.79
		3-Jun-2019	15.43	576.83
		12-Aug-2019	15.40	576.86
		16-Mar-2021	14.99	575.17
MW18	OU2	12-Dec-2018	9.11	582.88
		19-Mar-2019	9.02	582.97
		3-Jun-2019	9.03	582.96
		12-Aug-2019	9.21	582.78
		16-Mar-2021	9.26	579.72
MW19[3,4]	OU2	12-Dec-2018	NM	NM
		19-Mar-2019	NM	NM
		3-Jun-2019	NM	NM
		12-Aug-2019	NM	NM
		16-Mar-2021	11.99	580.38
MW20[3]	OU2	12-Dec-2018	12.16	582.37
		19-Mar-2019	12.22	582.31
		3-Jun-2019	11.95	582.58
		12-Aug-2019	11.82	582.71
		16-Mar-2021	12.20	577.77

Table 2.5-1
OU1 and OU2 Groundwater Elevations, December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (feet BTOC)	Calculated Groundwater Elevation (feet AMSL)
MW21	OU2	12-Dec-2018	7.89	583.78
		19-Mar-2019	7.45	584.22
		3-Jun-2019	6.86	584.81
		12-Aug-2019	8.29	583.38
MW21R	OU2	16-Mar-2021	4.28	583.70
MW22[3]	OU2	12-Dec-2018	14.76	579.53
		19-Mar-2019	14.68	579.61
		3-Jun-2019	14.49	579.80
		12-Aug-2019	14.05	580.24
		16-Mar-2021	14.45	576.94
MW23	OU2	12-Dec-2018	9.32	583.24
		19-Mar-2019	9.38	583.18
		3-Jun-2019	9.25	583.31
		12-Aug-2019	9.69	582.87
		16-Mar-2021	9.51	579.35
MW24[3]	OU2	12-Dec-2018	14.60	581.22
		19-Mar-2019	14.57	581.25
		3-Jun-2019	14.46	581.36
		12-Aug-2019	14.44	581.38
		16-Mar-2021	15.91	576.02
MW25	OU2	12-Dec-2018	9.87	583.00
		19-Mar-2019	9.79	583.08
		3-Jun-2019	9.71	583.16
		12-Aug-2019	10.05	582.82
		16-Mar-2021	10.00	579.84
MW26	OU2	16-Mar-2021	1.10	583.70

Notes:
AMSL = above mean sea level (using NAVD 88 datum)
BTOC = below top of casing
NM = not measured
CAMU = Corrective Action Management Unit

[1] *Well not found*
[2] *Well accessed with a boat or all-terrain vehicle*
[3] *Corrective Action Management Unit (CAMU) monitoring well*
[4] *Well contains free product*

Table 2.5-2
OU1 Groundwater Horizontal Gradient Calculations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Date	Flow Line Number[1]	Location	Start Elevation (feet)	End Elevation (feet)	Head Difference (feet)	Distance (feet)	Horizontal Gradient (feet/foot)
Dec-18	1	OU1, Zone 1	583.00	582.00	1.00	187	0.005
	2	OU1, Zone 2	583.00	581.00	2.00	2141	0.001
	3	OU1, Zone 3	583.00	581.00	2.00	1434	0.001
Mar-19	1	OU1, Zone 1	584.00	582.00	2.00	356	0.006
	2	OU1, Zone 2	583.00	581.00	2.00	2165	0.001
	3	OU1, Zone 3	583.00	581.00	2.00	1303	0.002
Jun-19	1	OU1, Zone 1	585.00	583.00	2.00	327	0.006
	2	OU1, Zone 2	583.00	581.01	1.99	2874	0.001
	3	OU1, Zone 3	584.00	582.00	2.00	1893	0.001
Aug-19	1	OU1, Zone 1	582.00	581.00	1.00	557	0.002
	2	OU1, Zone 2	582.00	580.30	1.70	2854	0.001
	3	OU1, Zone 3	582.00	581.00	1.00	633	0.002
Mar-21	1	OU1, Zone 1	583.00	582.00	1.00	176	0.006
	2	OU1, Zone 2	582.00	581.00	1.00	264	0.004
	3	OU1, Zone 3	582.00	581.00	1.00	352	0.003
						Highest	0.006
						Lowest	0.001
						Average	0.003

Notes:

[1] *Flow line numbers shown on Figure 2.5-2 for December 2018, Figure 2.5-3 for March 2019, Figure 2.5-4 for June 2019, and Figure 2.5-5 for August 2019.*

Table 2.5-3
OU1 Groundwater Vertical Gradient Calculations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Date	Monitoring Well Couplet	Location	Elevation of Shallow Well SWL (feet AMSL)	Elevation of Deeper Well SWL (feet AMSL)	Head Difference between Shallow and Deeper Wells (feet)	Elevation of Shallow Well Screen Bottom (feet AMSL)	Elevation of Saturated Shallow Screen Midpoint (feet AMSL)	Depth to Deeper Screen Midpoint (feet BTOC)	Vertical Distance between Shallow and Deeper Screen Midpoints (feet)	Vertical Gradient (feet/foot)
Dec-18	OU1MW3/3D	OU1 Zone 3	582.70	582.70	0.00	573.20	577.95	559.07	18.88	0.0000
	OU1MW5/5D	OU1 Zone 2	581.81	581.81	0.00	574.10	577.95	560.12	17.83	0.0000
	OU1MW6/6D	OU1 Zone 1	581.63	581.72	0.09	573.04	577.33	558.65	18.69	0.0048
Mar-19	OU1MW3/3D	OU1 Zone 3	583.04	583.04	0.00	573.20	578.12	559.07	19.05	0.0000
	OU1MW5/5D	OU1 Zone 2	581.52	581.52	0.00	574.10	577.81	560.12	17.69	0.0000
	OU1MW6/6D	OU1 Zone 1	581.66	581.72	0.06	573.04	577.35	558.65	18.70	0.0032
Jun-19	OU1MW3/3D	OU1 Zone 3	584.06	584.04	-0.02	573.20	578.63	559.07	19.56	-0.0010
	OU1MW5/5D	OU1 Zone 2	582.06	582.05	-0.01	574.10	578.08	560.12	17.96	-0.0006
	OU1MW6/6D	OU1 Zone 1	582.53	582.61	0.08	573.04	577.78	558.65	19.14	0.0042
Aug-19	OU1MW3/3D	OU1 Zone 3	582.39	582.42	0.03	573.20	577.80	559.07	18.72	0.0016
	OU1MW5/5D	OU1 Zone 2	581.02	581.02	0.00	574.10	577.56	560.12	17.44	0.0000
	OU1MW6/6D	OU1 Zone 1	581.34	581.41	0.07	573.04	577.19	558.65	18.54	0.0038
									OU1MW6/6D Average	0.0040

Notes:
SWL = Static water level
AMSL = above mean sea level
BTOC = below top of casing
OU1MW3/3D and OU1MW5/5D, no discernable vertical gradient was detected within the water level measurement margin of error.

Table 2.5-4
OU1 Groundwater Slug Test Results and Hydraulic Conductivity Calculations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well	Test Date	TD (feet)	H (feet)	L (feet)	Falling Head		Rising Head	
					ID (feet)	K (cm/sec)[1]	ID (feet)	K (cm/sec)[1]
OU1MW1	17-Dec-2018	13	9.70	10	0.15	9.72E-04	0.15	7.60E-04
					0.14	9.86E-04	0.10	1.07E-03
					0.12	1.34E-03	0.17	2.98E-03
OU1MW2	14-Dec-2018	13	7.93	10	0.16	1.89E-03	0.15	2.11E-03
					0.16	2.32E-03	0.14	2.87E-03
					0.16	3.37E-03	0.14	2.45E-03
OU1MW3	14-Dec-2018	13	10.28	10	0.18	2.87E-03	0.45	5.20E-03
					0.22	4.29E-03	0.66	5.80E-03
					0.82	7.46E-03	1.07	7.68E-03
OU1MW3D	14-Dec-2018	29.5	26.64	5	1.55	4.40E-03	1.47	4.15E-03
					1.51	4.35E-03	1.45	4.23E-03
					1.58	4.37E-03	1.58	4.37E-03
OU1MW4	14-Dec-2018	13	8.74	10	0.10	6.54E-04	0.13	1.03E-03
					0.18	1.15E-03	0.12	1.78E-03
					0.43	5.17E-03	0.11	1.71E-03
OU1MW5	17-Dec-2018	13	7.74	10	0.12	4.62E-04	0.17	8.77E-04
					0.18	1.19E-03	0.18	1.19E-03
					0.18	1.32E-03	0.17	9.31E-04
OU1MW5D	17-Dec-2018	29.5	24.25	5	1.49	3.47E-03	1.61	3.52E-03
					1.40	3.09E-03	1.58	3.26E-03
					1.63	3.52E-03	1.66	2.94E-03
OU1MW6	17-Dec-2018	13	9.01	10	0.16	1.34E-03	0.12	1.21E-03
					0.13	1.22E-03	0.10	1.69E-03
					0.09	1.37E-03	0.10	1.31E-03

Table 2.5-4
OU1 Groundwater Slug Test Results and Hydraulic Conductivity Calculations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well	Test Date	TD (feet)	H (feet)	L (feet)	Falling Head		Rising Head	
					ID (feet)	K (cm/sec)[1]	ID (feet)	K (cm/sec)[1]
OU1MW6D	17-Dec-2018	30	25.74	5	1.22	4.27E-03	1.42	4.11E-03
					1.36	4.26E-03	1.50	4.42E-03
					1.54	4.32E-03	1.56	3.91E-03
OU1MW7	17-Dec-2018	13	7.72	10	0.16	1.11E-03	0.16	1.40E-03
					0.13	1.09E-03	0.12	1.55E-03
					0.11	1.07E-03	0.10	1.16E-03
OU1MW8	14-Dec-2018	13	7.62	10	0.20	1.54E-03	0.15	1.31E-03
					0.15	1.31E-03	0.16	1.61E-03
					0.18	2.51E-03	0.12	1.22E-03
							Geomean, All Wells	**2.09E-03**
							Geomean, Shallow Wells	**1.72E-03**
							Geomean, Deep Wells	**3.91E-03**

Notes:

TD = Total Well Depth
H = Static Water Column Height
L = Total Screen Length
ID = Initial Displacement
K = Hydraulic Conductivity
FT = Feet

1.) All wells had a casing & well radius of 0.0833 ft (1 inch).
2.) Aquifer model used in AQTESOLV was "unconfined".
3.) Saturated thickness was assumed to be 50 feet thick based on information of the Calumet Aquifer as stated on page 21 of the USS Lead Remedial Investigation/Feasibility Study Work Plan for 2018.

Footnote:
[1] Analyzed using Bower-Rice (1976) Solution in AQTESOLV.

Table 2.8-1
OU2 Ecological Evaluation Results
Ecological Receptors Observed at the Site
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Common Name	Scientific Name	Nature of Observation (Sight, Sound, Other)	Observed Habitat (Emergent Wetland, Open Water Wetland, Offsite)	
			Emergent Wetland	Open Water Wetland
American beaver	*Castor canadensis*	Other (Paths/channels,Anecdotal)	X	X
American crow	*Corvus brachyrhynchos*	Sight (Fly-over)	NA	NA
American kestrel	*Falco sparverius*	Sight	X	
American robin	*Turdus migratorius*	Sight	X	
American toad	*Anaxyrus americanus*	Sight	X	
Bald eagle	*Haliaeetus leucocephalus*	Sight	X	
Canada Goose	*Branta canadensis*	Sight		X
Chironomid	*Chironomidae spp.*	Sight		X
Common grackle	*Quiscalus quiscula*	Sight	X	
Crayfish	*Orconectes spp.*	Other (Burrows)	X	
Cricket	*Acheta spp.*	Sound	X	
Double crested cormorant	*Phalacrocorax auritus*	Sight (Fly-over)	NA	NA
Downy woodpecker	*Picoides pubescens*	Sight	X	
Dragonfly (adults, larvae)	*Anisoptera spp.*	Sight	X	X
Eastern cottontail	*Sylvilagus floridanus*	Sight	X	
Eastern phoebe	*Sayornis phoebe*	Sound	X	

Table 2.8-1
OU2 Ecological Evaluation Results
Ecological Receptors Observed at the Site
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Common Name	Scientific Name	Nature of Observation (Sight, Sound, Other)	Observed Habitat (Emergent Wetland, Open Water Wetland, Offsite)	
			Emergent Wetland	Open Water Wetland
European starling	*Sturnus vulgaris*	Sight	X	
Fish (adult, minnows)	-	Sight		X
Fishfly larvae	*Chauliodes rastricornis*	Sight		X
Great blue heron	*Ardea herodias*	Sight		X
Great egret	*Ardea alba*	Sight		X
Green frog (adults, tadpoles)	*Lithobates clamitans*	Sight)		X
Killdeer	*Charadrius vociferus*	Sound	X	
Mallard	*Anas platyrhynchos*	Sight (Fly-over)	NA	NA
Monarch butterfly	*Danaus plexippus*	Sight	X	
Mosquito	*Culicidae spp.*	Sight	X	
Mourning dove	*Zenaida macroura*	Sight	X	
Muskrat	*Ondatra zibethicus*	Other (Paths/channels, scat)	X	
Northern flicker	*Colaptes auratus*	Sight	X	
Oligochete	*Oligochaeta spp.*	Sight		X
Orb spider	*Araneidae spp.*	Sight	X	
Painted turtle	*Chrysemys picta*	Sight		X

Table 2.8-1
OU2 Ecological Evaluation Results
Ecological Receptors Observed at the Site
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Common Name	Scientific Name	Nature of Observation (Sight, Sound, Other)	Observed Habitat (Emergent Wetland, Open Water Wetland, Offsite)	
			Emergent Wetland	Open Water Wetland
Peregrine falcon	*Falco peregrinus*	Sight	X	
Red-tailed hawk	*Buteo jamaicensis*	Sight	X	
Red winged blackbird	*Agelaius phoeniceus*	Sight	X	
Scud	*Gammarus spp.*	Sight		X
Snail	*Gastropoda spp.*	Sight	X	X
Sparrow	*Passer spp.*	Sight	X	
Swamp sparrow	*Melospiza georgiana*	Sight	X	
White tailed deer	*Odocoileus virginianus*	Sight, Other (Droppings, Tracks)	X	

Notes:
X = species observed
NA = not applicable

Table 2.8-2
OU2 Ecological Evaluation Results
Listed Species Desktop Review Summary
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Species (Common Name)	Species (Scientific Name)	Federal Status	State Status	General Habitat Description	Potential at Site
Mammals					
Indiana bat	*Myotis sodalis*	Endangered		Wooded areas with adjacent streams, open water, or wetlands. Summer roosting habitat includes trees with loose bark; often dead and/or dying trees. Winter hibernation typically occurs within caves.	Potential summer roost habitat located within dune/swale habitat.
Northern long-eared bat	*Myotis septentrionalis*	Threatened		Summer roosting Northern long-eared bats roost singly or in colonies underneath bark, in cavities or in crevices of both live trees and snags (dead trees). Males and non-reproductive females may also roost in cooler places, like caves and mines. Northern long-eared bats seem to be flexible in selecting roosts, choosing roost trees based on suitability to retain bark or provide cavities or crevices. This bat has also been found rarely roosting in structures, like barns and sheds. Winter hibernation typically occurs within caves.	Potential summer roost habitat located within dune/swale habitat.

Table 2.8-2
OU2 Ecological Evaluation Results
Listed Species Desktop Review Summary
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Species (Common Name)	Species (Scientific Name)	Federal Status	State Status	General Habitat Description	Potential at Site
Mammals (continued)					
Franklin's Ground Squirrel	*Spermophilus franklinii*		Endangered	Characteristic species of tallgrass and mid-grass prairie, but also found along woodland edges, forest openings, thickets and marsh or bog borders. Have been noted along abandoned railroads.	Likely insufficient habitat for this species at the Site; however, the last known occurrence of this species was noted east of the Site, across Kennedy Ave. in 2002 and they have been known to utilize railroad corridors (present within the Site). No observations of this species occurred during the Site habitat assessment, but they could be an occasional visitor if present in the area.
Birds					
Black tern	*Chlidonias niger*		Endangered	General habitat includes inland marshes, ponds, mouths of rivers, and shores of large Great Lakes. Black terns specifically nest on floating, matted and dead vegetation.	The last known occurrence of black tern was noted along the Grand Calumet River in 1991. Since no other known observations of this species has occurred recently, it is likely not present within the Site; however, the Site habitat would be conducive for black tern if present in the area.

Table 2.8-2
OU2 Ecological Evaluation Results
Listed Species Desktop Review Summary
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Species (Common Name)	Species (Scientific Name)	Federal Status	State Status	General Habitat Description	Potential at Site
Birds (continued)					
Marsh wren	*Cistothorus palustris*		Endangered	Marsh Wrens occupy wetlands filled with cattails, sedges, bulrushes, and *Phragmites* as well as cordgrass-filled saltmarshes year-round.	Habitat for species present at the Site; however, no occurrences were noted during the Site field assessment and the last known occurrence was noted in 1987. Since no other known observations of this species has occurred recently, it is likely not present within the Site.
Virginia rail	*Rallus limicola*		Endangered	Virginia Rails occupy shallow freshwater wetlands with tall stands of cattails and rushes. They need areas with standing water typically less than 6 inches deep with a muddy bottom. They are most common in wetlands with 40–70% coverage of tall emergent vegetation, mixed with open water, mudflats, and areas with matted vegetation.	Habitat is present at the Site and an occurrence of this species was noted east of the Site, across Kennedy Avenue, within the Seidner Dunes nature preserve in 2017. Although this species was not noted during the field habitat assessment, it is possible this species occurs at the Site due to the 2017 observation at Seidner Dunes nature preserve.

Table 2.8-2
OU2 Ecological Evaluation Results
Listed Species Desktop Review Summary
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Species (Common Name)	Species (Scientific Name)	Federal Status	State Status	General Habitat Description	Potential at Site
Birds (continued)					
Bald Eagle	*Haliaeetus leucocephalus*		Special Concern	Bald Eagles typically nest in forested areas adjacent to large bodies of water, staying away from heavily developed areas when possible. Bald Eagles are tolerant of human activity when feeding, and may congregate around fish processing plants, dumps, and below dams where fish concentrate. For perching, Bald Eagles prefer tall, mature coniferous or deciduous trees that afford a wide view of the surroundings.	Known to be present at the Site. An active nest has been confirmed as indicated in **Figure 2**.
Insects					
Two-lined Cosmotettix (*Cosmotettix bilineatus*)	*Cosmotettix bilineatus*			The two-lined cosmotettix is a state threatened moth species that has a preferred habitat of prairie fens and wet meadows.	Most recently noted within the Seidner Dunes nature preserve east of the Site, across Kennedy Avenue to the east, in 2003. Habitat is present at the Site within the dune and swale complex. Although this species was not noted during the field habitat assessment, it is possible this species occurs at the Site due to the 2003 observation at Seidner Dunes nature preserve.

Table 3.2-1
OU2 Discrete Soil Sample Results
Total and SPLP Metals - December 2018 through June 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

							Antimony		Arsenic		Cadmium		Iron		Lead		Selenium	
Sample Location	Sample Name	Sample Type	Sample Date	Sample Depth (Feet)	Analysis Type	Units	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
RI1	RI1-SO1-0-24-112718	N	27 Nov 2018	0 to 2	Total	mg/kg	13		**49**		1		3800		100	J	0.35	J
					SPLP	µg/L	87		61		0.42	J	740		34		0.81	U
RI2	RI2-SO1-0-24-112718	N	27 Nov 2018	0 to 2	Total	mg/kg	210		**410**		6.5		19000		**1000**	J	1.2	
					SPLP	µg/L	310		110		0.76	J	3800		190		0.94	J
RI3	RI3-SO1-0-24-112718	N	27 Nov 2018	0 to 2	Total	mg/kg	8.3		**9.5**		0.18		2600		23	J	0.67	
					SPLP	µg/L	82		30		0.33	J	1500		40		0.81	U
RI4	RI4-SO1-0-24-112718	N	27 Nov 2018	0 to 2	Total	mg/kg	12		**8.4**		3.8		2400		100	J	0.62	J
					SPLP	µg/L	95		17		2.2		870		47		1.1	J
RI4	QC-SO-FD-1-112718	FD	27 Nov 2018	0 to 2	Total	mg/kg	14		**12**		5.1		2400		110	J	0.64	J
					SPLP	µg/L	97		16		2.5		840		54		1.3	J
RI5	RI5-SO1-0-24-112718	N	27 Nov 2018	0 to 2	Total	mg/kg	3.5		**3.3**		0.27		3100		23	J	0.077	U
					SPLP	µg/L	22		5.9		0.72	J	3700		63		0.81	U
RI6	RI6-SO1-0-24-112718	N	27 Nov 2018	0 to 2	Total	mg/kg	11		**40**		12		3100		39	J	0.35	J
					SPLP	µg/L	92		170		27		3700		88		1.7	J
RI7	RI7-SO1-0-24-112718	N	27 Nov 2018	0 to 2	Total	mg/kg	17		**3.1**		1.7		3500		60	J	0.14	J
					SPLP	µg/L	190		7.2		4.1		2900		130		0.81	U
RI8	RI8-S01-0-24-091919	N	19 Sep 2019	0 to 2	Total	mg/kg	33		**36**		0.73		5000	J+	270	J	0.38	J
					SPLP	µg/L	160		28		0.27	J	2100		140		1.7	J
RI9	RI9-S01-0-24-091919	N	19 Sep 2019	0 to 2	Total	mg/kg	210		**150**		1.9		9400	J+	**1000**	J	0.93	
					SPLP	µg/L	510		130		0.32	J	2000		160	J	2.1	J
RI9	QC-SO-FD-1-091919	FD	19 Sep 2019	0 to 2	Total	mg/kg	220		**140**		1.9		10000	J+	**820**	J	0.97	
					SPLP	µg/L	540		130		0.26	J	1600		94	J	1.5	U
RI10	RI10-S01-0-24-091919	N	19 Sep 2019	0 to 2	Total	mg/kg	65		**630**		2.9		13000	J+	580	J	1.3	
					SPLP	µg/L	180		850		0.5	J	2200		70		1.5	J
RI11	RI11-S01-0-24-091919	N	19 Sep 2019	0 to 2	Total	mg/kg	77		**340**		2.2		6700	J+	710	J	0.76	
					SPLP	µg/L	420		320		0.46	J	770		130		1.5	U

Table 3.2-1
OU2 Discrete Soil Sample Results
Total and SPLP Metals - December 2018 through June 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

							Antimony		Arsenic		Cadmium		Iron		Lead		Selenium	
Sample Location	Sample Name	Sample Type	Sample Date	Sample Depth (Feet)	Analysis Type	Units	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
RI12	RI12-S01-0-24-091919	N	19 Sep 2019	0 to 2	Total	mg/kg	9.3		**82**		12		2700	J+	35	J	0.15	U
					SPLP	µg/L	55		350		13		2500		100		1.5	U
RI13	RI13-S01-0-24-091919	N	19 Sep 2019	0 to 2	Total	mg/kg	18		3		14		2400	J+	64	J	0.15	U
					SPLP	µg/L	230		6.2		31		1700		100		1.5	U
MW7(SW)	MW7(SW)-S01-(0-2')-031121	N	11 Mar 2021	0-2	Total	mg/kg	190		**35**		3.6		13000		800	J-	1.9	
					SPLP	µg/L	490		30		0.57	J	3400		150		1.5	J
	MW7 SW-S02-(2-4')-031121	N	11 Mar 2021	2-4	Total	mg/kg	10		**16**		0.16		2800		22		0.22	
					SPLP	µg/L	120		20		0.22	U	700		8.4		1.5	U
	MW7 SW-S03-(4-6')-031121	N	11 Mar 2021	4-6	Total	mg/kg	9.2		**12**		0.091		4800		9.2		0.16	U
					SPLP	µg/L	45		12		0.22	U	830		2.6		1.5	U
MW7(N)	MW7(N)-S01-(0-2')-031121	N	11 Mar 2021	0-2	Total	mg/kg	34		**13**		0.23		3600		57	J-	0.28	J
					SPLP	µg/L	390		33		0.22		1100		20		1.5	U
	MW7N -S02-(2-4')-031121	N	11 Mar 2021	2-4	Total	mg/kg	11		**10**		0.076		2700		17		0.16	U
					SPLP	µg/L	110		31		0.22	U	650		6.9		1.5	U
	MW7N -S03-(4-6')-031121	N	11 Mar 2021	4-6	Total	mg/kg	9.6		**11**		0.032		3000		7.9		0.16	U
					SPLP	µg/L	120		34		0.22	U	710		4.1		1.5	U
MW7(NE)	MW7(NE)-S01-(0-2')-031121	N	11 Mar 2021	0-2	Total	mg/kg	23		**24**		0.46		2600		41	J-	0.11	U
					SPLP	µg/L	100		88		0.47		660		31		1.5	U
	MW7 NE-S02-(2-4')-031121	N	11 Mar 2021	2-4	Total	mg/kg	12		**13**		0.032		2100		2.8		0.2	
					SPLP	µg/L	120		11		0.22	U	490		2.4		1.5	U
	MW7 NE-S03-(4-6')-031121	N	11 Mar 2021	4-6	Total	mg/kg	19		**12**		0.047		2500		4.4		0.22	
					SPLP	µg/L	220		23		0.22	U	2400		4.2		1.5	U
MW7NW	MW7NW-SO1-(0-2')-06032021	N	6 Jun 2021	0-2	Total	mg/kg	54		**31**		0.83		4300		160		0.51	
					SPLP	µg/L	1200		23		0.31		2400		89		1.6	
MW7SSW	MW7SSW-SO1-(0-2')-06032021	N	6 Jun 2021	0-2	Total	mg/kg	1.9		**67**		0.16		14000		31		0.11	
					SPLP	µg/L	94		29		0.22	U	410		1.6		1.5	U

Table 3.2-1
OU2 Discrete Soil Sample Results
Total and SPLP Metals - December 2018 through June 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

							Antimony		Arsenic		Cadmium		Iron		Lead		Selenium	
Sample Location	Sample Name	Sample Type	Sample Date	Sample Depth (Feet)	Analysis Type	Units	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
MW21R(E)	MW21R(E)-S01-(0-2')-031121	N	11 Mar 2021	0-2	Total	mg/kg	1.9		1.9		2.2		2200		34		0.095	U
					SPLP	µg/L	11		5.6		4		1800		72		1.5	U
	QC-SO-FD-1-031121	FD	11 Mar 2021	0-2	Total	mg/kg	2.7		1.9		2.5		2600		35		0.11	U
					SPLP	µg/L	11		4.9		3.8		1800		75		1.5	U
	MW21R(E)-S02-(2-4')-031121	N	11 Mar 2021	2-4	Total	mg/kg	2.6	J-	1.8	J-	0.26	J-	2600	J-	4.7		0.15	U
					SPLP	µg/L	13		2.5		0.49		1500		11		1.5	U
	MW21R(E)-S03-(4-6')-031121	N	11 Mar 2021	4-6	Total	mg/kg	0.97	J-	1.3	J-	0.21	J-	2200	J-	1.4		0.15	U
					SPLP	µg/L	6.5		1.1		0.28		710		1.4		1.5	U
MW21R(W)	MW21R(W)-S01-(0-2')-031121	N	11 Mar 2021	0-2	Total	mg/kg	7.3		**4.2**		2.6		3000		**1800**	J-	0.16 J	
					SPLP	µg/L	9.3		2.2		0.62		510		210		1.5	U
	MW21R(W)-S01-(0-2')-031121	RE/RA	11 Mar 2021	0-2	Total	mg/kg	6.9		2.6		2.8		2900		**2000**		0.18	
	MW21R(W)-S02-(2-4')-031121	N	11 Mar 2021	2-4	Total	mg/kg	3.4	J-	1.1	J-	6.6	J-	1200	J-	**1500**		0.15	U
					SPLP	µg/L	13		3.9		20		920		2400		1.5	U
	MW21R(W)-S03-(4-6')-031121	N	11 Mar 2021	4-6	Total	mg/kg	3.7	J-	0.87	J-	33	J-	1200	J-	**1700**		0.15	U
					SPLP	µg/L	9.9		0.47		38		180		770		1.5	U
MW26B	MW26B-SO1-(0-2')-060321	N	6 Jun 2021	0-2	Total	mg/kg	17		**24**		3.8		5500		520		0.35	
					SPLP	µg/L	120		33		0.67		750		84		2.2	
	MW26B-SO2-(2-4')-060321	N	6 Jun 2021	2-4	Total	mg/kg	10		**4.5**		73		3400		310		0.14	U
					SPLP	µg/L	40		9.1		31		1700		350		1.5	U
	MW26B-SO3-(4-6')-060321	N	6 Jun 2021	4-6	Total	mg/kg	9.7		2		80		2600		290		0.11	U
					SPLP	µg/L	51		8.2		110		2800		710		1.5	U
	QC-SO-FD-1-060321	FD	6 Jun 2021	0-2	Total	mg/kg	12		**29**		1.9		4900		460		0.34	
					SPLP	µg/L	100		29		0.96		970		120		2.4	
MW26N	MW26N-SO1-(0-2')-060321	N	6 Jun 2021	0-2	Total	mg/kg	11		**5.5**		9.9		2900		88		0.3	
					SPLP	µg/L	310		20		45		4000		230		3.6	
	MW26N-SO2-(2-4')-060321	N	6 Jun 2021	2-4	Total	mg/kg	110		**130**		530		66000		250		3.8	U
					SPLP	µg/L	57		24		300		2400		61		1.5	U
	MW26N-SO3-(4-6')-060321	N	6 Jun 2021	4-6	Total	mg/kg	3.6		**4.4**		16		2500		11		0.13	U
					SPLP	µg/L	61		22		200		2500		66		1.5	U

Table 3.2-1
OU2 Discrete Soil Sample Results
Total and SPLP Metals - December 2018 through June 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

							Antimony		Arsenic		Cadmium		Iron		Lead		Selenium	
Sample Location	Sample Name	Sample Type	Sample Date	Sample Depth (Feet)	Analysis Type	Units	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
MW26W	MW26W-SO1-(0-2')-060321	N	6 Jun 2021	0-2	Total	mg/kg	5.8		**4.1**		3.1		2600		320		0.12	U
					SPLP	µg/L	100		53		16		7500		1600		1.5	U
	MW26W-SO2-(2-4')-060321	N	6 Jun 2021	2-4	Total	mg/kg	3.8		2.3		3.3		3600		21		0.15	U
					SPLP	µg/L	23		5		3.6		4200		81		1.5	U
	MW26W-SO3-(4-6')-060321	N	6 Jun 2021	4-6	Total	mg/kg	2.8		1.5		6.8		2400		9.3		0.14	U
					SPLP	µg/L	22		3.9				3500		57		1.5	U
MW26S	MW26S-SO1-(0-2')-060321	N	6 Jun 2021	0-2	Total	mg/kg	6.1		**5.2**		2.4		2400		600		0.11	U
					SPLP	µg/L	20		6.4		1.3		440		270		1.5	U
	MW26S-SO2-(2-4')-060321	N	6 Jun 2021	2-4	Total	mg/kg	5.2		2.4		4		2200		130		0.11	U
					SPLP	µg/L	17		5.6		1		920		180		1.5	U
	MW26S-SO3-(4-6')-060321	N	6 Jun 2021	4-6	Total	mg/kg	5		1.4		13		2600		49		0.13	U
					SPLP	µg/L	37		3.2		11		1700		190		1.5	U
					USEPA RSLs (Industrial Direct Contact)		470		3		980		820,000		800		5,800	
					2021 IDEM SL (C/I)		470		30		980		77,000		800		5,800	
					2021 IDEM SL (C/E)		790		920		1900		100000		1000		9800	

Notes:
[grey shading] *Concentration is greater than the IDEM Screening Level for Commercial/Industrial Direct Contact*
BOLD *= Concentration is greater than the USEPA Regional Screening Level for Industrial Direct Contact*
N = Normal (or investigative) sample
FD = Field duplicate
DV Quals = Final data qualifier after data validation
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the reported detection limit.
J+ = The result is an estimated quantity, but the result may be biased high.

Table 3.2-2
OU2 ISM Sediment Sample Results
Metals - December 2018
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Units	Antimony mg/kg		Arsenic mg/kg		Cadmium mg/kg		Iron mg/kg		Lead mg/kg		Selenium mg/kg	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
DU1-SE1	DU1-SE1-0-6-112818	N	28 Nov 2018	**47**		**320**		**12**		**53000**		**980**		**2.8**	
DU1-SE2	DU1-SE2-0-6-112818	N	28 Nov 2018	**49**		**390**		**14**		**53000**		**1100**		**3.3**	
DU1-SE3	DU1-SE3-0-6-112818	N	28 Nov 2018	**51**		**390**		**13**		**54000**		**1100**		**3.2**	
DU2-SE1	DU2-SE1-0-6-112918	N	29 Nov 2018	**39**		**410**		**6.0**		**23000**		**710**		**7.4**	
DU2-SE2	DU2-SE2-0-6-112918	N	29 Nov 2018	**20**		**270**		**4.0**		**22000**		**390**		**4.3**	
DU2-SE3	DU2-SE3-0-6-112918	N	29 Nov 2018	**27**		**290**		**4.6**		**22000**		**450**		**5.0**	
DU3-SE1	DU3-SE1-0-6-120518	N	05 Dec 2018	**11**	J-	**240**		**5.4**		**27000**		**260**		**5.3**	
DU3-SE2	DU3-SE2-0-6-120518	N	05 Dec 2018	**15**	J-	**290**		**7.4**		**27000**		**340**		**7.4**	
DU3-SE3	DU3-SE3-0-6-120518	N	05 Dec 2018	**12**	J-	**260**		**7.0**		**28000**		**400**		**6.2**	
DU4-SE1	DU4-SE1-0-6-120618	N	06 Dec 2018	**15**		**230**		**7.3**		**25000**		**350**		**5.3**	
DU4-SE2	DU4-SE2-0-6-120618	N	06 Dec 2018	**11**		**200**		**7.3**		**24000**		**290**		**4.1**	
DU4-SE3	DU4-SE3-0-6-120618	N	06 Dec 2018	**16**		**270**		**7.9**		**23000**		**420**		**5.6**	
DU5-SE1	DU5-SE1-0-6-120718	N	07 Dec 2018	**34**		**550**		**21**		**21000**		**660**		**10**	
DU5-SE2	DU5-SE2-0-6-120718	N	07 Dec 2018	**36**		**590**		**19**		**22000**		**800**		**11**	
DU5-SE3	DU5-SE3-0-6-120718	N	07 Dec 2018	**33**		**570**		**15**		**21000**		**640**		**10**	
DU6-SE1	DU6-SE1-0-6-120418	N	04 Dec 2018	**26**		**320**		**56**		**36000**		**680**		**6.1**	
DU6-SE2	DU6-SE2-0-6-120418	N	04 Dec 2018	**28**		**320**		**57**		**43000**		**890**		**5.8**	
DU6-SE3	DU6-SE3-0-6-120418	N	04 Dec 2018	**30**		**380**		**65**		**44000**		**950**		**6.6**	
DU7-SE1	DU7-SE1-0-6-120318	N	03 Dec 2018	**16**		**200**		**33**		**36000**		**640**		**3.7**	
DU7-SE2	DU7-SE2-0-6-120318	N	03 Dec 2018	**12**		**180**		**29**		**34000**		**590**		**3.1**	
DU7-SE3	DU7-SE3-0-6-120318	N	03 Dec 2018	**15**		**180**		**33**		**37000**		**690**		**3.4**	

Table 3.2-2
OU2 ISM Sediment Sample Results
Metals - December 2018
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Units	Antimony mg/kg		Arsenic mg/kg		Cadmium mg/kg		Iron mg/kg		Lead mg/kg		Selenium mg/kg	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
DU8-SE1	DU8-SE1-0-6-113018	N	30 Nov 2018	**46**		**310**		**64**		**76000**		**1800**		**6.0**	
DU8-SE2	DU8-SE2-0-6-113018	N	30 Nov 2018	**44**		**300**		**56**		**64000**		**1500**		**6.1**	
DU8-SE3	DU8-SE3-0-6-113018	N	30 Nov 2018	**48**		**280**		**58**		**52000**		**1500**		**5.4**	
			Region IV ESVs	2		9.8		1.0		20,000		35.8		0.72	

Notes:

BOLD = *Concentration is greater than the U.S. EPA Region IV Ecological Screening Value (ESV) for sediment*
N = *Normal (or investigative) sample*
DV Qual = *Final data qualifier after data validation*
mg/kg = *milligrams per kilogram*
J- = *The result is an estimated quantity, but the result may be biased low.*

Table 3.2-3
OU2 Discrete Sediment Sample Results
AVS, SEM, and TOC - December 2018
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Units	Antimony-SEM µmol/g		Arsenic-SEM µmol/g		Cadmium-SEM µmol/g		Copper-SEM µmol/g		Lead-SEM µmol/g		Nickel-SEM µmol/g		Silver-SEM µmol/g		Zinc-SEM µmol/g		Acid Volatile Sulfide µmol/g		Fraction Organic Carbon gC/g	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
DU1A	DU1-A-SE1-0-6-112718	N	27 Nov 2018	0.22	J	3.2	J	0.14	J	1.3	J	8.1	J	0.67		0.00060	UJ	15	J	0.48	UJ	0.085	J-
DU1B	DU1-B-SE1-0-6-112718	N	27 Nov 2018	0.019	J	0.24	J	0.0071	J	0.31	J	0.56	J	0.34		0.0012	J	1.1	J	0.25	UJ	0.036	J-
DU1C	DU1-C-SE1-0-6-112818	N	28 Nov 2018	0.15	J	2.1	J	0.16	J	2.4	J	6.3	J	0.32		0.013	J	41	J	0.36	UJ	0.089	J-
DU2A	DU2-A-SE1-0-6-112918	N	29 Nov 2018	0.0095		0.60		0.018		0.32		0.58		0.48		0.00039	U	6.9		0.31	U	0.050	J-
DU2B	DU2-B-SE1-0-6-112918	N	29 Nov 2018	0.013		0.91		0.028		0.17		0.26		0.29		0.00033	U	4.6		0.32	J	0.031	J-
DU2C	DU2-C-SE1-0-6-112918	N	29 Nov 2018	0.047		1.1		0.023		0.32		0.76		0.51		0.00038	U	7.4		0.30	U	0.072	J-
DU3A	DU3A-SE1-0-6-120518	N	05 Dec 2018	0.0044	J-	1.7		0.010		0.23	J	0.20	J+	0.39		0.00038	UJ	3.7	J	0.30	U	0.025	J
DU3B	DU3B-SE1-0-6-120518	N	05 Dec 2018	0.0014	UJ	0.46		0.033	J	0.16	J	0.14	J	0.38		0.00038	UJ	7.4	J	0.42	J	0.039	J
DU3B	QC-SE-FD-2-120518	FD	05 Dec 2018	0.016	J	0.39		0.070	J	0.26	J	1.1	J	0.52		0.00041	UJ	8.8	J	0.94	J	0.061	J
DU3C	DU3C-SE1-0-6-120518	N	05 Dec 2018	0.0049	J-	0.18		0.0046		0.15	J	0.16	J+	0.20		0.00037	UJ	1.8	J	0.29	U	0.028	J
DU4A	DU4A-SE1-0-6-120618	N	06 Dec 2018	0.0053		0.24		0.013		0.21		0.59		0.27		0.00037	U	3.5		0.30	U	0.044	J-
DU4B	DU4B-SE1-0-6-120618	N	06 Dec 2018	0.0014	U	0.28		0.052		0.092		0.53		0.28		0.00038	U	7.2		2.3		0.071	J-
DU4C	DU4C-SE1-0-6-120618	N	06 Dec 2018	0.070	J	1.5	J	0.079		0.39		1.7		0.58		0.00042	U	9.8		1.4		0.079	J-
DU4C	QC-SE-FD-3-120618	FD	06 Dec 2018	0.020	J	0.70	J	0.084		0.25		1.1		0.55		0.00042	U	10		1.8		0.096	J-
DU5A	DU5A-SE1-0-6-120718	N	07 Dec 2018	0.022		1.0		0.090		0.41		1.5		0.41		0.00053	U	9.5		1.8		0.081	J-
DU5B	DU5B-SE1-0-6-120718	N	07 Dec 2018	0.016		0.50		0.046		0.18		1.6		0.28		0.00055	U	6.8		7.3		0.100	J-
DU5C	DU5C-SE1-0-6-120718	N	07 Dec 2018	0.0032	UJ	0.75	J	0.46	J	0.11	J	1.8	J	0.62		0.00090	UJ	25	J	20		0.230	J-
DU6A	DU6A-SE1-0-6-120418	N	04 Dec 2018	0.0019	UJ	0.37	J-	0.25		0.22	J-	0.34	J-	0.90		0.00052	UJ	82		20		0.068	J
DU6B	DU6B-SE1-0-6-120418	N	04 Dec 2018	0.0090	J-	0.89	J-	0.15		0.21	J-	0.43	J-	0.47		0.00035	UJ	11		0.69	J	0.035	J
DU6C	DU6C-SE1-0-6-120418	N	04 Dec 2018	0.034	J-	1.6	J-	0.37		0.51	J-	1.2	J-	0.63		0.00045	UJ	26		2.9		0.043	J
DU7A	DU7A-SE1-0-6-120318	N	03 Dec 2018	0.0012	U	0.071		0.027		0.20		0.13		0.35		0.00033	U	8.2		0.91		0.046	J-
DU7B	DU7B-SE1-0-6-120318	N	03 Dec 2018	0.0042	J	0.18	J	0.79	J	0.12	J	1.8	J	0.86		0.00048	U	78		14	J	0.087	J-
DU7B	QC-SE-FD-1-120318	FD	03 Dec 2018	0.0017	J	0.87	J	0.38	J	0.22	J	0.55	J	0.99		0.00042	U	59		2.6	J	0.067	J-
DU7C	DU7C-SE1-0-6-120318	N	03 Dec 2018	0.011		0.47		0.12		0.34		0.87		0.31		0.00041	U	6.7		0.35	J	0.049	J-
DU8A	DU8-A-SE1-0-6-113018	N	30 Nov 2018	0.0027	U	0.093		0.34		0.065		0.92		0.60		0.00075	U	76		40		0.250	J-
DU8B	DU8-B-SE1-0-6-113018	N	30 Nov 2018	0.25		1.5		0.45		1.1		10		0.39		0.00073	U	27		9.5		0.210	J-
DU8C	DU8-C-SE1-0-6-113018	N	30 Nov 2018	0.0098	U	0.57		0.32		0.46		4.0		0.52		0.00055	U	82		32		0.190	J-

Notes:
AVS = acid volatile sulfide
SEM = simultaneously extracted metals
TOC = total organic carbon
N = Normal (or investigative) sample
FD = Field duplicate
DV Qual = final data qualifier after data validation
µmol/g = micromoles per gram
µg/kg = micrograms per kilogram
gC/g = grams carbon per gram
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the level of the reported detection limit.
UJ = The analyte was analyzed for, but was not detected. The reported detection limit is approximate and may be inaccurate or imprecise.
J- = The result is an estimated quantity, but the result may be biased low.
J+ = The result is an estimated quantity, but the result may be biased high.

Table 3.2-4
OU2 Plant and Invertebrate Tissue Results
Metals, Lipids, and Percent Moisture - May and June 2019
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Units	Antimony mg/kg		Arsenic mg/kg		Cadmium mg/kg		Iron mg/kg		Lead mg/kg		Selenium mg/kg		% Lipds		% Moisture	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
Invertebrate Tissue																			
DU1-TI	DU1-TI-060319	N	03 Jun 2019	0.76		8.8	J+	0.46		500	J+	8.2		0.56		0.97		75.5	
DU2-TI	DU2-TI-060419	N	04 Jun 2019	0.33		27	J	0.094	J	770	J	3.8		0.57		0.53	U	66.8	
DU2-TI	QC-TI-FD-1-060519	FD	05 Jun 2019	0.50		59	J	0.11		1400	J	3.7		0.59		0.45	U	67.4	
DU3-TI	DU3-TI-060419	N	04 Jun 2019	0.95		40	J+	0.11		1100	J+	9.6		0.72		0.53	U	73.2	
DU4-TI	DU4-TI-060319	N	03 Jun 2019	0.69		9.8	J+	0.044	J	510	J+	7.3		0.65		0.56	U	79.5	
DU5-TI	DU5-TI-052319	N	23 May 2019	1.0		12		0.039	J	550		8.6		0.79		0.78		80.1	
DU6-TI	DU6-TI-052319	N	23 May 2019	0.59		11		0.021	J	630		12		0.47	J	0.68		84.0	
DU7-TI	DU7-TI-052219	N	22 May 2019	0.18	J	4.1		0.062	J	490		2.7		0.46	J	1.2		77.1	
DU8-TI	DU8-TI-052219	N	22 May 2019	1.6		170		0.087	J	3500		17		0.58		0.63		75.7	
Plant Tissue																			
DU1-PL	DU1-PL-052419	N	24 May 2019	0.063	U	0.11		0.033	J	22		0.068	J	0.12	U	0.23		86.1	
DU2-PL	DU2-PL-052419	N	24 May 2019	0.062	U	0.22		0.017	U	14		0.063	J	0.12	U	0.20		86.3	
DU3-PL	DU3-PL-052419	N	24 May 2019	0.064	U	0.56		0.018	U	25		0.26		0.13	U	0.24		87.2	
DU4-PL	DU4-PL-052419	N	24 May 2019	0.062	U	0.11		0.017	U	9.5		0.15		0.12	U	0.19		88.2	
DU5-PL	DU5-PL-052319	N	23 May 2019	0.065	U	0.091	J	0.018	U	6.5		0.51		0.13	U	0.23		86.9	
DU6-PL	DU6-PL-052119	N	21 May 2019	0.061	U	0.051	J	0.017	U	5.1		0.035	J	0.12	U	0.27		85.4	
DU7-PL	DU7-PL-052119	N	21 May 2019	0.062	U	0.056	J	0.036	J	6.6		0.099	J	0.12	U	0.27		87.0	
DU8-PL	DU8-PL-052119	N	21 May 2019	0.061	U	0.10		0.017	U	6.7		0.055	J	0.12	U	0.25		84.9	
DU8-PL	QC-PL-FD-1-052119	FD	21 May 2019	0.061	U	0.11		0.018	J	6.0		0.85	J	0.12	U	0.24		85.0	

Notes:
N = Normal (or investigative) sample
FD = Field duplicate
mg/kg = Milligram per kilograms
% = percent
DV Quals = final data qualifiers after data validation
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the level of the reported sample detection limit.
J+ = The result is an estimated quantity, but the result may be biased high.
Results reported on a wet weight basis

Table 3.2-5

OU1 Groundwater Results

Field Parameters - December 2018 through March 2021

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

	Chemical Units	DO, Field mg/L	ORP, Field mV	pH, Field S.U. Units	Temperature, Field °C	Turbidity, Field NTU
Well ID	Sample Date	Result	Result	Result	Result	Result
OU1MW1	13 Dec 2018	1.60	-27	7.09	11.04	0.6
OU1MW1	21 Mar 2019	NA	-	7.22	6.68	6.9
OU1MW1	05 Jun 2019	NA	-	7.07	17.32	0.2
OU1MW1	12 Aug 2019	0.66	-33	6.79	16.97	0.1
OU1MW2	13 Dec 2018	1.88	85	7.83	12.35	2.2
OU1MW2	21 Mar 2019	1.66	-	7.58	7.89	6.5
OU1MW2	05 Jun 2019	2.86	-	7.43	13.85	0.0
OU1MW2	12 Aug 2019	1.95	193	5.93	17.34	2.7
OU1MW3	13 Dec 2018	0.59	-	6.90	10.86	0.8
OU1MW3	20 Mar 2019	NA	-	6.74	6.31	3.8
OU1MW3	04 Jun 2019	NA	-	7.04	12.15	4.2
OU1MW3	13 Aug 2019	0.31	-125	6.84	17.68	4.7
OU1MW3D	21 Dec 2018	NA	-195	7.36	10.13	0.5
OU1MW3D	20 Mar 2019	NA	-	7.37	9.92	93.4
OU1MW3D	04 Jun 2019	NA	-	7.10	12.83	0.0
OU1MW3D	13 Aug 2019	0.52	-141	6.43	14.07	5.0
OU1MW4	14 Dec 2018	1.45	-71	6.73	11.59	3.3
OU1MW4	20 Mar 2019	NA	-	7.00	7.71	0.5
OU1MW4	05 Jun 2019	NA	-	7.09	13.65	2.4
OU1MW4	13 Aug 2019	0.32	-71	7.06	20.36	12.0
OU1MW5	14 Dec 2018	3.37	-98	13.90	12.06	36.4
OU1MW5	21 Mar 2019	0.38	-	12.75	8.85	4.2
OU1MW5	04 Jun 2019	6.86	-	12.83	12.74	1.1
OU1MW5	13 Aug 2019	0.20	-135	11.36	16.72	337.0
OU1MW5D	14 Dec 2018	1.48	-156	7.18	12.55	0.7
OU1MW5D	21 Mar 2019	NA	-	7.16	11.89	0.0
OU1MW5D	04 Jun 2019	NA	-	7.05	14.01	1.8
OU1MW5D	13 Aug 2019	0.62	-134	6.36	13.62	2.8

Table 3.2-5

OU1 Groundwater Results

Field Parameters - December 2018 through March 2021

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

	Chemical Units	DO, Field mg/L	ORP, Field mV	pH, Field S.U. Units	Temperature, Field °C	Turbidity, Field NTU
Well ID	Sample Date	Result	Result	Result	Result	Result
OU1MW5E	17 Mar 2021	0.58	144	7.32	8.20	4.4
OU1MW5W	17 Mar 2021	0.79	145	7.19	8.20	9.5
OU1MW5N	17 Mar 2021	0.24	-21	7.25	9.20	1.1
OU1MW5S	17 Mar 2021	0.96	-155	7.19	7.90	22.2
OU1MW6	14 Dec 2018	6.24	-55	7.95	12.34	4.8
OU1MW6	21 Mar 2019	0.36	-	6.81	7.71	0.0
OU1MW6	03 Jun 2019	1.33	-	7.45	13.05	1.8
OU1MW6	13 Aug 2019	0.52	-62	6.97	17.33	4.7
OU1MW6D	14 Dec 2018	2.47	-151	7.22	12.71	1.0
OU1MW6D	21 Mar 2019	NA	-	7.33	11.99	0.0
OU1MW6D	03 Jun 2019	NA	-	7.52	13.96	2.8
OU1MW6D	13 Aug 2019	0.47	-154	6.51	14.06	1.2
OU1MW7	13 Dec 2018	1.55	40	7.83	13.03	0.7
OU1MW7	21 Mar 2019	NA	-	7.52	8.57	0.0
OU1MW7	04 Jun 2019	3.02	-	7.28	12.47	3.5
OU1MW7	13 Aug 2019	0.76	12	6.70	18.16	1.7
OU1MW8	13 Dec 2018	1.56	-1	7.35	14.60	1.5
OU1MW8	21 Mar 2019	NA	-	7.09	9.46	0.3
OU1MW8	05 Jun 2019	NA	-	6.87	15.50	4.0
OU1MW8	13 Aug 2019	4.35	-21	6.77	19.94	1.7
OU1MW13	44273	0.26	8	6.98	7.20	11.5
OU1MW14	44273	0.27	-102	7.18	7.70	49.7
OU1MW15	44272	0.45	-114	7.11	8.30	15.7
ECHA-MW-01	20 Mar 2019	0.53	-	7.43	6.86	8.8
ECHA-MW-01	03 Jun 2019	NA	-	7.14	12.92	3.8
ECHA-MW-01	12 Aug 2019	0.85	179	6.69	17.34	0.0
ECHA-MW-09	20 Mar 2019	NA	-	7.03	6.98	18.7
ECHA-MW-09	03 Jun 2019	NA	-	7.40	12.87	2.4

Table 3.2-5

OU1 Groundwater Results

Field Parameters - December 2018 through March 2021

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

	Chemical Units	DO, Field mg/L	ORP, Field mV	pH, Field S.U. Units	Temperature, Field °C	Turbidity, Field NTU
Well ID	Sample Date	Result	Result	Result	Result	Result
ECHA-MW-09	12 Aug 2019	0.50	-64	5.58	17.31	4.9
ECHA-MW-35	20 Mar 2019	NA	-	7.25	6.97	16.8
ECHA-MW-35	03 Jun 2019	NA	-	7.35	12.74	4.6
ECHA-MW-35	12 Aug 2019	0.78	8	6.60	16.50	0.0
MW1	17-Mar-2021	0.60	-129	7.07	11.60	17.4
MW3	17-Mar-2021	0.36	-119	7.23	8.20	5.4
MW4	17-Mar-2021	0.26	-119	6.92	8.30	6.8
MW21R	16-Mar-2021	0.59	19.7	7.69	5.90	27.7
MW26	16-Mar-2021	0.69	-83.7	7.45	7.00	16.3

Notes:

DO = dissolved oxygen

NA = Not Available (instrument malfunction)

ORP = oxidation reduction potential

mg/L = milligrams per liter

mV = millivolts

S.U. = Standard Units

µS/cm = Microsiemens per centimeter

°C = degrees Celsius

NTU = Nephelometric Turbidity Unit

- = not measured

Table 3.2-6
OU1 Groundwater Results
Metals, Hardness, Alkalinity, and pH - December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical, Fraction Units	Antimony, Total µg/L		Antimony, Dissolved µg/L		Arsenic, Total µg/L		Arsenic, Dissolved µg/L		Cadmium, Total µg/L		Cadmium, Dissolved µg/L		Iron, Total µg/L		Iron, Dissolved µg/L		Lead, Total µg/L		Lead, Dissolved µg/L		Selenium, Total µg/L		Selenium, Dissolved µg/L		Alkalinity, Total as $CaCO_3$ mg/L		Hardness as $CaCO_3$ mg/L		pH, Lab S.U.	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
OU1MW1	OU1MW1-GW-121318	N	13 Dec 2018	**8.5**				1.4				0.13	U			550	J			0.094	U			0.81	U			530		380			
OU1MW1	OU1MW1-GW-FF-121318	N	13 Dec 2018			**8.4**				1.4				0.13	U			580				0.094	U			0.81	U						
OU1MW1	OU1MW1-GW-032119	N	21 Mar 2019	**8.7**				0.64	J			0.13	U			410				0.22	J			2.6	U			290		340			
OU1MW1	OU1MW1-GW-FF-032119	N	21 Mar 2019			**8.6**				0.55	J			0.13	U			210				0.13	U			2.6	U						
OU1MW1	OU1MW1-GW-060519	N	05 Jun 2019	**13**				0.45	J			0.13	U			53				0.13	U			2.6	U			280		320			
OU1MW1	OU1MW1-GW-FF-060519	N	05 Jun 2019			**14**				0.50	J			0.13	U			40	J			0.13	U			2.6	U						
OU1MW1	OU1MW1-GW-081219	N	12 Aug 2019	7.8				0.84	J			0.13	U			640				0.13	U			1.5	U			250		300			
OU1MW1	OU1MW1-GW-FF-081219	N	12 Aug 2019			**7.9**				1.0				0.13	U			600				0.13	U			1.5	U						
OU1MW2	OU1MW2-GW-121318	N	13 Dec 2018	**10**				0.59	J			0.13	U			45	J			0.094	U			0.81	U			210		220			
OU1MW2	OU1MW2-GW-FF-121318	N	13 Dec 2018			**9.6**				0.50	J			0.13	U			14	U			0.094	U			0.81	U						
OU1MW2	OU1MW2-GW-032119	N	21 Mar 2019	7.7				0.36	J			0.13	U			100				0.13	U			2.6	U			220		260			
OU1MW2	OU1MW2-GW-FF-032119	N	21 Mar 2019			**8.3**				0.32	U			0.13	U			19	J			0.13	U			2.6	U						
OU1MW2	OU1MW2-GW-060519	N	05 Jun 2019	**12**				0.32	J			0.13	U			14	U			0.13	U			3.2	J			230		230			
OU1MW2	OU1MW2-GW-FF-060519	N	05 Jun 2019			**12**				0.32	U			0.13	U			14	U			0.13	U			2.6	U						
OU1MW2	OU1MW2-GW-081219	N	12 Aug 2019	**11**				0.36	J			0.13	U			20	U			0.13	U			1.8	J			220		220			
OU1MW2	OU1MW2-GW-FF-081219	N	12 Aug 2019			**11**				0.32	U			0.13	U			20	U			0.13	U			3.5	J						
OU1MW3	OU1MW3-GW-121318	N	13 Dec 2018	3.2				4.3				0.13	U			7000	J			0.094	U			0.81	U			210		670			
OU1MW3	OU1MW3-GW-FF-121318	N	13 Dec 2018			**3.0**				4.2				0.13	U			7000				0.094	U			0.81	U						
OU1MW3	OU1MW3-GW-032019	N	20 Mar 2019	2.1				4.4				0.13	U			6600				0.13	U			2.6	U			280		600			
OU1MW3	QC-GW-FD-1-032019	FD	20 Mar 2019	1.7	J			4.7				0.13	U			7700				0.13	U			2.6	U			270		620			
OU1MW3	OU1MW3-GW-FF-032019	N	20 Mar 2019			2.2				4.4				0.13	U			6400				0.13	U			2.6	U						
OU1MW3	QC-GW-FF-FD-1-032019	FD	20 Mar 2019			1.6	J			4.3				0.13	U			7200				0.13	U			2.6	U						
OU1MW3	OU1MW3-GW-060419	N	04 Jun 2019	3.3				5.3				0.13	U			6900				0.13	U			2.6	U			280		620			
OU1MW3	QC-GW-FD-1-060419	FD	04 Jun 2019	2.8				5.6				0.13	U			7500				0.13	U			2.6	U			280		630			
OU1MW3	OU1MW3-GW-FF-060419	N	04 Jun 2019			3.2				5.9				0.13	U			7600				0.13	U			2.6	U						
OU1MW3	QC-GW-FF-FD-1-060419	FD	04 Jun 2019			2.9				5.9				0.13	U			7600				0.13	U			2.6	U						
OU1MW3	OU1MW3-GW-081319	N	13 Aug 2019	1.8	J			6.5				0.13	U			6500				0.13	U			1.5	U			220		720			
OU1MW3	QC-GW-FD-1-081319	FD	13 Aug 2019	1.6	J			6.4				0.13	U			6200				0.13	U			1.5	U			220		710			
OU1MW3	OU1MW3-GW-FF-081319	N	13 Aug 2019			2.0				6.5				0.13	U			6500				0.25	J			1.5	U						
OU1MW3	QC-GW-FF-FD-1-081319	FD	13 Aug 2019			2.1				6.0				0.13	U			6100				0.13	U			1.5	U						
OU1MW3D	OU1MW3D-GW-121318	N	13 Dec 2018	1.1	U			**41**				0.13	U			**34000**	J			0.094	U			0.81	U			140		1500			
OU1MW3D	OU1MW3D-GW-122118	N	21 Dec 2018	1.1	U			**43**				0.13	U			**26000**				0.094	U			0.81	U					1500			
OU1MW3D	QC-GW-FD-1-122118	FD	21 Dec 2018	1.1	U			**42**				0.13	U			**25000**				0.094	U			0.81	U					1500			
OU1MW3D	OU1MW3D-GW-FF-122118	N	21 Dec 2018			1.1	U			**43**				0.13	U			**26000**				0.094	U			0.81	U						
OU1MW3D	QC-GW-FD-1-122118	FD	21 Dec 2018			1.1	U			**42**				0.13	U			**26000**				0.094	U			0.81	U						
OU1MW3D	OU1MW3D-GW-032019	N	20 Mar 2019	0.38	U			**50**				0.13	U			**23000**				0.13	U			2.6	U			190		1600			
OU1MW3D	QC-GW-FD-2-032019	FD	20 Mar 2019	0.38	U			**49**				0.13	U			**24000**				0.13	U			2.6	U			180		1600			
OU1MW3D	OU1MW3D-GW-FF-032019	N	20 Mar 2019			0.38	U			**47**				0.13	U			**23000**				0.13	U			2.6	U						
OU1MW3D	QC-GW-FF-FD-2-032019	FD	20 Mar 2019			0.38	U			**51**				0.13	U			**27000**				0.13	U			2.6	U						
OU1MW3D	OU1MW3D-GW-060419	N	04 Jun 2019	0.38	U			**49**				0.13	U			**24000**				0.13	U			2.6	U			160		1500			
OU1MW3D	QC-GW-FD-2-060419	FD	04 Jun 2019	0.38	U			**52**				0.13	U			**27000**				0.13	U			2.6	U			170		1500			
OU1MW3D	OU1MW3D-GW-FF-060419	N	04 Jun 2019			0.38	U			**53**				0.13	U			**27000**				0.13	U			2.6	U						
OU1MW3D	QC-GW-FF-FD-2-060419	FD	04 Jun 2019			0.38	U			**50**				0.13	U			**26000**				0.13	U			2.6	U						
OU1MW3D	OU1MW3D-GW-081319	N	13 Aug 2019	0.38	U			**48**				0.13	U			**24000**				0.13	U			1.5	U			150		1500			
OU1MW3D	QC-GW-FD-2-081319	FD	13 Aug 2019	0.38	U			**49**				0.13	U			**25000**				0.13	U			1.5	U			140		1500			
OU1MW3D	OU1MW3D-GW-FF-081319	N	13 Aug 2019			0.53	J			**51**				0.13	U			**25000**				0.13	U			1.5	U						
OU1MW3D	QC-GW-FF-FD-2-081319	FD	13 Aug 2019			0.38	U			**47**				0.13	U			**23000**				0.13	U			1.5	U						
OU1MW5	OU1MW5-GW-121418	N	14 Dec 2018	1.5	J			0.82	J			0.13	U			14	UJ			**96**				0.81	U			1800		1800			
OU1MW5	OU1MW5-GW-FF-121418	N	14 Dec 2018			1.3	J			0.74	J			0.13	U			14	U			**99**				0.81	U						
OU1MW5	OU1MW5-GW-032119	N	21 Mar 2019	3.3				1.2				0.13	U			84				**30**				2.6	U			740		890			
OU1MW5	OU1MW5-GW-FF-032119	N	21 Mar 2019			3.2				0.78	J			0.13	U			14	U			**20**				2.6	U						
OU1MW5	OU1MW5-GW-060419	N	04 Jun 2019	4.1				0.39	J			0.13	U			14	U			**220**				2.6	U			1700		1700			
OU1MW5	OU1MW5-GW-FF-060419	N	04 Jun 2019			4.0				0.50	J			0.13	U			14	U			**230**				2.6	U						
OU1MW5	OU1MW5-GW-081319	N	13 Aug 2019	**18**				1.5				0.13	U			20	J			11				1.5	U			83		480		10.7	

Table 3.2-6
OU1 Groundwater Results
Metals, Hardness, Alkalinity, and pH - December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical, Fraction Units	Antimony, Total µg/L		Antimony, Dissolved µg/L		Arsenic, Total µg/L		Arsenic, Dissolved µg/L		Cadmium, Total µg/L		Cadmium, Dissolved µg/L		Iron, Total µg/L		Iron, Dissolved µg/L		Lead, Total µg/L		Lead, Dissolved µg/L		Selenium, Total µg/L		Selenium, Dissolved µg/L		Alkalinity, Total as $CaCO_3$ mg/L		Hardness as $CaCO_3$ mg/L		pH, Lab S.U.	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
OU1MW5	OU1MW5-GW-FF-081319	N	13 Aug 2019			**18**				0.96	J			0.13	U			20	U			2.3				1.5	U						
OU1MW5D	OU1MW5D-GW-121418	N	14 Dec 2018	1.1	U			**13**				0.13	U			8500				0.094	U			0.81	U			480		710			
OU1MW5D	OU1MW5D-GW-FF-121418	N	14 Dec 2018			1.1	U			**14**				0.13	U			8900				0.30	J			0.81	U						
OU1MW5D	OU1MW5D-GW-032119	N	21 Mar 2019	0.38	U			**18**				0.13	U			10000				0.13	U			2.6	U			530		720			
OU1MW5D	OU1MW5D-GW-FF-032119	N	21 Mar 2019			0.38	U			**18**				0.13	U			10000				0.13	U			2.6	U						
OU1MW5D	OU1MW5D-GW-060419	N	04 Jun 2019	0.48	J			**19**				0.13	U			12000				0.13	U			2.6	U			500		700			
OU1MW5D	OU1MW5D-GW-FF-060419	N	04 Jun 2019			0.45	J			**20**				0.13	U			12000				0.13	U			2.6	U						
OU1MW5D	OU1MW5D-GW-081319	N	13 Aug 2019	0.38	U			**17**				0.13	U			11000				0.13	U			1.5	U			490		720			
OU1MW5D	OU1MW5D-GW-FF-081319	N	13 Aug 2019			0.38	U			**17**				0.13	U			11000				0.13	U			1.5	U						
OU1MW5E	OU1MW5E-GW-031721	N	17 Mar 2021	2		1.6		1.6		0.31	U	0.22	U	0.22	U	110		20	U	0.23		0.13	U	1.5	U	1.5	U	220		260			
OU1MW5N	OU1MW5N-GW-031721	N	17 Mar 2021	5.5		5.7		5.7		0.31	U	0.22	U	0.22	U	77		27		0.13	U	0.13	U	1.5	U	1.5	U	250		400			
OU1MW5S	OU1MW5S-GW-031721	N	17 Mar 2021	1.2		1.1		1.1		4.4		0.22	U	0.22	U	10000		9500		0.77		0.13	U	1.5	U	1.5	U	530		730			
OU1MW5W	OU1MW5W-GW-031721	N	17 Mar 2021	24		23		23		0.33		0.22	U	0.22	U	230		20	U	0.3		0.13	U	2.6		2.2		320		290			
OU1MW6	OU1MW6-GW-121418	N	14 Dec 2018	6.5				1.8				0.13	U			310				0.14	J			4.5	J			310		350			
OU1MW6	OU1MW6-GW-FF-121418	N	14 Dec 2018			**6.2**				1.6				0.13	U			280				0.094	U			4.0	J						
OU1MW6	OU1MW6-GW-032119	N	21 Mar 2019	6.2				0.89	J			0.13	U			180				0.13	U			3.1	J			260		300			
OU1MW6	OU1MW6-GW-FF-032119	N	21 Mar 2019			**6.7**				1.2				0.13	U			160				0.13	U			3.0	J						
OU1MW6	OU1MW6-GW-060319	N	03 Jun 2019	**11**				0.69	J			0.13	U			18	J			0.13	U			6.7				270		380			
OU1MW6	OU1MW6-GW-FF-060319	N	03 Jun 2019			**12**				0.60	J			0.13	U			14	U			0.13	U			5.5							
OU1MW6	OU1MW6-GW-081319	N	13 Aug 2019	**11**				1.2				0.13	U			290				0.15	J			2.3	J			280		370			
OU1MW6	OU1MW6-GW-FF-081319	N	13 Aug 2019			**10**				1.1				0.13	U			230				0.13	U			2.6	J						
OU1MW6D	OU1MW6D-GW-121418	N	14 Dec 2018	1.1	U			**37**				0.13	U			5700				0.094	U			0.81	U			240		430			
OU1MW6D	OU1MW6D-GW-FF-121418	N	14 Dec 2018			1.1	U			**36**				0.13	U			5600				0.094	U			0.81	U						
OU1MW6D	OU1MW6D-GW-032119	N	21 Mar 2019	0.38	U			**47**				0.13	U			5900				0.13	U			2.6	U			230		440			
OU1MW6D	OU1MW6D-GW-FF-032119	N	21 Mar 2019			0.38	U			**46**				0.13	U			5600				0.13	U			2.6	U						
OU1MW6D	OU1MW6D-GW-060319	N	03 Jun 2019	0.42	J			**56**				0.13	U			12000				0.13	U			2.6	U			190		650			
OU1MW6D	OU1MW6D-GW-FF-060319	N	03 Jun 2019			0.38	U			**55**				0.13	U			12000				0.13	U			2.6	U						
OU1MW6D	OU1MW6D-GW-081319	N	13 Aug 2019	0.38	U			**54**				0.13	U			8800				0.13	U			1.5	U			190		490			
OU1MW6D	OU1MW6D-GW-FF-081319	N	13 Aug 2019			0.38	U			**53**				0.13	U			9000				0.13	U			1.5	U						
OU1MW7	OU1MW7-GW-121318	N	13 Dec 2018	5.2				0.78	J			0.13	U			68	J			0.10	J			1.3	J			290		300			
OU1MW7	OU1MW7-GW-FF-121318	N	13 Dec 2018			4.8				0.74	J			0.13	U			15	J			0.094	U			0.96	J						
OU1MW7	OU1MW7-GW-032119	N	21 Mar 2019	3.9				0.63	J			0.13	U			82				0.13	U			2.6	U			250		260			
OU1MW7	OU1MW7-GW-FF-032119	N	21 Mar 2019			4.3				0.48	J			0.13	U			20	J			0.13	U			2.6	U						
OU1MW7	OU1MW7-GW-060419	N	04 Jun 2019	**17**				0.45	J			0.13	U			28	J			0.13	U			2.6	U			240		240			
OU1MW7	OU1MW7-GW-FF-060419	N	04 Jun 2019			**18**				0.51	J			0.13	U			14	U			0.13	U			2.6	U						
OU1MW7	OU1MW7-GW-081319	N	13 Aug 2019	6.1				0.49	J			0.13	U			29	J			0.13	U			1.5	U			230		230			
OU1MW7	OU1MW7-GW-FF-081319	N	13 Aug 2019			7.0				0.72	J			0.13	U			20	U			0.13	U			2.3	J						
OU1MW8	OU1MW8-GW-121318	N	13 Dec 2018	6.7				1.4				0.13	U			430	J			0.094	U			0.81	U			540		480			
OU1MW8	OU1MW8-GW-FF-121318	N	13 Dec 2018			7.1				1.5				0.13	U			380				0.094	U			0.81	U						
OU1MW8	OU1MW8-GW-032119	N	21 Mar 2019	6.8				1.0				0.13	U			360				0.17	J			3.4	J			350		420			
OU1MW8	OU1MW8-GW-FF-032119	N	21 Mar 2019			5.8				1.0				0.13	U			190				0.13	U			2.6	U						
OU1MW8	OU1MW8-GW-060519	N	05 Jun 2019	**15**				1.2				0.13	U			340				0.13	U			3.2	J			390		740			
OU1MW8	OU1MW8-GW-FF-060519	N	05 Jun 2019			**16**				1.3				0.13	U			350				0.13	U			3.5	J						
OU1MW8	OU1MW8-GW-081319	N	13 Aug 2019	**13**				0.85	J			0.13	U			220				0.13	U			4.4	J			300		710			
OU1MW8	OU1MW8-GW-FF-081319	N	13 Aug 2019			**12**				0.88	J			0.13	U			200				0.13	U			4.6	J						
OU1MW13	QC-GW-FD-1-031821	FD	18 Mar 2021	19		20		10		10		0.22	U	0.22	U	1100		900		0.7		0.2		1.5	U	1.5	U	360		400			
OU1MW13	OU1MW13-GW-031821	N	18 Mar 2021	20		20		10		10		0.22	U	0.22	U	1000		870		0.71		0.2		1.5	U	1.5	U	360		390			
OU1MW14	OU1MW14-GW-031821	N	17 Mar 2021	2.5		0.38	U	3.2		2.5		0.22	U	0.5		3600		1300		16		0.21		1.5	U	1.5	U	260		400			
OU1MW15	OU1MW15-GW-031721	N	17 Mar 2021	1.9		1.9		2.9		2.6		0.22	U	0.22	U	4600		3800		1.4		0.13		1.5	U	1.5	U	380		410			
ECHA-MW-01	MW-01-GW-032019	N	20 Mar 2019	**920**				**380**				**49**				14	U			**20**				48				280		250			
ECHA-MW-01	MW-01-GW-FF-032019	N	20 Mar 2019			**960**				**390**				**46**				14	U			8.4				**54**							
ECHA-MW-01	ECHA-MW-01-GW-060319	N	03 Jun 2019	**1200**				**440**				**44**				39	J			**21**				**72**				250		250			
ECHA-MW-01	ECHA-MW-01-GW-FF-060319	N	03 Jun 2019			**1100**				**400**				**43**				14	U			10				**70**							

Table 3.2-6
OU1 Groundwater Results
Metals, Hardness, Alkalinity, and pH - December 2018 through March 2021
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical, Fraction Units	Antimony, Total µg/L		Antimony, Dissolved µg/L		Arsenic, Total µg/L		Arsenic, Dissolved µg/L		Cadmium, Total µg/L		Cadmium, Dissolved µg/L		Iron, Total µg/L		Iron, Dissolved µg/L		Lead, Total µg/L		Lead, Dissolved µg/L		Selenium, Total µg/L		Selenium, Dissolved µg/L		Alkalinity, Total as $CaCO_3$ mg/L		Hardness as $CaCO_3$ mg/L		pH, Lab S.U.	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
ECHA-MW-01	MW-01-GW-081219	N	12 Aug 2019	**1200**				**440**				**59**				20	J			15				**82**				240		240			
ECHA-MW-01	MW-01-GW-FF-081219	N	12 Aug 2019			**1200**				**440**				**59**				20	U			9.9				**82**							
ECHA-MW-09	MW-09-GW-032019	N	20 Mar 2019	**120**				**17**				4.7				67				**89**				3.8	J			300		270			
ECHA-MW-09	MW-09-GW-FF-032019	N	20 Mar 2019			**120**				**14**				4.3				14	U			**68**				3.3	J						
ECHA-MW-09	ECHA-MW-09-GW-060319	N	03 Jun 2019	**25**				**25**				1.0				670				**80**				2.6	U			250		280			
ECHA-MW-09	ECHA-MW-09-GW-FF-060319	N	03 Jun 2019			**24**				**23**				0.75	J			540				**47**				2.6	U						
ECHA-MW-09	MW-09-GW-081219	N	12 Aug 2019	**34**				**30**				0.50	J			930				**89**				1.5	U			270		290			
ECHA-MW-09	MW-09-GW-FF-081219	N	12 Aug 2019			**31**				26				0.41	J			890				**47**				1.5	U						
ECHA-MW-35	MW-35-GW-032019	N	20 Mar 2019	**68**				1.1				0.13	U			150				0.13	U			3.3	J			360		350			
ECHA-MW-35	MW-35-GW-FF-032019	N	20 Mar 2019			**68**				1.0				0.13	U			68				0.13	U			3.3	J						
ECHA-MW-35	ECHA-MW-35-GW-060319	N	03 Jun 2019	**36**				1.7				0.13	U			240				0.64	J			2.6	U			320		320			
ECHA-MW-35	ECHA-MW-35-GW-FF-060319	N	03 Jun 2019			**34**				1.7				0.13	U			180				0.15	J			2.6	U						
ECHA-MW-35	MW-35-GW-081219	N	12 Aug 2019	5.9				2.0				0.13	U			340				0.28	J			1.5	U			330		360			
ECHA-MW-35	MW-35-GW-FF-081219	N	12 Aug 2019			5.3				1.7				0.13	U			250				0.13	U			1.5	U						
			IDEM SL	6		6		10		10		5		5		14,000		14,000		15		15		50		50							
			USEPA RSL	7.8		7.8		10		10		5		5		14,000		14,000		15		15		50		50							

Notes:
(shaded) Concentration is greater than IDEM screening level and USEPA RSL for tapwater
***BOLD** = Concentration is greater than the USEPA Screening Levels for Industrial Direct Contact*
N = Normal (or investigative) sample
FD = Field duplicate
DV Quals = final data qualifier after data validation
µg/L = micrograms per liter
mg/L = milligrams per litere
$CaCO_3$ = calcium carbonate
S.U. = Standard Units
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the level of the reported sample detection limit.
UJ = The analyte was analyzed for, but was not detected. The reported detection limit is approximate and may be inaccurate or imprecise.

Table 3.2-7
OU1 Groundwater Results
Polycyclic Aromatic Hydrocarbons - December 2018 and June 2019
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Units	2-Methylnaphthalene µg/L		Acenaphthene µg/L		Acenaphthylene µg/L		Anthracene µg/L		Benzo(a)anthracene µg/L		Benzo(a)pyrene µg/L	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
OU1MW1	OU1MW1-GW-121318	N	13 Dec 2018	0.057	U	0.060	U	0.060	U	0.045	U	0.069	U	0.049	U
OU1MW1	OU1MW1-GW-060519	N	05 Jun 2019	0.062	U	0.065	U	0.065	U	0.049	U	0.075	U	0.053	U
OU1MW2	OU1MW2-GW-121318	N	13 Dec 2018	0.062	U	0.065	U	0.065	U	0.049	U	0.075	U	0.053	U
OU1MW2	OU1MW2-GW-060519	N	05 Jun 2019	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW3	OU1MW3-GW-121318	N	13 Dec 2018	0.057	U	0.060	U	0.060	U	0.045	U	0.069	U	0.049	U
OU1MW3	OU1MW3-GW-060419	N	04 Jun 2019	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW3	QC-GW-FD-1-060419	FD	04 Jun 2019	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW3D	OU1MW3D-GW-121318	N	13 Dec 2018	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW3D	OU1MW3D-GW-060419	N	04 Jun 2019	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW3D	QC-GW-FD-2-060419	FD	04 Jun 2019	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW4	OU1MW4-GW-121418	N	14 Dec 2018	0.057	U	0.060	U	0.060	U	0.045	U	0.069	U	0.049	U
OU1MW4	OU1MW4-GW-060519	N	05 Jun 2019	0.062	U	0.065	U	0.065	U	0.049	U	0.075	U	0.053	U
OU1MW5	OU1MW5-GW-121418	N	14 Dec 2018	0.062	U	0.065	U	0.065	U	0.049	U	0.075	U	0.053	U
OU1MW5	OU1MW5-GW-060419	N	04 Jun 2019	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW5D	OU1MW5D-GW-121418	N	14 Dec 2018	0.062	U	0.065	U	0.065	U	0.049	U	0.075	U	0.053	U
OU1MW5D	OU1MW5D-GW-060419	N	04 Jun 2019	0.062	U	0.065	U	0.065	U	0.049	U	0.075	U	0.053	U
OU1MW6	OU1MW6-GW-121418	N	14 Dec 2018	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW6	OU1MW6-GW-060319	N	03 Jun 2019	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW6D	OU1MW6D-GW-121418	N	14 Dec 2018	0.070	U	0.074	U	0.074	U	0.056	U	0.085	U	0.060	U
OU1MW6D	OU1MW6D-GW-060319	N	03 Jun 2019	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U
OU1MW7	OU1MW7-GW-121318	N	13 Dec 2018	0.065	U	0.068	U	0.068	U	0.051	U	0.078	U	0.055	U
OU1MW7	OU1MW7-GW-060419	N	04 Jun 2019	0.062	U	0.065	U	0.065	U	0.049	U	0.075	U	0.053	U
OU1MW8	OU1MW8-GW-121318	N	13 Dec 2018	0.062	U	0.065	U	0.065	U	0.049	U	0.075	U	0.053	U
OU1MW8	OU1MW8-GW-060519	N	05 Jun 2019	0.067	U	0.071	U	0.071	U	0.053	U	0.082	U	0.058	U
ECHA-MW-01	ECHA-MW-01-GW-060319	N	03 Jun 2019	0.062	U	0.065	U	0.065	U	0.049	U	0.075	U	0.053	U
ECHA-MW-09	ECHA-MW-09-GW-060319	N	03 Jun 2019	0.057	U	0.060	U	0.060	U	0.045	U	0.069	U	0.049	U
ECHA-MW-35	ECHA-MW-35-GW-060319	N	03 Jun 2019	0.060	U	0.063	U	0.063	U	0.047	U	0.072	U	0.051	U

Notes:
N = Normal (or investigative) sample
FD = Field duplicate
µg/L = micrograms per liter
DV Quals = final data qualifier after data validation
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the level of the reported sample detection limit.

UJ = The analyte was analyzed for, but was not detected. The reported detection limit is approximate and may be inaccurate or imprecise.

Table 3.2-7
OU1 Groundwater Results
Polycyclic Aromatic Hydrocarbons - December 2018 and June 2019
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Units	Benzo(b)fluoranthene µg/L		Benzo(g,h,i)perylene µg/L		Benzo(k)fluoranthene µg/L		Chrysene µg/L		Dibenzo(a,h)anthracene µg/L		Fluoranthene µg/L	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
OU1MW1	OU1MW1-GW-121318	N	13 Dec 2018	0.090	U	0.064	U	0.081	U	0.075	U	0.067	U	0.056	U
OU1MW1	OU1MW1-GW-060519	N	05 Jun 2019	0.097	U	0.069	U	0.088	U	0.081	U	0.072	U	0.060	U
OU1MW2	OU1MW2-GW-121318	N	13 Dec 2018	0.097	U	0.069	U	0.088	U	0.081	U	0.072	U	0.060	U
OU1MW2	OU1MW2-GW-060519	N	05 Jun 2019	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW3	OU1MW3-GW-121318	N	13 Dec 2018	0.090	U	0.064	U	0.081	U	0.075	U	0.067	U	0.056	U
OU1MW3	OU1MW3-GW-060419	N	04 Jun 2019	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW3	QC-GW-FD-1-060419	FD	04 Jun 2019	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW3D	OU1MW3D-GW-121318	N	13 Dec 2018	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW3D	OU1MW3D-GW-060419	N	04 Jun 2019	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW3D	QC-GW-FD-2-060419	FD	04 Jun 2019	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW4	OU1MW4-GW-121418	N	14 Dec 2018	0.090	U	0.064	U	0.081	U	0.075	U	0.067	U	0.056	U
OU1MW4	OU1MW4-GW-060519	N	05 Jun 2019	0.097	U	0.069	U	0.088	U	0.081	U	0.072	U	0.060	U
OU1MW5	OU1MW5-GW-121418	N	14 Dec 2018	0.097	U	0.069	U	0.088	U	0.081	U	0.072	U	0.060	U
OU1MW5	OU1MW5-GW-060419	N	04 Jun 2019	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW5D	OU1MW5D-GW-121418	N	14 Dec 2018	0.097	U	0.069	U	0.088	U	0.081	U	0.072	U	0.060	U
OU1MW5D	OU1MW5D-GW-060419	N	04 Jun 2019	0.097	U	0.069	U	0.088	U	0.081	U	0.072	U	0.060	U
OU1MW6	OU1MW6-GW-121418	N	14 Dec 2018	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW6	OU1MW6-GW-060319	N	03 Jun 2019	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW6D	OU1MW6D-GW-121418	N	14 Dec 2018	0.110	U	0.078	U	0.100	U	0.092	U	0.082	U	0.068	U
OU1MW6D	OU1MW6D-GW-060319	N	03 Jun 2019	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U
OU1MW7	OU1MW7-GW-121318	N	13 Dec 2018	0.100	U	0.072	U	0.092	U	0.084	U	0.075	U	0.063	U
OU1MW7	OU1MW7-GW-060419	N	04 Jun 2019	0.097	U	0.069	U	0.088	U	0.081	U	0.072	U	0.060	U
OU1MW8	OU1MW8-GW-121318	N	13 Dec 2018	0.097	U	0.069	U	0.088	U	0.081	U	0.072	U	0.060	U
OU1MW8	OU1MW8-GW-060519	N	05 Jun 2019	0.110	U	0.075	U	0.096	U	0.088	U	0.078	U	0.065	U
ECHA-MW-01	ECHA-MW-01-GW-060319	N	03 Jun 2019	0.097	U	0.069	U	0.088	U	0.081	U	0.072	U	0.060	U
ECHA-MW-09	ECHA-MW-09-GW-060319	N	03 Jun 2019	0.090	U	0.064	U	0.081	U	0.075	U	0.067	U	0.056	U
ECHA-MW-35	ECHA-MW-35-GW-060319	N	03 Jun 2019	0.093	U	0.066	U	0.085	U	0.078	U	0.069	U	0.058	U

Notes:
N = Normal (or investigative) sample
FD = Field duplicate
µg/L = micrograms per liter
DV Quals = final data qualifier after data validation
J = The result is an estimated quantity. The associated numerical value is the approximate
U = The analyte was analyzed for, but was not detected above the level of the reported sa

UJ = The analyte was analyzed for, but was not detected. The reported detection limit is a

Table 3.2-7
OU1 Groundwater Results
Polycyclic Aromatic Hydrocarbons - December 2018 and June 2019
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Units	Fluorene µg/L		Indeno(1,2,3-cd)pyrene µg/L		Naphthalene µg/L		Phenanthrene µg/L		Pyrene µg/L	
Sample Location	Sample Name	Sample Type	Sample Date	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals	Result	DV Quals
OU1MW1	OU1MW1-GW-121318	N	13 Dec 2018	0.064	U	0.079	U	0.055	U	0.065	J	0.050	U
OU1MW1	OU1MW1-GW-060519	N	05 Jun 2019	0.069	U	0.085	U	0.059	U	0.060	J	0.054	U
OU1MW2	OU1MW2-GW-121318	N	13 Dec 2018	0.069	U	0.085	U	0.059	U	0.055	U	0.054	U
OU1MW2	OU1MW2-GW-060519	N	05 Jun 2019	0.066	U	0.082	U	0.057	U	0.065	J	0.052	U
OU1MW3	OU1MW3-GW-121318	N	13 Dec 2018	0.064	U	0.079	U	0.055	U	0.051	U	0.050	U
OU1MW3	OU1MW3-GW-060419	N	04 Jun 2019	0.066	U	0.082	U	0.057	U	0.053	U	0.052	U
OU1MW3	QC-GW-FD-1-060419	FD	04 Jun 2019	0.066	U	0.082	U	0.057	U	0.056	J	0.052	U
OU1MW3D	OU1MW3D-GW-121318	N	13 Dec 2018	0.066	U	0.082	U	0.057	U	0.056	J	0.052	U
OU1MW3D	OU1MW3D-GW-060419	N	04 Jun 2019	0.066	U	0.082	U	0.057	U	0.053	J	0.052	U
OU1MW3D	QC-GW-FD-2-060419	FD	04 Jun 2019	0.066	U	0.082	U	0.057	U	0.057	J	0.052	U
OU1MW4	OU1MW4-GW-121418	N	14 Dec 2018	0.064	U	0.079	U	0.055	UJ	0.071	J	0.050	U
OU1MW4	OU1MW4-GW-060519	N	05 Jun 2019	0.069	U	0.085	U	0.059	U	0.082	J	0.054	U
OU1MW5	OU1MW5-GW-121418	N	14 Dec 2018	0.069	U	0.085	U	0.059	U	0.13	J	0.054	U
OU1MW5	OU1MW5-GW-060419	N	04 Jun 2019	0.066	U	0.082	U	0.057	U	0.088	J	0.052	U
OU1MW5D	OU1MW5D-GW-121418	N	14 Dec 2018	0.069	U	0.085	U	0.059	U	0.055	U	0.054	U
OU1MW5D	OU1MW5D-GW-060419	N	04 Jun 2019	0.069	U	0.085	U	0.059	U	0.056	J	0.054	U
OU1MW6	OU1MW6-GW-121418	N	14 Dec 2018	0.066	U	0.082	U	0.057	U	0.053	U	0.052	U
OU1MW6	OU1MW6-GW-060319	N	03 Jun 2019	0.066	U	0.082	U	0.057	U	0.13	J	0.052	U
OU1MW6D	OU1MW6D-GW-121418	N	14 Dec 2018	0.078	U	0.097	U	0.067	U	0.063	U	0.061	U
OU1MW6D	OU1MW6D-GW-060319	N	03 Jun 2019	0.066	U	0.082	U	0.057	U	0.11	J	0.052	U
OU1MW7	OU1MW7-GW-121318	N	13 Dec 2018	0.072	U	0.089	U	0.061	U	0.057	U	0.056	U
OU1MW7	OU1MW7-GW-060419	N	04 Jun 2019	0.069	U	0.085	U	0.059	UJ	0.063	J	0.054	U
OU1MW8	OU1MW8-GW-121318	N	13 Dec 2018	0.069	U	0.085	U	0.059	U	0.055	U	0.054	U
OU1MW8	OU1MW8-GW-060519	N	05 Jun 2019	0.075	U	0.092	U	0.064	U	0.075	J	0.059	U
ECHA-MW-01	ECHA-MW-01-GW-060319	N	03 Jun 2019	0.069	U	0.085	U	0.059	U	0.11	J	0.054	U
ECHA-MW-09	ECHA-MW-09-GW-060319	N	03 Jun 2019	0.064	U	0.079	U	0.055	U	0.10	J	0.057	J
ECHA-MW-35	ECHA-MW-35-GW-060319	N	03 Jun 2019	0.066	U	0.082	U	0.057	U	0.11	J	0.052	U

Notes:
N = Normal (or investigative) sample
FD = Field duplicate
µg/L = micrograms per liter
DV Quals = final data qualifier after data validation
J = The result is an estimated quantity. The associated numerical value is the approximate
U = The analyte was analyzed for, but was not detected above the level of the reported sa
UJ = The analyte was analyzed for, but was not detected. The reported detection limit is a

Table 4.1-1
USEPA and IDEM Screening Levels for Nature and Extent of Contamination Former USS Lead Site
East Chicago, IN

	Soil (C/I)		Soil (C/E)		Soil to Groundwater		Groundwater		Sediment	Soil	Surface Water
	RSL[1]	IDEM[2]	RSL[3]	IDEM[4]	RSL[5]	IDEM[6]	MCL/RSL[7]	IDEM[8]	ESV[9]	ESV[10]	ESV[11]
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(ug/l)	(ug/l)	(mg/kg)	(mg/kg)	(ug/l)
PAHs											
Acenaphthalene	45,000	45,000	NA	1,000,000	5.5	110	530	530	6.7	29*	15
Anthracene	230,000	1,000,000	NA	1,000,000	58	1,200	1,800	1,800	57	29*	0.02
Benzo(a)anthracene	21	210	NA	12,000	0.1	2.1	0.3	0.3	108	1.1*	4.7
Benzo(a)pyrene	2.1	21	NA	500	0.24	4.7	0.2	0.2	150	1.1*	0.06
Benzo(b)fluoranthene	21	210	NA	12,000	3	60	2.5	2.5	190	1.1*	2.6
Benzo(k)fluoranthene	210	2,100	NA	100,000	29	590	25	25	240	1.1*	0.06
Chrysene	2,100	21,000	NA	100,000	90	1,800	250	250	166	1.1*	4.7
Dibenz(a,h)anthracene	2	21	NA	1,200	0.96	19	0.25	0.25	33	1.1*	0.012
Fluoranthene	30,000	30,000	NA	68,000	89	1,800	800	800	423	1.1*	0.8
Fluorene	30,000	30,000	NA	68,000	5.4	110	290	290	77	29*	19
Indeno(1,2,3-cd)pyrene	21	210	NA	12,000	9.8	200	2.5	2.5	200	1.1*	0.012
2-Methylnaphthalene	3,000	3,000	NA	6,800	0.19	3.7	36	36	20.2	29*	4.7
Naphthalene	8.6	170	NA	3,100	0.0038	0.11	1.2	1.7	176	29*	21
Pyrene	23,000	23,000	NA	51,000	13	260	120	120	195	1.1*	4.6
Metals											
Antimony	470	470	NA	790	0.27	5.4	6	7.8	2	0.27	190
Arsenic	3	30	NA	920	0.29	5.9	10	10	9.8	18	150
Cadmium	980	980	NA	1,900	0.38	7.5	5	5	1	0.36	0.45
Iron	820,000	77,000	NA	100,000	350	7,100	300	14,000	20,000	Narrative	1,000
Lead	800	800	NA	1,000	14	270	15	15	35.8	11	1.25
Selenium	5,800	5,800	NA	9,800	0.26	5.3	50	50	0.72	0.52	5

Notes:

1. EPA Regional Screening Levels (RSLs), direct contact with industrial soil, May 2021, HQ=1, TCR=1E-06.
4. IDEM commercial/industrial worker direct contact SLs; 2020 risc screening table A6.
3. RSLs are not available (NA) for construction/excavation workers.
4. IDEM excavation worker direct contact SLs; 2020 risc screening table A6.
5. EPA Regional Screening Levels (RSLs), soil migrating to groundwater, May 2021, HQ=1, TCR=1E-06.
6. IDEM soil migrating to groundwater SLs; 2020 risc screening level table A6.
7. EPA Maximum Contaminant Level (MCL), if available, or Regional Screening Level (RSL), May 2021. Secondary MCL used for iron.
8. IDEM groundwater SLs; resident tapwater; 2020 risc screening level table A6.
9. EPA Region 4 Ecological Screening Value (ESV), March 2018; freshwater sediment screening values, tables 2a & 2b.
10. EPA Region 4 Ecological Screening Value (ESV), March 2018; soil screening values, all receptors, table 3.

* - Total low molecular weight PAHs 29 mg/kg; total high molecular weight PAHs 1.1 mg/kg.

11. EPA Region 4 Ecological Screening Value (ESV), March 2018; freshwater screening values, chronic, table 1a.

NA - Not Available.

Table 4.2-1
Environmental Studies used for this Remedial Investigation
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Study Name	Data Collection Year	Publication Year	Study Authors	Purpose	Media	Analytes
USS Lead Modified Resource Conservation and Recovery Act (RCRA) Facility Investigation (MRFI) Report	2003	2004	Geochemical Solutions	Determine the nature and extent of any release of hazardous constituents to off-site areas from and directly attributable to operations at the USS Lead Facility.	Soil, Sediment, Surface Water, and Groundwater	Antimony, Arsenic, Cadmium, Iron, Lead, and Selenium
Site-Wide Sampling and Analysis Report	2001	2001	Geochemical Solutions	This Site-Wide Sampling and Analysis Report provides data collected on the soil, sediment and surface water at the USS Lead Site to verify that the site meets remediation goals in partial :fulfillment of the Indiana Department of Environmental Management (IDEM) requirements for closure and the Partial Interim Agreed Order in Cause No. N-296.	Soil and Sediment	Antimony, Arsenic, Cadmium, Lead, Selenium
Expanded Site Inspection Work Plan For USS Lead	2007	2007	IDEM	The project objective is to determine if a high concentration of metals, specifically lead, are present within the wetland area located on the USS Lead property.	Soil and Sediment	Antimony, Arsenic, Cadmium, and Lead
Report of Canal Sampling and Analytical Results - Post Remediation	2000	2000	Law Engineering and Environmental Services, Inc.	Canal soil sampling was conducted to determine if remediation has been completed to acceptable soil contamination levels in the canal, as required in the Interim Stabilization Measures (ISM) Work Plan and Canal Remediation Work Plan	Soil and Sediment	Antimony and Lead
Canal Access Road and Holding Pond Report	2001	2001	DAI Environmental	This investigation was designed to provide data to document the areas that were used to transport (road) and contain (ponds) material from the canal excavation have also been successfully remediated	Soil and Sediment	Antimony, Arsenic, Cadmium, and Lead
USS Lead Sediment Investigation in the Grand Calumet River Area of Concern	2015	2015	Tetra Tech	Part of remedial investigations for portions of the Grand Calument River, Indiana Harbor Canal, and Lake George Canal in East Chicago, Indiana.	Soil and Sediment	Antimony, Arsenic, Cadmium, Lead, and Selenium
1997 EPA IDEM USS LEAD Q2 Progress Report	1997	1997	ENACT	RCRA progress reports	Soil and Sediment	Arsenic, Cadmium, Lead, Selenium
1997 EPA IDEM USS LEAD Q3 Progress Report	1997	1997	ENACT	RCRA progress reports	Soil and Sediment	Arsenic, Cadmium, Lead, Selenium
1999 EPA IDEM USS LEAD Q2 Progress Report	1999	1999	Geochemical Solutions	RCRA progress reports	Soil and Sediment	Arsenic, Cadmium, Lead, Selenium
2000 EPA IDEM USS LEAD Q4 Progress Report	2000	2001	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2001 EPA IDEM USS LEAD Q2 Progress Report	2001	2001	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2001 EPA IDEM USS LEAD Q3 Progress Report	2001	2001	Geochemical Solutions	RCRA progress reports	Soil, Sediment, and Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium

Table 4.2-1
Environmental Studies used for this Remedial Investigation
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Study Name	Data Collection Year	Publication Year	Study Authors	Purpose	Media	Analytes
2001 EPA IDEM USS LEAD Q4 Progress Report	2001	2001	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2002 EPA IDEM USS LEAD Q1 Progress Report	2002	2002	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2002 EPA IDEM USS LEAD Q2 Progress Report	2002	2002	Geochemical Solutions	RCRA progress reports	Soil, Sediment, and Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2002 EPA IDEM Q3 Progress Report	2002	2002	Geochemical Solutions	RCRA progress reports	Soil, Sediment, and Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2002 EPA IDEM Q4 Progress Report	2002	2002	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2003 EPA IDEM Q1 Progress Report	2003	2003	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2003 EPA IDEM Q2 Progress Report	2003	2003	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2003 EPA IDEM Q3 Progress Report	2003	2003	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2003 EPA IDEM Q4 Progress Report	2003	2003	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2004 EPA IDEM Q1 Progress Report	2004	2004	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2004 EPA IDEM Q2 Progress Report	2004	2004	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2004 EPA IDEM Q3 Progress Report	2004	2004	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2004 EPA IDEM Q4 Progress Report	2004	2004	Geochemical Solutions	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2005 EPA IDEM Q1 Progress Report	2005	2005	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2005 EPA IDEM Q2 Progress Report	2005	2005	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2005 EPA IDEM Q3 Progress Report	2005	2005	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2005 EPA IDEM Q4 Progress Report	2005	2005	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium

Table 4.2-1
Environmental Studies used for this Remedial Investigation
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Study Name	Data Collection Year	Publication Year	Study Authors	Purpose	Media	Analytes
2006 EPA IDEM Q1 Progress Report	2006	2006	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2006 EPA IDEM Q2 Progress Report	2006	2006	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2006 EPA IDEM Q3 Progress Report	2006	2006	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2006 EPA IDEM Q4 Progress Report	2006	2006	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2007 EPA IDEM Q1 Progress Report	2007	2007	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2007 EPA IDEM Q2 Progress Report	2007	2007	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2007 EPA IDEM Q3 Progress Report	2007	2007	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
2007 EPA IDEM Q4 Progress Report	2007	2007	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2008 Post Closure Monitoring Report	2008	2008	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2008 Post Closure Monitoring Report	2008	2008	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2009 Post Closure Monitoring Report	2009	2009	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2009 Post Closure Monitoring Report	2009	2009	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2010 Post Closure Monitoring Report	2010	2010	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2010 Post Closure Monitoring Report	2010	2010	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2011 Post Closure Monitoring Report	2011	2011	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2011 Post Closure Monitoring Report	2011	2011	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2012 Post Closure Monitoring Report	2012	2012	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium

Table 4.2-1
Environmental Studies used for this Remedial Investigation
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Study Name	Data Collection Year	Publication Year	Study Authors	Purpose	Media	Analytes
Second Biannual 2012 Post Closure Monitoring Report	2012	2012	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2013 Post Closure Monitoring Report	2013	2013	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2013 Post Closure Monitoring Report	2013	2013	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2014 Post Closure Monitoring Report	2014	2014	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2014 Post Closure Monitoring Report	2014	2014	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2015 Post Closure Monitoring Report	2015	2015	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2015 Post Closure Monitoring Report	2015	2015	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2016 Post Closure Monitoring Report	2016	2016	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2016 Post Closure Monitoring Report	2016	2016	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2017 Post Closure Monitoring Report	2017	2017	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Phase II Environmental Site Assessment West Calument Housing Complex East Chicago, IN 46312	2017	2017	Americo, INC.	Phase II ESA was conducted to investigate and assess environmental conditions that may be of concern during the demolition of the improvements onsite.	Soil, Sediment, and Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
No Report. Data from ETS directly.	2018	2018	ETS Environmental	RCRA progress reports and this RI	Groundwater	Antimony, Arsenic, Cadmium, Iron, Lead, Selenium, PAHs, Alkalinity, VOCs
No Report. Data from ETS directly.	2019	2019	ETS Environmental	RCRA progress reports and this RI	Groundwater	Antimony, Arsenic, Cadmium, Iron, Lead, Selenium, PAHs, Hardness, Alkalinity
First Biannual 2018 Post Closure Monitoring Report	2018	2018	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2018 Post Closure Monitoring Report	2018	2018	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium

Table 4.2-1
Environmental Studies used for this Remedial Investigation
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Study Name	Data Collection Year	Publication Year	Study Authors	Purpose	Media	Analytes
First Biannual 2019 Post Closure Monitoring Report	2019	2019	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2019 Post Closure Monitoring Report	2019	2019	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
First Biannual 2020 Post Closure Monitoring Report	2020	2020	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium
Second Biannual 2020 Post Closure Monitoring Report	2020	2020	ETS Environmental	RCRA progress reports	Groundwater	Antimony, Arsenic, Cadmium, Lead, and Selenium

Notes:
EPA = Environmental Protection Agency
ESA = Environmental Site Assessment
IDEM = Indiana Department of Environmental Management
PAHs = Polycyclic aromatic hydrocarbons
RCRA = Resource Conservation and Recovery Act
RI = Remedial Investigation
VOC = Volatile organic compound

Table 4.2-2

Sample Summary Table

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

Operable Unit	Media	Sample Type	Analyte	Historical Samples	2018-2019 Samples	2020 Samples	2021 Samples	Total Samples
OU1	Soil	Discrete	Grain Size	0	0	0	1	1
	Groundwater	Discrete	PAHs	0	27	0	0	27
	Groundwater	Discrete	Metals	710	113	0	13	836
OU2	Soil	Discrete	Metals	58	15	0	15	88
	Sediment	Discrete	Metals	372	0	0	0	372
	Sediment	ISM	Metals	0	24	0	0	24
	Sediment	ISM	AVS, SEM, TOC	0	27	0	0	27
	Surface Water	Discrete	Metals	30	4	2	2	38
	Biota	Plant	Metals	0	9	0	0	9
	Biota	Invertebrate	Metals	0	9	0	0	9

Notes:

Only groundwater under OU1 is monitored as part of the RI.

Table 7.2-1
Solubility, Kd and Volatility
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

COI	Solubility (mg/l)	Kd (cm3/g)	Volatility
Antimony	NS	4.50E+01	NV
Arsenic	NS	2.90E+01	NV
Cadmium	NS	7.50E+01	NV
Lead	NS	9.00E+02	NV
Selenium	NS	5.00E+00	NV

Notes:
NS - Not soluble
NV - Not volatile

Table 7.4-1
OU2 Discrete Soil Sample Results
Ratio of SPLP to Total Metal Concentrations in Soil
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

							Antimony	Arsenic	Cadmium	Iron	Lead	Selenium
Sample Location	Sample Name	Sample Type	Sample Date	Sample Interval (Feet)	Analysis Type	Units	Result	Result	Result	Result	Result	Result
RI1	RI1-SO1-0-24-112718	N	27-Nov-2018	0-2	SPLP	µg/L	87	61	0.42	740	34	0.81
					Total	mg/kg	13	49	1	3800	100	0.35
					SPLP/Total[1]	%	13	2.5	0.84	0.39	0.7	4.6
RI2	RI2-SO1-0-24-112718	N	27-Nov-2018	0-2	SPLP	µg/L	310	110	0.76	3800	190	0.9
					Total	mg/kg	210	410	6.5	19000	1000	1.2
					SPLP/Total	%	3.0	0.5	0.2	0.4	0.4	1.6
RI3	RI3-SO1-0-24-112718	N	27-Nov-2018	0-2	SPLP	µg/L	82	30	0.3	1500	40	0.8
					Total	mg/kg	8.3	9.5	0.2	2600	23	0.7
					SPLP/Total	%	19.8	6.3	3.7	1.2	3.5	2.4
RI4	RI4-SO1-0-24-112718	N	27-Nov-2018	0-2	SPLP	µg/L	95	17	2	870	47	1.1
					Total	mg/kg	12	8.4	3.8	2400	100	0.6
					SPLP/Total	%	16	4.0	1.2	0.7	0.9	3.5
RI5	RI5-SO1-0-24-112718	N	27-Nov-2018	0-2	SPLP	µg/L	22	5.9	0.7	3700	63	0.81
					Total	mg/kg	3.5	3.3	0.27	3100	23	0.08
					SPLP/Total	%	12.6	3.6	5.3	2.4	5	21
RI6	RI6-SO1-0-24-112718	N	27-Nov-2018	0-2	SPLP	µg/L	92	170	27	3700	88	1.7
					Total	mg/kg	11	40	12	3100	39	0.4
					SPLP/Total	%	16.7	8.5	4.5	2.4	4.5	9.7
RI7	RI7-SO1-0-24-112718	N	27-Nov-2018	0-2	SPLP	µg/L	190	7.2	4.1	2900	130	0.81
					Total	mg/kg	17	3	2	3500	60	0.14
					SPLP/Total	%	22.4	4.6	4.8	1.7	4.3	11.6
RI8	RI8-S01-0-24-091919	N	19-Sep-2019	0-2	SPLP	µg/L	160	28	0.3	2100	140	1.7
					Total	mg/kg	33	36	0.7	5000	270	0.4
					SPLP/Total	%	9.7	1.6	0.7	0.8	1.0	8.9
RI9	RI9-S01-0-24-091919	N	19-Sep-2019	0-2	SPLP	µg/L	510	130.0	0.3	2000	160	2.1
					Total	mg/kg	210	150.0	1.9	9400	1000	0.9
					SPLP/Total	%	4.9	1.7	0.34	0.4	0.3	4.5
RI10	RI10-S01-0-24-091919	N	19-Sep-2019	0-2	SPLP	µg/L	180	850	0.50	2200	70	1.5
					Total	mg/kg	65	630	2.9	13000	580	1.3
					SPLP/Total	%	5.5	2.7	0.34	0.34	0.24	2.3
RI11	RI11-S01-0-24-091919	N	19-Sep-2019	0-2	SPLP	µg/L	420	320	0.5	770	130	1.5
					Total	mg/kg	77	340	2	6700	710	0.8
					SPLP/Total	%	11	1.9	0.42	0.23	0.37	3.9
RI12	RI12-S01-0-24-091919	N	19-Sep-2019	0-2	SPLP	µg/L	55	350	13	2500	100	1.5
					Total	mg/kg	9.3	82	12	2700	35	0.2
					SPLP/Total	%	12	9	2.2	1.9	5.7	20
RI13	RI13-S01-0-24-091919	N	19-Sep-2019	0-2	SPLP	µg/L	230	6.2	31	1700	100	1.5
					Total	mg/kg	18	3.0	14	2400	64	0.2
					SPLP/Total	%	26	4.1	4.4	1.4	3.1	20
MW7(SW)	MW7(SW)-S01-(0-2')-031121	N	11 Mar 2021	0-2	SPLP	µg/L	490	30	0.6	3400	150	1.5
					Total	mg/kg	190	35	3.6	13000	800	1.9
					SPLP/Total	%	5	2	0.3	0.52	0.38	1.6
	MW7 SW-S02-(2-4')-031121	N	11 Mar 2021	2-4	SPLP	µg/L	120	20	0.2	700	8	1.5
					Total	mg/kg	10	16	0.2	2800	22	0.2
					SPLP/Total	%	24	3	2.8	0.50	0.76	13.6
	MW7 SW-S03-(4-6')-031121	N	11 Mar 2021	4-6	SPLP	µg/L	45	12	0.2	830	3	1.5
					Total	mg/kg	9	12	0.1	4800	9	0.2
					SPLP/Total	%	10	2	4.8	0.35	0.57	18.8

Table 7.4-1
OU2 Discrete Soil Sample Results
Ratio of SPLP to Total Metal Concentrations in Soil
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

							Antimony	Arsenic	Cadmium	Iron	Lead	Selenium
Sample Location	Sample Name	Sample Type	Sample Date	Sample Interval (Feet)	Analysis Type	Units	Result	Result	Result	Result	Result	Result
MW7(N)	MW7(N)-S01-(0-2')-031121	N	11 Mar 2021	0-2	SPLP	µg/L	390	33	0.2	1100	20	1.5
					Total	mg/kg	34	13	0.2	3600	57	0.3
					SPLP/Total	%	23	5	1.9	0.61	0.70	10.7
	MW7N -S02-(2-4')-031121	N	11 Mar 2021	2-4	SPLP	µg/L	110	31	0.2	650	7	1.5
					Total	mg/kg	11	10	0.1	2700	17	0.2
					SPLP/Total	%	20	6	5.8	0.48	0.81	18.8
	MW7N -S03-(4-6')-031121	N	11 Mar 2021	4-6	SPLP	µg/L	120	34	0.2	710	4.1	1.5
					Total	mg/kg	10	11	0.032	3000	7.9	0.2
					SPLP/Total	%	25	6	13.8	0	1	18.8
MW7(NE)	MW7(NE)-S01-(0-2')-031121	N	11 Mar 2021	0-2	SPLP	µg/L	100	88	0.5	660	31	1.5
					Total	mg/kg	23	24	0.5	2600	41	0.1
					SPLP/Total	%	9	7.3	2.0	1	1.5	27.3
	MW7 NE-S02-(2-4')-031121	N	11 Mar 2021	2-4	SPLP	µg/L	120	11	0.2	490	2.4	1.5
					Total	mg/kg	12	13	0.0	2100	2.8	0.2
					SPLP/Total	%	20	1.7	14	0	1.7	15.0
	MW7 NE-S03-(4-6')-031121	N	11 Mar 2021	4-6	SPLP	µg/L	220	23	0	2400	4.2	1.5
					Total	mg/kg	19	12	0	2500	4.4	0.2
					SPLP/Total	%	23	3.8	9	2	1.9	13.6
MW7NW	MW7NW-SO1-(0-2')-06032021	N	6 Jun 2021	0-2	SPLP	µg/L	1200	23	0	2400	89	1.6
					Total	mg/kg	54	31	1	4300	160	0.5
					SPLP/Total	%	44	1.5	1	1	1.1	6.3
MW7SSW	MW7SSW-SO1-(0-2')-06032021	N	6 Jun 2021	0-2	SPLP	µg/L	94	29	0	410	1.6	1.5
					Total	mg/kg	1.9	67	0	14000	31	0.1
					SPLP/Total	%	98.9	0.9	3	0	0.1	27.3
MW21R(E)	MW21R(E)-S01-(0-2')-031121	N	11 Mar 2021	0-2	SPLP	µg/L	11	5.6	4	1800	72	1.5
					Total	mg/kg	1.9	1.9	2	2200	34	0.1
					SPLP/Total	%	11.6	5.9	4	2	4.2	31.6
	QC-SO-FD-1-031121	FD	11 Mar 2021	0-2	SPLP	µg/L	11	4.9	4	1800	75	1.5
					Total	mg/kg	2.7	1.9	3	2600	35	0.1
					SPLP/Total	%	8.1	5.2	3	1	4.3	27.3
	MW21R(E)-S02-(2-4')-031121	N	11 Mar 2021	2-4	SPLP	µg/L	13	2.5	0	1500	11	1.5
					Total	mg/kg	2.6	1.8	0	2600	4.7	0.2
					SPLP/Total	%	10	2.8	4	1	4.7	20.0
	MW21R(E)-S03-(4-6')-031121	N	11 Mar 2021	4-6	SPLP	µg/L	6.5	1.1	0	710	1.4	1.5
					Total	mg/kg	1	1.3	0	2200	1.4	0.2
					SPLP/Total	%	13.4	1.7	3	1	2.0	20.0
MW21R(W)	MW21R(W)-S01-(0-2')-031121	N	11 Mar 2021	0-2	SPLP	µg/L	9.3	2.2	0.62	510	210	1.5
					Total	mg/kg	7.3	4.2	2.6	3000	1800	0.16
					SPLP/Total	%	2.55	1.05	0.48	0.34	0.23	18.75
	MW21R(W)-S02-(2-4')-031121	N	11 Mar 2021	2-4	SPLP	µg/L	13	3.9	20	920	2400	1.5
					Total	mg/kg	3.4	1.1	6.6	1200	1500	0.15
					SPLP/Total	%	7.6	7.1	6.1	1.5	3.2	20.0
	MW21R(W)-S03-(4-6')-031121	N	11 Mar 2021	4-6	SPLP	µg/L	9.9	0.47	38	180	770	1.5
					Total	mg/kg	3.7	0.87	33	1200	1700	0.15
					SPLP/Total	%	5.4	1.08	2.3	0.30	0.91	20

Table 7.4-1
OU2 Discrete Soil Sample Results
Ratio of SPLP to Total Metal Concentrations in Soil
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Sample Location	Sample Name	Sample Type	Sample Date	Sample Interval (Feet)	Analysis Type	Units	Antimony Result	Arsenic Result	Cadmium Result	Iron Result	Lead Result	Selenium Result
MW26B	MW26B-SO1-(0-2')-060321	N	6 Jun 2021	0-2	SPLP	µg/L	120	33	0.67	750	84	2.2
					Total	mg/kg	17	24	3.8	5500	520	0.35
					SPLP/Total	%	14.1	2.8	0.35	0.27	0.32	12.6
	MW26B-SO2-(2-4')-060321	N	6 Jun 2021	2-4	SPLP	µg/L	40	9.1	31	1700	350	1.5
					Total	mg/kg	10	4.5	73	3400	310	0.14
					SPLP/Total	%	8.00	4.04	0.85	1.00	2.26	21.43
	MW26B-SO3-(4-6')-060321	N	6 Jun 2021	4-6	SPLP	µg/L	51	8.2	110	2800	710	1.5
					Total	mg/kg	9.7	2	80	2600	290	0.11
					SPLP/Total	%	10.5	8.2	2.8	2.2	4.9	27.3
	QC-SO-FD-1-060321	FD	6 Jun 2021	0-2	SPLP	µg/L	100	29	0.96	970	120	2.4
					Total	mg/kg	12	29	1.9	4900	460	0.34
					SPLP/Total	%	16.7	2	1.01	0.40	0.52	14.1
MW26N	MW26N-SO1-(0-2')-060321	N	6 Jun 2021	0-2	SPLP	µg/L	310	20	45	4000	230	3.6
					Total	mg/kg	11	5.5	9.9	2900	88	0.3
					SPLP/Total	%	56.4	7.3	9.1	2.8	5.2	24
	MW26N-SO2-(2-4')-060321	N	6 Jun 2021	2-4	SPLP	µg/L	57	24	300	2400	61	1.5
					Total	mg/kg	110	130	530	66000	250	3.8
					SPLP/Total	%	1.04	0.37	1.13	0.07	0.49	0.79
	MW26N-SO3-(4-6')-060321	N	6 Jun 2021	4-6	SPLP	µg/L	61	22	200	2500	66	1.5
					Total	mg/kg	3.6	4.4	16	2500	11	0.13
					SPLP/Total	%	33.89	10.0	25.00	2.00	12.00	23.08
MW26W	MW26W-SO1-(0-2')-060321	N	6 Jun 2021	0-2	SPLP	µg/L	100	53	16	7500	1600	1.5
					Total	mg/kg	5.8	4.1	3.1	2600	320	0.12
					SPLP/Total	%	34.5	25.9	10.3	5.8	10.0	25
	MW26W-SO2-(2-4')-060321	N	6 Jun 2021	2-4	SPLP	µg/L	23	5	3.6	4200	81	1.5
					Total	mg/kg	3.8	2.3	3.3	3600	21	0.15
					SPLP/Total	%	12.11	4.35	2.18	2.33	7.71	20
	MW26W-SO3-(4-6')-060321	N	6 Jun 2021	4-6	SPLP	µg/L	22	3.9		3500	57	1.5
					Total	mg/kg	2.8	1.5	6.8	2400	9.3	0.14
					SPLP/Total	%	15.7	5.20	0.0	2.92	12.3	21.4
MW26S	MW26S-SO1-(0-2')-060321	N	6 Jun 2021	0-2	SPLP	µg/L	20	6.4	1.3	440	270	1.5
					Total	mg/kg	6.1	5.2	2.4	2400	600	0.11
					SPLP/Total	%	6.6	2.5	1.1	0.37	0.90	27.3
	MW26S-SO2-(2-4')-060321	N	6 Jun 2021	2-4	SPLP	µg/L	17	5.6	1	920	180	1.5
					Total	mg/kg	5.2	2.4	4	2200	130	0.11
					SPLP/Total	%	6.5	4.7	0.50	0.84	2.8	27.3
	MW26S-SO3-(4-6')-060321	N	6 Jun 2021	4-6	SPLP	µg/L	37	3.2	11	1700	190	1.5
					Total	mg/kg	5	1.4	13	2600	49	0.13
					SPLP/Total	%	14.8	4.6	1.7	1.3	7.8	23.1
				MIN	SPLP/Total	%	1.04	0.37	0.00	0.06	0.10	0.79
				MAX	SPLP/Total	%	98.9	25.9	25.0	5.8	12.3	31.6
				AVG	SPLP/Total	%	17.35	4.45	3.75	1.15	2.91	16.15

Notes:
N = Normal (or investigative) sample
Total = total metals analyzed in solid sample
SPLP = metals analyzed by Synthetic Precipitation Leaching Procedure
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
% = percent

[1] SPLP results were converted to soil concentration by multiplying by 20 and then converted to milligrams by dividing by 1000. The resulting value was divided by the total concentration and converted to a percent.

Table 7.4-2
OU2 Discrete Sediment Sample Results
Bioavailability Calculations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Sample	Cadmium-SEM		Copper-SEM		Lead-SEM		Nickel-SEM		Silver-SEM		Zinc-SEM		Sample	∑SEM	AVS		fOC	(∑SEM-AVS) / fOC	Bioavailability[1]		
	µmol/g	DV Quals	µmol/g	DV Quals	µmol/g	DV Quals	µmol/g	DV Quals	µmol/g	DV Quals	µmol/g	DV Quals		µmol/g	µmol/g	DV Quals		(µmole/gOC)	No	Uncertain	Likely
DU1A	0.14	J	1.3	J	8.1	J	0.67		0.00060	UJ	15	J	DU1A	25.2106	0.48	UJ	0.085	290.95		*	
DU1B	0.0071	J	0.31	J	0.56	J	0.34		0.0012	J	1.1	J	DU1B	2.3183	0.25	UJ	0.036	57.45	*		
DU1C	0.16	J	2.4	J	6.3	J	0.32		0.013	J	41	J	DU1C	50.1930	0.36	UJ	0.089	559.92		*	
DU2A	0.018		0.32		0.58		0.48		0.00039	U	6.9		DU2A	8.2984	0.31	U	0.050	159.77		*	
DU2B	0.028		0.17		0.26		0.29		0.00033	U	4.6		DU2B	5.3483	0.32	J	0.031	162.20		*	
DU2C	0.023		0.32		0.76		0.51		0.00038	U	7.4		DU2C	9.0134	0.30	U	0.072	121.02	*		
DU3A	0.010		0.23	J	0.20	J+	0.39		0.00038	UJ	3.7	J	DU3A	4.5304	0.30	U	0.025	169.22		*	
DU3B	0.033	J	0.16	J	0.14	J	0.38		0.00038	UJ	7.4	J	DU3B	8.1134	0.42	J	0.039	197.27		*	
DU3B dup	0.070	J	0.26	J	1.1	J	0.52		0.00041	UJ	8.8	J	DU3B dup	10.7504	0.94	J	0.061	160.83		*	
DU3C	0.0046		0.15	J	0.16	J+	0.20		0.00037	UJ	1.8	J	DU3C	2.3150	0.29	U	0.028	72.32	*		
DU4A	0.013		0.21		0.59		0.27		0.00037	U	3.5		DU4A	4.5834	0.30	U	0.044	97.35	*		
DU4B	0.052		0.092		0.53		0.28		0.00038	U	7.2		DU4B	8.1544	2.3		0.071	82.46	*		
DU4C	0.079		0.39		1.7		0.58		0.00042	U	9.8		DU4C	12.5494	1.4		0.079	141.13		*	
DU4C dup	0.084		0.25		1.1		0.55		0.00042	U	10		DU4C dup	11.9844	1.8		0.096	106.09	*		
DU5A	0.090		0.41		1.5		0.41		0.00053	U	9.5		DU5A	11.9105	1.8		0.081	124.82	*		
DU5B	0.046		0.18		1.6		0.28		0.00055	U	6.8		DU5B	8.9066	7.3		0.100	16.07	*		
DU5C	0.46	J	0.11	J	1.8	J	0.62		0.00090	UJ	25	J	DU5C	27.9909	20		0.230	34.74	*		
DU6A	0.25		0.22	J-	0.34	J-	0.90		0.00052	UJ	82		DU6A	83.7105	20		0.068	936.92		*	
DU6B	0.15		0.21	J-	0.43	J-	0.47		0.00035	UJ	11		DU6B	12.2604	0.69	J	0.035	330.58		*	
DU6C	0.37		0.51	J-	1.2	J-	0.63		0.00045	UJ	26		DU6C	28.7105	2.9		0.043	600.24		*	
DU7A	0.027		0.20		0.13		0.35		0.00033	U	8.2		DU7A	8.9073	0.91		0.046	173.86		*	
DU7B	0.79	J	0.12	J	1.8	J	0.86		0.00048	U	78		DU7B	81.5705	14	J	0.087	776.67		*	
DU7B dup	0.38	J	0.22	J	0.55	J	0.99		0.00042	U	59		DU7B dup	61.1404	2.6	J	0.067	873.74		*	
DU7C	0.12		0.34		0.87		0.31		0.00041	U	6.7		DU7C	8.3404	0.35	J	0.049	163.07		*	
DU8A	0.34		0.065		0.92		0.60		0.00075	U	76		DU8A	77.9258	40		0.250	151.70		*	
DU8B	0.45		1.1		10		0.39		0.00073	U	27		DU8B	38.9407	9.5		0.210	140.19		*	
DU8C	0.32		0.46		4.0		0.52		0.00055	U	82		DU8C	87.3006	32		0.190	291.06		*	

Notes:
SEM = simultaneously extracted metals
AVS = acid volatile sulfide
fOC = fraction of organic carbon
∑SEM = sum of SEM concentrations
µmole/g = micromoles per gram
µmole/gOC = micromoles per gram organic carbon
dup = duplicate
DV Qual = final data qualifier after data validation

J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
U = The analyte was analyzed for, but was not detected above the level of the reported sample quantitation limit.
UJ = The analyte was analyzed for, but was not detected. The reported quantitation limit is approximate and may be inaccurate or imprecise.
J- = The result is an estimated quantity, but the result may be biased low.
J+ = The result is an estimated quantity, but the result may be biased high.

Footnote
[1] *USEPA. 2005. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver, and Zinc). 600-R-02-011. Office of Research and Development. Washington, DC.*

Table 7.4-3
OU2 ICM Soil Sample Results
Ratio of SEM to Total Metal Concentrations in Sediment
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

					Antimony	Arsenic	Cadmium	Lead
Decision Unit	Replicate	Sample Name	Analysis Type	Units	Result	Result	Result	Result
DU1	*1/A*	DU1-SE1-0-6-112818	SEM	mmol/g	0.00022	0.00320	0.00014	0.00810
			Total	mg/kg	47	320	12	980
			SEM/Total	%	57	75	131	171
	2/B	DU1-SE2-0-6-112818	SEM	mmol/g	0.000019	0.00024	0.0000071	0.00056
			Total	mg/kg	49	390	14	1100
			SEM/Total	%	5	5	6	11
	3/C	DU1-SE3-0-6-112818	SEM	mmol/g	0.00015	0.0021	0.00016	0.0063
			Total	mg/kg	51	390	13	1100
			SEM/Total	%	35.8	40	138	119
DU2	*1/A*	DU2-SE1-0-6-112918	SEM	mmol/g	0.0000095	0.0006	0.000018	0.00058
			Total	mg/kg	39	410	6	710
			SEM/Total	%	2.97	11	33.72	17
	2/B	DU2-SE2-0-6-112918	SEM	mmol/g	0.000013	0.00091	0.000028	0.00026
			Total	mg/kg	20	270	4	390
			SEM/Total	%	7.91	25	79	14
	3/C	DU2-SE3-0-6-112918	SEM	mmol/g	0.000047	0.0011	0.000023	0.00076
			Total	mg/kg	27	290	4.6	450
			SEM/Total	%	21	28.4	56.21	35.0
DU3	*1/A*	DU3-SE1-0-6-120518	SEM	mmol/g	0.0000044	0.0017	0.00001	0.0002
			Total	mg/kg	11	240	5.4	260
			SEM/Total	%	5	53	20.82	16
	2/B	DU3-SE2-0-6-120518	SEM	mmol/g	0.0000014	0.00046	0.000033	0.00014
			Total	mg/kg	15	290	7.4	340
			SEM/Total	%	1	12	50	9
	3/C	DU3-SE3-0-6-120518	SEM	mmol/g	0.0000049	0.00018	0.0000046	0.00016
			Total	mg/kg	12	260	7	400
			SEM/Total	%	5	5.2	7.39	8.3
DU4	*1/A*	DU4-SE1-0-6-120618	SEM	mmol/g	0.0000053	0.00024	0.000013	0.00059
			Total	mg/kg	15	230	7.3	350
			SEM/Total	%	4	8	20.02	35
	2/B	DU4-SE2-0-6-120618	SEM	mmol/g	0.0000014	0.00028	0.000052	0.00053
			Total	mg/kg	11	200	7.3	290
			SEM/Total	%	2	10	80	38
	3/C	DU4-SE3-0-6-120618	SEM	mmol/g	0.00007	0.0015	0.000079	0.0017
			Total	mg/kg	16	270	7.9	420
			SEM/Total	%	53	41.6	112.41	83.9
DU5	*1/A*	DU5-SE1-0-6-120718	SEM	mmol/g	0.000022	0.001	0.00009	0.0015
			Total	mg/kg	34	550	21	660
			SEM/Total	%	8	14	48.18	47
	2/B	DU5-SE2-0-6-120718	SEM	mmol/g	0.000016	0.0005	0.000046	0.0016
			Total	mg/kg	36	590	19	800
			SEM/Total	%	5	6	27	41
	3/C	DU5-SE3-0-6-120718	SEM	mmol/g	0.0000032	0.00075	0.00046	0.0018
			Total	mg/kg	33	570	15	640
			SEM/Total	%	1	9.9	344.73	58.3

Table 7.4-3
OU2 ICM Soil Sample Results
Ratio of SEM to Total Metal Concentrations in Sediment
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

					Antimony	Arsenic	Cadmium	Lead
Decision Unit	**Replicate**	**Sample Name**	**Analysis Type**	**Units**	**Result**	**Result**	**Result**	**Result**
DU6	*1/A*	DU6-SE1-0-6-120418	SEM	mmol/g	0.0000019	0.00037	0.00025	0.00034
			Total	mg/kg	26	320	56	680
			SEM/Total	%	1	9	50.18	10
	2/B	DU6-SE2-0-6-120418	SEM	mmol/g	0.000009	0.00089	0.00015	0.00043
			Total	mg/kg	28	320	57	890
			SEM/Total	%	4	21	30	10
	3/C	DU6-SE3-0-6-120418	SEM	mmol/g	0.000034	0.0016	0.00037	0.0012
			Total	mg/kg	30	380	65	950
			SEM/Total	%	14	31.5	63.99	26.2
DU7	*1/A*	DU7-SE1-0-6-120318	SEM	mmol/g	0.0000012	0.000071	0.000027	0.00013
			Total	mg/kg	16	200	33	640
			SEM/Total	%	1	3	9.20	4
	2/B	DU7-SE2-0-6-120318	SEM	mmol/g	0.0000042	0.00018	0.00079	0.0018
			Total	mg/kg	12	180	29	590
			SEM/Total	%	4	7	306	63
	3/C	DU7-SE3-0-6-120318	SEM	mmol/g	0.000011	0.00047	0.00012	0.00087
			Total	mg/kg	15	180	33	690
			SEM/Total	%	9	19.6	40.88	26.1
DU8	*1/A*	DU8-SE1-0-6-113018	SEM	mmol/g	0.0000027	0.000093	0.00034	0.00092
			Total	mg/kg	46	310	64	1800
			SEM/Total	%	1	2	59.72	10.59073333
	2/B	DU8-SE2-0-6-113018	SEM	mmol/g	0.00025	0.0015	0.00045	0.01
			Total	mg/kg	44	300	56	1500
			SEM/Total	%	69	37	90	138.14
	3/C	DU8-SE3-0-6-113018	SEM	mmol/g	0.0000098	0.00057	0.00032	0.004
			Total	mg/kg	48	280	58	1500
			SEM/Total	%	2	15.3	62.02	55.3

Notes:

N = Normal (or investigative) sample

Total = total metals analyzed in solid sample

SPLP = metals analyzed by Synthetic Precipitation Leaching Procedure

mg/kg = milligrams per kilogram

µg/L = micrograms per liter

% = percent

Key

∑SEM = sum of simultaneously extracted metals concentrations

AVS = acid volatile sulfide

µmole/g = micromoles per gram

fOC = fraction of organic carbon

µmole/gOC = micromoles per gram organic carbon

Footnote

[1] USEPA. 2005. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver, and Zinc). 600-R-02-011. Office of Research and Development. Washington, DC.

APPENDICES

APPENDIX A ENVIRONMENTAL RESTRICTIVE COVENANT

File: [redacted]
[redacted] USS Lead.

SWIDLER BERLIN LLP

Robert N. Steinwurtzel
Phone 202.424.7830
Fax 202.424.7645
rnsteinwurtzel@swidlaw.com

The Washington Harbour
3000 K Street, N.W., Suite 300
Washington, D.C. 20007-5116
Phone 202.424.7500
Fax 202.424.7647
www.swidlaw.com

June 9, 2005

RECEIVED
JUN 14 2005
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
OFFICE OF LAND QUALITY

VIA CERTIFIED MAIL, RETURN RECEIPT

Office of the Recorder for Lake County
Building 'A,' 2nd Floor
2293 North Main Street
Crown Point, IN 46307

Dear Sir or Madame:

On behalf of USS Lead Refinery, Inc., 5300 Kennedy Avenue, East Chicago, Indiana, we are hereby submitting an Environmental Restrictive Covenant to be recorded for the property along with a filing fee of $17.00.

The Environmental Restrictive Covenant is being recorded in accordance with the regulations promulgated by the Indiana Department of Environmental Management (IDEM) in connection with IDEM's issuance of a Post Closure Permit for the facility. Specifically, since chemicals of concern have been deposited at the facility, IDEM requires USS Lead Refinery, Inc. to record the Environmental Restrictive Covenant to protect the environment and public health.

Please provide me with confirmation that the Environmental Restrictive Covenant has been recorded by your office. Thank you.

Sincerely,

Robert N. Steinwurtzel

Robert N. Steinwurtzel

Enclosures: Environmental Restrictive Covenant with Exhibit A
Filing Fee

cc: Ruth Jean, IDEM (with encls.)
Norman S. Johnson, USS Lead Refinery, Inc. (w/o encls.)

ENVIRONMENTAL RESTRICTIVE COVENANT

THIS COVENANT is made this 6th day of June, 2005, by USS Lead Refinery, Inc. ("USS Lead"), located at 5300 Kennedy Avenue, East Chicago, Indiana (together with his/her/its/their successors and assignees, collectively "Owner").

WHEREAS: Owner owns certain real estate in the County of Lake, Indiana, which is more particularly described in the attached legal description (Exhibit "A") and made a part hereof ("Real Estate").

WHEREAS: Hazardous waste or hazardous constituents are present on said Real Estate, where USS Lead (EPA ID No. IND047030226) operated waste storage piles. A map showing the location where the chemicals of concern have been deposited into the Corrective Action Management Unit ("CAMU") is attached hereto along with the legal description as Exhibit "A".

WHEREAS: As a result of the presence of hazardous waste or hazardous constituents, a Closure Plan was prepared and implemented in accordance with Indiana law. The Closure Plan, a survey of affected areas of the Real Estate, and a list of the chemicals of concern remaining on the Real Estate are incorporated herein by reference and may be examined at the offices of the Commissioner of the Indiana Department of the Environmental Management ("the Department").

WHEREAS: The Closure Plan, as approved by the Indiana Department of Environmental Management, provides that certain chemicals of concern will remain on or beneath the surface of the Real Estate, therefore requiring an institutional control (Restrictive Covenant). This Environmental Restrictive Covenant is necessary to ensure the protection of public health and the environment.

WHEREAS: Based on the level of cleanup achieved, the intention of this Environmental Restrictive Covenant is to restrict the use of this land to commercial/industrial purposes.

NOW THEREFORE, Owner, hereby in consideration for the promises contained herein and other good and valuable consideration, imposes restrictions on the Real Estate and covenants and agrees that:

1. Any conveyance of title, easement, or other interest in the Real Estate shall provide for prevention of exposure to chemicals of concern in accordance with item 3, below.

2. The Owner shall grant to the Department and its designated representatives the right to enter upon the Real Estate at reasonable times and upon advance notice for the purpose of determining the land use restrictions described in item 3 are being maintained to ensure the protection of public health, safety or welfare, and the environment, including, but not limited to, the right to take samples and inspect records.

3. The Owner shall:

a. Neither engage in nor allow installation or use of drinking water wells.

b. Neither engage in nor allow the use of the Real Estate for residential purposes, including the placement of any residential buildings for use as a human dwelling place.

c. Neither engage in nor allow off-site placement of surface or sub-surface soil emanating from the Real Estate unless soil is properly sampled and characterized for appropriate use or disposal.

d. Neither engage in nor allow any activity that will impact, damage or threaten the integrity of the CAMU which extends over approximately 11 acres and consists of three components: (i) a six inch layer of compacted sand; (ii) a geosynthetic clay liner covered by a high-density polyethylene geomembrane; and (iii) a 36 inch layer of sand with a vegetative base.

e. Neither engage in nor allow any activity that will impact, damage or threaten the integrity of either (i) the slurry wall installed to a depth of approximately 34 feet surrounding the CAMU, or (ii) the groundwater monitoring wells installed around the CAMU.

4. By taking title to the Real Estate, any subsequent owner agrees to comply with these restrictions and the terms of this Covenant.

5. The restrictions and other requirements described in this Covenant shall run with the land and be binding on the Owner and the Owner's successors, assignees, and lessees or their authorized agents, employees, contractors, representatives, agents, lessees, licensees, invitees, guests, or persons acting under their direction or control. No transfer, mortgage, lease, license, easement, or other conveyance of any interest in all or any part of the Real Estate by any person shall limit the restrictions set forth herein.

6. The restrictions shall apply until the Indiana Department of Environmental Management determines that the chemicals of concern no longer present an unacceptable risk to the public health, safety, or welfare, or to the environmental. This Covenant shall not be amended, modified, or terminated except by written instrument executed between the Department and the owner of the Real Estate at the time of the proposed amendment, modification or termination. Within five (5) days of executing an amendment, modification, or termination of the Covenant, such amendment, modification or termination shall be recorded with the Office of the Recorder of Lake County and within five (5) days after recording, a true copy of the recorded amendment, modification, or termination shall be presented to the Department.

7. In no event shall this Covenant be rendered unenforceable if Indiana's Risk Integrated System of Closure guidelines for environmental restrictive covenants, institution or engineering controls, or land use restrictions change as to form or content.

8. The parties to this Covenant shall have the right to demand and seek specific performance and/or immediate injunctive relief to enforce this Covenant in addition to any other remedies they may have at law or at equity.

9. No failure on the part of the Department at any time to require performance by any person of any term of this Covenant shall be taken or held to be a waiver of such term or in any way affect the Department's right to enforce such term, and no waiver on the part of the Department of any term hereof shall be taken or held to be a waiver of any other term hereof or the breach thereof.

10. The undersigned persons executing this Covenant on behalf of the Owner represent and certify that they are duly authorized and have been fully empowered to execute, record, and deliver this Covenant.

Owner hereby attests to the accuracy of the statements in this document and all attachments.

IN WITNESS WHEREOF, the said Owner of the Real Estate described above has caused this Environmental Restrictive Covenant to be executed on this 6th day of June, 2005.

Michael Baum
Michael Baum
President,
USS Lead Refinery, Inc.

STATE OF ARKANSAS

COUNTY OF Cross SS:

BEFORE ME, the undersigned a Notary Public in and for said County and State, personally appeared Michael Baum, and he did sign said instrument in his capacity as representative of USS Lead Refinery, Inc., acknowledging and affirming the execution of the foregoing instrument.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my official seal this 6th day of June, 2005.

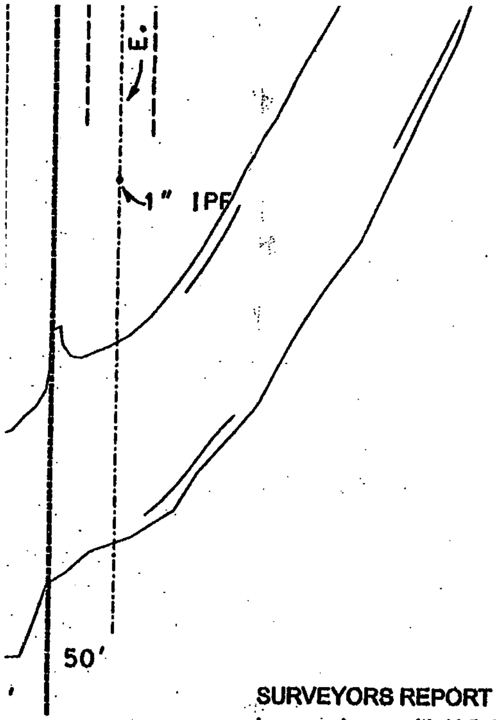
My county of residence is:
Cross County, Arkansas

Jennifer Hale
Signature of Notary Public

Jennifer Hale
Printed Name of Notary

Jennifer Hale
My Comm. Exp.
NOTARY
PUBLIC
Sept. 14, 2009
Cross County Arkansas

My Commission expires:
9/14/09



SURVEYORS REPORT

In accordance with IAC 865 1-29 (Rule 12), this survey was conducted as a retracement survey of the subject property. A reconnaissance was made by the surveyor to locate controlling physical monuments within the vicinity of the subject property. A copy of a Plat of Survey performed by Hylton E. Donaldson of Great Lakes Engineering, dated July 27th, 1999 was used for this retracement.

A: Availability and condition of reference monuments: Monuments were found and are indicated on the plat. The found monumentation is consistent with platted dimensions and were used for retracement purposes.

B: Occupation or possession lines: The occupation lines were consistent with the deed lines.

C: Clarity or ambiguity of the record description: No apparent uncertainty.

D: The theoretical uncertainty of measurements (due to random errors in measurements): This survey is consistent with a Class D survey which has an allowable theoretical uncertainty of plus or minus 1.00 feet.

PLAT OF SURVEY PREPARED FOR: U.S.S. LEAD REFINERY INC.	SHEET 1 OF 1 PROJECT USLØ1 SCALE 1"= 150'

Ref. 1 large format drawing for add'l info.

EXHIBIT A

APPENDIX B BORING LOGS FOR GROUNDWATER MONITORING WELLS

OU1 Well Logs

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW1

Client: USS Lead **Project Name:** USS Lead Superfund Site

Project Number: 0432213 **Project Location:** East Chicago, IN

DATE STARTED: 11/27/2018 **TOTAL DEPTH:** 15 ft BGS **GROUND ELEVATION:** 584.49 ft bgs

DATE COMPLETED: 11/27/2018 **DIAMETER:** 7.25 inches **TOC ELEVATION:** 584.121 ft BGS

DRILLING CONTRACTOR: Geoserve, Inc **LOGGED BY:** Jay S. Kim (ERM) **NORTHING:** 2323748.99 N/A

DRILLING METHOD: Geoprobe 7720DT (Track) **CHECKED BY:** **EASTING:** 2849920.604 N/A

DRILLING EQUIPMENT: Geoprobe 7720DT (Track) **DRILLER:** Matt **GROUNDWATER DEPTH:** 4 ft BGS TOC

SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot

NOTES: HA to 5', 5-15' Geoprobe/HSA (3.25" ID), Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)	WELL DIAGRAM
		HA 1	12	SM	1.0	FINE TO MEDIUM SILTY SAND, Brown (10YR 5/3), subrounded <5% trace organics, black (10YR 2/1), poorly sorted, loose, dry.		0.7" Steel Casing (8.5"); 0-1' Grouted to top
		HA 2	12	SM	3.0	FINE TO MEDIUM SILTY SAND, Brown (10YR 3/3), subangular <5% trace organics, black (10YR 2/1), poorly sorted, loose to dense, moist, orange mottling.		1-2' Bentonite Chips
		HA 3	12					2-13' No 5 Sand
		HA 4	12	SM	4.0	FINE TO MEDIUM SILTY SAND, Dark Yellow Brown (10YR 3/4), subrounded trace roots, poorly sorted, dense, wet.		
5	579	HA 5	12	SM	6.0	Water at 4' BGS. FINE TO MEDIUM SILTY SAND, Very Dark Brown (10YR 2/2), subrounded Macroinvertebrate shells (<5%), poorly sorted, dense, wet.		
		DP 6	32	SM	10.0	FINE SAND, Yelllowish Brown (10YR 5/4), subrounded poorly sorted, dense, wet. <1" thick layer of trace organics, black (10YR 2/1) at 10' BGS.		3-13' Screen
10	574	DP 7	40					
15	569	DP 8	36	SM	15.0	FINE SAND, Very Dark Greyish Brown (10YR 3/2), subrounded poorly sorted, dense, wet.		

Bottom of Boring @ 15.00 ft bgs

SAMPLE TYPE

- Hand Auger
- Direct Push

GRAPHIC LOG LEGEND

- Silty Sand

ACRONYM LEGEND

amsl = above mean sea level
BGS = below ground surface
DP = Direct Push
EOB = End of Boring
' = Feet
NR = No Recovery
MW = Monitoring Well
PID = Photoionization Detector
PVC = Polyvinylchloride Casing
SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW2

Client: USS Lead | **Project Name:** USS Lead Superfund Site
Project Number: 0432213 | **Project Location:** East Chicago, IN

DATE STARTED: 11/27/2018 | **TOTAL DEPTH:** 15 ft BGS | **GROUND ELEVATION:** 587.403 ft bgs
DATE COMPLETED: 11/27/2018 | **DIAMETER:** 7.25 inches | **TOC ELEVATION:** 587.12 ft BGS
DRILLING CONTRACTOR: Geoserve, Inc | **LOGGED BY:** Jay S. Kim (ERM) | **NORTHING:** 2323646.631 N/A
DRILLING METHOD: Geoprobe 7720DT (Track) | **CHECKED BY:** | **EASTING:** 2851487.801 N/A
DRILLING EQUIPMENT: Geoprobe 7720DT (Track) | **DRILLER:** Matt | **GROUNDWATER DEPTH:** 5 ft BGS TOC
SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot
NOTES: HA to 5', 5-15' Geoprobe/HSA (3.25" ID), Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)	WELL DIAGRAM
		HA 1	12	FILL	0.5	FILL, Black (10YR 2/1), subrounded loose, dry.		0.7" Steel Casing (8.5"); 0-1' Grouted to top
		HA 2	12	SM	2.0	FINE TO MEDIUM SILTY SAND, Light Yellow Brown (10YR 4/4), poorly sorted, loose, dry.		1-2' Bentonite Chips
		HA 3	12	SM		FINE TO MEDIUM SILTY SAND, Dark Yellow Brown (10YR 6/4), subrounded poorly sorted, loose to dense, dry to moist.		2-13' No 5 Sand
		HA 4	12					
5	582	HA 5	12		5.0	Small 1" ceramic fragment.		
		DP 6	26	SM		water at 5' BGS. FINE SILTY SAND, Dark Yellow Brown (10YR 6/4), subrounded poorly sorted, dense, wet. <5% coarse sand grains present.		3-13' Screen
10	577	DP 7	36		11.0	1" subangular erratic present.		
15	572	DP 8	34	SM	15.0	<5% coarse grained SAND present throughout 12-15' BGS. FINE SILTY SAND, Very Dark Gray (10YR 3/1), subrounded poorly sorted, dense, wet. <1" thick layer of trace organics, black (10YR 2/1) at 13' BGS.		

Bottom of Boring @ 15.00 ft bgs

SAMPLE TYPE
- Hand Auger
- Direct Push

GRAPHIC LOG LEGEND
- Fill Materials
- Silty Sand

ACRONYM LEGEND
amsl = above mean sea level
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PVC = Polyvinylchloride Casing
SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

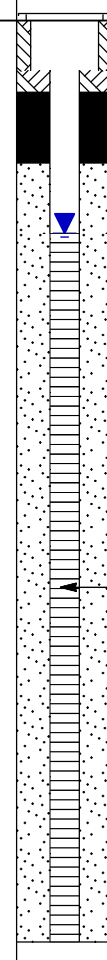
OU1MW3

Client: USS Lead
Project Name: USS Lead Superfund Site
Project Number: 0432213
Project Location: East Chicago, IN

DATE STARTED: 11/27/2018
TOTAL DEPTH: 15 ft BGS
GROUND ELEVATION: 586.203 ft bgs
DATE COMPLETED: 11/27/2018
DIAMETER: 7.25 inches
TOC ELEVATION: 585.723 ft BGS
DRILLING CONTRACTOR: Geoserve, Inc
LOGGED BY: Jay S. Kim (ERM)
NORTHING: 2322357.69 N/A
DRILLING METHOD: Geoprobe 7720DT (Track)
CHECKED BY:
EASTING: 2850272.677 N/A
DRILLING EQUIPMENT: Geoprobe 7720DT (Track)
DRILLER: Matt
GROUNDWATER DEPTH: 3 ft BGS TOC
SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot
NOTES: HA to 5', 5-15' Geoprobe/HSA (3.25" ID), Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
		HA 1	12	FILL	1.0	FILL, Black (10YR 2/1), trace roots, loose, dry.	
		HA 2	12	SM		Water at 3' BGS. FINE TO MEDIUM SILTY SAND, Brown (10YR 4/3), subrounded poorly sorted, loose to dense, dry to wet.	
		HA 3	12				
		HA 4	12				
5	581	HA 5	12		6.0		
		DP 6	27	SM	7.0	FINE TO MEDIUM SILTY SAND, Dark Brown (10YR 3/3), subrounded poorly sorted, dense, wet.	
				SM	8.0	FINE TO MEDIUM SILTY SAND, Very Dark Greyish Brown (10YR 3/2), subrounded poorly sorted, dense, wet.	
10	576	DP 7	33	SM		FINE SILTY SAND, Very Dark Greyish Brown (10YR 3/2), subrounded poorly sorted, dense, wet.	
15	571	DP 8	36		15.0		

WELL DIAGRAM



Bottom of Boring @ 15.00 ft bgs

SAMPLE TYPE
- Hand Auger
- Direct Push

GRAPHIC LOG LEGEND
- Fill Materials
- Silty Sand

ACRONYM LEGEND
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TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW3D

Client: USS Lead **Project Name:** USS Lead Superfund Site

Project Number: 0432213 **Project Location:** East Chicago, IN

DATE STARTED: 11/27/2018
DATE COMPLETED: 11/27/2018
DRILLING CONTRACTOR: Geoserve, Inc
DRILLING METHOD: Geoprobe 7720DT (Track)
DRILLING EQUIPMENT: Geoprobe 7720DT (Track)

TOTAL DEPTH: 30 ft BGS
DIAMETER: 7.25 inches
LOGGED BY: Jay S. Kim (ERM)
CHECKED BY:
DRILLER: Matt

GROUND ELEVATION: 586.073 ft bgs
TOC ELEVATION: 585.843 ft BGS
NORTHING: 2322361.455 N/A
EASTING: 2850273.074 N/A
GROUNDWATER DEPTH: 3 ft BGS TOC

SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot
NOTES: HA to 5', 5-20' Geoprobe/HSA (3.25" ID), 20-30' HSA, Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
		HA 1	12	FILL	1.0	FILL, Black (10YR 2/1), trace roots, loose, dry.	
		HA 2	12	SM		Water at 3' BGS.	
		HA 3	12			FINE TO MEDIUM SILTY SAND, Brown (10YR 4/3), subrounded poorly sorted, loose to dense, dry to wet.	
		HA 4	12				
5	581	HA 5	12		6.0		
		DP 6	27	SM	7.0	FINE TO MEDIUM SILTY SAND, Dark Brown (10YR 3/3), subrounded poorly sorted, dense, wet.	
				SM	8.0	FINE TO MEDIUM SILTY SAND, Very Dark Greyish Brown (10YR 3/2), subrounded poorly sorted, dense, wet.	
10	576	DP 7	33	SM		FINE SILTY SAND, Very Dark Greyish Brown (10YR 3/2), subrounded poorly sorted, dense, wet.	
15	571	DP 8	48				

WELL DIAGRAM

SAMPLE TYPE
- Hand Auger
- Direct Push
- Auger Cuttings

GRAPHIC LOG LEGEND
- Fill Materials
- Silty Sand

ACRONYM LEGEND
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TMW = Temporary Monitoring Well
TOC = top of casing

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OU1MW3D

Client: USS Lead **Project Name:** USS Lead Superfund Site

Project Number: 0432213 **Project Location:** East Chicago, IN

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)	WELL DIAGRAM
20	566	DP 9	42					
25	561	AU 10	120	SM		Heaving sand present at 20' BGS, could not sample with pushprobe, switched to HSA, lithologies below described from HSA cuttings. <5% coarse grained SAND fragments present from 22-30' BGS. FINE SILTY SAND, Very Dark Greyish Brown (10YR 3/2), subrounded poorly sorted, dense, wet. *(continued)*		23.5-29.5' No 5 Sand 24.5-29.5' Screen
30	556					30.0		
						Bottom of Boring @ 30.00 ft bgs		

SAMPLE TYPE

- Hand Auger
- Direct Push
- Auger Cuttings

GRAPHIC LOG LEGEND

- Fill Materials
- Silty Sand

ACRONYM LEGEND

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EOB = End of Boring
' = Feet
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SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
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ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW4

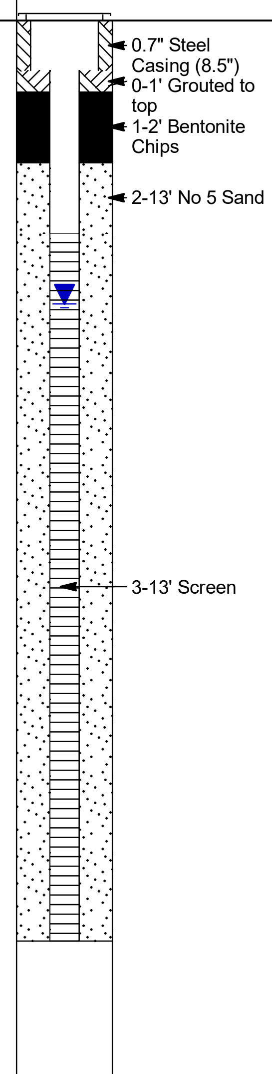
PAGE 1 OF 1

Client: USS Lead
Project Name: USS Lead Superfund Site
Project Number: 0432213
Project Location: East Chicago, IN

DATE STARTED: 11/28/2018
TOTAL DEPTH: 15 ft BGS
GROUND ELEVATION: 587.22 ft bgs
DATE COMPLETED: 11/28/2018
DIAMETER: 7.25 inches
TOC ELEVATION: 587.003 ft BGS
DRILLING CONTRACTOR: Geoserve, Inc
LOGGED BY: Jay S. Kim (ERM)
NORTHING: 2322126.058 N/A
DRILLING METHOD: Geoprobe 7720DT (Track)
CHECKED BY:
EASTING: 2849377.876 N/A
DRILLING EQUIPMENT: Geoprobe 7720DT (Track)
DRILLER: Matt
GROUNDWATER DEPTH: 4 ft BGS TOC
SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot
NOTES: HA to 5', 5-15' Geoprobe/HSA (3.25" ID), Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
		HA 1	12	FILL		FILL, Black (10YR 2/1) to Strong Brown (7.5YR 5/6), trace subrounded fine sand, trace roots, poorly sorted, brittle, dry, orange mottling.	
		HA 2	12				
		HA 3	12		3.0		
		HA 4	12	SM	4.0	FINE TO MEDIUM SILTY SAND, Dark Yellow Brown (10YR 3/4), subrounded trace roots, poorly sorted, loose to dense, moist.	
5	582	HA 5	12	SM	5.0	water at 4' BGS. FINE TO MEDIUM SILTY SAND, Dark Yellow Brown (10YR 3/4), subrounded <5% organics, black (10YR 2/1), trace orange mottling, poorly sorted, dense, wet.	
		DP 6	28	SM	8.0	FINE TO MEDIUM SILTY SAND, Dark Yellow Brown (10YR 3/4), subrounded <5% trace organics, black (10YR 2/1), tiny woodchunks spotted (possible slough from top), poorly sorted, dense, wet.	
10	577	DP 7	36	SM	12.0	FINE SILTY SAND, Very Dark Greyish Brown (10YR 3/3), subrounded <5% trace organics, black (10YR 2/1), <5% coarse sand grains present, <0.5" Fine to Medium SILTY SAND lenses present at 9' & 10' BGS, poorly sorted, dense, wet.	
15	572	DP 8	26	SM	15.0	FINE TO MEDIUM SILTY SAND, Very Dark Greyish Brown (10YR 3/3), subrounded <5% trace organics, black (10YR 2/1), <5% coarse sand grains present, poorly sorted, dense, wet.	
						Bottom of Boring @ 15.00 ft bgs	

WELL DIAGRAM



SAMPLE TYPE

Hand Auger
Direct Push

GRAPHIC LOG LEGEND

Fill Materials
Silty Sand

ACRONYM LEGEND

amsl = above mean sea level
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PVC = Polyvinylchloride Casing
SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW5

Client: USS Lead **Project Name:** USS Lead Superfund Site

Project Number: 0432213 **Project Location:** East Chicago, IN

DATE STARTED: 11/28/2018 **TOTAL DEPTH:** 15 ft BGS **GROUND ELEVATION:** 587.097 ft bgs

DATE COMPLETED: 11/28/2018 **DIAMETER:** 7.25 inches **TOC ELEVATION:** 586.895 ft BGS

DRILLING CONTRACTOR: Geoserve, Inc **LOGGED BY:** Jay S. Kim (ERM) **NORTHING:** 2321882.519 N/A

DRILLING METHOD: Geoprobe 7720DT (Track) **CHECKED BY:** **EASTING:** 2848516.648 N/A

DRILLING EQUIPMENT: Geoprobe 7720DT (Track) **DRILLER:** Matt **GROUNDWATER DEPTH:** 5 ft BGS TOC

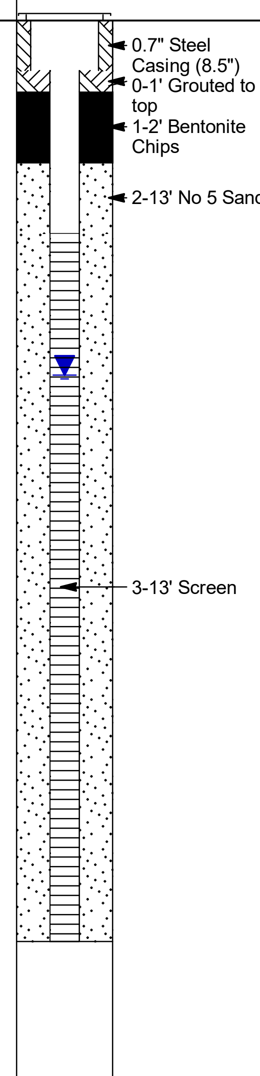
SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot

NOTES: HA to 5', 5-15' Geoprobe/HSA (3.25" ID), Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
		HA 1	12	FILL		FILL, Very Dark Brown (10YR 2/2), with subrounded medium to coarse gravelly sand, poorly sorted, loose to dense, dry to wet.	
		HA 2	12				
		HA 3	12				
		HA 4	12				
5	582	HA 5	12			Water at 5' BGS.	
		DP 6	36		6.0	3" thick layer of fine SILTY SAND lenses at 8' BGS.	
10	577	DP 7	39	SM		<5% Macroinvertibrate shells observed at 9.5' BGS. FINE TO MEDIUM SILTY SAND, Brown (10YR 4/3), subrounded <5% trace organics, black (10YR 2/1), poorly sorted, dense, wet.	
		DP 8	36			1" thick layer of fine SILTY SAND lenses at 13' BGS.	
15	572			SM	14.0 – 15.0	FINE TO MEDIUM SILTY SAND, Dark Yellow Brown (10YR 4/6), subrounded <5% trace organics, black (10YR 2/1), poorly sorted, dense, wet.	

Bottom of Boring @ 15.00 ft bgs

WELL DIAGRAM



SAMPLE TYPE

- Hand Auger
- Direct Push

GRAPHIC LOG LEGEND

- Fill Materials
- Silty Sand

ACRONYM LEGEND

amsl = above mean sea level
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SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW5D

Client: USS Lead **Project Name:** USS Lead Superfund Site

Project Number: 0432213 **Project Location:** East Chicago, IN

DATE STARTED: 11/28/2018 **TOTAL DEPTH:** 30 ft BGS **GROUND ELEVATION:** 587.122 ft bgs

DATE COMPLETED: 11/28/2018 **DIAMETER:** 7.25 inches **TOC ELEVATION:** 586.888 ft BGS

DRILLING CONTRACTOR: Geoserve, Inc **LOGGED BY:** Jay S. Kim (ERM) **NORTHING:** 2321882.571 N/A

DRILLING METHOD: Geoprobe 7720DT (Track) **CHECKED BY:** **EASTING:** 2848513.721 N/A

DRILLING EQUIPMENT: Geoprobe 7720DT (Track) **DRILLER:** Matt **GROUNDWATER DEPTH:** 5 ft BGS TOC

SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot

NOTES: HA to 5', 5-20' Geoprobe/HSA (3.25" ID), 16-30' HSA, Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
		HA 1	12	FILL		FILL, Very Dark Brown (10YR 2/2), with subrounded medium to coarse gravelly sand, poorly sorted, loose to dense, dry to wet.	
		HA 2	12				
		HA 3	12				
		HA 4	12				
5	582	HA 5	12			Water at 5' BGS.	
					6.0		
		DP 6	36	SM		3" thick layer of fine SILTY SAND lenses at 8' BGS.	
10	577	DP 7	39			<5% Macroinvertibrate shells observed at 9.5' BGS. FINE TO MEDIUM SILTY SAND, Brown (10YR 4/3), subrounded <5% trace organics, black (10YR 2/1), poorly sorted, dense, wet. 1" thick layer of fine SILTY SAND lenses at 13' BGS.	
					14.0		
15	572	DP 8	43	SM	15.0	FINE TO MEDIUM SILTY SAND, Dark Yellow Brown (10YR 4/6), subrounded <5% trace organics, black (10YR 2/1), poorly sorted, dense, wet.	

WELL DIAGRAM

SAMPLE TYPE

- Hand Auger
- Direct Push
- Auger Cuttings

GRAPHIC LOG LEGEND

- Fill Materials
- Silty Sand

ACRONYM LEGEND

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ERM
1701 Golf Rd # 1-700
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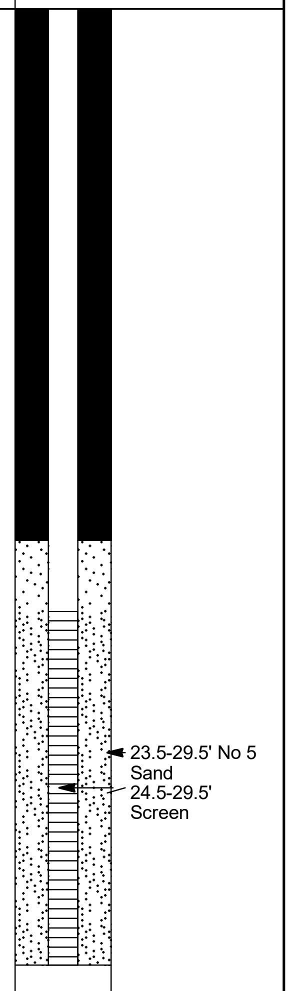
Telephone: (847) 258-8900

Client: USS Lead **Project Name:** USS Lead Superfund Site

Project Number: 0432213 **Project Location:** East Chicago, IN

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)	WELL DIAGRAM
						Heaving sand at 16' BGS, switched to HSA to 30' BGS.		
20	567					Lithology changes from what was described at 14-16' BGS to this current lithology somewhere between 14-16' BGS. Lithology described from HSA cuttings.		
		AU 9	168	SM		FINE SILTY SAND, Dark Grayish Brown (10YR 3/2), subrounded poorly sorted, dense, wet. *(continued)*		
25	562							
30	557				30.0	Bottom of Boring @ 30.00 ft bgs		



SAMPLE TYPE

- Hand Auger
- Direct Push
- Auger Cuttings

GRAPHIC LOG LEGEND

- Fill Materials
- Silty Sand

ACRONYM LEGEND

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TMW = Temporary Monitoring Well
TOC = top of casing

50 Public Square 36th Fl
Cleveland OH 44113
P: 216.593.5200
F: 216.593.5201

PROJECT:
USS Lead
USS Lead Superfund Site
East Chicago, IN

BORING # **OU1MW5N**
ERM PROJECT # 0432213
SHEET 1 OF 1

DRILLING CONTRACTOR	GeoServe, Inc. Woodstock, IL	ERM REPRESENTATIVE	Samuel Gaeth
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Cleveland, OH
DRILLING METHOD	Direct Push/Hollow Stem Auger	DATE: START	03/10/2021
DRILLING EQUIPMENT	7822 DT	FINISH	03/10/2021

HORIZONTAL DATUM
NORTHING 2321958.663
EASTING 2848506.489
ELEVATION 586.672 ft
VERTICAL DATUM: (NAVD 88 Datum)

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT
Method: *Manual Surge and Purge - Bailer 0.3 hours*
Duration:
Gals. Purged: *10*
Depth to Water 6 feet bgs 03/10/2021

DEPTH (feet)	ELEVATION (feet ASL)	STRATA DESCRIPTION	DEPTH (feet ASL)	USCS	GRAPHIC LOG	RECOVERY (inches)	SAMPLE TYPE		LAB SAMPLE ID	LAB ANALYSIS
0–2		Dark Brown SANDY LOAM.	2	SP-SM		60	Hand Auger			
2–5	585	Brown fine SAND.	5	SP						
5–6		Brown and gray fine SAND, saturated.	6	SP		22				
6–7.5	581	Black ORGANIC MATTER and coarse sand.	7.5	OL						
7.5–8		Brown and gray fine SAND.	8	SP						
8–10	579	Brown fine SAND.	10	SP		48				
10–10.08	577	Dark brown medium coarse SAND lense.	10.08	SP						
10.08–14	575	Brown fine SAND.	14	SP		48				
14–14.25	573	Dark brown medium coarse SAND lense.	14.25	SP						
14.25–16	571	Brown fine SAND.	16	SP						

Bottom of Boring @ 16.00 feet bgs

Well construction: 8-inch manhole to grade; Bentonite Seal 8in-3ft bgs; No. 5 Sand 3-13.77ft bgs; 0.010-slot Schedule 40 PVC Screen 3.77-13.77ft bgs

REMARKS:

LAB ANALYSIS:

SAMPLER TYPE
Hand Auger
Direct-Push Geoprobe

GRAPHIC LOG LEGEND
Poorly-graded Sand with Silt
Poorly-graded Sand
Low Plasticity Organic silt or clay

ACRONYM LEGEND:
ASL = above sea level
bgs = below ground surface
eV = electronvolt
NM = not measured
PID = photoionization detector
ppm = parts per million
USCS = Unified Soil Classification System

50 Public Square 36th Fl
Cleveland OH 44113
P: 216.593.5200
F: 216.593.5201

PROJECT:
USS Lead
USS Lead Superfund Site
East Chicago, IN

BORING # **OU1MW5E**
ERM PROJECT # 0432213
SHEET 1 OF 1

DRILLING CONTRACTOR	GeoServe, Inc. Woodstock, IL	ERM REPRESENTATIVE	Samuel Gaeth
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Cleveland, OH
DRILLING METHOD	Direct Push/Hollow Stem Auger	DATE: START	03/10/2021
DRILLING EQUIPMENT	7822 DT	FINISH	03/10/2021

HORIZONTAL DATUM
NORTHING 2321812.509
EASTING 2848614.008
ELEVATION 586.289 ft
VERTICAL DATUM: (NAVD 88 Datum)

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT
Method: *Manual Surge and Purge - Bailer*
Duration: *0.6 hours*
Gals. Purged: *9.5*
Depth to Water: 5 feet bgs 03/11/2021

DEPTH (feet)	ELEVATION (feet ASL)	STRATA DESCRIPTION	DEPTH (feet ASL)	USCS	RECOVERY (inches)	SAMPLE TYPE	LAB SAMPLE ID	LAB ANALYSIS
0–6	586–580	Brown fine SAND.	6	SP	60	Hand Auger		
6–7	580–579	Dark brown fine SAND.	7	SP	24			
7–8	579–578	Black ORGANIC MATTER.	8	OL				
8–11.75	578–574	Brown fine SAND.	11.75	SP	48			
11.75–12	574	Black ORGANIC MATTER.	12	OL				
12–15.75	574–570	Brown fine SAND.	15.75	SP	48			
15.75–16	570	Black fine SAND.	16	SP				

Bottom of Boring @ 16.00 feet bgs

Well construction:
- 8-inch manhole to grade
- Bentonite Seal 8in-3ft bgs
- No. 5 Sand 3-14ft bgs
- 0.010-slot Schedule 40 PVC Screen 4-14ft bgs

REMARKS:

SAMPLER TYPE
- Hand Auger
- Direct-Push Geoprobe

GRAPHIC LOG LEGEND
- Poorly-graded Sand
- Low Plasticity Organic silt or clay

LAB ANALYSIS:

ACRONYM LEGEND:
ASL = above sea level
bgs = below ground surface
eV = electronvolt
NM = not measured
PID = photoionization detector
ppm = parts per million
USCS = Unified Soil Classification System

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Cleveland OH 44113
P: 216.593.5200
F: 216.593.5201

PROJECT:
USS Lead
USS Lead Superfund Site
East Chicago, IN

BORING # **OU1MW5S**
ERM PROJECT # 0432213
SHEET 1 OF 1

DRILLING CONTRACTOR	GeoServe, Inc. Woodstock, IL
DRILLING FOREMAN	Matt Palsgrove
DRILLING METHOD	Direct Push/Hollow Stem Auger
DRILLING EQUIPMENT	7822 DT
ERM REPRESENTATIVE	Samuel Gaeth
OFFICE LOCATION	Cleveland, OH
DATE: START	03/10/2021
FINISH	03/10/2021

HORIZONTAL DATUM

NORTHING	2321727.34
EASTING	2848501.344
ELEVATION	585.894 ft

VERTICAL DATUM: (NAVD 88 Datum)

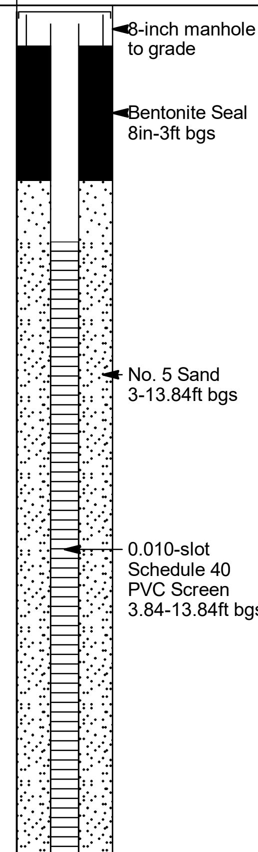
WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT

Method:	*Manual Surge and Purge - Bailer 0.5 hours*
Duration:	
Gals. Purged:	*13.5*
Depth to Water	5.5 feet bgs 03/10/2021

DEPTH (feet)	ELEVATION (feet ASL)	STRATA DESCRIPTION	DEPTH (feet ASL)	USCS	RECOVERY (inches)
0		Brown fine SAND.		SP	60
2	584	Brown and black fine SAND, trace cobble.	2	SP	
4	582				
		Light brown fine to medium corase SAND, saturated.	5	SP	48
6	580	Light brown coarse SAND.	6	SP	
		Gray fine SAND.	6.1	SP	
8	578				
10	576				48
		Black ORGANIC MATTER.	11	OL	
		Gray fine SAND.	11.08	SP	
12	574				
14	572				48
16	570	*Bottom of Boring @ 16.00 feet bgs*	16		
	568				



REMARKS:

SAMPLER TYPE

GRAPHIC LOG LEGEND
Poorly-graded Sand
Low Plasticity Organic silt or clay

LAB ANALYSIS:

ACRONYM LEGEND:
ASL = above sea level
bgs = below ground surface
eV = electronvolt
NM = not measured
PID = photoionization detector
ppm = parts per million
USCS = Unified Soil Classification System

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PROJECT:
USS Lead
USS Lead Superfund Site
East Chicago, IN

BORING # **OU1MW5W**
ERM PROJECT # 0432213
SHEET 1 OF 1

DRILLING CONTRACTOR	GeoServe, Inc. Woodstock, IL	ERM REPRESENTATIVE	Samuel Gaeth
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Cleveland, OH
DRILLING METHOD	Direct Push/Hollow Stem Auger	DATE: START	03/11/2021
DRILLING EQUIPMENT	7822 DT	FINISH	03/11/2021

HORIZONTAL DATUM
NORTHING 2321958.671
EASTING 2848408.51
ELEVATION 586.61 ft
VERTICAL DATUM: (NAVD 88 Datum)

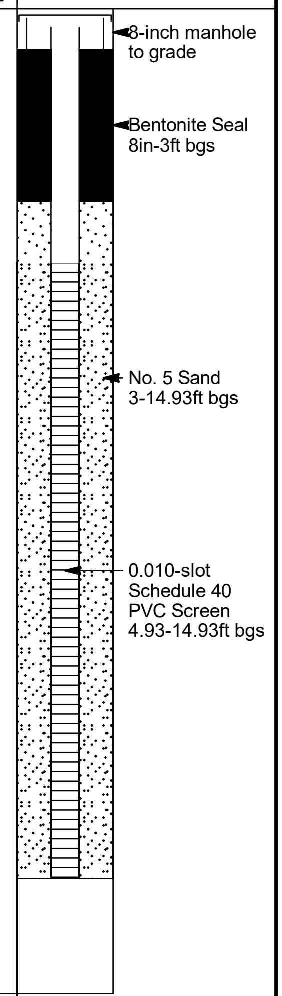
WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT
Method: *Manual Surge and Purge - Bailer*
Duration: *0.3 hours*
Gals. Purged: *10*
Depth to Water: 5 feet bgs 03/11/2021

DEPTH (feet)	ELEVATION (feet ASL)	STRATA DESCRIPTION	DEPTH (feet ASL)	USCS	RECOVERY (inches)	SAMPLE TYPE	LAB SAMPLE ID	LAB ANALYSIS
0–0.25		Brown CLAY LOAM.	0.25	CL				
0.25–8		Brown fine SAND.	8	SP	60 (0–5); 15 (5–8)	Hand Auger		
8–16		Brown fine SAND, some dark brown fine sand.	16	SP	48 (8–12); 48 (12–16)			
		Bottom of Boring @ 16.00 feet bgs						

Depth / elevation scale: 2 – 585; 4 – 583; 6 – 581; 8 – 579; 10 – 577; 12 – 575; 14 – 573; 16 – 571; 569



REMARKS:

SAMPLER TYPE
Hand Auger
Direct-Push Geoprobe

GRAPHIC LOG LEGEND
Low Plasticity Clay
Poorly-graded Sand

LAB ANALYSIS:

ACRONYM LEGEND:
ASL = above sea level
bgs = below ground surface
eV = electronvolt
NM = not measured
PID = photoionization detector
ppm = parts per million
USCS = Unified Soil Classification System

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW6

Client: USS Lead **Project Name:** USS Lead Superfund Site

Project Number: 0432213 **Project Location:** East Chicago, IN

DATE STARTED: 12/10/2018 **TOTAL DEPTH:** 15 ft BGS **GROUND ELEVATION:** 586.039 ft bgs

DATE COMPLETED: 12/10/2018 **DIAMETER:** 7.25 inches **TOC ELEVATION:** 585.562 ft BGS

DRILLING CONTRACTOR: Geoserve, Inc **LOGGED BY:** Eric Slater (ERM) **NORTHING:** 2323698.686 N/A

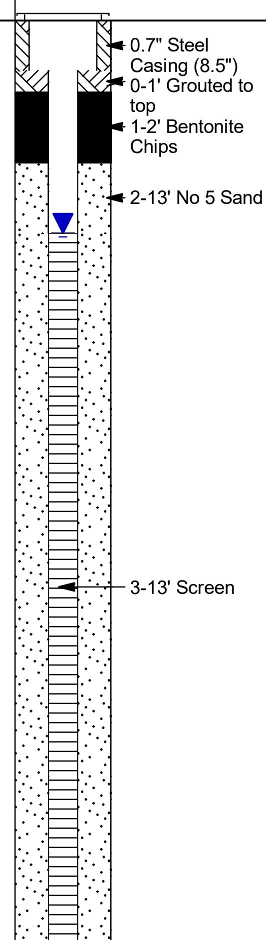
DRILLING METHOD: Geoprobe 7720DT (Track) **CHECKED BY:** **EASTING:** 2847960.586 N/A

DRILLING EQUIPMENT: Geoprobe 7720DT (Track) **DRILLER:** Matt **GROUNDWATER DEPTH:** 3 ft BGS TOC

SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot

NOTES: HA to 5', 5-15' Geoprobe/HSA (3.25" ID), Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)	WELL DIAGRAM
		HA 1	12	FILL		FILL, Dark Yellow Brown (10YR 4/4), with subrounded fine to medium sand, poorly sorted, loose to dense, dry to wet. Water at 3' BGS.		
		HA 2	12					
		HA 3	12					
		HA 4	12					
5	581	HA 5	12		6.0			
		DP 6	32	SM		FINE TO MEDIUM SILTY SAND, Brown (7.5YR 5/4), subangular moderately sorted, loose, wet.		
10	576	DP 7	40		10.8			
15	571	DP 8	36	SM	15.0	FINE SILTY SAND, Dark Gray (10YR 4/1), subangular well sorted, firm, wet.		
						Bottom of Boring @ 15.00 ft bgs		



SAMPLE TYPE

Hand Auger
Direct Push

GRAPHIC LOG LEGEND

Fill Materials
Silty Sand

ACRONYM LEGEND

amsl = above mean sea level
BGS = below ground surface
DP = Direct Push
EOB = End of Boring
' = Feet
NR = No Recovery
MW = Monitoring Well
PID = Photoionization Detector
PVC = Polyvinylchloride Casing
SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW6D

Client: USS Lead
Project Name: USS Lead Superfund Site
Project Number: 0432213
Project Location: East Chicago, IN

DATE STARTED: 12/10/2018
DATE COMPLETED: 12/10/2018
DRILLING CONTRACTOR: Geoserve, Inc
DRILLING METHOD: Geoprobe 7720DT (Track)
DRILLING EQUIPMENT: Geoprobe 7720DT (Track)
TOTAL DEPTH: 30 ft BGS
DIAMETER: 7.25 inches
LOGGED BY: Eric Slater (ERM)
CHECKED BY:
DRILLER: Matt
GROUND ELEVATION: 586.148 ft bgs
TOC ELEVATION: 585.909 ft BGS
NORTHING: 2323698.306 N/A
EASTING: 2847939.088 N/A
GROUNDWATER DEPTH: 3 ft BGS TOC
SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot
NOTES: HA to 5', 5-20' Geoprobe/HSA (3.25" ID), 20-30' HSA, Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)	WELL DIAGRAM
		HA 1	12	FILL		FILL, Dark Yellow Brown (10YR 4/4), with subrounded fine to medium sand, poorly sorted, loose to dense, dry to wet. Water at 3' BGS.		0.7" Steel Casing (8.5"); 0-1' Grouted to top
		HA 2	12					
		HA 3	12					
		HA 4	12					
5	581	HA 5	12					
		DP 6	32		6.0			
				SM		FINE TO MEDIUM SILTY SAND, Brown (7.5YR 5/4), subangular moderately sorted, loose, wet.		
10	576	DP 7	40		10.8			
				SM		FINE SILTY SAND, Dark Gray (10YR 4/1), subangular well sorted, firm, wet. <5% Subrounded coarse SAND grains present.		1-24' Bentonite Chips
15	571	DP 8	46					

SAMPLE TYPE
- Hand Auger
- Direct Push
- Auger Cuttings

GRAPHIC LOG LEGEND
- Fill Materials
- Silty Sand

ACRONYM LEGEND
amsl = above mean sea level
BGS = below ground surface
DP = Direct Push
EOB = End of Boring
' = Feet
NR = No Recovery
MW = Monitoring Well
PID = Photoionization Detector
PVC = Polyvinylchloride Casing
SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW6D

Client: USS Lead
Project Name: USS Lead Superfund Site
Project Number: 0432213
Project Location: East Chicago, IN

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)	WELL DIAGRAM
		DP 9	48			Silt content steadily increases starting at 17' BGS.		
20	566					Heaving sand at 20' BGS, switched to HSA to 30' BGS, lithologies below described from HSA cuttings.		
				SM		FINE SILTY SAND, Dark Gray (10YR 4/1), subangular well sorted, firm, wet. *(continued)*		
25	561	AU 10	120					24-30' No 5 Sand 25-30' Screen
30	556					30.0		
						Bottom of Boring @ 30.00 ft bgs		

SAMPLE TYPE

- Hand Auger
- Direct Push
- Auger Cuttings

GRAPHIC LOG LEGEND

- Fill Materials
- Silty Sand

ACRONYM LEGEND

amsl = above mean sea level
BGS = below ground surface
DP = Direct Push
EOB = End of Boring
' = Feet
NR = No Recovery
MW = Monitoring Well
PID = Photoionization Detector
PVC = Polyvinylchloride Casing
SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

OU1MW7

PAGE 1 OF 1

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

Client: USS Lead
Project Name: USS Lead Superfund Site
Project Number: 0432213
Project Location: East Chicago, IN

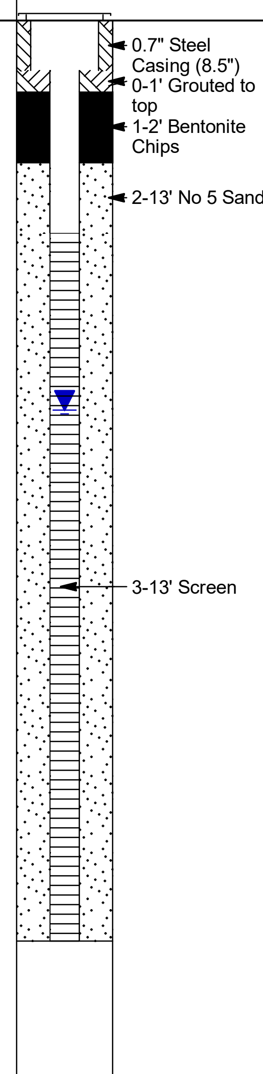
DATE STARTED: 11/29/2018	**TOTAL DEPTH:** 15 ft BGS	**GROUND ELEVATION:** 586.142 ft bgs
DATE COMPLETED: 11/29/2018	**DIAMETER:** 7.25 inches	**TOC ELEVATION:** 585.852 ft BGS
DRILLING CONTRACTOR: Geoserve, Inc	**LOGGED BY:** Jay S. Kim (ERM)	**NORTHING:** 2324166.874 N/A
DRILLING METHOD: Geoprobe 7720DT (Track)	**CHECKED BY:**	**EASTING:** 2848605.522 N/A
DRILLING EQUIPMENT: Geoprobe 7720DT (Track)	**DRILLER:** Matt	**GROUNDWATER DEPTH:** 5.5 ft BGS TOC

SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot
NOTES: HA to 5', 5-15' Geoprobe/HSA (3.25" ID), Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
		HA 1	12	FILL	1.0	FINE TO MEDIUM SILTY SAND, Black (10YR 2/1), subrounded 5-10% trace organics, black (10YR 2/1), poorly sorted, loose, dry.	
		HA 2	12	SM			
		HA 3	12				
		HA 4	12			Lithology goes from moist to wet from 4-5' BGS.	
5	581	HA 5	12				
		DP 6	28			Water at 5.5' BGS. FINE TO MEDIUM SILTY SAND, Dark Yellow Brown (10YR 4/4), subrounded <5% trace organics, black (10YR 2/1), poorly sorted, loose to dense, dry to wet.	
10	576	DP 7	38		11.0	<0.5" thick, silty SAND, greyish brown (10YR 5/2) laminations, trace macroinvertibrate shells.	
				SM	13.0	FINE TO MEDIUM SILTY SAND, Dark Brown (10YR 3/3), subrounded poorly sorted, dense, wet.	
15	571	DP 8	32	SM	15.0	1" thick silty SAND, very dark brown (10YR 2/2), with macroinvertibrate shell fragments at 13' BGS. FINE SILTY SAND, Dark Brown (10YR 3/3), subrounded to subangular <5% coarse grained sand present, poorly sorted, dense, wet.	

Bottom of Boring @ 15.00 ft bgs

WELL DIAGRAM



SAMPLE TYPE

- Hand Auger
- Direct Push

GRAPHIC LOG LEGEND

- Fill Materials
- Silty Sand

ACRONYM LEGEND

amsl = above mean sea level
BGS = below ground surface
DP = Direct Push
EOB = End of Boring
' = Feet
NR = No Recovery
MW = Monitoring Well
PID = Photoionization Detector
PVC = Polyvinylchloride Casing
SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

ERM
1701 Golf Rd # 1-700
Rolling Meadows, IL 60008
Telephone: (847) 258-8900

OU1MW8

Client: USS Lead | **Project Name:** USS Lead Superfund Site

Project Number: 0432213 | **Project Location:** East Chicago, IN

DATE STARTED: 11/29/2018
DATE COMPLETED: 11/29/2018
DRILLING CONTRACTOR: Geoserve, Inc
DRILLING METHOD: Geoprobe 7720DT (Track)
DRILLING EQUIPMENT: Geoprobe 7720DT (Track)

TOTAL DEPTH: 15 ft BGS
DIAMETER: 7.25 inches
LOGGED BY: Jay S. Kim (ERM)
CHECKED BY:
DRILLER: Matt

GROUND ELEVATION: 586.819 ft bgs
TOC ELEVATION: 586.501 ft BGS
NORTHING: 2323162.474 N/A
EASTING: 2849391.308 N/A
GROUNDWATER DEPTH: 5 ft BGS TOC

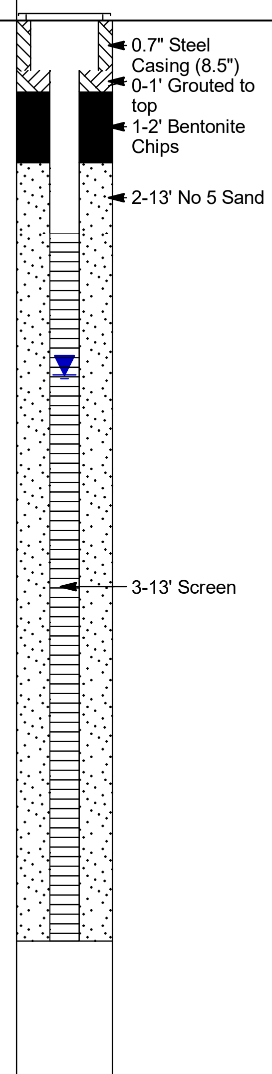
SURVEY DATUM: Indiana West Zone 1983 Datum US Survey Foot

NOTES: HA to 5', 5-15' Geoprobe/HSA (3.25" ID), Flushmount PVC Well

DEPTH (ft)	ELEVATION (feet amsl)	SAMPLE TYPE	RECOVERY (FEET)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	PID (ppm)
		HA 1	12		0.3	0.33 ' ASPHALT (4").	
		HA 2	12	FILL		FILL, Dark Grayish Brown (10YR 3/2), with subrounded sandy gravel, <5% medium GRAVEL sized chunks, trace roots, poorly sorted, loose, dry.	
		HA 3	12		3.0		
		HA 4	12	SM		FINE TO MEDIUM SILTY SAND, Dark Brown (10YR 3/3), subrounded poorly sorted, loose to dense, dry to moist. Color changes to black (10YR 2/1).	
5	582	HA 5	12		5.0		
		DP 6	20	SM		Water at 5' BGS. <1" thick, fine SAND, greyish brown (10YR 5/2), laminations at 6' & 7' BGS. FINE TO MEDIUM SILTY SAND, Dark Yellow Brown (10YR 4/4), subrounded poorly sorted, loose to dense, dry to moist.	
10	577	DP 7	36		11.0		
15	572	DP 8	33	SM	15.0	FINE SILTY SAND, Dark Grayish Brown (10YR 4/2), subrounded poorly sorted, dense, moist. <5% coarse grained SAND present at 14' BGS.	

Bottom of Boring @ 15.00 ft bgs

WELL DIAGRAM



SAMPLE TYPE
Hand Auger
Direct Push

GRAPHIC LOG LEGEND
Asphalt
Fill Materials
Silty Sand

ACRONYM LEGEND
amsl = above mean sea level
BGS = below ground surface
DP = Direct Push
EOB = End of Boring
' = Feet
NR = No Recovery
MW = Monitoring Well
PID = Photoionization Detector
PVC = Polyvinylchloride Casing
SB = Soil Boring
TMW = Temporary Monitoring Well
TMW = Temporary Monitoring Well
TOC = top of casing

ERM
50 Public Square 36th Fl
Cleveland OH 44113
P: 216.593.5200
F: 216.593.5201

PROJECT:
USS Lead
USS Lead Superfund Site
East Chicago, IN

BORING # **OU1MW13**

ERM PROJECT # 0432213
SHEET 1 OF 1

DRILLING CONTRACTOR	GeoServe, Inc. Woodstock, IL	ERM REPRESENTATIVE	Samuel Gaeth
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Cleveland, OH
DRILLING METHOD	Direct Push/Hollow Stem Auger	DATE: START	03/10/2021
DRILLING EQUIPMENT	7822 DT	FINISH	03/10/2021

HORIZONTAL DATUM
NORTHING 2323127.231
EASTING 2847063.497
ELEVATION 586.597 ft
VERTICAL DATUM: (NAVD 88 Datum)

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

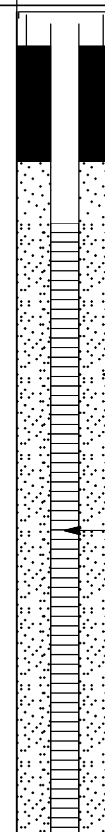
WELL DEVELOPMENT

Method:	*Manual Surge and Purge - Bailer*
Duration:	*0.25 hours*
Gals. Purged:	*9.5*
Depth to Water	5 feet bgs 03/10/2021

DEPTH (feet)	ELEVATION (feet ASL)	STRATA DESCRIPTION	DEPTH (feet ASL)	USCS	GRAPHIC LOG	RECOVERY (inches)	SAMPLE TYPE		LAB SAMPLE ID	LAB ANALYSIS
0–2	586.6–585	Brown fine SAND, trace cobble.	2	SP		60	Hand Auger			
2–4	585–583	Dark brown fine SAND, some silt with light orange mottling.	4	SP						
4–9.5	583–577	Brown fine SAND. (water level at 5 ft)	9.5	SP		22				
9.5–14	577–573	Gray fine SAND.	14	SP		48				
14–14.125	573	Gray limestone GRAVEL.	14.125	GP		48				
14.125–16	573–571	Gray fine SAND.	16	SP						

Bottom of Boring @ 16.00 feet bgs

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16; Elevation scale: 585, 583, 581, 579, 577, 575, 573, 571, 569



REMARKS:

SAMPLER TYPE
Hand Auger
Direct-Push Geoprobe

GRAPHIC LOG LEGEND
Poorly-graded Sand
Poorly-graded Gravel

LAB ANALYSIS:

ACRONYM LEGEND:
ASL = above sea level
bgs = below ground surface
eV = electronvolt
NM = not measured
PID = photoionization detector
ppm = parts per million
USCS = Unified Soil Classification System

OHIO WELL USS LEAD USS LEAD LOGS.GPJ MORGAN CLVD.GDT 4/8/21

ERM	50 Public Square 36th Fl Cleveland OH 44113 P: 216.593.5200 F: 216.593.5201	PROJECT: **USS Lead** **USS Lead Superfund Site** **East Chicago, IN**	BORING # **OU1MW14** ERM PROJECT # 0432213 SHEET 1 OF 1

DRILLING CONTRACTOR	GeoServe, Inc. Woodstock, IL	ERM REPRESENTATIVE	Samuel Gaeth
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Cleveland, OH
DRILLING METHOD	Direct Push/Hollow Stem Auger	DATE: START	03/10/2021
DRILLING EQUIPMENT	7822 DT	FINISH	03/10/2021

HORIZONTAL DATUM

NORTHING	2322517.928
EASTING	2846904.338
ELEVATION	586.241 ft

VERTICAL DATUM: (NAVD 88 Datum)

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT

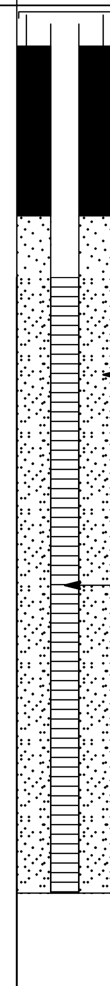
Method:	*Manual Surge and Purge - Bailer 0.5 hours*
Duration:	
Gals. Purged:	*10.15*
Depth to Water	6 feet bgs 03/10/2021

DEPTH (feet)	ELEVATION (feet ASL)	STRATA DESCRIPTION	DEPTH (feet ASL)	USCS	RECOVERY (inches)	SAMPLE TYPE	LAB SAMPLE ID	LAB ANALYSIS
0–2	586.2–584	Brown fine SAND, some cobble.	2	SP	60	Hand Auger		
2–5	584–581	Brown fine SAND with some silt.	5	SP				
5–11	581–575	Light orange to gray incrase in depth fine SAND. (water level at 6 ft)	11	SP	15 48			
11–11.5		Black ORGANIC MATTER.	11.5	OL				
11.5–16		Gray fine SAND.	16	SP	48			

Bottom of Boring @ 16.00 feet bgs

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16; Elevation scale: 584, 582, 580, 578, 576, 574, 572, 570, 568

WELL CONSTRUCTION



REMARKS:

SAMPLER TYPE
- Hand Auger
- Direct-Push Geoprobe

GRAPHIC LOG LEGEND
- Poorly-graded Sand
- Low Plasticity Organic silt or clay

LAB ANALYSIS:

ACRONYM LEGEND:
ASL = above sea level
bgs = below ground surface
eV = electronvolt
NM = not measured
PID = photoionization detector
ppm = parts per million
USCS = Unified Soil Classification System

ERM
50 Public Square 36th Fl
Cleveland OH 44113
P: 216.593.5200
F: 216.593.5201

PROJECT:
USS Lead
USS Lead Superfund Site
East Chicago, IN

BORING # **OU1MW15**
ERM PROJECT # 0432213
SHEET 1 OF 1

DRILLING CONTRACTOR	GeoServe, Inc. Woodstock, IL	ERM REPRESENTATIVE	Samuel Gaeth
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Cleveland, OH
DRILLING METHOD	Direct Push/Hollow Stem Auger	DATE: START	03/10/2021
DRILLING EQUIPMENT	7822 DT	FINISH	03/10/2021

HORIZONTAL DATUM
NORTHING 2321703.496
EASTING 2847805.189
ELEVATION 586.249 ft
VERTICAL DATUM: (NAVD 88 Datum)

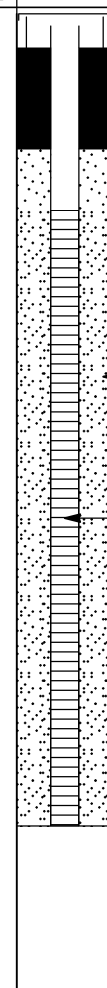
WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT
Method: *Manual Surge and Purge - Bailer 0.3 hours*
Duration: *Bailer 0.3 hours*
Gals. Purged: *10.5*
Depth to Water 3.5 feet bgs 03/10/2021

DEPTH (feet)	ELEVATION (feet ASL)	STRATA DESCRIPTION	DEPTH (feet ASL)	USCS	GRAPHIC LOG	RECOVERY (inches)	SAMPLE TYPE	LAB SAMPLE ID	LAB ANALYSIS
0–2	586–584	Brown fine SAND and SILT, moist.	2	SP-SM		60	Hand Auger		
2–2.5	584	Brown CLAY.	2.5	CL					
2.5–5	582	Light brown fine SAND with some black organic matter, saturated.	5	SP					
5–8	580	Brown fine SAND with black organic matter.	8	SP		22			
8–16	578–570	Gray fine SAND.	16	SP		48 48			

Bottom of Boring @ 16.00 feet bgs



REMARKS:

SAMPLER TYPE
Hand Auger
Direct-Push Geoprobe

GRAPHIC LOG LEGEND
Poorly-graded Sand with Silt
Low Plasticity Clay
Poorly-graded Sand

LAB ANALYSIS:

ACRONYM LEGEND:
ASL = above sea level
bgs = below ground surface
eV = electronvolt
NM = not measured
PID = photoionization detector
ppm = parts per million
USCS = Unified Soil Classification System

OU1 ECHA Boring & Well Logs

SOIL BORING & MONITORING WELL LOCATIONS
SCALE: 1"=100'

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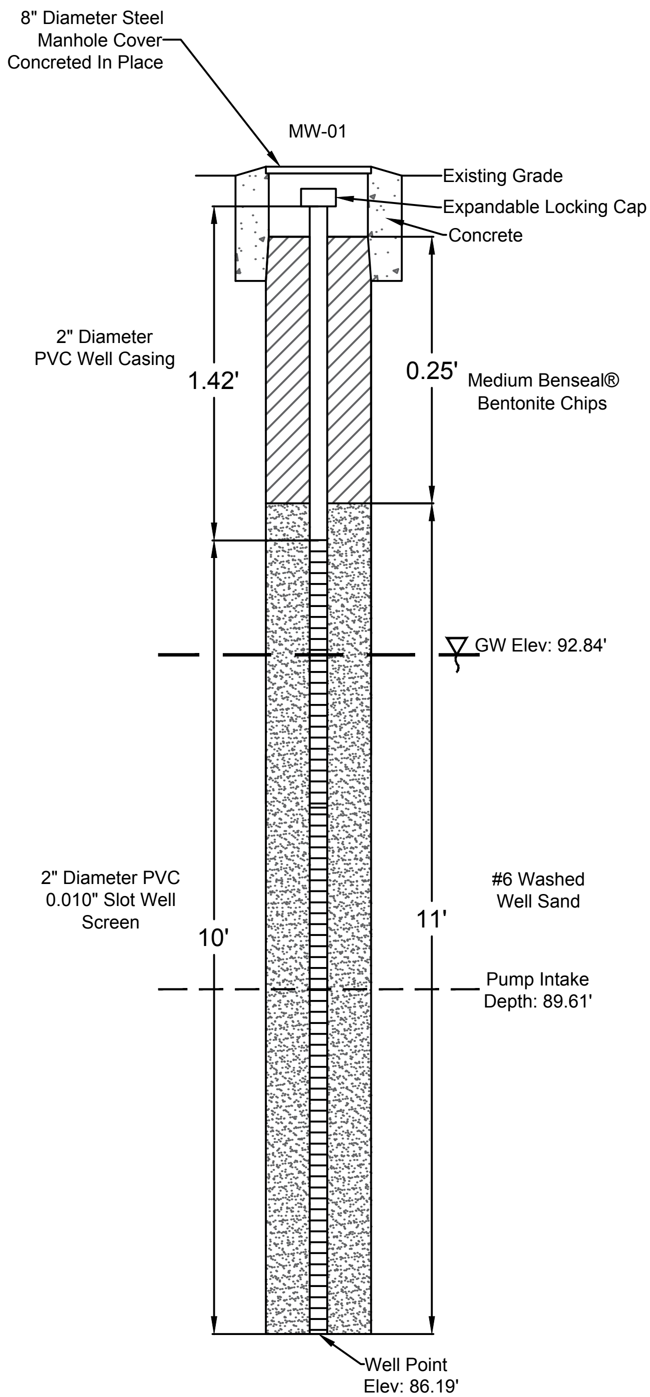
AMERECO, INC.
CONSULTING ENGINEERS-PROJECT MANAGERS
54 MICHIGAN AVENUE
VALPARAISO, IN 46383 219-531-0531

WEST CALUMET HOUSING COMPLEX
EAST CHICAGO HOUSING AUTHORITY
EAST CHICAGO INDIANA

NO.	DATE	ISSUED FOR
1	02/10/17	PHASE II ESA

TITLE: SOIL BORING & MW LOCATIONS
PROJECT #: 16.1151.2.4
DRAWN BY: A. WILKER
REVIEWED BY: Z. HEINE
SCALE: 1"=100'
SHEET: 3

MW ID#	Water Elevation	Pump Intake	Well Depth
MW-01	92.84'	89.61'	86.19'
MW-09	93.57'	89.30'	84.52'
MW-12	94.43'	89.80'	84.98'
MW-35	94.11'	90.31'	85.21'



*Note: This Drawing Is Not To Scale. Dimensions Have Been Exaggerated For Information Purposes.

**Note: Installed with 8.25" O.D. Hollow Stem Augers

***Note: All 2" Monitoring Wells constructed similar.

MONITORING WELL CONSTRUCTION DIAGRAM
SCALE: NTS

TITLE: MW CONST. DIAGRAM
PROJECT #: 16.1151.4.2
SHEET: 9A
DRAWN BY: A. WILKER
REVIEWED BY: Z. HEINE
SCALE: NTS

NO.	DATE	ISSUED FOR
1	02/15/17	PHASE II ESA

WEST CALUMET HOUSING COMPLEX EAST CHICAGO HOUSING AUTHORITY

EAST CHICAGO INDIANA

AMERECO, INC.
CONSULTING ENGINEERS-PROJECT MANAGERS
54 MICHIGAN AVENUE
VALPARAISO, IN 46383 219-531-0531

Amereco Engineering

204 E. Jefferson Street
Valparaiso, Indiana 46383
Tel: 219-531-0531

Boring Number: SB-01

Project: West Calumet Housing Complex
Location: East Chicago

Water Level Data

First Encountered:	8'
Static Water Level:	4.77'

Legend

SS = Soil Sample
GW = Groundwater Sample
SG = Soil Gas Sample
PP = Pocket Pentrometer
REC = Percent Recovery

Drilling Information

Drilling Rig Type:	6610DT	Boring Start Date:	1/27/2017
Drilling Method:	Dual Tube	Boring End Date:	1/27/2017
Sample Type:	Direct Push	Backfill Type:	Cuttings/Bentonite
Casing Length:	12'	Well Length:	12'
Casing Depth:	12'	Well Diameter:	2"
Drilling Company:	Amereco INC.	Representative :	Greg Koliboski
		Well License # :	2059

Depth (ft)	Sample	PID	Description	USCS	REC (%)	PP
1			6" Topsoil - Silty Sand (3" Slag at 2')		75	
2		0.4				
3			Light Brown Very Fine to Fine Sand			
4		0.5				
5				SM	100	
6		0.5				
7	S-001A					
8		0.5				
9			Dark Brown Fine to Medium Sand		100	
10		0.5		SM		
11						
12		0.4				
13			End of Boring			
14						
15						
16						
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36						

Notes:

Amereco Engineering
204 E. Jefferson Street
Valparaiso, Indiana 46383
Tel: 219-531-0531

Boring Number: SB-09

Project: West Calumet Housing Complex

Location: East Chicago

Water Level Data

First Encountered: 6'
Static Water Level: 2.73'

Legend

SS = Soil Sample
GW = Groundwater Sample
SG = Soil Gas Sample
PP = Pocket Pentrometer
REC = Percent Recovery

Drilling Information

Drilling Rig Type:	6610DT	Boring Start Date:	1/27/2017
Drilling Method:	Dual Tube	Boring End Date:	1/27/2017
Sample Type:	Direct Push	Backfill Type:	Cuttings/Bentonite
Casing Length:	12'	Well Length:	12'
Casing Depth:	12'	Well Diameter:	2"
Drilling Company:	Amereco INC.	Representative :	Greg Koliboski
		Well License # :	2059

Depth (ft)	Sample	PID	Description	USCS	REC (%)	PP
1			6" Topsoil			
2		2.4	Silty Fine Sand with Slag and Gravel		100	
3						
4		10.4				
5	WCS-009A		Oily Sheen at 5' Very Fine to Fine Brown Sand	SM		
6		4.5			100	
7			Fine Silty Sand with Concrete Fragments	SM		
8		2.0	Very Fine to Fine Gray Sand	SM		
9			Fine to Medium Gray Sand	SM		
10		2.4			100	
11			Very Fine Gray Sand	SM		
12		1.5				
13			End of Boring			
14						
15						
16						
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36						

Notes:

Amereco Engineering
204 E. Jefferson Street
Valparaiso, Indiana 46383
Tel: 219-531-0531

Boring Number: SB-12

Project: West Calumet Housing Complex
Location: East Chicago

Water Level Data

First Encountered:	6'
Static Water Level:	2.37'

Legend
SS = Soil Sample
GW = Groundwater Sample
SG = Soil Gas Sample
PP = Pocket Pentrometer
REC = Percent Recovery

Drilling Information

Drilling Rig Type:	6610DT	Boring Start Date:	1/31/2017
Drilling Method:	Dual Tube	Boring End Date:	1/31/2017
Sample Type:	Direct Push	Backfill Type:	Cuttings/Bentonite
Casing Length:	12'	Well Length:	12'
Casing Depth:	12'	Well Diameter:	2"
Drilling Company:	Amereco INC.	Representative :	Greg Koliboski
		Well License # :	2059

Depth (ft)	Sample	PID	Description	USCS	REC (%)	PP
1			3" Topsoil			
2		1.0	Brown Very Fine to Fine Sand		75	
3			3" Gravel/Sand Fill			
4		0.8	Oily Sheen at 5'			
5	WCS-012A					
6		1.1			50	
7						
8		0.8				
9			Gray Very Fine to Fine Sand	SM		
10	WCS-012B	1.2			100	
11						
12		0.6				
13			End of Boring			
14						
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Notes:

Amereco Engineering	**Boring Number:**	**SB-35**
204 E. Jefferson Street	**Project:**	West Calumet Housing Complex
Valparaiso, Indiana 46383	**Location:**	East Chicago, IN 46312
Tel: 219-531-0531		

Water Level Data	
First Encountered:	5'
Static Water Level:	3.2'

SS = Soil Sample
GW = Groundwater Sample
SG = Soil Gas Sample
PP = Pocket Pentrometer
REC = Percent Recovery

Drilling Information

Drilling Rig Type:	6610DT	Boring Start Date:	2/1/2017
Drilling Method:	Dual Tube	Boring End Date:	2/1/2017
Sample Type:	Direct Push	Backfill Type:	Cuttings/Bentonite
Casing Length:	12'	Well Length:	12'
Casing Depth:	12'	Well Diameter:	1"
Drilling Company:	Amereco INC.	Representative :	Greg Koliboski
		Well License # :	2059

Depth (ft)	Sample	PID	Description	USCS	REC (%)	PP
1			6" Topsoil			
2		0.3	Dark Brown Sand with Occasional Slag		75	
3						
4	WCS-035A	0.4	Brown Very Fine to Fine Sand			
5				SM	100	
6		0.3				
7						
8		0.3	Gray Very Fine to Fine Sand			
9					100	
10		0.3		SM		
11						
12		0.3				
13			End of Boring			
14						
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36						

Notes:

OU2 Boring & Well Logs

ERM 50 Public Square 36th Fl Cleveland OH 44113 P: 216.593.5200 F: 216.593.5201	PROJECT: **USS Lead** **USS Lead Superfund Site** **East Chicago, IN**	BORING # **MW21R** ERM PROJECT # 0432213 SHEET 1 OF 1

DRILLING CONTRACTOR	GeoServe, Inc. Woodstock, IL	ERM REPRESENTATIVE	Samuel Gaeth
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Cleveland, OH
DRILLING METHOD	Direct Push/Hollow Stem Auger	DATE: START	03/11/2021
DRILLING EQUIPMENT	7822 DT	FINISH	03/11/2021

HORIZONTAL DATUM

NORTHING	2320586.444
EASTING	2848815.951
ELEVATION	587.977 ft

VERTICAL DATUM: (NAVD 88 Datum)

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

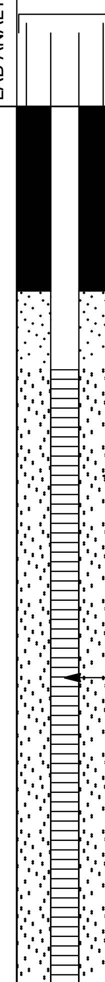
WELL DEVELOPMENT

Method:	*Manual Surge and Purge - Bailer*
Duration:	*0.7 hours*
Gals. Purged:	*12.5*
Depth to Water (hh:mm, date):	3 feet bgs 03/11/2021

DEPTH (feet)	ELEVATION (feet ASL)	STRATA DESCRIPTION	DEPTH (feet ASL)	USCS	GRAPHIC LOG	RECOVERY (inches)	SAMPLE TYPE	LAB SAMPLE ID	LAB ANALYSIS
0–10	587.977–578	Brown fine SAND.	10	SP		60	Hand Auger		
						22			
10–12	578–576	Brown to gray fine SAND.	12	SP		48			
12–15	576–573	Gray fine SAND.	15	SP		48			
15–15.02		Black coarse SAND.	15.02	SP					
15.02–16	572	Gray fine SAND.	16	SP					

Bottom of Boring @ 16.00 feet bgs

WELL CONSTRUCTION



REMARKS:
OU2

SAMPLER TYPE
- Hand Auger
- Direct-Push Geoprobe

GRAPHIC LOG LEGEND
- Poorly-graded Sand

LAB ANALYSIS:

ACRONYM LEGEND:
ASL = above sea level
bgs = below ground surface
eV = electronvolt
NM = not measured
PID = photoionization detector
ppm = parts per million
USCS = Unified Soil Classification System

50 Public Square 36th Fl
Cleveland OH 44113
P: 216.593.5200
F: 216.593.5201

PROJECT:
USS Lead
USS Lead Superfund Site
East Chicago, IN

BORING # **MW26**
ERM PROJECT # 0432213
SHEET 1 OF 1

DRILLING CONTRACTOR	GeoServe, Inc. Woodstock, IL	ERM REPRESENTATIVE	Austin Linville
DRILLING FOREMAN	Matt Palsgrove	OFFICE LOCATION	Cleveland, OH
DRILLING METHOD	Direct Push/Hollow Stem Auger	DATE: START	03/11/2021
DRILLING EQUIPMENT	7822 DT	FINISH	03/11/2021

HORIZONTAL DATUM
NORTHING 2320586.485
EASTING 2848748.838
ELEVATION 584.8 ft
VERTICAL DATUM: (NAVD 88 Datum)

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

WELL DEVELOPMENT
Method: *Manual Surge and Purge - Bailer 0.5 hours*
Duration:
Gals. Purged: *15*
Depth to Water 3 feet bgs 03/11/2021

DEPTH (feet)	ELEVATION (feet ASL)	STRATA DESCRIPTION	DEPTH (feet ASL)	USCS	GRAPHIC LOG	RECOVERY (inches)	SAMPLE TYPE		LAB SAMPLE ID	LAB ANALYSIS	WELL CONSTRUCTION
0–6	584.8–579	Brown find SAND.		SP		60	Hand Auger				8-inch manhole to grade; Bentonite Seal 8in-3ft bgs
6–7	579–578	Brown fine SAND, some gray fine sand, saturated.	6	SP		22					No. 5 Sand 3-13.71ft bgs
7–16	578–569	Gray to dark gray fine SAND, saturated.	7	SP		48					0.010-slot Schedule 40 PVC Screen 3.71-13.71ft bgs
						48					
16	569	*Bottom of Boring @ 16.00 feet bgs*	16								

Depth scale: 2 (583), 4 (581), 6 (579), 8 (577), 10 (575), 12 (573), 14 (571), 16 (569), 567

REMARKS:
North of CAMU and MW21R

SAMPLER TYPE
Hand Auger
Direct-Push Geoprobe

GRAPHIC LOG LEGEND
Poorly-graded Sand

LAB ANALYSIS:

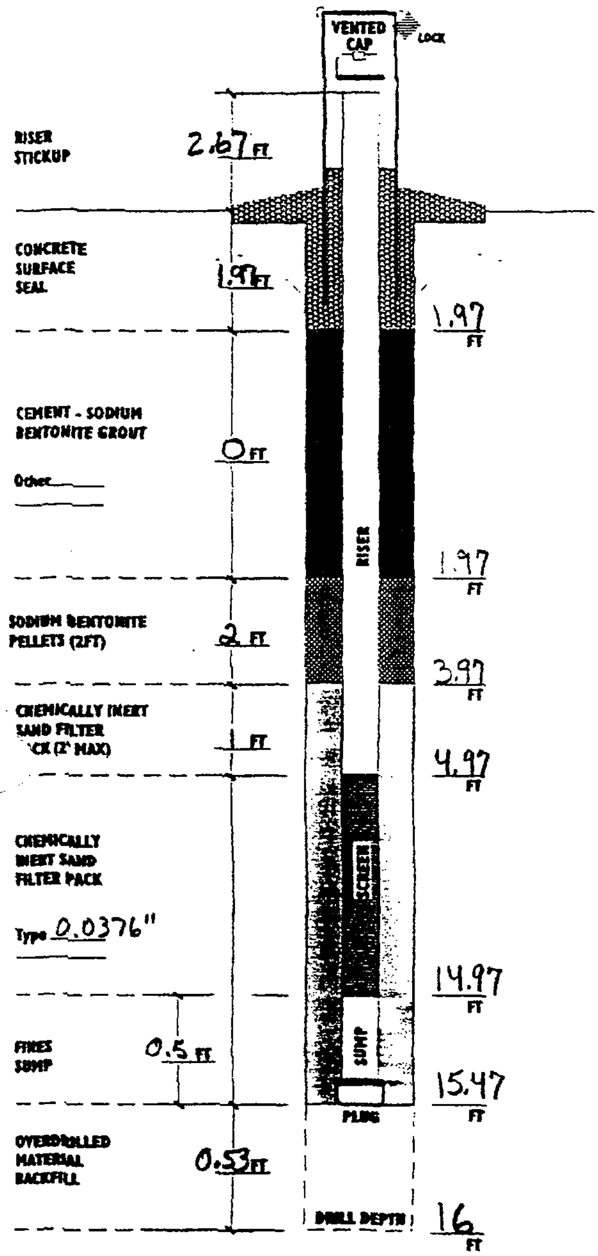
ACRONYM LEGEND:
ASL = above sea level
bgs = below ground surface
eV = electronvolt
NM = not measured
PID = photoionization detector
ppm = parts per million
USCS = Unified Soil Classification System

SOIL BORING LOG

DATE:	Aug. 19, 1996	DRILLING COMPANY:	Fox Exploration	BORING NO:	BH-1 (MW-1)
TIME:	1:05pm	DRILLING METHOD:	Wet Rotary	SHEET:	1 of 1
PROJECT NO:	C-101	HOLE DIAMETER:	4 1/2"	SURFACE ELEVATION:	587.5
CLIENT:	USS Lead	SCREEN:	Diam Length Slot Size	TOTAL DEPTH:	36'
SITE:	USS Lead E. Chicago	CASING:	Diam Length Type	GW DEPTH:	4'
LOGGED BY:	Les Cole				

ENTACT

DEPTH (FT)	SOIL SYMBOL	WELL CONSTRUCTION	LITHOLOGIC DESCRIPTION	MUNSELL COLOR IDENTIFICATION	% RECOVERY	SAMPLE TYPE	SAMPLE DEPTH	SAMPLES NO	DEPTH (FT)
0									0
2			Sand (PT) w/organcs, roots, fiber, some slag, loose, dry, no odor, black HCl(-), occ. white shell	10YR 2/1	80	SS	2'	1	
5			Sand (SP) 90% med., 20% silt clay, loose, moist, no odor, yellow brown, HCl(-) Slt(+), poorly sorted	10YR 5/4	80	SS	4'	2	5
6					50	SS	6'	3	
			Sand (SW), crs 60% med 30%, loose HCl Slt(+), well sorted, common wsp., no odor	10YR 5/3	80	SS	8'	4	
7			Back to med. sand, SP, sparse organic root zones						
10					80	SS	10'	5	10
11			Color change gray, becomes 70% fine, 20% med. sand	10YR 5/1	80	SS	12'	6	
					80	SS	14'	7	15
16			Several micro-shell (carbonate), rich zones, 1/2" wood pieces, sand, med 20%, 70% fine		90	SS	16'	8	
19			Organic root/wood zone 2" thick		60	SS	18'	9	
20					50	SS	20'	10	20
21			Snail shell, becomes 90% fine sand		50	SS	22'	11	
25					60	SS	24'	12	25
28			Sand (SM) becomes 90% fine sand, 10% clay, increase in black streak zones		70	SS	26'	13	
					70	SS	28'	14	
30			Snail shell		70	SS	30'	15	30
31					90	SS	32'	16	
			Clay (CL), 80% clay, 20% silt, med plast. firm, moist, gray, no odor, HCl(+)	10YR 5/1					
35					100	SS	34'	17	35
					100	ST	36'	18	
			TD 36', wet						
40			*Very fine grained, black grains possibly heavy minerals (garnet, magnetite, rutile)						40
45									45
50									50



Sand: Global FilterPack, quartz Silica Sand, 0.0376", 50lb bag

Bentonite: CETCO 1/4" Volclay Pure Gold 50lb bucket

WELL SPECIFICATIONS

Lock: (Yes) No — Weep Hole: Yes (No)

Concrete Pad: (Yes) No — Riser Cap w/Vent: (Yes) No

Size of Pad: 4'x4'

Type of Riser: (PVC) Galv Teflon Stainless Other ______

Type of Riser Screen Joints: (Screw-Coupled) Glue-Coupled Other ______

Type of Screen: (PVC) Galv Teflon Stainless Other ______

Type of Screen Perforation: (Slotted) Other ______

Diameter of Screen (ID) 2" inches — Diameter of Riser (ID) 2 inches

Slot Size of Screen: 0.010 inches — Borehole Diameter: 7 1/4 inches

Drilling Additives: (None) Revert Water Air Bentonite

Volume of Drilling Additive: — gallons

Was Fines Sump of Dense Phase Sampling Cup Installed? (Yes) No

Installed Protector Pipe w/Lock: (Yes) No

Was Outer Steel Casing Used? Yes (No)

Depth of Steel Casing: ______ to ______ feet

Well Developed By: (Pumping) Boiling Air Surge Nitrogen Other Bailer Surge

Approximate Water Volume Removed: 100 gallons

Water Clarity after Development (Clear) Turbid Opaque

Did Water have an Odor? Yes (No) If yes, describe ______

Did Water have a Color? Yes (No) If yes, describe ______

Water Level from Top of Riser Before Development ____ ft Date ______

Water Level from Top of Riser After Development 6.06 ft Date 8/23/96

Water Level 6.13 ft Date 8/24/96

Ground Surface Elevation: 587.5 ft — Top of Riser Elevation: 590.17 ft

Time Drilling Started: 1:30pm — Time Drilling Stopped: 1:50pm

Time Well Installation Started: 1:50pm — Time Well Installation Stopped: 2:45pm

Length of Screen Used: 10' — Length of Riser Used: 10'

Amount of Bentonite Used: 1 bucket — Amount of Sand Filter Used: 5 1/2 bags

Amount of Cement Used: ______ — Amount of Concrete Used: 5 bags

ENTACT

MONITORING WELL INSTALLATION RECORD

1616 CORPORATE COURT # 150
IRVING, TEXAS 75038

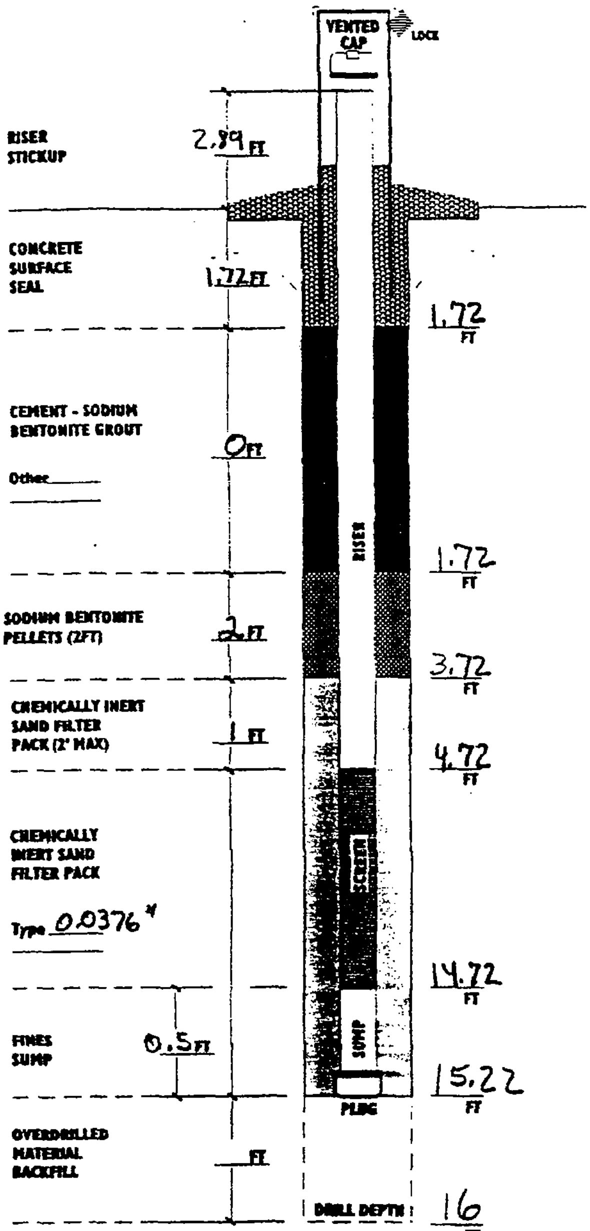
WELL NO:	MW-1	DATE:	8/19/96
PROJECT NO:	C-101	ENTACT PM:	Les Cole
PROJECT:	USS Lead	DRILLER:	Fox
LOCATION:	E. Chicago	METHOD:	H.S. Auger

SOIL BORING LOG

DATE:	Aug. 20, 1996	DRILLING COMPANY:	Fox Exploration	BORING NO:	BH-2 (MW-2)
TIME:	3:45pm	DRILLING METHOD:	Wet Rotary	SHEET:	1 of 1
PROJECT NO:	C-101	HOLE DIAMETER:	4 1/2"	SURFACE ELEVATION:	587.4
CLIENT:	USS Lead	SCREEN:	Diam Length Slot Size	TOTAL DEPTH:	32'
SITE:	USS Lead E. Chicago	CASING:	Diam Length Type	GW DEPTH:	4'
LOGGED BY:	Les Cole				

ENTACT

DEPTH (FT)	SOIL SYMBOL	WELL CONSTRUCTION	LITHOLOGIC DESCRIPTION	MUNSELL COLOR IDENTIFICATION	% RECOVERY	SAMPLE TYPE	SAMPLE DEPTH	SAMPLES NO	DEPTH (FT)
0									0
0.5			Sand (OL), 80% fine qtz. & silt/clay 20% organic roots, loose, dry, black	10YR 2/1	80	SS	2'	1	
5			Sand (SP)90%med., loose, moist, no odor, poorly sort., pale brown, SP, HCl Slt(+)	10YR 7/4	80	SS	4'	2	5
7			thin zone micro shells, organics, light olive brown	2.5Y 5/4	80	SS	6'	3	
8			Sand, (SP)90% fine qtz., loose, wet, no odor, poorly sort., green brown	2.5Y 5/2	70	SS	8'	4	
10					70	SS	10'	5	10
			olive gray	5Y 5/2	60	SS	12'	6	
					60	SS	14'	7	15
			organic zone wood, peat 2" thick		70	SS	16'	8	
					60	SS	18'	9	
20			Sand 80% fine qtz., 20% fines of clay, silt		50	SS	20'	10	20
					90	SS	22'	11	
24			rare, 1/8" - 1/4" gravel		60	SS	24'	12	
25									25
					80	SS	26'	13	
29.5			coarse sand 70% Gvl 10% zone 2" thick						
30			Clay(CL), 80% clay, w/silt some coarse sand, very firm, moist, med /high plast., gray, HCl(+)no odor	10YR 5/1	90	SS	30'	14	30
			TD 32', wet		100	SS	32'	15	
35									35
40									40
45									45
50									50



Sand: Global Filter Sand
Quartz Sand, 0.0376", 50lb bags
Bentonite: Pure Gold Volclay 1/4"
50lb bucket by CETCO

WELL SPECIFICATIONS

Lock: (Yes) No — Weep Hole: Yes (No)
Concrete Pad: (Yes) No — Riser Cap w/Vent: (Yes) No
Size of Pad: 4'x4'

Type of Riser: (PVC) Galv Teflon Stainless Other ______

Type of Riser Screen Joints: (Screw-Coupled) Glue-Coupled Other ______

Type of Screen: (PVC) Galv Teflon Stainless Other ______

Type of Screen Perforation: (Slotted) Other ______

Diameter of Screen (ID) 2 inches — Diameter of Riser (ID) 2 inches

Slot Size of Screen: 0.010 inches — Borehole Diameter: 7 1/4 inches

Drilling Additives: None Revert Water Air Bentonite

Volume of Drilling Additive: ______ gallons

Was Fines Sump of Dense Phase Sampling Cup installed? (Yes) No

Installed Protector Pipe w/Lock: (Yes) No

Was Outer Steel Casing Used? Yes (No)

Depth of Steel Casing: ______ to ______ feet

Well Developed By: (Pumping) Boiling Air Surge Nitrogen Other Bailer Surge

Approximate Water Volume Removed: 100 gallons

Water Clarity after Development (Clear) Turbid Opaque

Did Water have an Odor? Yes (No) If yes, describe ______

Did Water have a Color? Yes (No) If yes, describe ______

Water Level from Top of Riser Before Development ______ ft Date ______

Water Level from Top of Riser After Development 6.78 ft Date 8/23/96

Water Level 6.80 ft Date 8/24/96

Ground Surface Elevation: 587.4 ft — Top of Riser Elevation: 590.29 ft

Time Drilling Started: 2:00 pm — Time Drilling Stopped: 2:20pm

Time Well Installation Started: 2:20PM — Time Well Installation Stopped: 3:20pm

Length of Screen Used: 10' — Length of Riser Used: 10'

Amount of Bentonite Used: 1 bucket — Amount of Sand Filter Used: 5 bags

Amount of Cement Used: ______ — Amount of Concrete Used: 5 bags

ENTACT

MONITORING WELL INSTALLATION RECORD

1616 CORPORATE COURT # 150
IRVING, TEXAS 75038

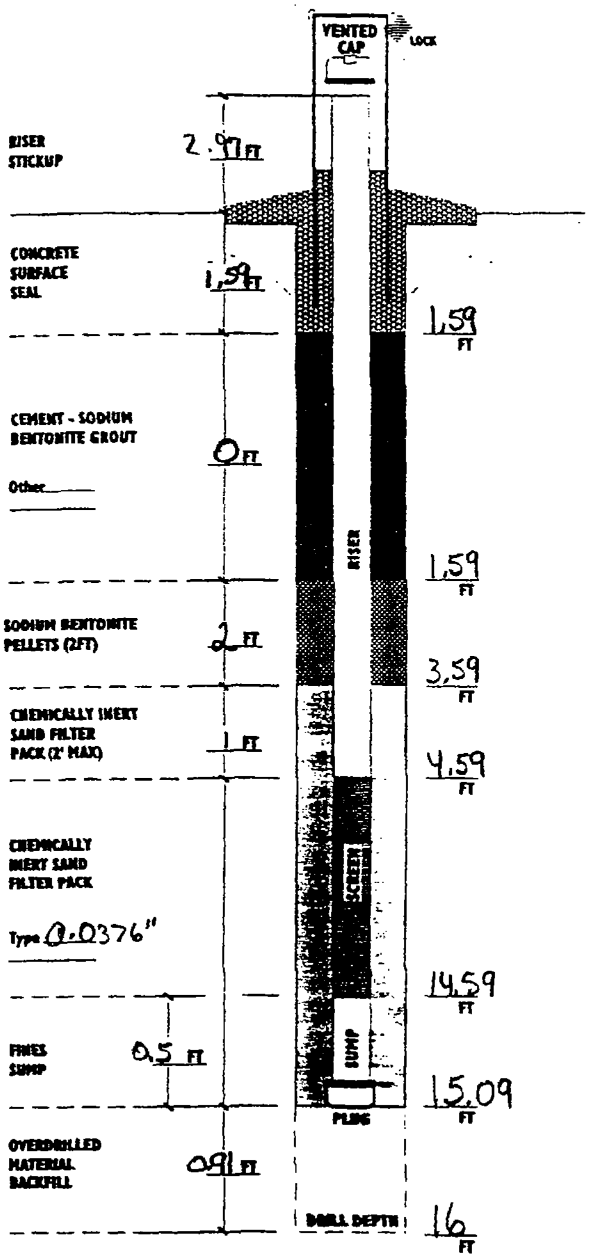
WELL NO:	MW-2	**DATE:**	8/20/96
PROJECT NO:	C-101	**ENTACT PM:**	Les Cole
PROJECT:	USS Lead	**DRILLER:**	Fox
LOCATION:	E. Chicago	**METHOD:**	H.S. Auger

SOIL BORING LOG

DATE:	Aug. 21, 1996	DRILLING COMPANY:	Fox Exploration	BORING NO:	BH-3 (MW-3)
TIME:	2:45pm	DRILLING METHOD:	Wet Rotary	SHEET:	1 of 1
PROJECT NO:	C-101	HOLE DIAMETER:	4 1/2"	SURFACE ELEVATION:	587.4
CLIENT:	USS Lead	SCREEN:	Diam Length Slot Size	TOTAL DEPTH:	32'
SITE:	USS Lead E. Chicago	CASING:	Diam Length Type	GW DEPTH:	4'
LOGGED BY:	Les Cole				

ENTACT

DEPTH (FT)	SOIL SYMBOL	WELL CONSTRUCTION	LITHOLOGIC DESCRIPTION	MUNSELL COLOR IDENTIFICATION	% RECOVERY	SAMPLE TYPE	SAMPLE DEPTH	SAMPLES NO	DEPTH (FT)
0			Sand (SP), 70% med. w/silt, dry, roots, loose, no odor, black, 3" zone of cinders, slag						0
0.5			Sand (SP), 90% med., loose, moist, no odor, HCl Slt(+) yellow brown	10YR 6/6	60	SS	2'	1	
4			wet		90	SS	4'	2	
5			light yellow brown	2.5 6/3					5
			light olive brown	2.5Y 5/3	90	SS	6'	3	
			olive gray, 90% fine qtz. sand	5Y 5/2	70	SS	8'	4	
10					90	SS	10'	5	10
11			occasional streaks of 1/4" misc. shell pieces, darker streaks of heavy minerals		70	SS	12'	6	
					70	SS	14'	7	15
			2" zone organic wood pieces & micro shells, black		50	SS	16'	8	
19			common peat zones, 2" thick, wood, shells, some sand		50	SS	18'	9	
20					80	SS	20'	10	20
21			peat zone 4" thick, wood black, spongy, w/shells, some sand		100	SS	22'	11	
22			snail shell, shell pieces						
25					70	SS	24'	12	25
					80	SS	26'	13	
29			2" gravel zone, to 1/2", w/coarse sand		80	SS	28'	14	
30			Clay (CL), very firm, med-high plast., no odor, 90% clay 10% silt fine sand	10YR 6/1	80	SS	30'	15	30
					100	SS	32'	16	
34			TD 34'. wet		100	ST	34'	18	
35									35
40									40
45									45
50									50



Sand: Global Filter Sand, Quartz, 0.0376", 50 lb bags
Bentonite: Pure Gold Volclay 1/4" 50 lb bucket

WELL SPECIFICATIONS

Lock: (Yes) No — Weep Hole: Yes (No)
Concrete Pad: (Yes) No — Riser Cap w/Vent: (Yes) No
Size of Pad: 4'x4'

Type of Riser: (PVC) Galv Teflon Stainless Other ______

Type of Riser Screen joints: (Screw-Coupled) Glue-Coupled Other ______

Type of Screen: (PVC) Galv Teflon Stainless Other ______

Type of Screen Perforation: (Slotted) Other ______

Diameter of Screen (ID) 2 inches — Diameter of Riser (ID) 2 inches

Slot Size of Screen: 0.010 inches — Borehole Diameter: 7 1/4 inches

Drilling Additives: (None) Revert Water Air Bentonite

Volume of Drilling Additive: ______ gallons

Was Fines Sump of Dense Phase Sampling Cup Installed? (Yes) No

Installed Protector Pipe w/Lock: (Yes) No

Was Outer Steel Casing Used? Yes No

Depth of Steel Casing: ______ to ______ feet

Well Developed By: (Pumping) Boiling Air Surge Nitrogen Other Bailer Surge

Approximate Water Volume Removed: 100 gallons

Water Clarity after Development (Clear) Turbid Opaque

Did Water have an Odor? Yes (No) If yes, describe ______

Did Water have a Color? Yes (No) If yes, describe ______

Water Level from Top of Riser Before Development ___ ft Date ______

Water Level from Top of Riser After Development 6.65 ft Date 8/23/96

Water Level 6.71 ft Date 8/24/96

Ground Surface Elevation: 587.4 ft — Top of Riser Elevation: 590.37 ft

Time Drilling Started: 1:25pm — Time Drilling Stopped: 1:45pm

Time Well Installation Started: 1:45pm — Time Well Installation Stopped: 2:25pm

Length of Screen Used: 10' — Length of Riser Used: 10'

Amount of Bentonite Used: 1 bucket — Amount of Sand Filter Used: 5 bags

Amount of Cement Used: ______ — Amount of Concrete Used: 6 bags

ENTACT

MONITORING WELL INSTALLATION RECORD

1616 CORPORATE COURT # 150
IRVING, TEXAS 75038

WELL NO: MW-3
PROJECT NO: C-101
PROJECT: USS Lead
LOCATION: E. Chicago

DATE: 8/21/96
ENTACT PM: Les Cole
DRILLER: Fox
METHOD: H.S. Auger

SOIL BORING LOG

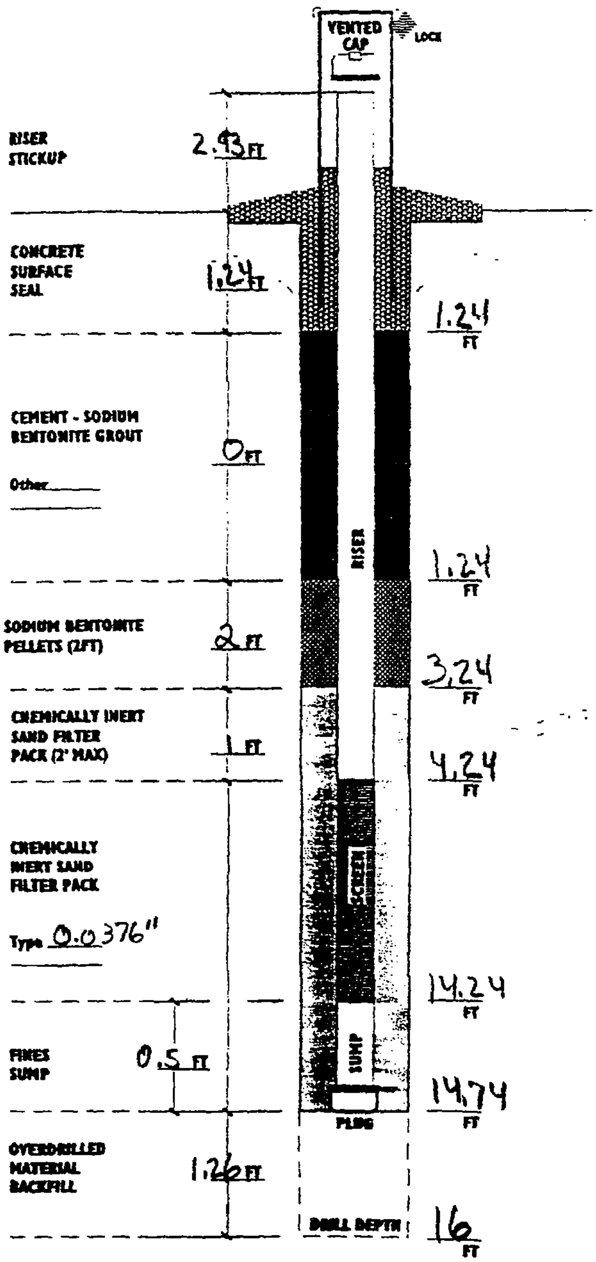
DATE: Aug. 23, 1996
TIME: 10:15pm
PROJECT NO: C-101
CLIENT: USS Lead
SITE: USS Lead E. Chicago
LOGGED BY: Les Cole

DRILLING COMPANY: Fox Exploration
DRILLING METHOD: Wet Rotary
HOLE DIAMETER: 4 1/2"
SCREEN: Diam Length Slot Size
CASING: Diam Length Type

BORING NO: BH-4 (MW-4)
SHEET: 1 of 1
SURFACE ELEVATION: 588.6
TOTAL DEPTH: 34'
GW DEPTH: 3'

ENTACT

DEPTH (FT)	SOIL SYMBOL	WELL CONSTRUCTION	LITHOLOGIC DESCRIPTION	MUNSELL COLOR IDENTIFICATION	% RECOVERY	SAMPLE TYPE	SAMPLE DEPTH	SAMPLES NO	DEPTH (FT)
0			Asphalt and gravel fill						0
0.5			Sand (SP) 90% med., moist, loose, yellow brown, poor sort HCl(-)	10YR 5/8	50		2'	1	
					100		4'	2	
5			gravel fill to 1"						5
6			Sand (SP), 80% fine qtz., 20% vfs/silt, loose, no odor, w/black streaks, roots, olive, poorly sorted, HCL(-), occ. dark waves of heavy minerals	5Y 4/3	50		6'	3	
9			gravel zone, 3" thick, up to 1/2", angular		80		8'	4	
10					90		10'	5	10
					50		12'	6	
					90		14'	7	15
16			occ. dark waves of heavy minerals w/micro shells		90		16'	8	
18			becomes prim. fine/vf qtz. sand 80%		90		18'	9	
20					100		20'	10	20
					80		22'	11	
25					100		24'	12	25
26			increase micro shells, common 26.5' - 27.5'				NS		
29			peat zone 1/2", increase dark waves of heavy minerals		100		28'	13	
29.5			2" gravel zone, 1/4" dia. loose, w/coarse sand, NCl(+)		100		30'	14	30
31			gravel, 1/4" w/coarse sand						
32			Clay(CL), very firm to firm, moist, 80% clay 20% silt w/scat 1/4" gravel, gray med plast., no odor HCL(+)Slt.	5Y 5/1	10		32'	15	
35					90		34'	16	35
			TD 34', wet						
40									40
45									45
50									50



Sand: Global Filter Sand, Quartz, 0.0376", 50lb Bag

Bentonite: Pure Gold CETCO Volclay 1/4", 50 lb bucket

WELL SPECIFICATIONS

Lock: (Yes) No — Weep Hole: Yes (No)

Concrete Pad: (Yes) No — Riser Cap w/Vent: (Yes) No

Size of Pad: 4x4'

Type of Riser: (PVC) Galv Teflon Stainless Other ____

Type of Riser Screen Joints: (Screw-Coupled) Glue-Coupled Other ____

Type of Screen: (PVC) Galv Teflon Stainless Other ____

Type of Screen Perforation: (Slotted) Other ____

Diameter of Screen (ID) 2 inches — Diameter of Riser (ID) 2 inches

Slot Size of Screen: 0.010 inches — Borehole Diameter: 7 1/4 inches

Drilling Additives: (None) Revert Water Air Bentonite

Volume of Drilling Additive: ____ gallons

Was Fines Sump of Dense Phase Sampling Cup Installed? (Yes) No

Installed Protector Pipe w/Lock: (Yes) No

Was Outer Steel Casing Used? Yes (No)

Depth of Steel Casing: ____ to ____ feet

Well Developed By: (Pumping) Boiling Air Surge Nitrogen Other Bailer Surge

Approximate Water Volume Removed: 100 gallons

Water Clarity after Development (Clear) Turbid Opaque

Did Water have an Odor? Yes (No) If yes, describe ____

Did Water have a Color? Yes (No) If yes, describe ____

Water Level from Top of Riser Before Development ____ ft Date ____

Water Level from Top of Riser After Development 6.87 ft Date 8/23/96

Water Level 6.92 ft Date 8/24/96

Ground Surface Elevation: 588.6 ft — Top of Riser Elevation: 591.53 ft

Time Drilling Started: 8:25AM — Time Drilling Stopped: 8:45AM

Time Well Installation Started: 8:45 — Time Well Installation Stopped: 9:40

Length of Screen Used: 10' — Length of Riser Used: 10'

Amount of Bentonite Used: 1 bucket — Amount of Sand Filter Used: 5 bags

Amount of Cement Used: ____ — Amount of Concrete Used: 3 bags

ENTACT

MONITORING WELL INSTALLATION RECORD

1616 CORPORATE COURT # 150
IRVING, TEXAS 75038

WELL NO: MW-4
PROJECT NO: C-101
PROJECT: USS Lead
LOCATION: E. Chicago

DATE: 8/22/96
ENTACT PM: Les Cole
DRILLER: Fox
METHOD: H.S. Auger

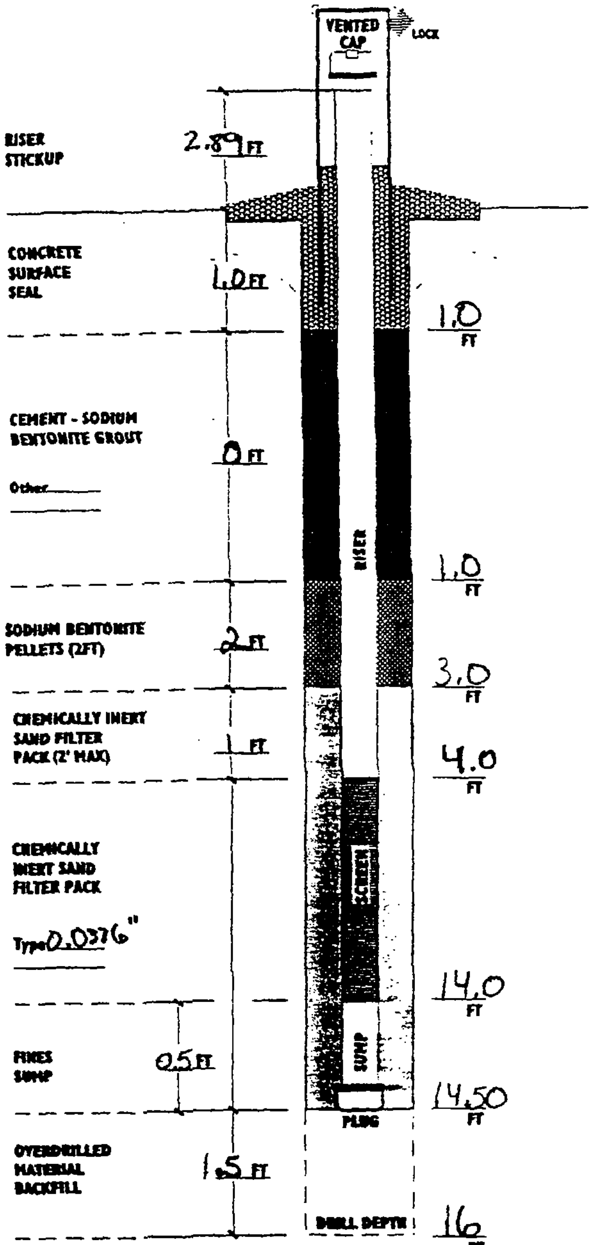
SOIL BORING LOG

DATE:	Aug. 22, 1996	DRILLING COMPANY:	Fox Exploration	BORING NO:	BH-5 (MW-5)
TIME:	12:20pm	DRILLING METHOD:	Wet Rotary	SHEET:	1 of 1
PROJECT NO:	C-101	HOLE DIAMETER:	4 1/2"	SURFACE ELEVATION:	584.0
CLIENT:	USS Lead	SCREEN:	Diam Length Slot Size	TOTAL DEPTH:	30'
SITE:	USS Lead E. Chicago	CASING:	Diam Length Type	GW DEPTH:	4'
LOGGED BY:	Les Cole				

ENTACT

DEPTH (FT)	SOIL SYMBOL	WELL CONSTRUCTION	LITHOLOGIC DESCRIPTION	MUNSELL COLOR IDENTIFICATION	% RECOVERY	SAMPLE TYPE	SAMPLE DEPTH	SAMPLES NO	DEPTH (FT)
0			Fill occa. battery chips, black, dark brown med sand dry, no odor						0
0.5			Sand(SP), 80% med qtz., 20% fines, moist, loose, no odor pale brown HCl(+)	10YR 6/3	60	SS	2'	1	
4			grayish brown, wet	2.5Y 5/2	70	SS	4'	2	5
			gray 80% fine qtz. sand, loose, no odor	5Y 5/1	70	SS	6'	3	
					60	SS	8'	4	
10					50	SS	10'	5	10
12			occ. peat zones 1/2" thick, with micro shells		50	SS	12'	6	
			peat zone 2" thick, spongy, other common smaller peat stringers		80	SS	14'	7	15
					80	SS	16'	8	
17			peat zones 2" thick		90	SS	18'	9	
20			peat zones		80	SS	20'	10	20
					80	SS	22'	11	
23			very coarse sand, minor small gravel, loose, no odor						
23.5			clayey siltly sand(SM), 70% fine qtz., loose to soft, no odor dark gray, NCl(+)	5Y 4/1	70	SS	24'	12	25
					90	SS	26'	13	
			clay on tube, small gravel zone top of clay		0	-	28'	NR	
27.5			clay(CL), very firm 90% clay 10% silt/coarse sand, gray, med plast. moist HCl Slt(+)	10YR 5/1	100	SS	30'	14	30
			TD 30'. wet						
35									35
40									40
45									45
50									50

WELL SPECIFICATIONS



Sand used: Global Filter Sand, Quartz, 0.0376", 50lb bag.

Bentonite: PureGold CETCO Volclay, 1/4", 50lb bucket

Lock: (Yes) No — Weep Hole: Yes (No)

Concrete Pad: (Yes) No — Riser Cap w/Vent: (Yes) No

Size of Pad: 4x4'

Type of Riser: (PVC) Galv Teflon Stainless Other ________

Type of Riser Screen joints: (Screw-Coupled) Glue-Coupled Other ________

Type of Screen: (PVC) Galv Teflon Stainless Other ________

Type of Screen Perforation: (Slotted) Other ________

Diameter of Screen (ID) 2 inches — Diameter of Riser (ID) 2 inches

Slot Size of Screen: 0.010 inches — Borehole Diameter: 7 1/4" inches

Drilling Additives: (None) Revert Water Air Bentonite

Volume of Drilling Additive: ________ gallons

Was Fines Sump of Dense Phase Sampling Cup installed? (Yes) No

Installed Protector Pipe w/Lock: (Yes) No

Was Outer Steel Casing Used? Yes (No)

Depth of Steel Casing: ________ to ________ feet

Well Developed By: (Pumping) Boiling Air Surge Nitrogen Other Bailer Surge

Approximate Water Volume Removed: 100 gallons

Water Clarity after Development (Clear) Turbid Opaque

Did Water have an Odor? Yes (No) If yes, describe ________

Did Water have a Color? Yes (No) If yes, describe ________

Water Level from Top of Riser Before Development ____ ft Date ________

Water Level from Top of Riser After Development 5.03 ft Date 8/23/96

Water Level 5.13 ft Date 8/24/96

Ground Surface Elevation: 584.0 ft — Top of Riser Elevation: 586.89 ft

Time Drilling Started: 10:10 AM — Time Drilling Stopped: 10:30 AM

Time Well Installation Started: 10:30 AM — Time Well Installation Stopped: 11:15 AM

Length of Screen Used: 10' — Length of Riser Used: 10'

Amount of Bentonite Used: 1 bucket — Amount of Sand Filter Used: 5 bags

Amount of Cement Used: ________ — Amount of Concrete Used: 6 bags

ENTACT

MONITORING WELL INSTALLATION RECORD

1616 CORPORATE COURT # 150
IRVING, TEXAS 75038

WELL NO:	MW-5	DATE:	8/22/96
PROJECT NO:	C-101	ENTACT PM:	Les Cole
PROJECT:	USS Lead	DRILLER:	Fox
LOCATION:	E. Chicago	METHOD:	HS Auger

SOIL BORING LOG

DATE: Aug. 23, 1996
TIME: 7:50am
PROJECT NO: C-101
CLIENT: USS Lead
SITE: USS Lead E. Chicago
LOGGED BY: Les Cole

DRILLING COMPANY: Fox Exploration
DRILLING METHOD: Wet Rotary
HOLE DIAMETER: 4 1/2"
SCREEN: Diam Length Slot Size
CASING: Diam Length Type

BORING NO: BH-6 (No MW)
SHEET: 1 of 1
SURFACE ELEVATION: No Measurement
TOTAL DEPTH: 32'
GW DEPTH: 4'

ENTACT

DEPTH (FT)	SOIL SYMBOL	WELL CONSTRUCTION	LITHOLOGIC DESCRIPTION	MUNSELL COLOR IDENTIFICATION	% RECOVERY	SAMPLE TYPE	SAMPLE DEPTH	SAMPLES NO	DEPTH (FT)
0			fill poss. RR ballast?,, black, sandy w/gravel loose, damp black, no odor						0
			sand(SP), med qtz. 90% sand, loose, moist, no odor yellow bn.	10TR 6/6	50	SS	2'	1	
3 4 5			black stained zone 4" - 6" internal		90	SS	4'	2	5
			light olive brown, wet	2.5Y 5/3	100	SS	6'	3	
7			3" zone, gravel, black (RR ballas?)		60	SS	8'	4	
10			sand (SP), fine qtz. 80%, loose, wet, no odor, olive gray	5Y 5/2	60	SS	10'	5	10
			rare stringers of peat, scattered micro shells		80	SS	12'	6	
					40	SS	14'	7	15
					50	SS	16'	8	
18			occ. micro. shell dark stringers heavy minerals, w/coarse sand		80	SS	18'	9	
20					90	SS	20'	10	20
					80	SS	22'	11	
25					80	SS	24'	12	25
					70	SS	26'	13	
					80	SS	28'	14	
30			clay(CL), 90% clay, 10% silt, med. plast. - firm, moist, gray, no odor	10YR 5/1	80	SS	30'	15	30
			TD 32', wet		100	SS	32'	16	
35									35
40									40
45									45
50									50

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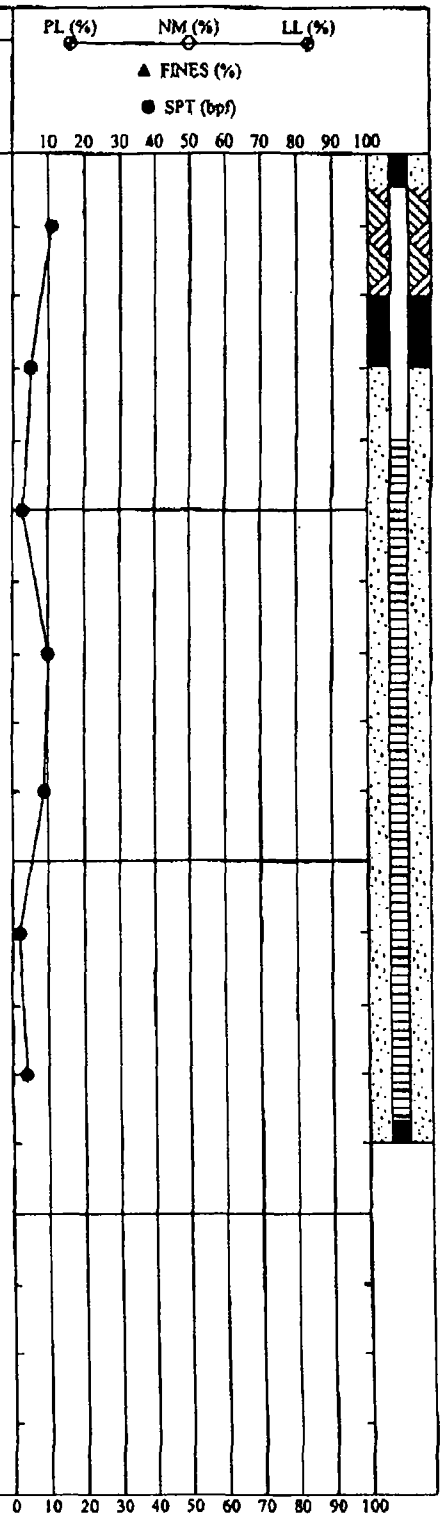
DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Brown, silty CLAY (CL-ML), moist					
				SS-1		2-5-6
	Light gray, silty medium SAND (SM), moist			SS-2		2-3-2
	Gray, fine silty SAND (SM), moist to saturated					
5				SS-3		2-1-2
				SS-4		2-4-6
				SS-5		2-6-3
10						
	Gray, fine silty SAND (SM), saturated, with black mottles			SS-6		3-1-1
				SS-7		3-1-3
	Boring terminated at 14 feet below grade					
15						



SOIL 06917.GPJ LAW_GIBB.GDT 12/21/00

CONTRACTOR:	Fox Drilling
DRILLER:	
EQUIPMENT:	Hollow Stem Auger 4 1/4 I.D.
METHOD:	Hollow Stem Auger
HOLE DIA.:	WELL: Stickup 2.45' Size 2" inner diameter
REMARKS:	Installed monitoring well MW-6. Well set at 14 feet

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

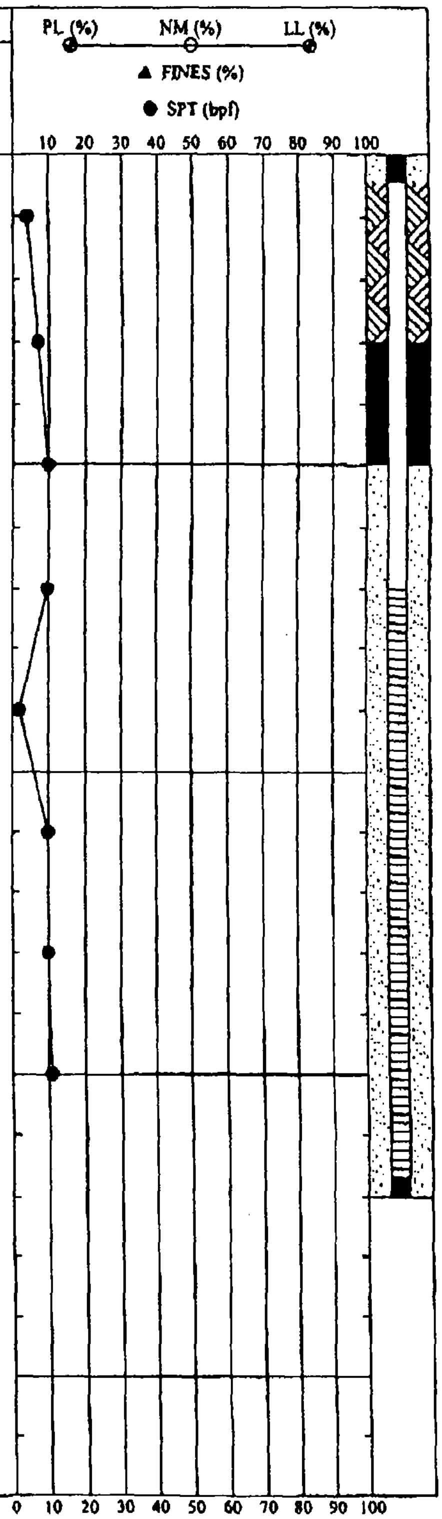
SOIL TEST BORING RECORD

Project:	USS Lead	**Boring No.:**	MW-6
Coord N:		**Prepared By:**	KJC
Coord E:		**Checked By:**	JAB
Drilled:	October 25, 2000	**Date:**	12/21/00
Proj. No.:	52000-0-2308-06-917	**Figure:**	1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	LEGEND	ELEV (ft)
0	Dark brown, sandy loam		
3	Light brown, medium to fine SAND (SW)		
6	Light brown, medium to fine SAND (SW), with dark brown mottles		
8	Dark gray, fine silty SAND (ORGFINE), 30% organic		
10	Gray, fine silty sand (SM), saturated		
17	Boring terminated at 17 feet below grade		

SAMPLES IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
SS-1		2-2-2
SS-2		2-3-4
SS-3		3-4-6
SS-4		2-4-6
SS-5		1-1-1
SS-6		3-4-6
SS-7		4-5-5
SS-8		4-6-5



SOIL 06917.GPJ LAW GIBB.GDT 12/21/00

CONTRACTOR: Fox Drilling
DRILLER:
EQUIPMENT: Hollow Stem Auger 4 1/4 I.D.
METHOD: Hollow Stem Auger
HOLE DIA.: WELL: Stickup 2.9' Size 2" inner diameter
REMARKS: Installed monitoring well MW-7. Well set at 17 feet

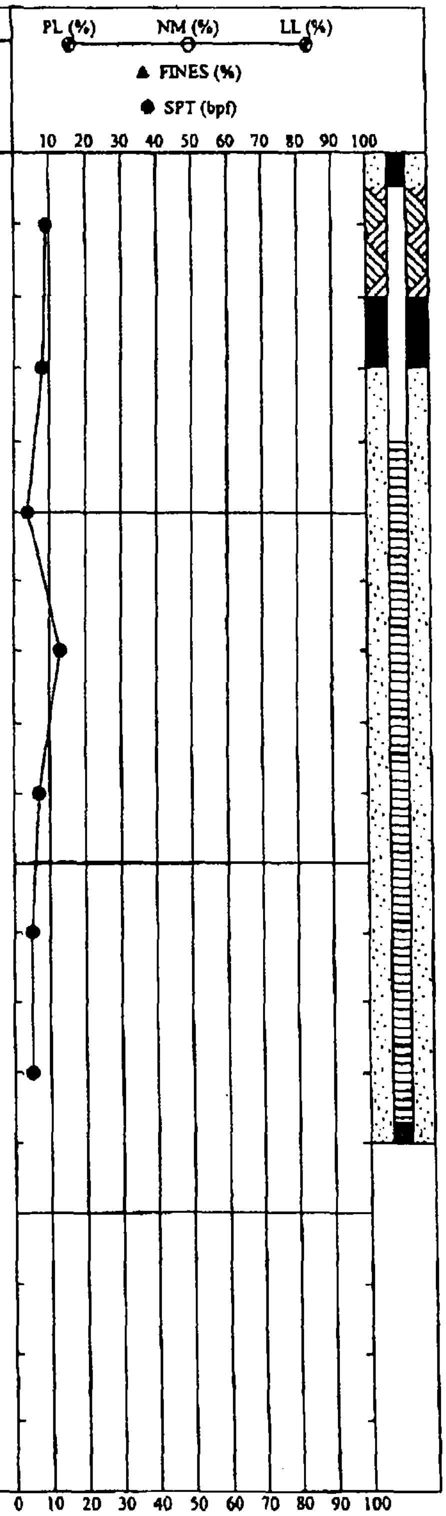
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

Project: USS Lead — **Boring No.:** MW-7
Coord N: — **Prepared By:** KJC
Coord E: — **Checked By:** JAB
Drilled: October 25, 2000 — **Date:** 12/21/00
Proj. No.: 52000-0-2308-06-917 — **Figure:** 1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Dark brown, silty loam					
	Light brown, medium to fine SAND (SW), wet			SS-1		3-4-5
	Light brown, medium to fine SAND (SW), with dark brown mottling, saturated			SS-2		3-4-4
	Gray, silty SAND (ORGFINE) with dark brown organic layers at 4.5 and 5.8, layers are .1' thick					
5				SS-3		3-2-2
	Light brown, fine silty SAND (SM), saturated			SS-4		5-6-7
	Gray, fine silty SAND (SM), saturated			SS-5		3-3-4
10						
				SS-6		4-2-3
	Gray to dark gray, .1' thick organic layers, 5 of each			SS-7		4-2-3
	Boring terminated at 14 feet below grade					
15						



SOIL 06917.GPJ LAW GIBB.GDT 12/21/00

CONTRACTOR:	Fox Drilling
DRILLER:	
EQUIPMENT:	Hollow Stem Auger 4 1/4 I.D
METHOD:	Hollow Stem Auger
HOLE DIA.:	WELL: Stickup 2' Size 2" inner diameter
REMARKS:	Installed monitoring well MW-8. Well set at 14 feet

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

Project:	USS Lead	**Boring No.:**	MW-8
Coord N:		**Prepared By:**	KJC
Coord E:		**Checked By:**	JMS
Drilled:	October 26, 2000	**Date:**	12/21/00
Proj. No.:	52000-0-2308-06-917	**Figure:**	1

LAW
LAWGIBB Group Member

110B

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf)
0	Blind drill to 28 feet. Boring terminated at 20 feet below grade			1					
5									
10									
15									
20									
25									
30									

10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

SOIL 06917.GPJ LAW GIBB.GDT 12/21/00

CONTRACTOR: Fox Drilling
DRILLER:
EQUIPMENT: Hollow Stem Auger 4 1/4 I.D.
METHOD: Hollow Stem Auger
HOLE DIA.: WELL: Stickup 2' Size 2" inner diameter
REMARKS: Installed monitoring well MW-9. Well set at 28 feet

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

Project: USS Lead
Boring No.: MW-9
Coord N:
Prepared By: KJC
Coord E:
Checked By: JAB
Drilled: October 27, 2000
Date: 12/21/00
Proj. No.: 52000-0-2308-06-917
Figure: 1

LAW
LAWGIBB Group Member

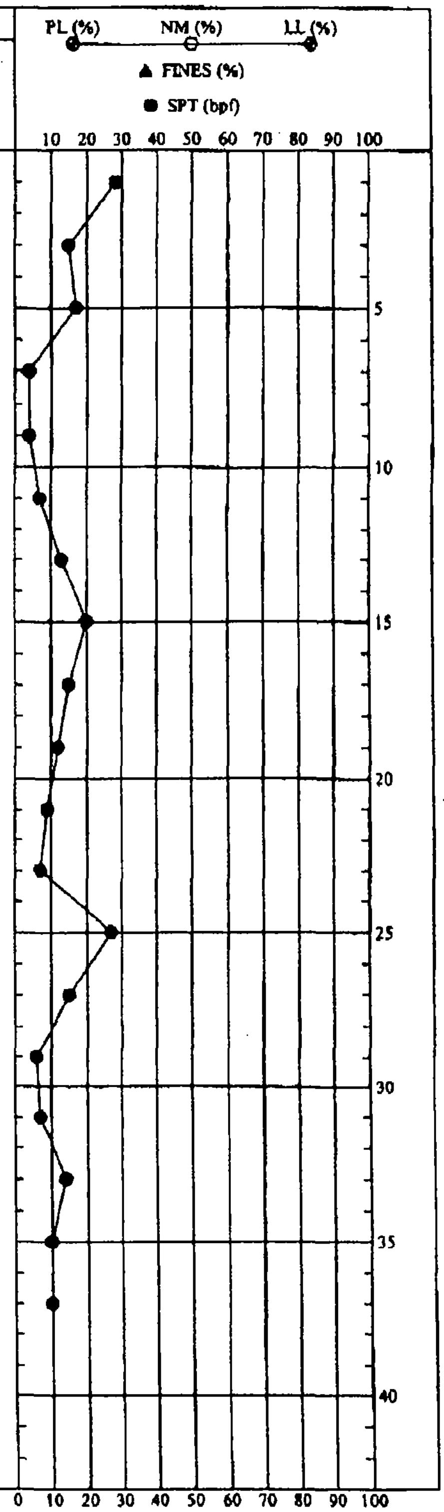
SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

- Brown, sandy clay FILL material
- Gray, clay FILL material
- Dark gray, silty SAND (SM), with black mottling
- Dark gray, fine silty SAND (ORGFINE), with 30% organic
- Light gray to dark grayish-black, fine silty SAND (SM), wet
- Light gray, fine silty SAND (SM), saturated
- Dark gray, fine silty SAND (SM), saturated
- Light gray, fine silty SAND (SM), saturated
- Dark gray, fine silty SAND (SM), saturated
- Light gray, fine silty SAND (SM), saturated
- Dark gray, fine silty SAND (SM), saturated
- Dark gray to greenish-brown, course SAND (SPG)
- Dark gray, fine silty SAND (SM)
- Brown, gravelly coarse SAND (SPG)
- Light gray, CLAY (CL)
- Boring terminated at 38 feet below grade

SAMPLES

IDENT	N-COUNT (1st 6" 2nd 6" 3rd 6")
SS-1	11-12-16
SS-2	6-8-7
SS-3	6-7-10
SS-4	2-2-2
SS-5	2-2-2
SS-6	4-5-2
SS-7	5-7-6
SS-8	6-8-12
SS-9	7-6-9
SS-10	5-6-6
SS-11	5-5-4
SS-12	5-5-2
SS-13	7-12-15
SS-14	6-8-7
SS-15	2-3-3
SS-16	3-4-3
SS-17	4-7-7
SS-18	4-4-6
SS-19	4-4-6



SOIL 06917.GPJ LAW GIBB.GDT 12/21/00

CONTRACTOR: Fox Drilling
DRILLER:
EQUIPMENT: Hollow Stem Auger 4 1/4 I.D.
METHOD: Hollow Stem Auger
HOLE DIA.:
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

Project: USS Lead — **Boring No.:** MWT-9/10
Coord N: — **Prepared By:** KJC
Coord E: — **Checked By:** JAS
Drilled: October 26, 2000 — **Date:** 12/21/00
Proj. No.: 52000-0-2308-06-917 — **Figure:** 1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"	PL (%) NM (%) LL (%) ▲ FINES (%) ● SPT (bpf)
0	Blind drill to 20 feet. Boring terminated at 20 feet below grade			1					
5									
10									
15									
20									
25									

SOIL 06917.GPJ LAW GIBB.GDT 12/21/00

CONTRACTOR:	Fox Drilling
DRILLER:	
EQUIPMENT:	Hollow Stem Auger 4 1/4 I.D.
METHOD:	Hollow Stem Auger
HOLE DIA.:	WELL: Stickup Stickup Type Size 2" inner diameter
REMARKS:	Installed monitoring well MW-10. Well set at 20 feet

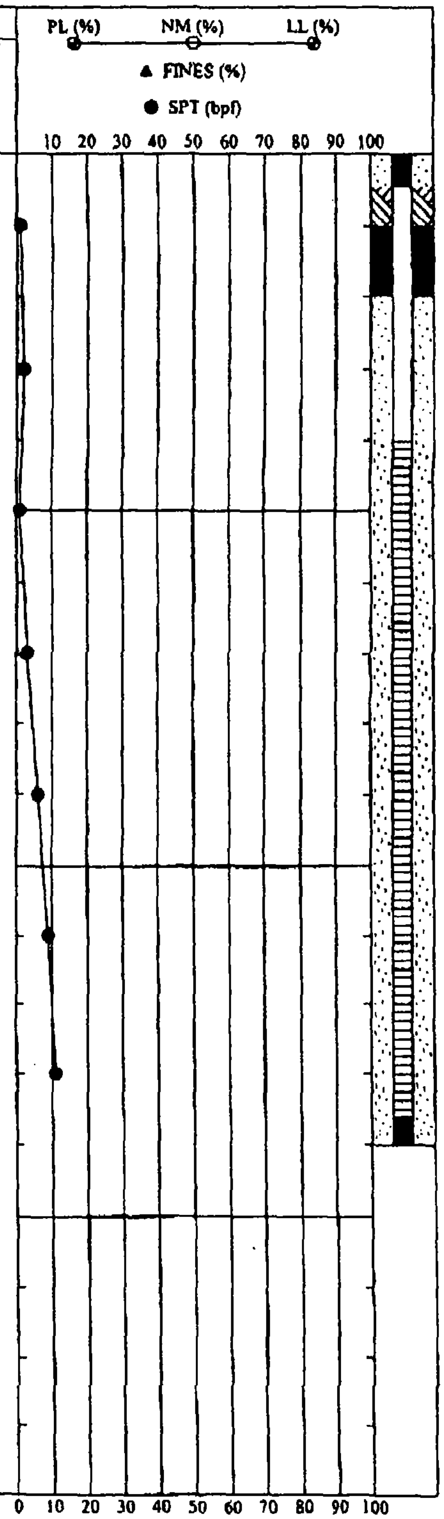
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

Project:	USS Lead	**Boring No.:**	MW-10
Coord N:		**Prepared By:**	KJC
Coord E:		**Checked By:**	JMS
Drilled:	October 27, 2000	**Date:**	12/21/00
Proj. No.:	52000-0-2308-06-917	**Figure:**	1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Dark brown, SILT (ORGFINE) with 75-80% organic, saturated					
				SS-1		1-1-0
				SS-2		2-1-1
	Light gray, fine silty SAND (SM), saturated					
5				SS-3		1-0-1
	Light gray, fine sandy SILT (MLS), saturated					
				SS-4		3-3-0
				SS-5		3-3-3
10	Light gray, fine silty SAND (SM), saturated					
				SS-6		6-5-4
				SS-7		5-6-5
	Boring terminated at 14 feet below grade					
15						



SOIL 06917.GPJ LAW GIBB.GDT 12/21/00

CONTRACTOR: Fox Drilling
DRILLER:
EQUIPMENT: Hollow Stem Auger 4 1/4 I.D.
METHOD: Hollow Stem Auger
HOLE DIA.: WELL: Stickup 1' Size 2" inner diameter
REMARKS: Installed monitoring well MW-11. Well set at 14 feet

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

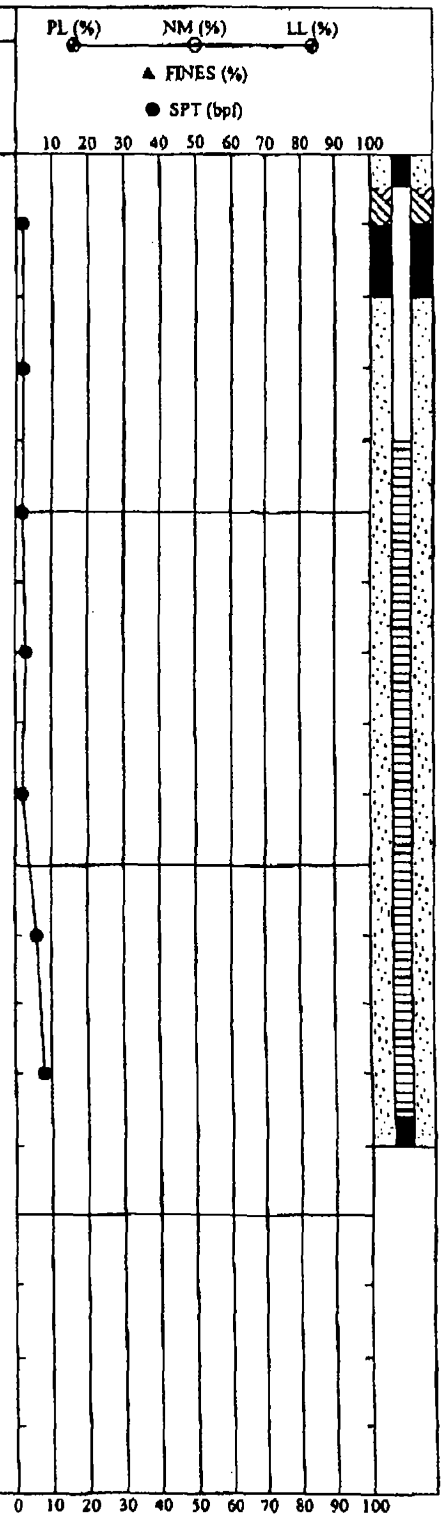
Project:	USS Lead	**Boring No.:**	MW-11
Coord N:		**Prepared By:**	KJC
Coord E:		**Checked By:**	JAS
Drilled:	October 27, 2000	**Date:**	12/21/00
Proj. No.:	52000-0-2308-06-917	**Figure:**	1

LAW
LAWGIBB Group Member

SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	SAMPLES IDENT	N-COUNT (1st 6" 2nd 6" 3rd 6")
0	Brown, SILT (ORGFINE), with 80% organic		
		SS-1	1-1-1
	Dark gray, sandy SILT (MLS), wet to saturated		
		SS-2	1-1-1
5		SS-3	1-0-2
		SS-4	4-2-1
		SS-5	4-2-0
10			
		SS-6	2-3-3
	Gray, silty SAND (SM), saturated		
		SS-7	3-4-4
	Boring terminated at 14 feet below grade		
15			



SOIL 06917.GPJ LAW_GIBB.GDT 12/21/00

CONTRACTOR:	Fox Drilling
DRILLER:	
EQUIPMENT:	Hollow Stem Auger 4 1/4 I.D.
METHOD:	Hollow Stem Auger
HOLE DIA.:	WELL: Stickup 6' Size 2" inner diameter
REMARKS:	Installed monitoring well MW-12. Well set at 14 feet

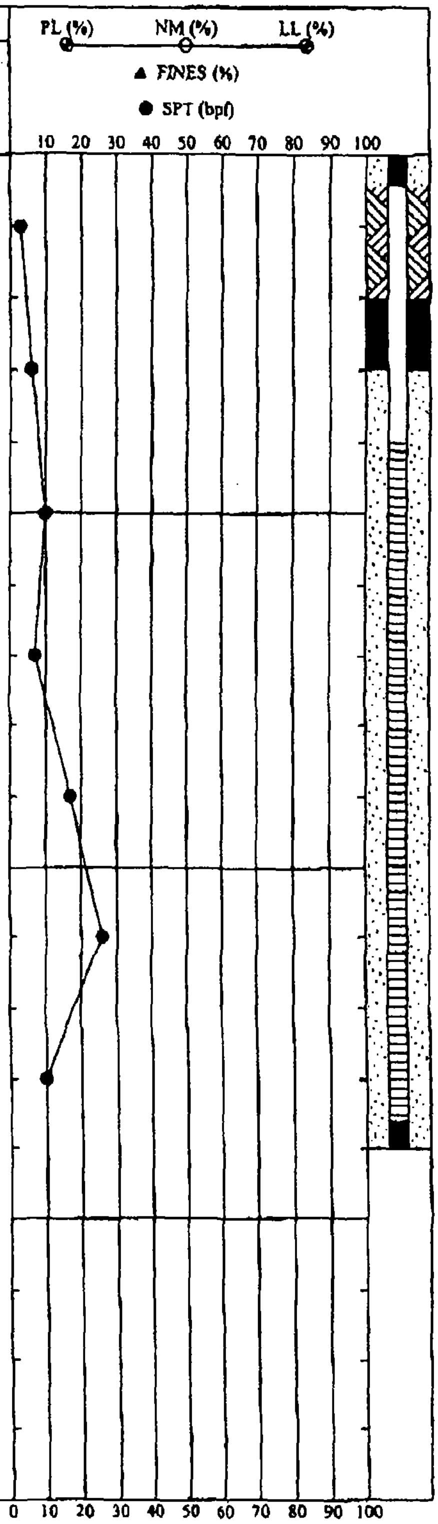
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

Project:	USS Lead	**Boring No.:**	MW-12
Coord N:		**Prepared By:**	KJC
Coord E:		**Checked By:**	JAB
Drilled:	October 30, 2000	**Date:**	12/21/00
Proj. No.:	52000-0-2308-06-917	**Figure:**	1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	SAMPLES IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	Dark brown, medium silty SAND (SM)		
	Light brown, medium SAND (SW)	SS-1	1-2-1
		SS-2	3-3-3
5		SS-3	3-5-5
		SS-4	3-4-3
	Light gray, silty SAND (SM), saturated	SS-5	5-6-11
10		SS-6	7-12-14
	Dark gray, silty SAND, fine, intermittent black layers	SS-7	3-4-6
	Boring terminated at 14 feet below grade		
15			



SOIL 06917.GPJ LAW_GIBB.GDT 12/21/00

CONTRACTOR: Fox Drilling
DRILLER:
EQUIPMENT: Hollow Stem Auger 4 1/4 I.D
METHOD: Hollow Stem Auger
HOLE DIA.: WELL: Stickup 6' Size 2" inner diameter
REMARKS: Installed monitoring well MW-13. Well set at 14 feet

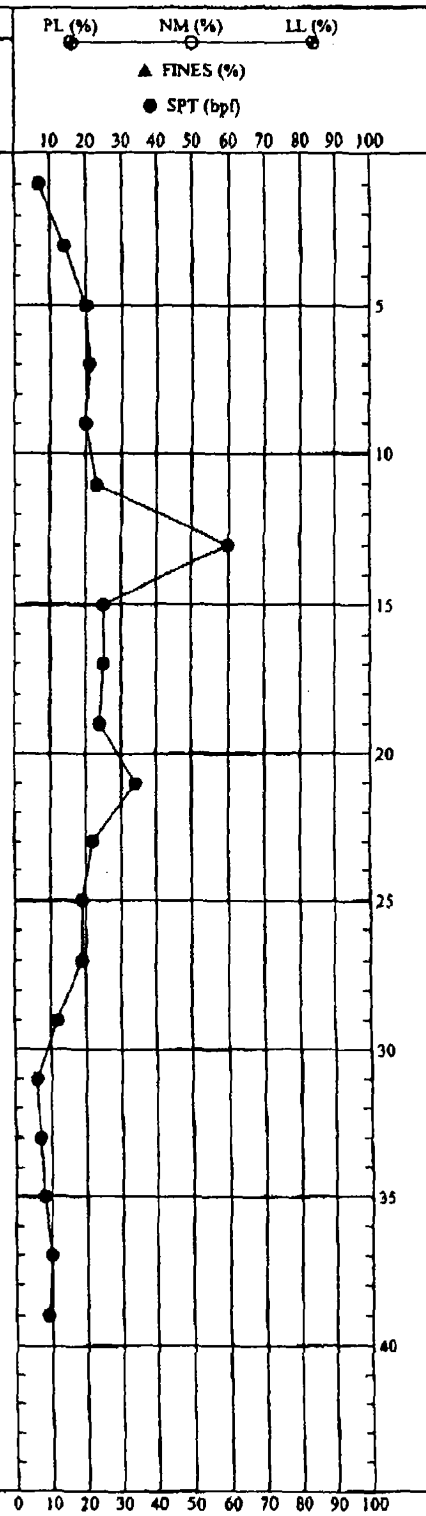
THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

Project: USS Lead **Boring No.:** MW-13
Coord N: **Prepared By:** KJC
Coord E: **Checked By:** JAB
Drilled: October 31, 2000 **Date:** 12/21/00
Proj. No.: 52000-0-2308-06-917 **Figure:** 1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS (SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.)	SAMPLE IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
0	Light brown, medium SAND (SW), saturated at 3'	SS-1	3-3-4
		SS-2	4-6-8
5		SS-3	6-8-12
		SS-4	6-9-12
		SS-5	7-12-8
10		SS-6	9-10-13
	Light gray, fine silty SAND (SM)	SS-7	10-22-38
15		SS-8	11-12-13
		SS-9	5-7-18
		SS-10	7-11-13
20		SS-11	5-16-18
		SS-12	11-10-12
25		SS-13	5-8-11
		SS-14	7-9-10
	White shells (OHSH)		
	Light gray, fine silty SAND (SM)	SS-15	4-5-7
30	Gray, CLAY (CL)	SS-16	2-3-3
		SS-17	2-3-4
35		SS-18	4-4-4
		SS-19	4-4-6
		SS-20	3-4-5
40	Boring terminated at 40 feet below grade		



SOIL 06917.GPJ LAW_GIBB.GDT 12/21/00

CONTRACTOR: Fox Drilling
DRILLER:
EQUIPMENT: Hollow Stem Auger 4 1/4 I.D.
METHOD: Hollow Stem Auger
HOLE DIA.:
REMARKS:

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

Project: USS Lead — **Boring No.:** MWT-14
Coord N: — **Prepared By:** KJC
Coord E: — **Checked By:** JAB
Drilled: October 31, 2000 — **Date:** 12/21/00
Proj. No.: 52000-0-2308-06-917 — **Figure:** 1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"
0	Blind drill to 30 feet. Boring terminated at 30 feet below grade			1				

PL (%) NM (%) LL (%)
▲ FINES (%)
● SPT (bpf)
10 20 30 40 50 60 70 80 90 100

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

SOIL 06917.GPJ LAW GIBB.GDT 12/21/00

CONTRACTOR: Fox Drilling
DRILLER:
EQUIPMENT: Hollow Stem Auger 4 1/4 I.D.
METHOD: Hollow Stem Auger
HOLE DIA.: WELL: Stickup 5' Size 2" inner diameter
REMARKS: Installed monitoring well MW-14. Well set at 30 feet

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL TEST BORING RECORD

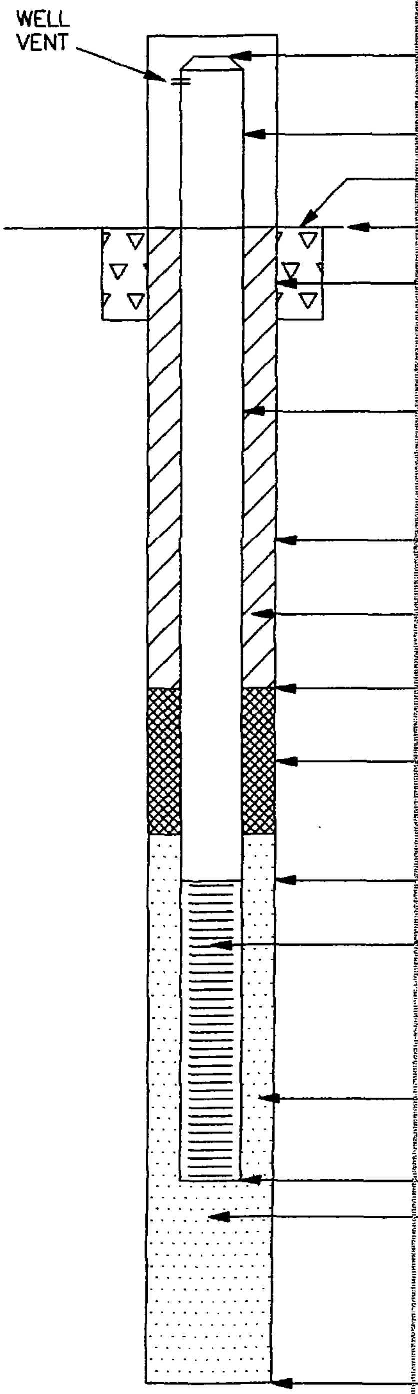
Project:	USS Lead	**Boring No.:**	MW-14
Coord N:		**Prepared By:**	KJC
Coord E:		**Checked By:**	JAB
Drilled:	October 31, 2000	**Date:**	12/21/00
Proj. No.:	52000-0-2308-06-917	**Figure:**	1

LAW
LAWGIBB Group Member

MONITORING WELL SHEET

ELEVATION: 592.00
FIELD GEOLOGIST: LAW ENGINEERING
DATE: FALL 1999

DRILLER: FOX DRILLING
DRILLING METHOD: HOLLOW STEM AUGER
DEVELOPMENT METHOD: BAILER



ELEVATION OF TOP OF RISER PIPE:	592.00
STICK-UP RISER PIPE: PVC	
TYPE OF SURFACE SEAL: CONCRETE	
GROUND SURFACE ELEVATION:	588.03
I.D. OF SURFACE CASING: 8"	
TYPE OF SURFACE CASING: STEEL	
RISER PIPE I.D.: 2"	
TYPE OF RISER PIPE: PVC	
BOREHOLE DIAMETER: 8"	
TYPE OF BACKFILL: BENTONITE/CONCRETE GROUT	
ELEVATION/DEPTH OF SEAL:	578.44
TYPE OF SEAL: BENTONITE CHIPS/HYDRATED	
DEPTH TOP OF SAND PACK:	576.44
ELEVATION/DEPTH TOP OF SCREEN:	574.44
TYPE OF SCREEN: PVC	
SLOT SIZE x LENGTH: 0.010" x 10'	
I.D. OF SCREEN: 2"	
TYPE OF SANDPACK: NO. 5 SAND	
ELEVATION/DEPTH BOTTOM OF SCREEN:	564.44
ELEVATION/DEPTH BOTTOM OF SAND PACK:	564.44
TYPE OF BACKFILL BELOW OBSERVATION WELL: NONE	
ELEVATION/DEPTH OF HOLE:	564.44

2303-MW15

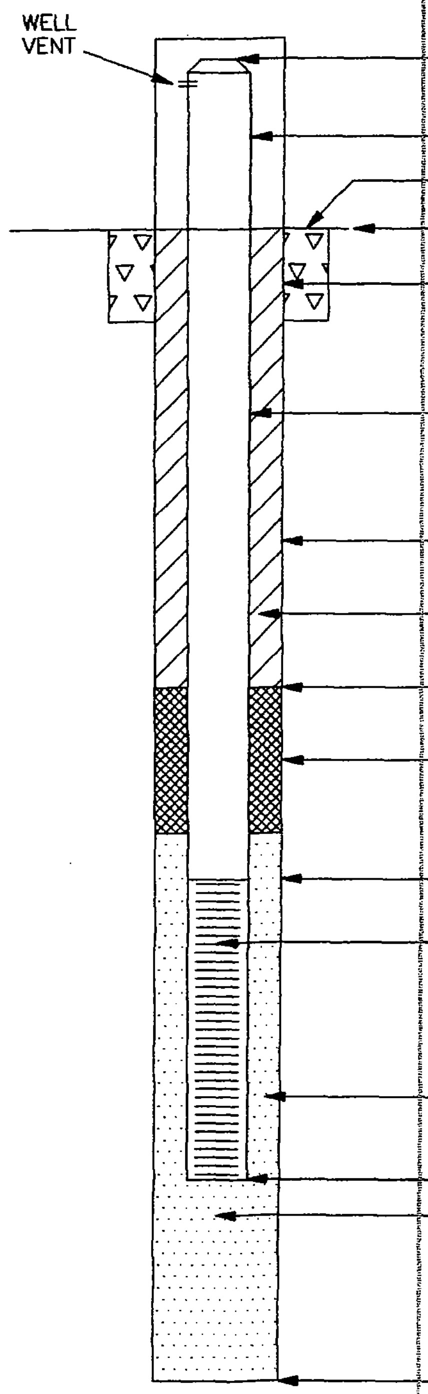
DAI ENVIRONMENTAL

USS LEAD REFINERY, INC
5300 KENNEDY AVENUE
EAST CHICAGO, INDIANA

MONITORING WELL MW-15
CONSTRUCTION DIAGRAM
LOG RECONSTRUCTED BY DAI
THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION: 593.28	DRILLER: FOX DRILLING
FIELD GEOLOGIST: LAW ENGINEERING	DRILLING METHOD: HOLLOW STEM AUGER
DATE: FALL 1999	DEVELOPMENT METHOD: BAILER



ELEVATION OF TOP OF RISER PIPE: 593.28

STICK-UP RISER PIPE: STAINLESS STEEL

TYPE OF SURFACE SEAL: CONCRETE

GROUND SURFACE ELEVATION: 589.32

I.D. OF SURFACE CASING: 8"

TYPE OF SURFACE CASING: STEEL

RISER PIPE I.D.: 4"

TYPE OF RISER PIPE: STAINLESS STEEL

BOREHOLE DIAMETER: 8"

TYPE OF BACKFILL: BENTONITE/CONCRETE GROUT

ELEVATION/DEPTH OF SEAL: 585.15

TYPE OF SEAL: BENTONITE CHIPS/HYDRATED

DEPTH TOP OF SAND PACK: 583.15

ELEVATION/DEPTH TOP OF SCREEN: 581.15

TYPE OF SCREEN: STAINLESS STEEL

SLOT SIZE x LENGTH: 0.010" x 10'

I.D. OF SCREEN: 4"

TYPE OF SANDPACK: NO. 5 SAND

ELEVATION/DEPTH BOTTOM OF SCREEN: 571.15

ELEVATION/DEPTH BOTTOM OF SAND PACK: 571.15

TYPE OF BACKFILL BELOW OBSERVATION WELL: NONE

ELEVATION/DEPTH OF HOLE: 571.15

2303–MW16

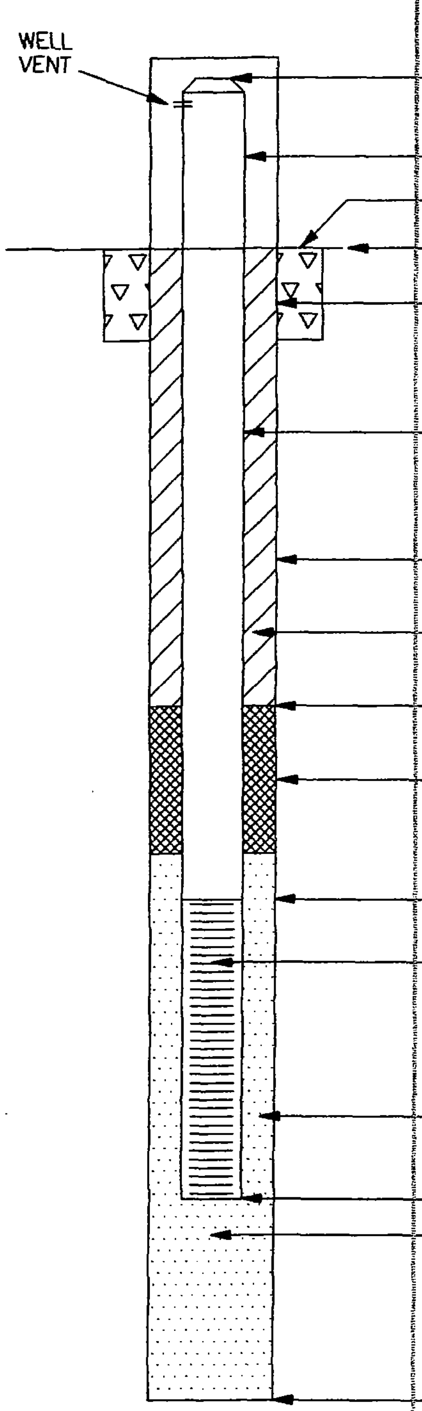
DAI ENVIRONMENTAL

USS LEAD REFINERY, INC
5300 KENNEDY AVENUE
EAST CHICAGO, INDIANA

MONITORING WELL MW–16
CONSTRUCTION DIAGRAM
LOG RECONSTRUCTED BY DAI
THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION: 592.04	DRILLER: FOX DRILLING
FIELD GEOLOGIST: LAW ENGINEERING	DRILLING METHOD: HOLLOW STEM AUGER
DATE: FALL 1999	DEVELOPMENT METHOD: BAILER



ELEVATION OF TOP OF RISER PIPE:	592.04
STICK-UP RISER PIPE: STAINLESS STEEL	
TYPE OF SURFACE SEAL: CONCRETE	
GROUND SURFACE ELEVATION:	586.68
I.D. OF SURFACE CASING: 8"	
TYPE OF SURFACE CASING: STEEL	
RISER PIPE I.D.: 4"	
TYPE OF RISER PIPE: STAINLESS STEEL	
BOREHOLE DIAMETER: 8"	
TYPE OF BACKFILL: BENTONITE/CONCRETE GROUT	
ELEVATION/DEPTH OF SEAL:	576.01
TYPE OF SEAL: BENTONITE CHIPS/HYDRATED	
DEPTH TOP OF SAND PACK:	574.01
ELEVATION/DEPTH TOP OF SCREEN:	572.01
TYPE OF SCREEN: STAINLESS STEEL	
SLOT SIZE x LENGTH: 0.010" x 10'	
I.D. OF SCREEN: 4"	
TYPE OF SANDPACK: NO. 5 SAND	
ELEVATION/DEPTH BOTTOM OF SCREEN:	562.01
ELEVATION/DEPTH BOTTOM OF SAND PACK:	562.01
TYPE OF BACKFILL BELOW OBSERVATION WELL: NONE	
ELEVATION/DEPTH OF HOLE:	562.01

2303–MW17

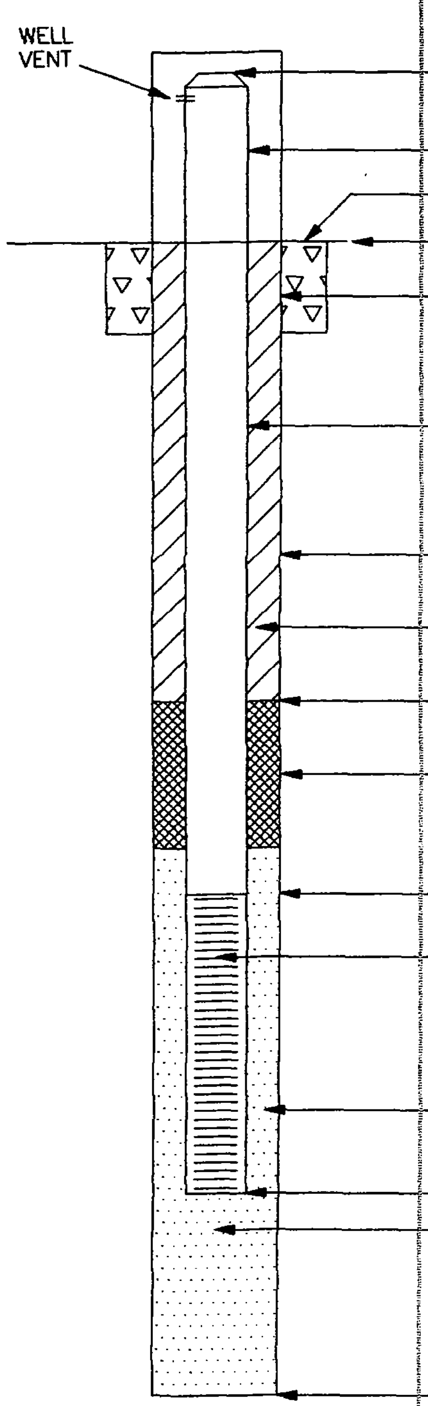
ENVIRONMENTAL

USS LEAD REFINERY, INC
5300 KENNEDY AVENUE
EAST CHICAGO, INDIANA

MONITORING WELL MW-17
CONSTRUCTION DIAGRAM
LOG RECONSTRUCTED BY DAI
THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION	591.65	DRILLER	FOX DRILLING
FIELD GEOLOGIST	LAW ENGINEERING	DRILLING METHOD	HOLLOW STEM AUGER
DATE	SUMMER 2000	DEVELOPMENT METHOD	BAILER



ELEVATION OF TOP OF RISER PIPE: 591.65

STICK-UP RISER PIPE: PVC

TYPE OF SURFACE SEAL: CONCRETE

GROUND SURFACE ELEVATION: 589.24

I.D. OF SURFACE CASING: 8"

TYPE OF SURFACE CASING: STEEL

RISER PIPE I.D.: 2"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 8"

TYPE OF BACKFILL: BENTONITE/CONCRETE GROUT

ELEVATION/DEPTH OF SEAL: 581.33

TYPE OF SEAL: BENTONITE CHIPS/HYDRATED

DEPTH TOP OF SAND PACK: 580.33

ELEVATION/DEPTH TOP OF SCREEN: 578.33

TYPE OF SCREEN: PVC

SLOT SIZE x LENGTH: 0.010" x 10'

I.D. OF SCREEN: 2"

TYPE OF SANDPACK: NO. 5 SAND

ELEVATION/DEPTH BOTTOM OF SCREEN: 568.33

ELEVATION/DEPTH BOTTOM OF SAND PACK: 568.33

TYPE OF BACKFILL BELOW OBSERVATION WELL: NONE

ELEVATION/DEPTH OF HOLE: 568.33

2303-MW18

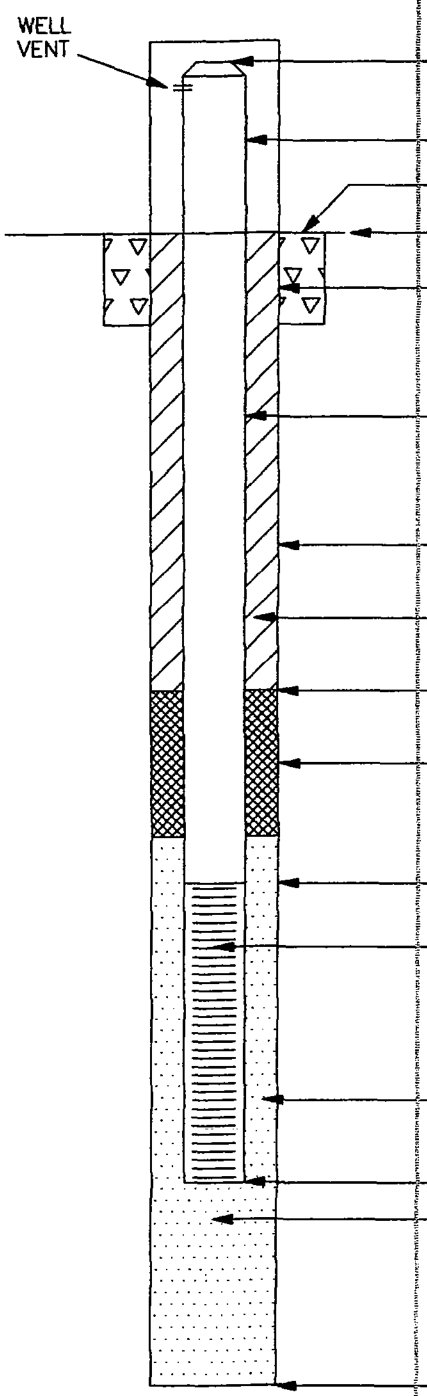
DAI ENVIRONMENTAL

USS LEAD REFINERY, INC
5300 KENNEDY AVENUE
EAST CHICAGO, INDIANA

MONITORING WELL MW-18
CONSTRUCTION DIAGRAM
LOG RECONSTRUCTED BY DAI THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION: 593.98	DRILLER: FOX DRILLING
FIELD GEOLOGIST: LAW ENGINEERING	DRILLING METHOD: HOLLOW STEM AUGER
DATE: SUMMER 2000	DEVELOPMENT METHOD: BAILER



ELEVATION OF TOP OF RISER PIPE: 593.98

STICK-UP RISER PIPE: STAINLESS STEEL

TYPE OF SURFACE SEAL: CONCRETE

GROUND SURFACE ELEVATION: 589.87

I.D. OF SURFACE CASING: 8"

TYPE OF SURFACE CASING: STEEL

RISER PIPE I.D.: 4"

TYPE OF RISER PIPE: STAINLESS STEEL

BOREHOLE DIAMETER: 8"

TYPE OF BACKFILL: BENTONITE/CONCRETE GROUT

ELEVATION/DEPTH OF SEAL: 579.59

TYPE OF SEAL: BENTONITE CHIPS/HYDRATED

DEPTH TOP OF SAND PACK: 577.39

ELEVATION/DEPTH TOP OF SCREEN: 575.59

TYPE OF SCREEN: STAINLESS STEEL

SLOT SIZE x LENGTH: 0.010" x 10'

I.D. OF SCREEN: 4"

TYPE OF SANDPACK: NO. 5 SAND

ELEVATION/DEPTH BOTTOM OF SCREEN: 565.59

ELEVATION/DEPTH BOTTOM OF SAND PACK: 565.59

TYPE OF BACKFILL BELOW OBSERVATION WELL: NONE

ELEVATION/DEPTH OF HOLE: 565.59

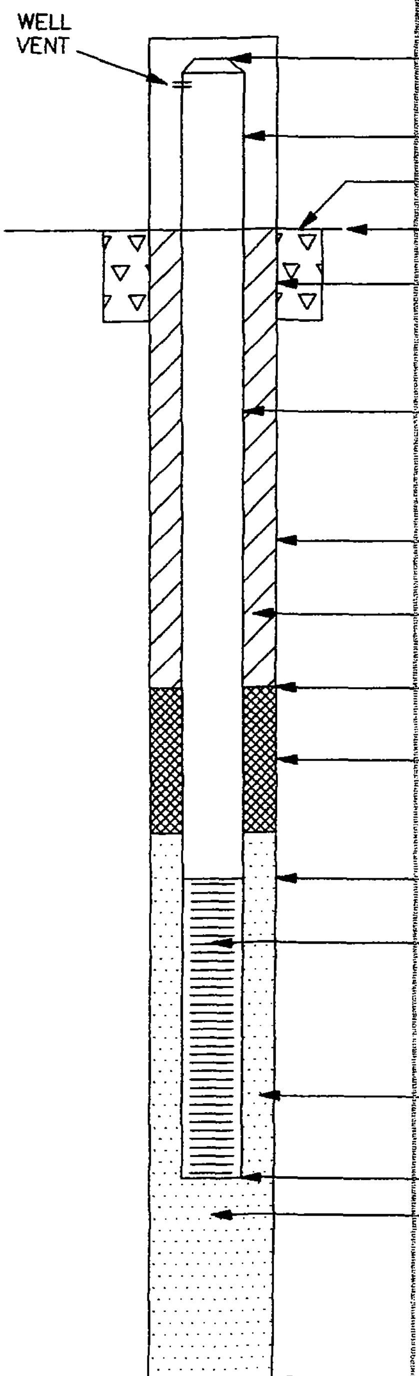
2303-MW19

DAI ENVIRONMENTAL	USS LEAD REFINERY, INC 5300 KENNEDY AVENUE EAST CHICAGO, INDIANA	MONITORING WELL MW-19 CONSTRUCTION DIAGRAM LOG RECONSTRUCTED BY DAI THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION 594.29
FIELD GEOLOGIST LAW ENGINEERING
DATE FALL 1999

DRILLER FOX DRILLING
DRILLING METHOD HOLLOW STEM AUGER
DEVELOPMENT METHOD BAILER



ELEVATION OF TOP OF RISER PIPE:	594.29
STICK-UP RISER PIPE:	STAINLESS STEEL
TYPE OF SURFACE SEAL:	CONCRETE
GROUND SURFACE ELEVATION:	591.92
I.D. OF SURFACE CASING:	8"
TYPE OF SURFACE CASING:	STEEL
RISER PIPE I.D.:	4"
TYPE OF RISER PIPE:	STAINLESS STEEL
BOREHOLE DIAMETER:	8"
TYPE OF BACKFILL:	BENTONITE/CONCRETE GROUT
ELEVATION/DEPTH OF SEAL:	586.77
TYPE OF SEAL:	BENTONITE CHIPS/HYDRATED
DEPTH TOP OF SAND PACK:	584.77
ELEVATION/DEPTH TOP OF SCREEN:	582.77
TYPE OF SCREEN:	STAINLESS STEEL
SLOT SIZE x LENGTH:	0.010" x 10'
I.D. OF SCREEN:	4"
TYPE OF SANDPACK:	NO. 5 SAND
ELEVATION/DEPTH BOTTOM OF SCREEN:	572.77
ELEVATION/DEPTH BOTTOM OF SAND PACK:	572.77
TYPE OF BACKFILL BELOW OBSERVATION WELL:	NONE
ELEVATION/DEPTH OF HOLE:	572.77

2303-MW20

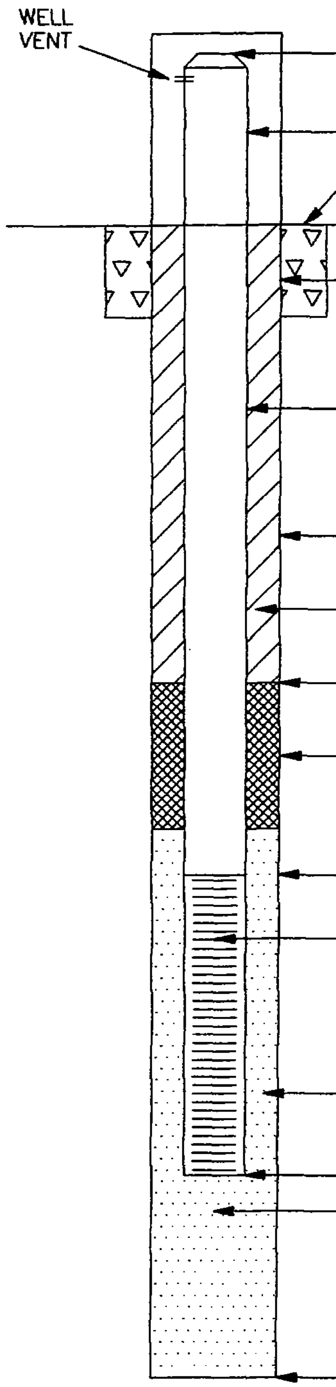
DAI ENVIRONMENTAL

USS LEAD REFINERY, INC
5300 KENNEDY AVENUE
EAST CHICAGO, INDIANA

MONITORING WELL MW-20
CONSTRUCTION DIAGRAM
LOG RECONSTRUCTED BY DAI
THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION: 591.22	DRILLER: FOX DRILLING
FIELD GEOLOGIST: LAW ENGINEERING	DRILLING METHOD: HOLLOW STEM AUGER
DATE: FALL 1999	DEVELOPMENT METHOD: BAILER



ELEVATION OF TOP OF RISER PIPE: 591.22

STICK-UP RISER PIPE: PVC PVC

TYPE OF SURFACE SEAL: CONCRETE

GROUND SURFACE ELEVATION: 587.00

I.D. OF SURFACE CASING: 8"

TYPE OF SURFACE CASING: STEEL

RISER PIPE I.D.: 2"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 8"

TYPE OF BACKFILL: BENTONITE/CONCRETE GROUT

ELEVATION/DEPTH OF SEAL: 585.35

TYPE OF SEAL: BENTONITE CHIPS/HYDRATED

DEPTH TOP OF SAND PACK: 583.35

ELEVATION/DEPTH TOP OF SCREEN: 581.35

TYPE OF SCREEN: PVC

SLOT SIZE x LENGTH: 0.010" x 10'

I.D. OF SCREEN: 2"

TYPE OF SANDPACK: NO. 5 SAND

ELEVATION/DEPTH BOTTOM OF SCREEN: 571.35

ELEVATION/DEPTH BOTTOM OF SAND PACK: 571.35

TYPE OF BACKFILL BELOW OBSERVATION WELL: NONE

ELEVATION/DEPTH OF HOLE: 571.35

2303-MW21

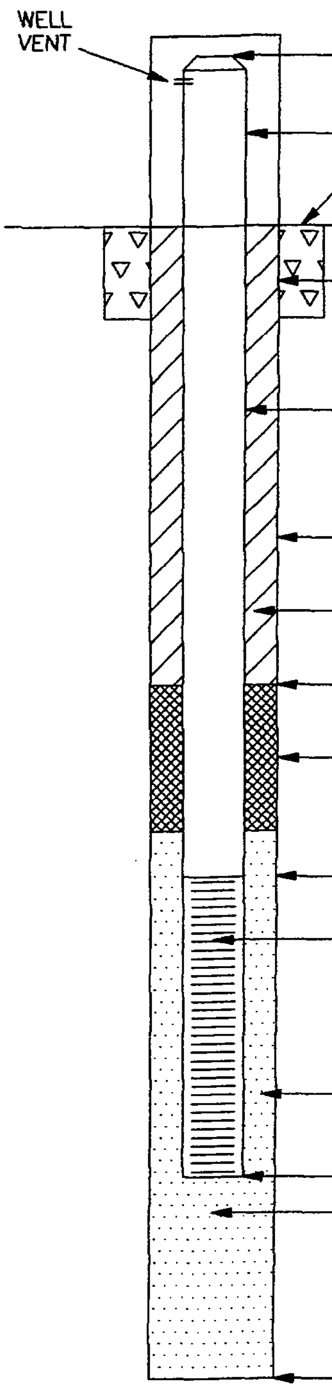
DAI ENVIRONMENTAL

USS LEAD REFINERY, INC
5300 KENNEDY AVENUE
EAST CHICAGO, INDIANA

MONITORING WELL MW-21
CONSTRUCTION DIAGRAM
LOG RECONSTRUCTED BY DAI
THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION	594.06	DRILLER	FOX DRILLING
FIELD GEOLOGIST	LAW ENGINEERING	DRILLING METHOD	HOLLOW STEM AUGER
DATE	SUMMER 2000	DEVELOPMENT METHOD	BAILER



ELEVATION OF TOP OF RISER PIPE: 594.06

STICK-UP RISER PIPE: STAINLESS STEEL

TYPE OF SURFACE SEAL: CONCRETE

GROUND SURFACE ELEVATION: 591.62

I.D. OF SURFACE CASING: 8"

TYPE OF SURFACE CASING: STEEL

RISER PIPE I.D.: 4"

TYPE OF RISER PIPE: STAINLESS STEEL

BOREHOLE DIAMETER: 8"

TYPE OF BACKFILL: BENTONITE/CONCRETE GROUT

ELEVATION/DEPTH OF SEAL: 586.01

TYPE OF SEAL: BENTONITE CHIPS/HYDRATED

DEPTH TOP OF SAND PACK: 584.01

ELEVATION/DEPTH TOP OF SCREEN: 582.01

TYPE OF SCREEN: STAINLESS STEEL

SLOT SIZE x LENGTH: 0.010" x 10'

I.D. OF SCREEN: 4"

TYPE OF SANDPACK: NO. 5 SAND

ELEVATION/DEPTH BOTTOM OF SCREEN: 572.01

ELEVATION/DEPTH BOTTOM OF SAND PACK: 572.01

TYPE OF BACKFILL BELOW OBSERVATION WELL: NONE

ELEVATION/DEPTH OF HOLE: 572.01

2303-MW22

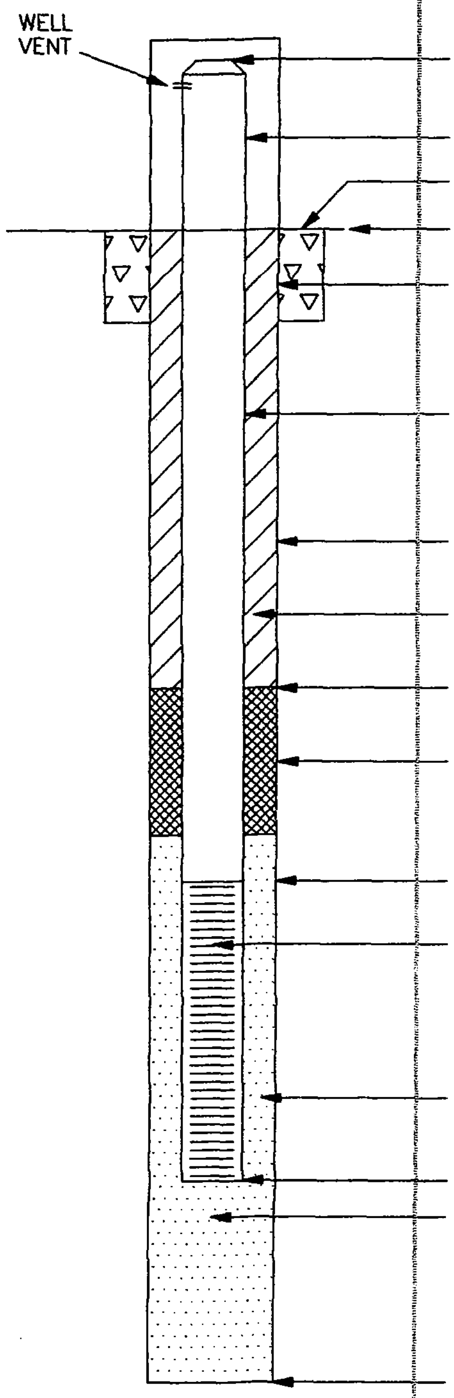
DAI ENVIRONMENTAL

USS LEAD REFINERY, INC
5300 KENNEDY AVENUE
EAST CHICAGO, INDIANA

MONITORING WELL MW-22
CONSTRUCTION DIAGRAM
LOG RECONSTRUCTED BY DAI
THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION: 592.36	DRILLER: FOX DRILLING
FIELD GEOLOGIST: LAW ENGINEERING	DRILLING METHOD: HOLLOW STEM AUGER
DATE: SUMMER 2000	DEVELOPMENT METHOD: BAILER



ELEVATION OF TOP OF RISER PIPE: 592.36

STICK-UP RISER PIPE: STAINLESS STEEL

TYPE OF SURFACE SEAL: CONCRETE

GROUND SURFACE ELEVATION: 587.99

I.D. OF SURFACE CASING: 8"

TYPE OF SURFACE CASING: STEEL

RISER PIPE I.D.: 2"

TYPE OF RISER PIPE: PVC

BOREHOLE DIAMETER: 8"

TYPE OF BACKFILL: BENTONITE/CONCRETE GROUT

ELEVATION/DEPTH OF SEAL: 585.01

TYPE OF SEAL: BENTONITE CHIPS/HYDRATED

DEPTH TOP OF SAND PACK: 583.01

ELEVATION/DEPTH TOP OF SCREEN: 581.01

TYPE OF SCREEN: PVC

SLOT SIZE x LENGTH: 0.010" x 10'

I.D. OF SCREEN: 2"

TYPE OF SANDPACK: NO. 5 SAND

ELEVATION/DEPTH BOTTOM OF SCREEN: 571.01

ELEVATION/DEPTH BOTTOM OF SAND PACK: 571.01

TYPE OF BACKFILL BELOW OBSERVATION WELL: NONE

ELEVATION/DEPTH OF HOLE: 571.01

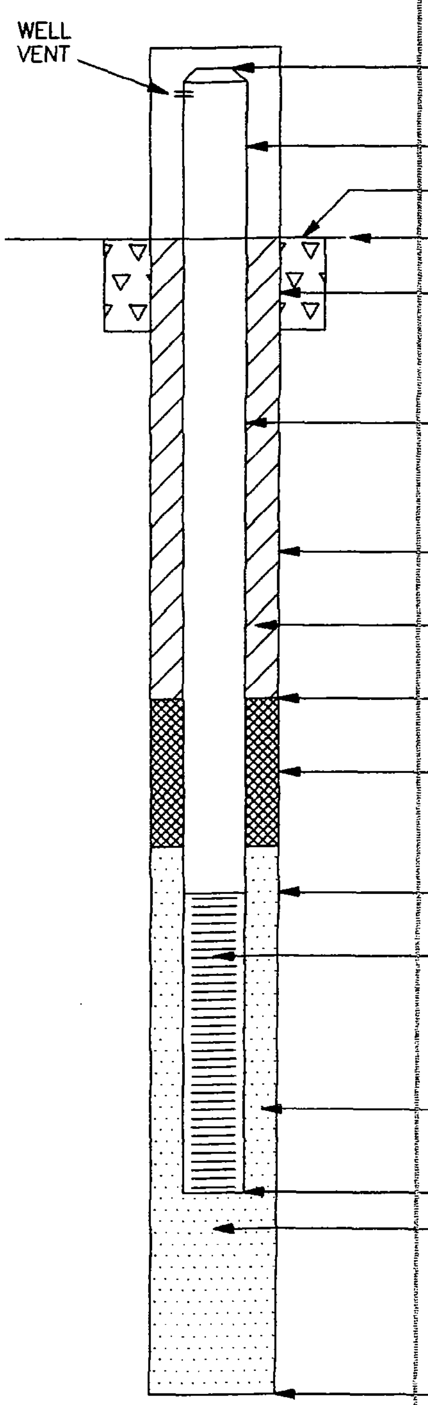
2303-MW23

DAI ENVIRONMENTAL	USS LEAD REFINERY, INC 5300 KENNEDY AVENUE EAST CHICAGO, INDIANA	MONITORING WELL MW-23 CONSTRUCTION DIAGRAM LOG RECONSTRUCTED BY DAI THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION: 595.63
FIELD GEOLOGIST: LAW ENGINEERING
DATE: SUMMER 2000

DRILLER: FOX DRILLING
DRILLING METHOD: HOLLOW STEM AUGER
DEVELOPMENT METHOD: BAILER



ELEVATION OF TOP OF RISER PIPE: 595.63

STICK-UP RISER PIPE: STAINLESS STEEL

TYPE OF SURFACE SEAL: CONCRETE

GROUND SURFACE ELEVATION: 593.48

I.D. OF SURFACE CASING: 8"

TYPE OF SURFACE CASING: STEEL

RISER PIPE I.D.: 4"

TYPE OF RISER PIPE: STAINLESS STEEL

BOREHOLE DIAMETER: 8"

TYPE OF BACKFILL: BENTONITE/CONCRETE GROUT

ELEVATION/DEPTH OF SEAL: 587.76

TYPE OF SEAL: BENTONITE CHIPS/HYDRATED

DEPTH TOP OF SAND PACK: 585.76

ELEVATION/DEPTH TOP OF SCREEN: 583.76

TYPE OF SCREEN: STAINLESS STEEL

SLOT SIZE x LENGTH: 0.010" x 10'

I.D. OF SCREEN: 4"

TYPE OF SANDPACK: NO. 5 SAND

ELEVATION/DEPTH BOTTOM OF SCREEN: 573.76

ELEVATION/DEPTH BOTTOM OF SAND PACK: 573.76

TYPE OF BACKFILL BELOW OBSERVATION WELL: NONE

ELEVATION/DEPTH OF HOLE: 573.76

2303-MW24

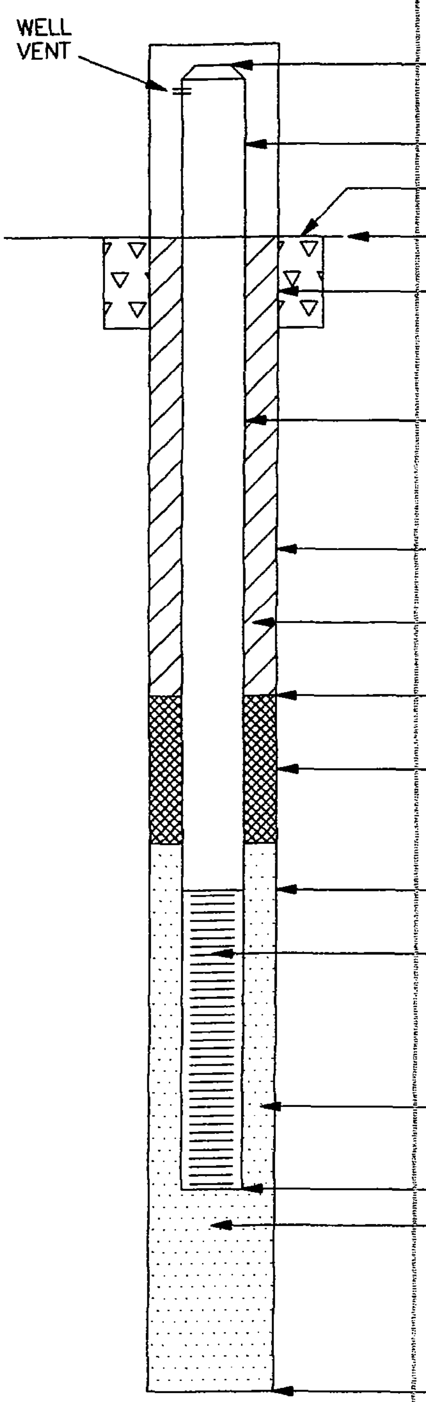
DAI ENVIRONMENTAL

USS LEAD REFINERY, INC
5300 KENNEDY AVENUE
EAST CHICAGO, INDIANA

MONITORING WELL MW-24
CONSTRUCTION DIAGRAM
LOG RECONSTRUCTED BY DAI
THROUGH AVAILABLE INFORMATION

MONITORING WELL SHEET

ELEVATION	592.63	DRILLER	FOX DRILLING
FIELD GEOLOGIST	LAW ENGINEERING	DRILLING METHOD	HOLLOW STEM AUGER
DATE	SUMMER 2000	DEVELOPMENT METHOD	BAILER



ELEVATION OF TOP OF RISER PIPE:		592.63
STICK-UP RISER PIPE:	PVC	
TYPE OF SURFACE SEAL:	CONCRETE	
GROUND SURFACE ELEVATION:		588.57
I.D. OF SURFACE CASING:	8"	
TYPE OF SURFACE CASING:	STEEL	
RISER PIPE I.D.:	2"	
TYPE OF RISER PIPE:	PVC	
BOREHOLE DIAMETER:	8"	
TYPE OF BACKFILL:	BENTONITE/CONCRETE GROUT	
ELEVATION/DEPTH OF SEAL:		585.36
TYPE OF SEAL:	BENTONITE CHIPS/HYDRATED	
DEPTH TOP OF SAND PACK:		583.36
ELEVATION/DEPTH TOP OF SCREEN:		581.36
TYPE OF SCREEN:	PVC	
SLOT SIZE x LENGTH:	0.010" x 10'	
I.D. OF SCREEN:	2"	
TYPE OF SANDPACK:	NO. 5 SAND	
ELEVATION/DEPTH BOTTOM OF SCREEN:		571.36
ELEVATION/DEPTH BOTTOM OF SAND PACK:		571.36
TYPE OF BACKFILL BELOW OBSERVATION WELL:	NONE	
ELEVATION/DEPTH OF HOLE:		571.36

2303-MW25

DAI ENVIRONMENTAL

USS LEAD REFINERY, INC
5300 KENNEDY AVENUE
EAST CHICAGO, INDIANA

MONITORING WELL MW-25
CONSTRUCTION DIAGRAM

LOG RECONSTRUCTED BY DAI
THROUGH AVAILABLE INFORMATION

OU2 CAMU Boring Logs

APR 23 '01 01:51PM P.2/7

SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" / 2nd 6" / 3rd 6"
0	Blind Drill - Brown, moist, silty SAND (SM), trace gravel (from soil cuttings) No PID readings.			AU-1		
5						
8	Brown, saturated, sandy SILT (MLS), trace gravel			AU-2		
10						
13	Boring terminated at 13 feet below existing grade					
15						

★ OVA (ppm) 1 2 3 4 5

PL (%) NM (%) LL (%)

▲ FINES (%) ● SPT (bpf)

10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

SOIL 02385.GPJ LAW GIBB.GDT 3/1/01

CONTRACTOR: Fox Drilling
DRILLER: Jeff
EQUIPMENT: 6 1/4" ID Hollow Stem Augers
METHOD: Hollow Stem Auger
HOLE DIA.:
REMARKS: H2O encountered at 7 feet below ground surface. Well set at 13' bgs. 4" ID stainless steel well.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

[illegible]

Project: USS Lead
Coord N:
Coord E:
Drilled: January 31, 2001
Proj. No.: 52000-1-2385-03-917

Boring No.: MW-20
Prepared By: KJC
Checked By: JAB
Date: 3/6/01
Figure: 1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"	★ OVA (ppm) 1 2 3 4 5 / PL (%) NM (%) LL (%) / ▲ FINES (%) ● SPT (bpf) 10 20 30 40 50 60 70 80 90 100
0	Blind Drill - Brown, silty SAND (SM), wet to moist (from soil cuttings) No PID readings.			AU-1			
5	∇						
	Brown, silty SAND (SM), saturated, trace gravel			AU-2			★
10							
	Boring terminated at 12.5 feet below existing grade						
15							

0 10 20 30 40 50 60 70 80 90 100

SOIL 02385.GPJ LAW GIBB.GDT 2/1/01

CONTRACTOR:	Fox Drilling
DRILLER:	Jeff
EQUIPMENT:	4 1/4" ID Hollow Stem Augers
METHOD:	Hollow Stem Auger
HOLE DIA.:	
REMARKS:	H2O encountered at 6.5 feet below ground surface. Well set at 12.5' bgs. 2" ID PVC well.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

[redacted]

Project:	USS Lead	Boring No.:	MW-21
Coord N:		Prepared By:	KJC
Coord E:		Checked By:	JAS
Drilled:	January 31, 2001	Date:	3/6/01
Proj. No.:	52000-1-2385-03-917	Figure:	1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES: IDENT	TYPE	N-COUNT (1st 6" / 2nd 6" / 3rd 6")
0	Blind Drill (0-8') - Brown, silty SAND (SM), moist to wet, trace gravel			AU-1		
5						
	Black sandy SILT (MLS), bad odor. No PID reading. ∇					
	Grayish-brown, sandy SILT (MLS), saturated			AU-2		
10						
	Boring terminated at 13 feet below existing grade					
15						

★ OVA (ppm) 1 2 3 4 5

PL (%) NM (%) LL (%)

▲ FINES (%) ● SPT (bpf)

10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

SOIL 02385.GPJ LAW GIBB.GDT 3/1/01

CONTRACTOR: Fox Drilling
DRILLER: Jeff
EQUIPMENT: 6 1/4" ID Hollow Stem Augers
METHOD: Hollow Stem Auger
HOLE DIA.:
REMARKS: H2O encountered at 7 feet below ground surface. Well set at 13' bgs. 4" stainless steel well.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SC[illegible]

Project: USS Lead
Coord N:
Coord E:
Drilled: January 31, 2001
Proj. No.: 52000-1-2385-03-917

Boring No.: MW-22
Prepared By: KJC
Checked By: JAB
Date: 3/6/01
Figure: 1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" / 2nd 6" / 3rd 6"
0	Blind Drill - Brown, moist, medium silty SAND (SM)			AU-1		
5						
8	Brown to gray, silty SAND (SM), saturated			AU-2		
10						
13	Boring terminated at 13 feet below existing grade					
15						

★ OVA (ppm): 1 2 3 4 5
PL (%) NM (%) LL (%)
▲ FINES (%) ● SPT (bpf)
10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

SOIL 02385.GPJ LAW GIBB.GDT 3/1/01

CONTRACTOR: Fox Drilling
DRILLER: Jeff
EQUIPMENT: 4 1/4" ID Hollow Stem Augers
METHOD: Hollow Stem Auger
HOLE DIA.:
REMARKS: H2O encountered at 7 feet below ground surface. Well set at 13' bgs. 2" ID PVC well.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Project:	USS Lead	Boring No.:	MW-23
Coord N:		Prepared By:	KJC
Coord E:		Checked By:	JAB
Drilled:	February 1, 2001	Date:	3/6/01
Proj. No.:	52000-1-2385-03-917	Figure:	1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"
0	Blind Drill - Black, sandy gravel FILL material			AU-1				
5								
	Dark brown to gray, sandy SILT (MLS), trace gravel			AU-2				
10								
	Boring terminated at 13 feet below existing grade							
15								

★ OVA (ppm) 1 2 3 4 5

PL (%) NM (%) LL (%)

▲ FINES (%) ● SPT (bpf)

10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

SOIL 02385.GPJ LAW GIBB.GDT 3/1/01

CONTRACTOR: Fox Drilling
DRILLER: Jeff
EQUIPMENT: 6 1/4" ID Hollow Stem Augers
METHOD: Hollow Stem Auger
HOLE DIA.:
REMARKS: H2O encountered at 7 feet below ground surface. Well set at 13' bgs. 4" ID stainless steel well.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

SOIL [illegible]

Project: USS Lead
Coord N:
Coord E:
Drilled: February 1, 2001
Proj. No.: 52000-1-2385-03-917

Boring No.: MW-24
Prepared By: KJC
Checked By: SAB
Date: 3/6/01
Figure: 1

LAW
LAWGIBB Group Member

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
0	Blind Drill (0-8') - Brown, moist, SAND (SW) and gravel			AU-1		
5						
	Gray, silty SAND (SM)					
	Brown, silty CLAY (CL-ML), moderate plasticity, saturated, some gray rock fragments					
	Brown, sandy SILT (MLS), saturated, very fine-grained			AU-2		
10						
	Boring terminated at 13 feet below existing grade					
15						

★ OVA (ppm) 1 2 3 4 5

PL (%) NM (%) LL (%)

▲ FINES (%) ● SPT (bpf)

10 20 30 40 50 60 70 80 90 100

0 10 20 30 40 50 60 70 80 90 100

SOIL 02385.GPJ LAW_GIBB.GDT 3/1/01

CONTRACTOR: Fox Drilling
DRILLER: Jeff
EQUIPMENT: 4 1/4" ID Hollow Stem Augers
METHOD: Hollow Stem Auger
HOLE DIA.:
REMARKS: H2O encountered at 7 feet below ground surface. Well set at 13'bgs. 2" ID PVC well.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

[illegible]

Project:	USS Lead	Boring No.:	MW-25
Coord N:		Prepared By:	KJC
Coord E:		Checked By:	SAB
Drilled:	February 1, 2001	Date:	3/6/01
Proj. No.:	52000-1-2385-03-917	Figure:	1

LAW
LAWGIBB Group Member

APPENDIX C HISTORICAL GROUNDWATER ELEVATIONS

Table C-1
Historical Groundwater Elevations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
OU1MW1	OU1, Zone 3	12/12/2018	3.29	580.83	584.121	
OU1MW1	OU1, Zone 3	3/19/2019	3.2	580.921	584.121	
OU1MW1	OU1, Zone 3	6/3/2019	1.83	582.29	584.121	
OU1MW1	OU1, Zone 3	8/12/2019	3.79	580.331	584.121	
OU1MW2	OU1, Zone 3	12/12/2018	5.05	582.07	587.12	
OU1MW2	OU1, Zone 3	3/19/2019	5.09	582.03	587.12	
OU1MW2	OU1, Zone 3	6/3/2019	4.42	582.7	587.12	
OU1MW2	OU1, Zone 3	8/12/2019	5.47	581.65	587.12	
OU1MW3	OU1, Zone 3	12/12/2018	3.02	582.7	585.723	
OU1MW3	OU1, Zone 3	3/19/2019	2.68	583.043	585.723	
OU1MW3	OU1, Zone 3	6/3/2019	1.66	584.06	585.723	
OU1MW3	OU1, Zone 3	8/12/2019	3.33	582.393	585.723	
OU1MW3D	OU1, Zone 3	12/12/2018	3.14	582.7	585.843	
OU1MW3D	OU1, Zone 3	3/19/2019	2.8	583.043	585.843	
OU1MW3D	OU1, Zone 3	6/3/2019	1.8	584.04	585.843	
OU1MW3D	OU1, Zone 3	8/12/2019	3.42	582.423	585.843	
OU1MW4	OU1, Zone 3	12/12/2018	4.36	582.64	587.003	
OU1MW4	OU1, Zone 3	3/19/2019	4.00	583.003	587.003	
OU1MW4	OU1, Zone 3	6/3/2019	2.77	584.23	587.003	
OU1MW4	OU1, Zone 3	8/12/2019	4.56	582.443	587.003	
OU1MW5	OU1, Zone 2	12/12/2018	5.09	581.81	586.895	
OU1MW5	OU1, Zone 2	3/19/2019	5.38	581.515	586.895	
OU1MW5	OU1, Zone 2	6/3/2019	4.84	582.06	586.895	
OU1MW5	OU1, Zone 2	8/12/2019	5.88	581.015	586.895	
OU1MW5N	OU1, Zone 2	3/17/2021	5.71	580.96	586.672	
OU1MW5E	OU1, Zone 2	3/17/2021	5.04	581.25	586.289	
OU1MW5S	OU1, Zone 2	3/17/2021	3.58	582.31	585.894	
OU1MW5W	OU1, Zone 2	3/17/2021	5.06	581.55	586.61	
OU1MW5D	OU1, Zone 2	12/12/2018	5.08	581.81	586.888	
OU1MW5D	OU1, Zone 2	3/19/2019	5.37	581.518	586.888	
OU1MW5D	OU1, Zone 2	6/3/2019	4.84	582.05	586.888	
OU1MW5D	OU1, Zone 2	8/12/2019	5.87	581.018	586.888	
OU1MW6	OU1, Zone 1	12/12/2018	3.93	581.63	585.562	
OU1MW6	OU1, Zone 1	3/19/2019	3.9	581.662	585.562	
OU1MW6	OU1, Zone 1	6/3/2019	3.03	582.53	585.562	
OU1MW6	OU1, Zone 1	8/12/2019	4.22	581.342	585.562	
OU1MW6D	OU1, Zone 1	12/12/2018	4.19	581.72	585.909	
OU1MW6D	OU1, Zone 1	3/19/2019	4.19	581.719	585.909	
OU1MW6D	OU1, Zone 1	6/3/2019	3.3	582.61	585.909	
OU1MW6D	OU1, Zone 1	8/12/2019	4.5	581.409	585.909	
OU1MW7	OU1, Zone 2	12/12/2018	5.28	580.57	585.852	
OU1MW7	OU1, Zone 2	3/19/2019	5.23	580.622	585.852	
OU1MW7	OU1, Zone 2	6/3/2019	4.84	581.01	585.852	
OU1MW7	OU1, Zone 2	8/12/2019	5.55	580.302	585.852	
OU1MW8	OU1, Zone 2	12/12/2018	5.33	581.17	586.501	
OU1MW8	OU1, Zone 2	3/19/2019	5.2	581.301	586.501	
OU1MW8	OU1, Zone 2	6/3/2019	4.07	582.43	586.501	
OU1MW8	OU1, Zone 2	8/12/2019	5.55	580.951	586.501	
OU1MW13	OU1, Zone 1	3/18/2021	4.05	582.55	586.597	
OU1MW14	OU1, Zone 1	3/18/2021	3.91	582.33	586.241	
OU1MW15	OU1, Zone 1	3/17/2021	3.11	583.14	586.249	
ECHA-MW-01	OU1, Zone 1	12/12/2018	3.9	582.933	586.833	ECHA area
ECHA-MW-01	OU1, Zone 1	3/20/2019	3.86	582.973	586.833	ECHA area
ECHA-MW-01	OU1, Zone 1	6/3/2019	1.94	584.89	586.833	ECHA area
ECHA-MW-01	OU1, Zone 1	8/12/2019	3.83	583.003	586.833	ECHA area
ECHA-MW-09	OU1, Zone 1	12/12/2018	2.12	583.415	585.535	ECHA area
ECHA-MW-09	OU1, Zone 1	3/20/2019	1.44	584.095	585.535	ECHA area
ECHA-MW-09	OU1, Zone 1	6/3/2019	0.28	585.26	585.535	ECHA area

Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
ECHA-MW-09	OU1, Zone 1	8/12/2019	2.95	582.585	585.535	ECHA area
ECHA-MW-12	OU1, Zone 1	12/12/2018	NA	NA	NA	ECHA area; well not found
ECHA-MW-12	OU1, Zone 1	3/20/2019	NA	NA	NA	ECHA area; well not found
ECHA-MW-12	OU1, Zone 1	6/3/2019	NA	NA	NA	ECHA area; well not found
ECHA-MW-12	OU1, Zone 1	8/12/2019	NA	NA	NA	ECHA area; well not found
ECHA-MW-35	OU1, Zone 1	12/12/2018	3.27	583.276	586.546	ECHA area
ECHA-MW-35	OU1, Zone 1	3/20/2019	2.9	583.646	586.546	ECHA area
ECHA-MW-35	OU1, Zone 1	6/3/2019	1.23	585.32	586.546	ECHA area
ECHA-MW-35	OU1, Zone 1	8/12/2019	3.99	582.556	586.546	ECHA area
MW1	OU2	2/1/1999	NM	584.83	590.23	
MW1	OU2	3/1/1999	NM	585.34	590.23	
MW1	OU2	4/1/1999	NM	584.83	590.23	
MW1	OU2	5/1/1999	NM	585.34	590.23	
MW1	OU2	6/1/1999	NM	584.81	590.23	
MW1	OU2	6/14/2001	5.85	581.87	590.23	
MW1	OU2	9/27/2001	6.32	581.4	590.23	
MW1	OU2	11/27/2001	7.36	582.32	590.23	
MW1	OU2	3/21/2002	6.48	581.24	590.23	
MW1	OU2	6/5/2002	6.29	581.43	590.23	
MW1	OU2	8/20/2002	8.29	579.43	590.23	
MW1	OU2	11/18/2002	11.34	576.38	590.23	
MW1	OU2	1/26/2003	6.85	582.83	590.23	
MW1	OU2	3/17/2003	8.93	578.79	590.23	
MW1	OU2	5/14/2003	7.77	581.91	590.23	
MW1	OU2	7/8/2003	7.51	582.17	590.23	
MW1	OU2	10/15/2003	6.85	582.83	590.23	
MW1	OU2	1/26/2004	6.85	582.83	590.23	
MW1	OU2	5/18/2004	6.35	583.33	590.23	
MW1	OU2	7/22/2004	6.57	583.11	590.23	
MW1	OU2	10/21/2004	7.29	582.39	590.23	
MW1	OU2	1/26/2005	5.85	583.83	590.23	
MW1	OU2	5/11/2005	6.72	582.96	590.23	
MW1	OU2	8/24/2005	8.37	581.31	590.23	
MW1	OU2	3/28/2006	6.95	582.73	590.23	
MW1	OU2	6/29/2006	7.17	582.51	590.23	
MW1	OU2	9/27/2006	6.2	583.48	590.23	
MW1	OU2	12/18/2006	6.08	583.6	590.23	
MW1	OU2	3/26/2007	5.75	583.93	590.23	
MW1	OU2	6/8/2007	5.79	583.89	590.23	
MW1	OU2	8/22/2007	6.21	583.47	590.23	
MW1	OU2	12/17/2007	6.77	582.91	590.23	
MW1	OU2	4/1/2009	5.25	584.43	590.23	
MW1	OU2	8/7/2011	6.5	583.18	590.23	
MW1	OU2	12/19/2017	6.75	582.93	590.23	
MW1	OU2	6/18/2018	6.69	582.99	590.23	
MW1	OU2	12/12/2018	6.53	583.7	590.23	
MW1	OU2	12/17/2018	6.45	583.78	590.23	
MW1	OU2	3/19/2019	6.13	584.1	590.23	
MW1	OU2	6/3/2019	5.18	585.05	590.23	
MW1	OU2	8/12/2019	6.86	583.37	590.23	
MW1	OU2	3/17/2021	6.64	583.59	590.23	
MW3	OU2	2/1/1999	NM	583.92	590.01	
MW3	OU2	3/1/1999	NM	584.37	590.01	
MW3	OU2	4/1/1999	NM	583.92	590.01	
MW3	OU2	5/1/1999	NM	584.37	590.01	
MW3	OU2	6/1/1999	NM	583.73	590.01	
MW3	OU2	6/14/2001	7.46	579.96	590.01	
MW3	OU2	9/27/2001	8.13	579.29	590.01	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW3	OU2	11/27/2001	7.79	582.04	590.01	
MW3	OU2	3/21/2002	7.44	579.98	590.01	
MW3	OU2	6/5/2002	7.28	580.14	590.01	
MW3	OU2	8/20/2002	7.94	579.48	590.01	
MW3	OU2	11/18/2002	8.71	578.71	590.01	
MW3	OU2	1/26/2003	7.55	582.28	590.01	
MW3	OU2	3/17/2003	11.31	576.11	590.01	
MW3	OU2	5/14/2003	7.95	581.88	590.01	
MW3	OU2	7/8/2003	8	581.83	590.01	
MW3	OU2	10/15/2003	7.55	582.28	590.01	
MW3	OU2	1/26/2004	7.55	582.28	590.01	
MW3	OU2	5/18/2004	6.96	582.87	590.01	
MW3	OU2	7/22/2004	7.47	582.36	590.01	
MW3	OU2	10/21/2004	7.93	581.9	590.01	
MW3	OU2	1/26/2005	6.93	582.9	590.01	
MW3	OU2	5/11/2005	7.43	582.4	590.01	
MW3	OU2	8/24/2005	9.09	580.74	590.01	
MW3	OU2	3/28/2006	7.53	582.3	590.01	
MW3	OU2	6/29/2006	7.8	582.03	590.01	
MW3	OU2	9/27/2006	7.19	582.64	590.01	
MW3	OU2	12/18/2006	7	582.83	590.01	
MW3	OU2	3/26/2007	6.8	583.03	590.01	
MW3	OU2	6/8/2007	6.89	582.94	590.01	
MW3	OU2	8/22/2007	7.19	582.64	590.01	
MW3	OU2	12/17/2007	7.41	582.42	590.01	
MW3	OU2	4/1/2009	6.38	583.45	590.01	
MW3	OU2	11/19/2009	7	582.83	590.01	
MW3	OU2	6/1/2010	6.82	583.01	590.01	
MW3	OU2	11/11/2010	8.21	581.62	590.01	
MW3	OU2	8/7/2011	7.48	582.35	590.01	
MW3	OU2	11/11/2011	8.21	581.62	590.01	
MW3	OU2	6/11/2012	8.26	581.57	590.01	
MW3	OU2	11/8/2012	8.58	581.25	590.01	
MW3	OU2	6/20/2013	6.96	582.87	590.01	
MW3	OU2	11/14/2013	7.59	582.24	590.01	
MW3	OU2	5/21/2014	6.31	583.52	590.01	
MW3	OU2	11/5/2014	6.77	583.06	590.01	
MW3	OU2	6/8/2015	6.88	582.95	590.01	
MW3	OU2	11/16/2015	7.32	582.51	590.01	
MW3	OU2	6/21/2016	7.46	582.37	590.01	
MW3	OU2	12/20/2016	7.14	582.69	590.01	
MW3	OU2	5/30/2017	6.77	583.06	590.01	
MW3	OU2	12/19/2017	7.04	582.79	590.01	
MW3	OU2	6/18/2018	7.15	582.68	590.01	
MW3	OU2	12/12/2018	6.84	583.17	590.01	
MW3	OU2	12/17/2018	6.75	583.26	590.01	
MW3	OU2	3/19/2019	6.68	583.33	590.01	
MW3	OU2	6/3/2019	6.27	583.74	590.01	
MW3	OU2	8/12/2019	7.22	582.79	590.01	
MW3	OU2	3/17/2021	7.02	582.99	590.01	
MW4	OU2	2/1/1999	NM	585.2	591.368	
MW4	OU2	3/1/1999	NM	585.6	591.368	
MW4	OU2	4/1/1999	NM	585.2	591.368	
MW4	OU2	5/1/1999	NM	585.6	591.368	
MW4	OU2	6/1/1999	NM	585.73	591.368	
MW4	OU2	6/14/2001	6.15	582.27	591.368	
MW4	OU2	9/27/2001	6.45	581.97	591.368	
MW4	OU2	11/27/2001	7.61	583.51	591.368	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW4	OU2	3/21/2002	7.15	581.27	591.368	
MW4	OU2	6/5/2002	6.96	581.46	591.368	
MW4	OU2	8/20/2002	8.33	580.09	591.368	
MW4	OU2	11/18/2002	9.53	578.89	591.368	
MW4	OU2	1/26/2003	7.62	583.5	591.368	
MW4	OU2	3/17/2003	5.16	583.26	591.368	
MW4	OU2	5/14/2003	7.99	583.13	591.368	
MW4	OU2	7/8/2003	7.75	583.37	591.368	
MW4	OU2	10/15/2003	7.03	584.09	591.368	
MW4	OU2	1/26/2004	7.62	583.5	591.368	
MW4	OU2	5/18/2004	7.68	583.44	591.368	
MW4	OU2	7/22/2004	6.85	584.27	591.368	
MW4	OU2	10/21/2004	7.7	583.42	591.368	
MW4	OU2	1/26/2005	6.74	584.38	591.368	
MW4	OU2	5/11/2005	7.28	583.84	591.368	
MW4	OU2	8/24/2005	8.65	582.47	591.368	
MW4	OU2	3/28/2006	7.45	583.67	591.368	
MW4	OU2	6/29/2006	7.67	583.45	591.368	
MW4	OU2	9/27/2006	6.9	584.22	591.368	
MW4	OU2	12/18/2006	6.8	584.32	591.368	
MW4	OU2	3/26/2007	6.36	584.76	591.368	
MW4	OU2	6/8/2007	6.56	584.56	591.368	
MW4	OU2	8/22/2007	5.89	585.23	591.368	
MW4	OU2	12/17/2007	7.18	583.94	591.368	
MW4	OU2	4/1/2009	5.73	585.39	591.368	
MW4	OU2	6/1/2010	6.19	584.93	591.368	
MW4	OU2	11/11/2010	7.65	583.47	591.368	
MW4	OU2	8/7/2011	6.74	584.38	591.368	
MW4	OU2	11/11/2011	7.65	583.47	591.368	
MW4	OU2	6/11/2012	7.39	583.73	591.368	
MW4	OU2	11/8/2012	8.31	582.81	591.368	
MW4	OU2	6/20/2013	6.73	584.39	591.368	
MW4	OU2	11/14/2013	NM	NA	591.368	
MW4	OU2	5/21/2014	5.81	585.31	591.368	
MW4	OU2	11/5/2014	7.15	583.97	591.368	
MW4	OU2	6/8/2015	NM	NA	591.368	
MW4	OU2	11/16/2015	7.25	583.87	591.368	
MW4	OU2	6/21/2016	7.23	583.89	591.368	
MW4	OU2	12/20/2016	7.13	583.99	591.368	
MW4	OU2	5/30/2017	6.65	584.47	591.368	
MW4	OU2	12/19/2017	7.2	583.92	591.368	
MW4	OU2	6/18/2018	7.12	584.25	591.368	
MW4	OU2	12/12/2018	6.87	584.50	591.368	
MW4	OU2	12/17/2018	6.7	584.67	591.368	
MW4	OU2	3/19/2019	6.54	584.83	591.368	
MW4	OU2	6/3/2019	6	585.37	591.368	
MW4	OU2	8/12/2019	7.35	584.02	591.368	
MW4	OU2	3/17/2021	6.90	584.47	591.368	
MW5	OU2	2/1/1999	NM	581.98	586.939	
MW5	OU2	3/1/1999	NM	582.38	586.939	
MW5	OU2	4/1/1999	NM	581.98	586.939	
MW5	OU2	5/1/1999	NM	582.38	586.939	
MW5	OU2	6/1/1999	NM	581.89	586.939	
MW5	OU2	6/14/2001	5.2	579.12	586.939	
MW5	OU2	9/27/2001	4.52	579.8	586.939	
MW5	OU2	11/27/2001	4.75	581.82	586.939	
MW5	OU2	3/21/2002	4.56	579.76	586.939	
MW5	OU2	6/5/2002	4.66	579.66	586.939	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW5	OU2	8/20/2002	4.24	580.08	586.939	
MW5	OU2	11/18/2002	4.99	579.33	586.939	
MW5	OU2	1/26/2003	4.69	581.88	586.939	
MW5	OU2	3/17/2003	4.23	580.09	586.939	
MW5	OU2	5/14/2003	5.06	581.51	586.939	
MW5	OU2	7/8/2003	5.75	580.82	586.939	
MW5	OU2	10/15/2003	4.73	581.84	586.939	
MW5	OU2	1/26/2004	4.69	581.88	586.939	
MW5	OU2	5/18/2004	4.14	582.43	586.939	
MW5	OU2	7/22/2004	4.63	581.94	586.939	
MW5	OU2	10/21/2004	5.62	580.95	586.939	
MW5	OU2	1/26/2005	4.2	582.37	586.939	
MW5	OU2	5/11/2005	4.53	582.04	586.939	
MW5	OU2	8/24/2005	7.32	579.25	586.939	
MW5	OU2	3/28/2006	5.59	580.98	586.939	
MW5	OU2	6/29/2006	5.38	581.19	586.939	
MW5	OU2	9/27/2006	4.29	582.28	586.939	
MW5	OU2	12/18/2006	4.2	582.37	586.939	
MW5	OU2	3/26/2007	4.15	582.42	586.939	
MW5	OU2	6/8/2007	4.2	582.37	586.939	
MW5	OU2	8/22/2007	4.5	582.07	586.939	
MW5	OU2	12/17/2007	4.7	581.87	586.939	
MW5	OU2	4/1/2009	4.21	582.36	586.939	
MW5	OU2	8/7/2011	4.55	582.02	586.939	
MW5	OU2	6/11/2012	NM	NA	586.939	
MW5	OU2	11/8/2012	6.58	579.99	586.939	
MW5	OU2	6/20/2013	4.58	581.99	586.939	
MW5	OU2	11/14/2013	4.82	581.75	586.939	
MW5	OU2	5/21/2014	NM	NA	586.939	
MW5	OU2	11/5/2014	7.07	579.5	586.939	
MW5	OU2	6/8/2015	NM	NA	586.939	
MW5	OU2	11/16/2015	NM	NA	586.939	
MW5	OU2	6/21/2016	4.48	582.09	586.939	
MW5	OU2	12/20/2016	4.15	582.42	586.939	
MW5	OU2	5/30/2017	NM	NA	586.939	
MW5	OU2	12/19/2017	4.12	582.45	586.939	
MW5	OU2	6/18/2018	4.21	582.36	586.939	
MW5	OU2	12/12/2018	4.03	582.909	586.939	
MW5	OU2	12/17/2018	4	582.94	586.939	
MW5	OU2	3/19/2019	4	582.939	586.939	
MW5	OU2	6/4/2019	3.95	582.99	586.939	
MW5	OU2	8/12/2019	4.19	582.749	586.939	
MW6	OU2	6/14/2001	3.49	578.55	584.153	
MW6	OU2	9/27/2001	4	578.04	584.153	
MW6	OU2	11/27/2001	3.3	580.69	584.153	
MW6	OU2	3/21/2002	3.5	578.54	584.153	
MW6	OU2	6/5/2002	3.19	578.85	584.153	
MW6	OU2	8/20/2002	4.03	578.01	584.153	
MW6	OU2	11/18/2002	4.13	577.91	584.153	
MW6	OU2	1/26/2003	3.51	580.48	584.153	
MW6	OU2	3/17/2003	11.4	570.64	584.153	
MW6	OU2	5/14/2003	3.55	580.44	584.153	
MW6	OU2	7/8/2003	3.81	580.18	584.153	
MW6	OU2	10/15/2003	3.48	580.51	584.153	
MW6	OU2	1/26/2004	3.51	580.48	584.153	
MW6	OU2	5/18/2004	2.78	581.21	584.153	
MW6	OU2	7/22/2004	3.26	580.73	584.153	
MW6	OU2	10/21/2004	3.97	580.02	584.153	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW6	OU2	1/26/2005	3.06	580.93	584.153	
MW6	OU2	5/11/2005	3.23	580.76	584.153	
MW6	OU2	8/24/2005	5.37	578.62	584.153	
MW6	OU2	3/28/2006	3.51	580.48	584.153	
MW6	OU2	6/29/2006	3.69	580.3	584.153	
MW6	OU2	9/27/2006	3.26	580.73	584.153	
MW6	OU2	12/18/2006	3.33	580.66	584.153	
MW6	OU2	3/26/2007	3.06	580.93	584.153	
MW6	OU2	6/8/2007	3.01	580.98	584.153	
MW6	OU2	8/22/2007	2.73	581.26	584.153	
MW6	OU2	12/17/2007	3.39	580.6	584.153	
MW6	OU2	4/1/2009	2.89	581.1	584.153	
MW6	OU2	11/19/2009	2.86	581.13	584.153	
MW6	OU2	6/1/2010	2.76	581.23	584.153	
MW6	OU2	11/11/2010	3.98	580.01	584.153	
MW6	OU2	8/7/2011	2.66	581.33	584.153	
MW6	OU2	11/11/2011	3.89	580.1	584.153	
MW6	OU2	6/11/2012	4.07	579.92	584.153	
MW6	OU2	11/8/2012	4.53	579.46	584.153	
MW6	OU2	6/20/2013	2.88	581.11	584.153	
MW6	OU2	11/14/2013	3.22	580.77	584.153	
MW6	OU2	5/21/2014	2.59	581.4	584.153	
MW6	OU2	11/5/2014	NM	NA	584.153	
MW6	OU2	6/8/2015	2.56	581.43	584.153	
MW6	OU2	11/16/2015	2.81	581.18	584.153	
MW6	OU2	6/21/2016	2.67	581.32	584.153	
MW6	OU2	12/20/2016	2.88	581.11	584.153	
MW6	OU2	5/30/2017	2.5	581.49	584.153	
MW6	OU2	12/19/2017	2.34	581.65	584.153	
MW6	OU2	6/18/2018	2.14	581.85	584.153	
MW6	OU2	12/12/2018	2.34	581.813	584.153	
MW6	OU2	12/17/2018	2.33	581.82	584.153	
MW6	OU2	3/19/2019	2.38	581.773	584.153	
MW6	OU2	6/3/2019	1.62	582.53	584.153	
MW6	OU2	8/12/2019	1.35	582.803	584.153	
MW7	OU2	6/14/2001	4.05	579.07	585.3	
MW7	OU2	9/27/2001	4.88	578.24	585.3	
MW7	OU2	11/27/2001	3.53	581.62	585.3	
MW7	OU2	3/21/2002	3.79	579.33	585.3	
MW7	OU2	6/5/2002	3.59	579.53	585.3	
MW7	OU2	8/20/2002	3.43	579.69	585.3	
MW7	OU2	11/18/2002	4.3	578.82	585.3	
MW7	OU2	1/26/2003	3.25	581.9	585.3	
MW7	OU2	3/17/2003	9.17	573.95	585.3	
MW7	OU2	5/14/2003	3.81	581.34	585.3	
MW7	OU2	7/8/2003	4.44	580.71	585.3	
MW7	OU2	10/15/2003	3.69	581.46	585.3	
MW7	OU2	1/26/2004	3.25	581.9	585.3	
MW7	OU2	5/18/2004	2.76	582.39	585.3	
MW7	OU2	7/22/2004	3.5	581.65	585.3	
MW7	OU2	10/21/2004	4.56	580.59	585.3	
MW7	OU2	1/26/2005	3.01	582.14	585.3	
MW7	OU2	5/11/2005	3.5	581.65	585.3	
MW7	OU2	8/24/2005	6.25	578.9	585.3	
MW7	OU2	3/28/2006	3.65	581.5	585.3	
MW7	OU2	6/29/2006	4.11	581.04	585.3	
MW7	OU2	9/27/2006	3.02	582.13	585.3	
MW7	OU2	12/18/2006	2.92	582.23	585.3	

Table C-1
Historical Groundwater Elevations
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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW7	OU2	3/26/2007	2.66	582.49	585.3	
MW7	OU2	6/8/2007	2.72	582.43	585.3	
MW7	OU2	8/22/2007	3.1	582.05	585.3	
MW7	OU2	12/17/2007	3.18	581.97	585.3	
MW7	OU2	5/14/2008	2.54	582.61	585.3	
MW7	OU2	11/5/2008	2.65	582.5	585.3	
MW7	OU2	4/1/2009	2.82	582.33	585.3	
MW7	OU2	11/19/2009	2.65	582.5	585.3	
MW7	OU2	6/1/2010	2.62	582.53	585.3	
MW7	OU2	11/11/2010	4	581.15	585.3	
MW7	OU2	8/7/2011	3.05	582.1	585.3	
MW7	OU2	11/11/2011	4	581.15	585.3	
MW7	OU2	6/11/2012	3.86	581.29	585.3	
MW7	OU2	11/8/2012	5.19	579.96	585.3	
MW7	OU2	6/20/2013	2.55	582.6	585.3	
MW7	OU2	11/14/2013	3.42	581.73	585.3	
MW7	OU2	5/21/2014	3.28	581.87	585.3	
MW7	OU2	11/5/2014	2.68	582.47	585.3	
MW7	OU2	6/8/2015	2.43	582.72	585.3	
MW7	OU2	11/16/2015	2.85	582.3	585.3	
MW7	OU2	6/21/2016	2.94	582.21	585.3	
MW7	OU2	12/20/2016	2.6	582.55	585.3	
MW7	OU2	5/30/2017	2.45	582.7	585.3	
MW7	OU2	12/19/2017	2.52	582.63	585.3	
MW7	OU2	6/18/2018	2.55	582.6	585.3	
MW7	OU2	12/12/2018	2.44	582.86	585.3	
MW7	OU2	12/17/2018	2.42	582.88	585.3	
MW7	OU2	3/19/2019	2.42	582.88	585.3	
MW7	OU2	6/3/2019	2.41	582.89	585.3	
MW7	OU2	8/12/2019	2.58	582.72	585.3	
MW8	OU2	6/14/2001	3.44	578.97	584.032	
MW8	OU2	9/27/2001	3.95	578.46	584.032	
MW8	OU2	11/27/2001	3.09	580.77	584.032	
MW8	OU2	3/21/2002	3.36	579.05	584.032	
MW8	OU2	6/5/2002	3.05	579.36	584.032	
MW8	OU2	8/20/2002	3.25	579.16	584.032	
MW8	OU2	11/18/2002	3.77	578.64	584.032	
MW8	OU2	1/26/2003	3.31	580.55	584.032	
MW8	OU2	3/17/2003	9.8	572.61	584.032	
MW8	OU2	5/14/2003	3.43	580.43	584.032	
MW8	OU2	7/8/2003	3.91	579.95	584.032	
MW8	OU2	10/15/2003	3.36	580.5	584.032	
MW8	OU2	1/26/2004	3.31	580.55	584.032	
MW8	OU2	5/18/2004	2.18	581.68	584.032	
MW8	OU2	7/22/2004	3.04	580.82	584.032	
MW8	OU2	10/21/2004	3.81	580.05	584.032	
MW8	OU2	1/26/2005	2.78	581.08	584.032	
MW8	OU2	5/11/2005	3.2	580.66	584.032	
MW8	OU2	8/24/2005	4.9	578.96	584.032	
MW8	OU2	3/28/2006	3.42	580.44	584.032	
MW8	OU2	6/29/2006	3.57	580.29	584.032	
MW8	OU2	9/27/2006	2.9	580.96	584.032	
MW8	OU2	12/18/2006	2.99	580.87	584.032	
MW8	OU2	3/26/2007	2.6	581.26	584.032	
MW8	OU2	6/8/2007	2.7	581.16	584.032	
MW8	OU2	8/22/2007	2.1	581.76	584.032	
MW8	OU2	12/17/2007	3.28	580.58	584.032	
MW8	OU2	5/14/2008	2.36	581.5	584.032	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW8	OU2	11/5/2008	2.7	581.16	584.032	
MW8	OU2	4/1/2009	2.22	581.64	584.032	
MW8	OU2	11/19/2009	2.31	581.55	584.032	
MW8	OU2	6/1/2010	2.42	581.44	584.032	
MW8	OU2	11/11/2010	3.65	580.21	584.032	
MW8	OU2	8/7/2011	2.23	581.63	584.032	
MW8	OU2	11/11/2011	3.65	580.21	584.032	
MW8	OU2	6/11/2012	3.72	580.14	584.032	
MW8	OU2	11/8/2012	4.49	579.37	584.032	
MW8	OU2	6/20/2013	2.69	581.17	584.032	
MW8	OU2	11/14/2013	3.08	580.78	584.032	
MW8	OU2	5/21/2014	1.95	581.91	584.032	
MW8	OU2	11/5/2014	2.6	581.26	584.032	
MW8	OU2	6/8/2015	2.04	581.82	584.032	
MW8	OU2	11/16/2015	2.45	581.41	584.032	
MW8	OU2	6/21/2016	2.43	581.43	584.032	
MW8	OU2	12/20/2016	2.54	581.32	584.032	
MW8	OU2	5/30/2017	2.05	581.81	584.032	
MW8	OU2	12/19/2017	2.09	581.77	584.032	
MW8	OU2	6/18/2018	2.02	581.84	584.032	
MW8	OU2	12/12/2018	1.9	582.132	584.032	
MW8	OU2	12/17/2018	1.88	582.15	584.032	
MW8	OU2	3/19/2019	1.92	582.112	584.032	
MW8	OU2	6/3/2019	1.49	582.54	584.032	
MW8	OU2	8/12/2019	1.3	582.732	584.032	
MW9	OU2	6/14/2001	10.21	578.15	592.087	
MW9	OU2	9/27/2001	10.57	577.79	592.087	
MW9	OU2	11/27/2001	10.01	581.8	592.087	
MW9	OU2	3/21/2002	10.06	578.3	592.087	
MW9	OU2	6/5/2002	9.81	578.55	592.087	
MW9	OU2	8/20/2002	10.93	577.43	592.087	
MW9	OU2	11/18/2002	11.34	577.02	592.087	
MW9	OU2	1/26/2003	10.16	581.65	592.087	
MW9	OU2	3/17/2003	11.85	576.51	592.087	
MW9	OU2	5/14/2003	10.56	581.25	592.087	
MW9	OU2	7/8/2003	10.61	581.2	592.087	
MW9	OU2	10/15/2003	10.41	581.4	592.087	
MW9	OU2	1/26/2004	10.16	581.65	592.087	
MW9	OU2	5/18/2004	9.94	581.87	592.087	
MW9	OU2	7/22/2004	11.33	580.48	592.087	
MW9	OU2	10/21/2004	10.85	580.96	592.087	
MW9	OU2	1/26/2005	9.96	581.85	592.087	
MW9	OU2	5/11/2005	10.25	581.56	592.087	
MW9	OU2	8/24/2005	12	579.81	592.087	
MW9	OU2	3/28/2006	10.41	581.4	592.087	
MW9	OU2	6/29/2006	10.64	581.17	592.087	
MW9	OU2	9/27/2006	10.05	581.76	592.087	
MW9	OU2	12/18/2006	10.18	581.63	592.087	
MW9	OU2	3/26/2007	9.85	581.96	592.087	
MW9	OU2	6/8/2007	9.97	581.84	592.087	
MW9	OU2	8/22/2007	10.1	581.71	592.087	
MW9	OU2	12/17/2007	10.19	581.62	592.087	
MW9	OU2	4/1/2009	9.62	582.19	592.087	
MW9	OU2	11/19/2009	10.15	581.66	592.087	
MW9	OU2	6/1/2010	9.67	582.14	592.087	
MW9	OU2	11/11/2010	10.57	581.24	592.087	
MW9	OU2	8/7/2011	NM	NA	592.087	
MW9	OU2	11/11/2011	10.57	581.24	592.087	

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Historical Groundwater Elevations
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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW9	OU2	6/11/2012	NM	NA	592.087	
MW9	OU2	11/8/2012	11.33	580.48	592.087	
MW9	OU2	6/20/2013	9.89	581.92	592.087	
MW9	OU2	11/14/2013	10.4	581.41	592.087	
MW9	OU2	5/21/2014	9.58	582.23	592.087	
MW9	OU2	11/5/2014	2.35	589.46	592.087	
MW9	OU2	6/8/2015	NM	NA	592.087	
MW9	OU2	11/16/2015	9.94	581.87	592.087	
MW9	OU2	6/21/2016	10.04	581.77	592.087	
MW9	OU2	12/20/2016	9.7	582.11	592.087	
MW9	OU2	5/30/2017	9.74	582.07	592.087	
MW9	OU2	12/19/2017	9.91	581.9	592.087	
MW9	OU2	6/18/2018	9.75	582.06	592.087	
MW9	OU2	12/12/2018	9.75	582.337	592.087	
MW9	OU2	12/17/2018	9.76	582.33	592.087	
MW9	OU2	3/19/2019	9.64	582.447	592.087	
MW9	OU2	6/3/2019	9.26	582.83	592.087	
MW9	OU2	8/12/2019	9.08	583.007	592.087	
MW10	OU2	6/14/2001	10.35	578.01	592.174	
MW10	OU2	9/27/2001	10.71	577.65	592.174	
MW10	OU2	11/27/2001	10.13	581.87	592.174	
MW10	OU2	3/21/2002	10.21	578.15	592.174	
MW10	OU2	6/5/2002	9.96	578.4	592.174	
MW10	OU2	8/20/2002	11.09	577.27	592.174	
MW10	OU2	11/18/2002	11.48	576.88	592.174	
MW10	OU2	1/26/2003	10.38	581.62	592.174	
MW10	OU2	3/17/2003	10.89	577.47	592.174	
MW10	OU2	5/14/2003	10.71	581.29	592.174	
MW10	OU2	7/8/2003	10.73	581.27	592.174	
MW10	OU2	10/15/2003	10.56	581.44	592.174	
MW10	OU2	1/26/2004	10.38	581.62	592.174	
MW10	OU2	5/18/2004	10.09	581.91	592.174	
MW10	OU2	7/22/2004	11.49	580.51	592.174	
MW10	OU2	10/21/2004	10.98	581.02	592.174	
MW10	OU2	1/26/2005	10.15	581.85	592.174	
MW10	OU2	5/11/2005	10.4	581.6	592.174	
MW10	OU2	8/24/2005	10.4	581.6	592.174	
MW10	OU2	3/28/2006	10.55	581.45	592.174	
MW10	OU2	6/29/2006	10.77	581.23	592.174	
MW10	OU2	9/27/2006	10.2	581.8	592.174	
MW10	OU2	12/18/2006	10.32	581.68	592.174	
MW10	OU2	3/26/2007	9.95	582.05	592.174	
MW10	OU2	6/8/2007	10.08	581.92	592.174	
MW10	OU2	8/22/2007	10.2	581.8	592.174	
MW10	OU2	12/17/2007	10.27	581.73	592.174	
MW10	OU2	5/14/2008	10	582	592.174	
MW10	OU2	11/5/2008	10.18	581.82	592.174	
MW10	OU2	4/1/2009	9.7	582.3	592.174	
MW10	OU2	11/19/2009	10.23	581.77	592.174	
MW10	OU2	6/1/2010	9.76	582.24	592.174	
MW10	OU2	11/11/2010	10.67	581.33	592.174	
MW10	OU2	8/7/2011	10.15	581.85	592.174	
MW10	OU2	11/11/2011	10.67	581.33	592.174	
MW10	OU2	6/11/2012	10.5	581.5	592.174	
MW10	OU2	11/8/2012	11.44	580.56	592.174	
MW10	OU2	6/20/2013	9.99	582.01	592.174	
MW10	OU2	11/14/2013	11.09	580.91	592.174	
MW10	OU2	5/21/2014	9.69	582.31	592.174	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW10	OU2	11/5/2014	NM	NA	592.174	
MW10	OU2	6/8/2015	9.7	582.3	592.174	
MW10	OU2	11/16/2015	10.04	581.96	592.174	
MW10	OU2	6/21/2016	10.12	581.88	592.174	
MW10	OU2	12/20/2016	9.81	582.19	592.174	
MW10	OU2	5/30/2017	9.84	582.16	592.174	
MW10	OU2	12/19/2017	10.01	581.99	592.174	
MW10	OU2	6/18/2018	9.86	582.14	592.174	
MW10	OU2	7/31/2018	9.85	582.32	592.174	
MW10	OU2	8/27/2018	10.08	582.09	592.174	
MW10	OU2	9/25/2018	10.05	582.12	592.174	
MW10	OU2	10/2/2018	10.03	582.14	592.174	
MW10	OU2	11/28/2018	9.82	582.35	592.174	
MW10	OU2	12/12/2018	9.85	582.324	592.174	
MW10	OU2	12/17/2018	9.85	582.32	592.174	
MW10	OU2	3/19/2019	9.72	582.454	592.174	
MW10	OU2	6/3/2019	9.36	582.81	592.174	
MW10	OU2	8/12/2019	9.18	582.994	592.174	
MW11	OU2	6/14/2001	4.09	583.94	584.712	
MW11	OU2	9/27/2001	4.56	583.47	584.712	
MW11	OU2	11/27/2001	4.23	580.52	584.712	
MW11	OU2	3/21/2002	4.34	583.69	584.712	
MW11	OU2	6/5/2002	3.91	584.12	584.712	
MW11	OU2	8/20/2002	5.62	582.41	584.712	
MW11	OU2	11/18/2002	5.18	582.85	584.712	
MW11	OU2	1/26/2003	4.65	580.1	584.712	
MW11	OU2	3/17/2003	11.18	576.85	584.712	
MW11	OU2	5/14/2003	4.9	579.85	584.712	
MW11	OU2	7/8/2003	4.4	580.35	584.712	
MW11	OU2	10/15/2003	4.44	580.31	584.712	
MW11	OU2	1/26/2004	4.65	580.1	584.712	
MW11	OU2	5/18/2004	3.85	580.9	584.712	
MW11	OU2	7/22/2004	NM	NA	584.712	
MW11	OU2	10/21/2004	4.73	580.02	584.712	
MW11	OU2	1/26/2005	3.73	581.02	584.712	
MW11	OU2	5/11/2005	3.95	580.8	584.712	
MW11	OU2	8/24/2005	5.95	578.8	584.712	
MW11	OU2	3/28/2006	4.33	580.42	584.712	
MW11	OU2	6/29/2006	4.5	580.25	584.712	
MW11	OU2	9/27/2006	NM	NA	584.712	
MW11	OU2	12/18/2006	4.13	580.62	584.712	
MW11	OU2	3/26/2007	3.97	580.78	584.712	
MW11	OU2	6/8/2007	3.95	580.8	584.712	
MW11	OU2	8/22/2007	NM	NA	584.712	
MW11	OU2	12/17/2007	4.24	580.51	584.712	
MW11	OU2	4/1/2009	NM	NA	584.712	
MW11	OU2	12/12/2018	3.38	581.332	584.712	
MW11	OU2	3/19/2019	3.31	581.402	584.712	
MW11	OU2	6/5/2019	2.28	582.43	584.712	
MW11	OU2	8/12/2019	2.06	582.652	584.712	
MW12	OU2	6/14/2001	3.45	578.38	584.313	
MW12	OU2	9/27/2001	4.04	577.79	584.313	
MW12	OU2	11/27/2001	3.37	580.77	584.313	
MW12	OU2	3/21/2002	3.43	578.4	584.313	
MW12	OU2	6/5/2002	3.15	578.68	584.313	
MW12	OU2	8/20/2002	5.7	576.13	584.313	
MW12	OU2	11/18/2002	4.66	577.17	584.313	
MW12	OU2	1/26/2003	3.85	580.29	584.313	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW12	OU2	3/17/2003	12.79	569.04	584.313	
MW12	OU2	5/14/2003	3.63	580.51	584.313	
MW12	OU2	7/8/2003	3.87	580.27	584.313	
MW12	OU2	10/15/2003	3.59	580.55	584.313	
MW12	OU2	1/26/2004	3.85	580.29	584.313	
MW12	OU2	5/18/2004	3.22	580.92	584.313	
MW12	OU2	7/22/2004	4.85	579.29	584.313	
MW12	OU2	10/21/2004	4.33	579.81	584.313	
MW12	OU2	1/26/2005	3.28	580.86	584.313	
MW12	OU2	5/11/2005	3.45	580.69	584.313	
MW12	OU2	8/24/2005	6.5	577.64	584.313	
MW12	OU2	3/28/2006	3.71	580.43	584.313	
MW12	OU2	6/29/2006	4.25	579.89	584.313	
MW12	OU2	9/27/2006	3.43	580.71	584.313	
MW12	OU2	12/18/2006	3.28	580.86	584.313	
MW12	OU2	3/26/2007	3.26	580.88	584.313	
MW12	OU2	6/8/2007	3.35	580.79	584.313	
MW12	OU2	8/22/2007	3.19	580.95	584.313	
MW12	OU2	12/17/2007	3.39	580.75	584.313	
MW12	OU2	5/14/2008	3.23	580.91	584.313	
MW12	OU2	11/5/2008	3.47	580.67	584.313	
MW12	OU2	4/1/2009	NM	NA	584.313	
MW12	OU2	11/19/2009	3.25	580.89	584.313	
MW12	OU2	6/1/2010	3.26	580.88	584.313	
MW12	OU2	11/11/2010	4.3	579.84	584.313	
MW12	OU2	8/7/2011	3.67	580.47	584.313	
MW12	OU2	11/11/2011	4.3	579.84	584.313	
MW12	OU2	6/11/2012	NM	NA	584.313	
MW12	OU2	11/8/2012	4.73	579.41	584.313	
MW12	OU2	6/20/2013	NM	NA	584.313	
MW12	OU2	11/14/2013	3.37	580.77	584.313	
MW12	OU2	5/21/2014	3.17	580.97	584.313	
MW12	OU2	11/5/2014	9.87	574.27	584.313	
MW12	OU2	6/8/2015	3.17	580.97	584.313	
MW12	OU2	11/16/2015	3.25	580.89	584.313	
MW12	OU2	6/21/2016	NM	NA	584.313	
MW12	OU2	12/20/2016	3.32	580.82	584.313	
MW12	OU2	5/30/2017	NM	NA	584.313	
MW12	OU2	12/19/2017	3	581.14	584.313	
MW12	OU2	6/18/2018	2.8	581.34	584.313	
MW12	OU2	12/12/2018	2.99	581.323	584.313	
MW12	OU2	12/17/2018	2.98	581.33	584.313	
MW12	OU2	3/19/2019	2.93	581.383	584.313	
MW12	OU2	6/5/2019	1.88	582.43	584.313	
MW12	OU2	8/12/2019	1.67	582.643	584.313	
MW13	OU2	6/14/2001	10.18	577.68	590.832	
MW13	OU2	9/27/2001	11.15	576.71	590.832	
MW13	OU2	11/27/2001	10.32	580.37	590.832	
MW13	OU2	3/21/2002	10.02	577.84	590.832	
MW13	OU2	6/5/2002	9.56	578.3	590.832	
MW13	OU2	8/20/2002	11.13	576.73	590.832	
MW13	OU2	11/18/2002	11.13	576.73	590.832	
MW13	OU2	1/26/2003	10.65	580.04	590.832	
MW13	OU2	3/17/2003	13	574.86	590.832	
MW13	OU2	5/14/2003	10.15	580.54	590.832	
MW13	OU2	7/8/2003	11.17	579.52	590.832	
MW13	OU2	10/15/2003	11.16	579.53	590.832	
MW13	OU2	1/26/2004	10.65	580.04	590.832	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW13	OU2	5/18/2004	9.5	581.19	590.832	
MW13	OU2	7/22/2004	10.16	580.53	590.832	
MW13	OU2	10/21/2004	11	579.69	590.832	
MW13	OU2	1/26/2005	9.56	581.13	590.832	
MW13	OU2	5/11/2005	10.11	580.58	590.832	
MW13	OU2	8/24/2005	11.66	579.03	590.832	
MW13	OU2	3/28/2006	10.37	580.32	590.832	
MW13	OU2	6/29/2006	10.73	579.96	590.832	
MW13	OU2	9/27/2006	9.96	580.73	590.832	
MW13	OU2	12/18/2006	9.93	580.76	590.832	
MW13	OU2	3/26/2007	9.45	581.24	590.832	
MW13	OU2	6/8/2007	9.41	581.28	590.832	
MW13	OU2	8/22/2007	9.55	581.14	590.832	
MW13	OU2	12/17/2007	10.4	580.29	590.832	
MW13	OU2	4/1/2009	8.74	581.95	590.832	
MW13	OU2	11/19/2009	9.64	581.05	590.832	
MW13	OU2	6/1/2010	9.98	580.71	590.832	
MW13	OU2	11/11/2010	11.28	579.41	590.832	
MW13	OU2	8/7/2011	10.15	580.54	590.832	
MW13	OU2	11/11/2011	11.28	579.41	590.832	
MW13	OU2	6/11/2012	11.57	579.12	590.832	
MW13	OU2	11/8/2012	11.35	579.34	590.832	
MW13	OU2	6/20/2013	9.82	580.87	590.832	
MW13	OU2	11/14/2013	10.39	580.3	590.832	
MW13	OU2	5/21/2014	8.78	581.91	590.832	
MW13	OU2	11/5/2014	3.14	587.55	590.832	
MW13	OU2	6/8/2015	9.35	581.34	590.832	
MW13	OU2	11/16/2015	9.79	580.9	590.832	
MW13	OU2	6/21/2016	9.54	581.15	590.832	
MW13	OU2	12/20/2016	9.78	580.91	590.832	
MW13	OU2	5/30/2017	8.91	581.78	590.832	
MW13	OU2	12/19/2017	9.18	581.51	590.832	
MW13	OU2	6/18/2018	9.1	581.59	590.832	
MW13	OU2	12/12/2018	8.82	582.012	590.832	
MW13	OU2	12/17/2018	8.86	581.97	590.832	
MW13	OU2	3/19/2019	8.67	582.162	590.832	
MW13	OU2	6/3/2019	7.7	583.13	590.832	
MW13	OU2	8/12/2019	8.61	582.222	590.832	
MW14	OU2	6/14/2001	6.09	581.7	589.953	
MW14	OU2	9/27/2001	6.55	581.24	589.953	
MW14	OU2	11/27/2001	7.6	582.39	589.953	
MW14	OU2	3/21/2002	6.72	581.07	589.953	
MW14	OU2	6/5/2002	6.53	581.26	589.953	
MW14	OU2	8/20/2002	8.53	579.26	589.953	
MW14	OU2	11/18/2002	11.54	576.25	589.953	
MW14	OU2	1/26/2003	7.1	582.89	589.953	
MW14	OU2	3/17/2003	10.34	577.45	589.953	
MW14	OU2	5/14/2003	8.01	581.98	589.953	
MW14	OU2	7/8/2003	7.78	582.21	589.953	
MW14	OU2	10/15/2003	7.09	582.9	589.953	
MW14	OU2	1/26/2004	7.1	582.89	589.953	
MW14	OU2	5/18/2004	6.59	583.4	589.953	
MW14	OU2	7/22/2004	8.15	581.84	589.953	
MW14	OU2	10/21/2004	7.55	582.44	589.953	
MW14	OU2	1/26/2005	6.11	583.88	589.953	
MW14	OU2	5/11/2005	6.92	583.07	589.953	
MW14	OU2	8/24/2005	8.6	581.39	589.953	
MW14	OU2	3/28/2006	7.18	582.81	589.953	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW14	OU2	6/29/2006	7.4	582.59	589.953	
MW14	OU2	9/27/2006	6.46	583.53	589.953	
MW14	OU2	12/18/2006	6.46	583.53	589.953	
MW14	OU2	3/26/2007	6	583.99	589.953	
MW14	OU2	6/8/2007	6.05	583.94	589.953	
MW14	OU2	8/22/2007	6.45	583.54	589.953	
MW14	OU2	12/17/2007	7.01	582.98	589.953	
MW14	OU2	4/1/2009	5.52	584.47	589.953	
MW14	OU2	8/7/2011	6.77	583.22	589.953	
MW14	OU2	6/21/2016	6.87	583.12	589.953	
MW14	OU2	12/20/2016	NM	NA	589.953	
MW14	OU2	12/19/2017	6.49	583.5	589.953	
MW14	OU2	6/18/2018	6.42	583.57	589.953	
MW14	OU2	12/12/2018	6.27	583.68	589.953	
MW14	OU2	12/17/2018	6.18	583.77	589.953	
MW14	OU2	3/19/2019	5.86	584.09	589.953	
MW14	OU2	6/3/2019	5.45	584.50	589.953	
MW14	OU2	8/12/2019	6.96	582.99	589.953	
MW14	OU2	3/17/2021	6.37	583.58	589.953	
MW15	OU2	6/14/2001	8.17	581.62	592.743	
MW15	OU2	9/27/2001	8.11	581.68	592.743	
MW15	OU2	11/27/2001	9.55	582.88	592.743	
MW15	OU2	3/21/2002	8.28	581.51	592.743	
MW15	OU2	6/5/2002	8.14	581.65	592.743	
MW15	OU2	8/20/2002	9.15	580.64	592.743	
MW15	OU2	11/18/2002	9.91	579.88	592.743	
MW15	OU2	1/26/2003	8.88	583.50	592.743	
MW15	OU2	3/17/2003	13.09	576.70	592.743	
MW15	OU2	5/14/2003	8.59	583.84	592.743	
MW15	OU2	7/8/2003	8.5	583.93	592.743	
MW15	OU2	10/15/2003	8.28	584.15	592.743	
MW15	OU2	1/26/2004	8.88	583.55	592.743	
MW15	OU2	5/18/2004	7.54	584.89	592.743	
MW15	OU2	7/22/2004	9.05	583.38	592.743	
MW15	OU2	10/21/2004	8.71	583.72	592.743	
MW15	OU2	1/26/2005	8.13	584.3	592.743	
MW15	OU2	5/11/2005	8.38	584.05	592.743	
MW15	OU2	8/24/2005	9.66	582.77	592.743	
MW15	OU2	3/28/2006	8.4	584.03	592.743	
MW15	OU2	6/29/2006	8.71	583.72	592.743	
MW15	OU2	9/27/2006	7.92	584.51	592.743	
MW15	OU2	12/18/2006	7.91	584.52	592.743	
MW15	OU2	3/26/2007	7.33	585.10	592.743	
MW15	OU2	6/8/2007	7.67	584.76	592.743	
MW15	OU2	8/22/2007	7.31	585.12	592.743	
MW15	OU2	12/17/2007	8.26	584.17	592.743	
MW15	OU2	5/14/2008	7.39	585.04	592.743	
MW15	OU2	11/5/2008	8.11	584.32	592.743	
MW15	OU2	4/1/2009	6.57	585.86	592.743	
MW15	OU2	11/19/2009	7.65	584.78	592.743	
MW15	OU2	6/1/2010	6.98	585.45	592.743	
MW15	OU2	11/11/2010	8.88	583.55	592.743	
MW15	OU2	8/7/2011	7.7	584.73	592.743	
MW15	OU2	11/11/2011	8.88	583.55	592.743	
MW15	OU2	6/11/2012	8.42	584.01	592.743	
MW15	OU2	11/8/2012	8.92	583.51	592.743	
MW15	OU2	6/20/2013	7.79	584.64	592.743	
MW15	OU2	11/14/2013	7.98	584.45	592.743	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW15	OU2	5/21/2014	6.68	585.75	592.743	
MW15	OU2	11/5/2014	9.65	582.78	592.743	
MW15	OU2	6/8/2015	6.99	585.44	592.743	
MW15	OU2	11/16/2015	8.36	584.07	592.743	
MW15	OU2	6/21/2016	8.29	584.14	592.743	
MW15	OU2	12/20/2016	8.2	584.23	592.743	
MW15	OU2	5/30/2017	7.7	584.73	592.743	
MW15	OU2	12/19/2017	8.27	584.16	592.743	
MW15	OU2	6/18/2018	8.11	584.32	592.743	
MW15	OU2	7/31/2018	7.95	584.79	592.743	
MW15	OU2	8/27/2018	8.21	584.53	592.743	
MW15	OU2	9/25/2018	8.28	584.46	592.743	
MW15	OU2	10/2/2018	8.42	584.32	592.743	
MW15	OU2	11/28/2018	7.44	585.3	592.743	
MW15	OU2	12/13/2018	7.88	584.86	592.743	
MW15	OU2	12/17/2018	7.7	585.04	592.743	
MW15	OU2	3/19/2019	7.55	585.193	592.743	
MW15	OU2	6/3/2019	6.92	585.82	592.743	
MW15	OU2	8/12/2019	8.49	584.253	592.743	
MW16	OU2	6/14/2001	10.33	578.99	593.508	
MW16	OU2	9/27/2001	10.45	578.87	593.508	
MW16	OU2	11/27/2001	10.58	582.7	593.508	
MW16	OU2	3/21/2002	10.54	578.78	593.508	
MW16	OU2	6/5/2002	10.17	579.15	593.508	
MW16	OU2	8/20/2002	10.73	578.59	593.508	
MW16	OU2	11/18/2002	11.21	578.11	593.508	
MW16	OU2	1/26/2003	11.14	582.14	593.508	
MW16	OU2	3/17/2003	11.5	577.82	593.508	
MW16	OU2	5/14/2003	11.72	581.56	593.508	
MW16	OU2	7/8/2003	11.35	581.93	593.508	
MW16	OU2	10/15/2003	11.15	582.13	593.508	
MW16	OU2	1/26/2004	11.14	582.14	593.508	
MW16	OU2	5/18/2004	12.14	581.14	593.508	
MW16	OU2	7/22/2004	12.2	581.08	593.508	
MW16	OU2	10/21/2004	11.44	581.84	593.508	
MW16	OU2	1/26/2005	11.12	582.16	593.508	
MW16	OU2	5/11/2005	11.11	582.17	593.508	
MW16	OU2	8/24/2005	12.31	580.97	593.508	
MW16	OU2	3/28/2006	11.63	581.65	593.508	
MW16	OU2	6/29/2006	11.6	581.68	593.508	
MW16	OU2	9/27/2006	11.38	581.9	593.508	
MW16	OU2	12/18/2006	11.65	581.63	593.508	
MW16	OU2	3/26/2007	11.1	582.18	593.508	
MW16	OU2	6/8/2007	10.94	582.34	593.508	
MW16	OU2	8/22/2007	11.19	582.09	593.508	
MW16	OU2	12/17/2007	11.22	582.06	593.508	
MW16	OU2	5/14/2008	11.1	582.18	593.508	
MW16	OU2	11/5/2008	11.05	582.23	593.508	
MW16	OU2	4/1/2009	10.7	582.58	593.508	
MW16	OU2	11/19/2009	11.14	582.14	593.508	
MW16	OU2	6/1/2010	10.58	582.7	593.508	
MW16	OU2	11/11/2010	11.08	582.2	593.508	
MW16	OU2	8/7/2011	10.72	582.56	593.508	
MW16	OU2	11/11/2011	11.08	582.2	593.508	
MW16	OU2	6/11/2012	11.15	582.13	593.508	
MW16	OU2	11/8/2012	11.7	581.58	593.508	
MW16	OU2	6/20/2013	10.94	582.34	593.508	
MW16	OU2	11/14/2013	11.14	582.14	593.508	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW16	OU2	5/21/2014	10.48	582.8	593.508	
MW16	OU2	11/5/2014	8.1	585.18	593.508	
MW16	OU2	6/8/2015	10.45	582.83	593.508	
MW16	OU2	11/16/2015	10.77	582.51	593.508	
MW16	OU2	6/21/2016	10.85	582.43	593.508	
MW16	OU2	12/20/2016	10.72	582.56	593.508	
MW16	OU2	5/30/2017	10.56	582.72	593.508	
MW16	OU2	12/19/2017	11.07	582.21	593.508	
MW16	OU2	6/18/2018	10.9	582.38	593.508	
MW16	OU2	7/31/2018	10.92	582.59	593.508	
MW16	OU2	8/27/2018	10.9	582.61	593.508	
MW16	OU2	9/25/2018	11.03	582.48	593.508	
MW16	OU2	10/2/2018	11.1	582.41	593.508	
MW16	OU2	11/28/2018	11.03	582.48	593.508	
MW16	OU2	12/12/2018	10.97	582.538	593.508	
MW16	OU2	12/17/2018	11.02	582.49	593.508	
MW16	OU2	3/19/2019	10.88	582.628	593.508	
MW16	OU2	6/3/2019	10.7	582.81	593.508	
MW16	OU2	8/12/2019	10.55	582.958	593.508	
MW17	OU2	6/14/2001	9.67	577.01	592.262	
MW17	OU2	9/27/2001	9.8	576.88	592.262	
MW17	OU2	11/27/2001	9.67	582.37	592.262	
MW17	OU2	3/21/2002	9.73	576.95	592.262	
MW17	OU2	6/5/2002	9.25	577.43	592.262	
MW17	OU2	8/20/2002	9.79	576.89	592.262	
MW17	OU2	11/18/2002	10.55	576.13	592.262	
MW17	OU2	1/26/2003	10.25	581.79	592.262	
MW17	OU2	3/17/2003	14.57	572.11	592.262	
MW17	OU2	5/14/2003	10.65	581.39	592.262	
MW17	OU2	7/8/2003	12.5	579.54	592.262	
MW17	OU2	10/15/2003	10.37	581.67	592.262	
MW17	OU2	1/26/2004	10.25	581.79	592.262	
MW17	OU2	5/18/2004	11.3	580.74	592.262	
MW17	OU2	7/22/2004	17.9	574.14	592.262	
MW17	OU2	10/21/2004	10.9	581.14	592.262	
MW17	OU2	1/26/2005	10.35	581.69	592.262	
MW17	OU2	5/11/2005	16.42	575.62	592.262	
MW17	OU2	8/24/2005	18.5	573.54	592.262	
MW17	OU2	3/28/2006	12.8	579.24	592.262	
MW17	OU2	6/29/2006	12.92	579.12	592.262	
MW17	OU2	9/27/2006	12.91	579.13	592.262	
MW17	OU2	12/18/2006	12.95	579.09	592.262	
MW17	OU2	3/26/2007	12.9	579.14	592.262	
MW17	OU2	6/8/2007	13	579.04	592.262	
MW17	OU2	8/22/2007	13.1	578.94	592.262	
MW17	OU2	12/17/2007	13.34	578.7	592.262	
MW17	OU2	5/14/2008	12	580.04	592.262	
MW17	OU2	11/5/2008	12.97	579.07	592.262	
MW17	OU2	4/1/2009	11.9	580.14	592.262	
MW17	OU2	11/19/2009	11.92	580.12	592.262	
MW17	OU2	6/1/2010	12	580.04	592.262	
MW17	OU2	11/11/2010	12.27	579.77	592.262	
MW17	OU2	8/7/2011	16.1	575.94	592.262	
MW17	OU2	11/11/2011	12.27	579.77	592.262	
MW17	OU2	6/11/2012	13.92	578.12	592.262	
MW17	OU2	11/8/2012	14.79	577.25	592.262	
MW17	OU2	6/20/2013	15.31	576.73	592.262	
MW17	OU2	11/14/2013	15	577.04	592.262	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW17	OU2	5/21/2014	15.06	576.98	592.262	
MW17	OU2	11/5/2014	10.54	581.5	592.262	
MW17	OU2	6/8/2015	15.78	576.26	592.262	
MW17	OU2	11/16/2015	15.85	576.19	592.262	
MW17	OU2	6/21/2016	15.51	576.53	592.262	
MW17	OU2	12/20/2016	15.6	576.44	592.262	
MW17	OU2	5/30/2017	15.65	576.39	592.262	
MW17	OU2	12/19/2017	15.83	576.21	592.262	
MW17	OU2	6/18/2018	14.25	577.79	592.262	
MW17	OU2	7/31/2018	15.33	576.93	592.262	
MW17	OU2	8/27/2018	15.33	576.93	592.262	
MW17	OU2	9/25/2018	15.35	576.91	592.262	
MW17	OU2	10/2/2018	15.43	576.83	592.262	
MW17	OU2	11/28/2018	15.33	576.93	592.262	
MW17	OU2	12/12/2018	15.53	576.732	592.262	
MW17	OU2	12/17/2018	15.49	576.77	592.262	
MW17	OU2	3/19/2019	15.47	576.792	592.262	
MW17	OU2	6/3/2019	15.43	576.83	592.262	
MW17	OU2	8/12/2019	15.4	576.862	592.262	
MW18	OU2	6/14/2001	10.53	578.71	591.991	
MW18	OU2	9/27/2001	11.27	577.97	591.991	
MW18	OU2	11/27/2001	10.03	581.62	591.991	
MW18	OU2	3/21/2002	10.32	578.92	591.991	
MW18	OU2	6/5/2002	9.89	579.35	591.991	
MW18	OU2	8/20/2002	10.47	578.77	591.991	
MW18	OU2	11/18/2002	10.81	578.43	591.991	
MW18	OU2	1/26/2003	9.85	581.8	591.991	
MW18	OU2	3/17/2003	11.81	577.43	591.991	
MW18	OU2	5/14/2003	10.3	581.35	591.991	
MW18	OU2	7/8/2003	10.75	580.9	591.991	
MW18	OU2	10/15/2003	10.45	581.2	591.991	
MW18	OU2	1/26/2004	9.85	581.8	591.991	
MW18	OU2	5/18/2004	9.28	582.37	591.991	
MW18	OU2	7/22/2004	11.05	580.6	591.991	
MW18	OU2	10/21/2004	10.96	580.69	591.991	
MW18	OU2	1/26/2005	9.81	581.84	591.991	
MW18	OU2	5/11/2005	9.99	581.66	591.991	
MW18	OU2	8/24/2005	12.61	579.04	591.991	
MW18	OU2	3/28/2006	10.05	581.6	591.991	
MW18	OU2	6/29/2006	10.41	581.24	591.991	
MW18	OU2	9/27/2006	9.69	581.96	591.991	
MW18	OU2	12/18/2006	9.72	581.93	591.991	
MW18	OU2	3/26/2007	9.29	582.36	591.991	
MW18	OU2	6/8/2007	9.2	582.45	591.991	
MW18	OU2	8/22/2007	9.72	581.93	591.991	
MW18	OU2	12/17/2007	9.84	581.81	591.991	
MW18	OU2	5/14/2008	9.18	582.47	591.991	
MW18	OU2	11/5/2008	9.34	582.31	591.991	
MW18	OU2	4/1/2009	8.84	582.81	591.991	
MW18	OU2	11/19/2009	9.35	582.3	591.991	
MW18	OU2	6/1/2010	9.2	582.45	591.991	
MW18	OU2	11/11/2010	10.59	581.06	591.991	
MW18	OU2	8/7/2011	9.64	582.01	591.991	
MW18	OU2	11/11/2011	10.59	581.06	591.991	
MW18	OU2	6/11/2012	10.43	581.22	591.991	
MW18	OU2	11/8/2012	11.65	580	591.991	
MW18	OU2	6/20/2013	9.21	582.44	591.991	
MW18	OU2	11/14/2013	9.84	581.81	591.991	

Table C-1
Historical Groundwater Elevations
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East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW18	OU2	5/21/2014	9.01	582.64	591.991	
MW18	OU2	11/5/2014	15.05	576.6	591.991	
MW18	OU2	6/8/2015	9.12	582.53	591.991	
MW18	OU2	11/16/2015	9.49	582.16	591.991	
MW18	OU2	6/21/2016	9.5	582.15	591.991	
MW18	OU2	12/20/2016	9.2	582.45	591.991	
MW18	OU2	5/30/2017	9.05	582.6	591.991	
MW18	OU2	12/19/2017	9.19	582.46	591.991	
MW18	OU2	6/18/2018	9.27	582.38	591.991	
MW18	OU2	7/31/2018	9.42	582.57	591.991	
MW18	OU2	8/27/2018	9.59	582.4	591.991	
MW18	OU2	9/25/2018	9.62	582.37	591.991	
MW18	OU2	10/2/2018	9.69	582.3	591.991	
MW18	OU2	11/28/2018	9.21	582.78	591.991	
MW18	OU2	12/12/2018	9.11	582.881	591.991	
MW18	OU2	12/17/2018	9.07	582.92	591.991	
MW18	OU2	3/19/2019	9.02	582.971	591.991	
MW18	OU2	6/3/2019	9.03	582.96	591.991	
MW18	OU2	8/12/2019	9.21	582.781	591.991	
MW19	OU2	6/14/2001	11.48	577.76	594.173	
MW19	OU2	9/27/2001	11.75	577.49	594.173	
MW19	OU2	11/27/2001	11.56	582.42	594.173	
MW19	OU2	3/21/2002	11.57	577.67	594.173	
MW19	OU2	6/5/2002	11.18	578.06	594.173	
MW19	OU2	8/20/2002	11.78	577.46	594.173	
MW19	OU2	11/18/2002	12.25	576.99	594.173	
MW19	OU2	1/26/2003	14.48	579.5	594.173	
MW19	OU2	3/17/2003	9.09	580.15	594.173	
MW19	OU2	5/14/2003	12.65	581.33	594.173	
MW19	OU2	7/8/2003	12.45	581.53	594.173	
MW19	OU2	10/15/2003	15.8	578.18	594.173	
MW19	OU2	1/26/2004	14.48	579.5	594.173	
MW19	OU2	5/18/2004	15.06	578.92	594.173	
MW19	OU2	7/22/2004	13.2	580.78	594.173	
MW19	OU2	10/21/2004	15.11	578.87	594.173	
MW19	OU2	1/26/2005	13.85	580.13	594.173	
MW19	OU2	5/11/2005	12.5	581.48	594.173	
MW19	OU2	8/24/2005	15.98	578	594.173	
MW19	OU2	3/28/2006	14.6	579.38	594.173	
MW19	OU2	6/29/2006	14.64	579.34	594.173	
MW19	OU2	9/27/2006	13.2	580.78	594.173	
MW19	OU2	12/18/2006	16.82	577.16	594.173	
MW19	OU2	3/26/2007	15.64	578.34	594.173	
MW19	OU2	6/8/2007	12.5	581.48	594.173	
MW19	OU2	8/22/2007	14.4	579.58	594.173	
MW19	OU2	12/17/2007	13.55	580.43	594.173	
MW19	OU2	5/14/2008	14.72	579.26	594.173	
MW19	OU2	11/5/2008	14.96	579.02	594.173	
MW19	OU2	4/1/2009	14.96	579.02	594.173	
MW19	OU2	11/19/2009	15	578.98	594.173	
MW19	OU2	6/1/2010	14.75	579.23	594.173	
MW19	OU2	11/11/2010	13.5	580.48	594.173	
MW19	OU2	8/7/2011	14	579.98	594.173	
MW19	OU2	11/11/2011	13.5	580.48	594.173	
MW19	OU2	6/11/2012	12.56	581.42	594.173	
MW19	OU2	11/8/2012	13.33	580.65	594.173	
MW19	OU2	6/20/2013	13.7	580.28	594.173	
MW19	OU2	11/14/2013	16.71	577.27	594.173	

Table C-1
Historical Groundwater Elevations
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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW19	OU2	5/21/2014	11.85	582.13	594.173	
MW19	OU2	11/5/2014	9.22	584.76	594.173	
MW19	OU2	6/8/2015	12.08	581.9	594.173	
MW19	OU2	11/16/2015	12.94	581.04	594.173	
MW19	OU2	6/21/2016	13.33	580.65	594.173	
MW19	OU2	12/20/2016	12.75	581.23	594.173	
MW19	OU2	5/30/2017	12.91	581.07	594.173	
MW19	OU2	12/19/2017	12.6	581.38	594.173	
MW19	OU2	6/18/2018	12.95	581.03	594.173	
MW19	OU2	7/31/2018	12.8	581.37	594.173	
MW19	OU2	8/27/2018	12.8	581.37	594.173	
MW19	OU2	9/25/2018	12.75	581.42	594.173	
MW19	OU2	10/2/2018	12.4	581.77	594.173	
MW19	OU2	10/3/2018	13.25	580.92	594.173	
MW19	OU2	11/28/2018	12.9	581.27	594.173	
MW19	OU2	12/12/2018	NM	NA	594.173	Well Contains Free Product
MW19	OU2	12/17/2018	12.95	581.22	594.173	
MW19	OU2	3/19/2019	NM	NA	594.173	Well Contains Free Product
MW19	OU2	6/3/2019	NM	NA	594.173	Well Contains Free Product
MW19	OU2	8/12/2019	NM	NA	594.173	Well Contains Free Product
MW20	OU2	6/14/2001	11.19	580.73	594.532	
MW20	OU2	9/27/2001	11.48	580.44	594.532	
MW20	OU2	11/27/2001	11.75	582.54	594.532	
MW20	OU2	3/21/2002	NM	NA	594.532	
MW20	OU2	6/5/2002	11.3	580.62	594.532	
MW20	OU2	8/20/2002	11.95	579.97	594.532	
MW20	OU2	11/18/2002	12.13	579.79	594.532	
MW20	OU2	1/26/2003	12.16	582.13	594.532	
MW20	OU2	3/17/2003	9.29	582.63	594.532	
MW20	OU2	5/14/2003	16.75	577.54	594.532	
MW20	OU2	7/8/2003	12.55	581.74	594.532	
MW20	OU2	10/15/2003	12.25	582.04	594.532	
MW20	OU2	1/26/2004	12.16	582.13	594.532	
MW20	OU2	5/18/2004	13.22	581.07	594.532	
MW20	OU2	7/22/2004	12.19	582.1	594.532	
MW20	OU2	10/21/2004	12.48	581.81	594.532	
MW20	OU2	1/26/2005	12.11	582.18	594.532	
MW20	OU2	5/11/2005	12.09	582.2	594.532	
MW20	OU2	8/24/2005	13.16	581.13	594.532	
MW20	OU2	3/28/2006	12.92	581.37	594.532	
MW20	OU2	6/29/2006	12.81	581.48	594.532	
MW20	OU2	9/27/2006	12.66	581.63	594.532	
MW20	OU2	12/18/2006	12.8	581.49	594.532	
MW20	OU2	3/26/2007	12.35	581.94	594.532	
MW20	OU2	6/8/2007	12.11	582.18	594.532	
MW20	OU2	8/22/2007	12.43	581.86	594.532	
MW20	OU2	12/17/2007	12.48	581.81	594.532	
MW20	OU2	5/14/2008	12.2	582.09	594.532	
MW20	OU2	11/5/2008	12.2	582.09	594.532	
MW20	OU2	4/1/2009	11.92	582.37	594.532	
MW20	OU2	11/19/2009	12.36	581.93	594.532	
MW20	OU2	6/1/2010	11.71	582.58	594.532	
MW20	OU2	11/11/2010	12.21	582.08	594.532	
MW20	OU2	8/7/2011	11.85	582.44	594.532	
MW20	OU2	11/11/2011	12.21	582.08	594.532	
MW20	OU2	6/11/2012	12.24	582.05	594.532	
MW20	OU2	11/8/2012	12.83	581.46	594.532	
MW20	OU2	6/20/2013	12.14	582.15	594.532	

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Historical Groundwater Elevations
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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW20	OU2	11/14/2013	12.28	582.01	594.532	
MW20	OU2	5/21/2014	11.73	582.56	594.532	
MW20	OU2	11/5/2014	11.89	582.4	594.532	
MW20	OU2	6/8/2015	11.57	582.72	594.532	
MW20	OU2	11/16/2015	12.08	582.21	594.532	
MW20	OU2	6/21/2016	12.11	582.18	594.532	
MW20	OU2	12/20/2016	11.96	582.33	594.532	
MW20	OU2	5/30/2017	11.86	582.43	594.532	
MW20	OU2	12/19/2017	12.42	581.87	594.532	
MW20	OU2	6/18/2018	12.2	582.09	594.532	
MW20	OU2	7/31/2018	12.26	582.27	594.532	
MW20	OU2	8/27/2018	12.25	582.28	594.532	
MW20	OU2	9/25/2018	12.27	582.26	594.532	
MW20	OU2	10/2/2018	12.36	582.17	594.532	
MW20	OU2	11/28/2018	12.42	582.11	594.532	
MW20	OU2	12/12/2018	12.16	582.372	594.532	
MW20	OU2	12/17/2018	12.33	582.2	594.532	
MW20	OU2	3/19/2019	12.22	582.312	594.532	
MW20	OU2	6/3/2019	11.95	582.58	594.532	
MW20	OU2	8/12/2019	11.82	582.712	594.532	
MW21	OU2	6/14/2001	6.98	580.02	591.667	
MW21	OU2	9/27/2001	7.21	579.79	591.667	
MW21	OU2	11/27/2001	9.35	581.87	591.667	
MW21	OU2	3/21/2002	7.95	579.05	591.667	
MW21	OU2	6/5/2002	7.8	579.2	591.667	
MW21	OU2	8/20/2002	10.9	576.1	591.667	
MW21	OU2	11/18/2002	12.31	574.69	591.667	
MW21	OU2	1/26/2003	8.21	583.01	591.667	
MW21	OU2	3/17/2003	5.85	581.15	591.667	
MW21	OU2	5/14/2003	9.25	581.97	591.667	
MW21	OU2	7/8/2003	9.02	582.2	591.667	
MW21	OU2	10/15/2003	8.38	582.84	591.667	
MW21	OU2	1/26/2004	8.21	583.01	591.667	
MW21	OU2	5/18/2004	8.9	582.32	591.667	
MW21	OU2	7/22/2004	8.06	583.16	591.667	
MW21	OU2	10/21/2004	8.73	582.49	591.667	
MW21	OU2	1/26/2005	7.42	583.8	591.667	
MW21	OU2	5/11/2005	8.18	583.04	591.667	
MW21	OU2	8/24/2005	9.93	581.29	591.667	
MW21	OU2	3/28/2006	8.39	582.83	591.667	
MW21	OU2	6/29/2006	8.62	582.6	591.667	
MW21	OU2	9/27/2006	7.77	583.45	591.667	
MW21	OU2	12/18/2006	7.6	583.62	591.667	
MW21	OU2	3/26/2007	7.35	583.87	591.667	
MW21	OU2	6/8/2007	7.39	583.83	591.667	
MW21	OU2	8/22/2007	8.11	583.11	591.667	
MW21	OU2	12/17/2007	8.4	582.82	591.667	
MW21	OU2	5/14/2008	7.57	583.65	591.667	
MW21	OU2	11/5/2008	7.8	583.42	591.667	
MW21	OU2	4/1/2009	6.95	584.27	591.667	
MW21	OU2	11/19/2009	7.89	583.33	591.667	
MW21	OU2	6/1/2010	7.61	583.61	591.667	
MW21	OU2	11/11/2010	9.17	582.05	591.667	
MW21	OU2	8/7/2011	8.19	583.03	591.667	
MW21	OU2	11/11/2011	9.17	582.05	591.667	
MW21	OU2	6/11/2012	8.93	582.29	591.667	
MW21	OU2	11/8/2012	9.64	581.58	591.667	
MW21	OU2	6/20/2013	7.56	583.66	591.667	

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Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW21	OU2	11/14/2013	8.6	582.62	591.667	
MW21	OU2	5/21/2014	7.02	584.2	591.667	
MW21	OU2	11/5/2014	11.63	579.59	591.667	
MW21	OU2	6/8/2015	7.82	583.4	591.667	
MW21	OU2	11/16/2015	8.37	582.85	591.667	
MW21	OU2	6/21/2016	8.08	583.14	591.667	
MW21	OU2	12/20/2016	8.02	583.2	591.667	
MW21	OU2	5/30/2017	7.24	583.98	591.667	
MW21	OU2	12/19/2017	8.08	583.14	591.667	
MW21	OU2	6/18/2018	8.01	583.21	591.667	
MW21	OU2	7/31/2018	8.29	583.38	591.667	
MW21	OU2	8/27/2018	8.59	583.08	591.667	
MW21	OU2	9/25/2018	8.6	583.07	591.667	
MW21	OU2	10/2/2018	8.65	583.02	591.667	
MW21	OU2	11/28/2018	8.07	583.6	591.667	
MW21	OU2	12/12/2018	7.89	583.777	591.667	
MW21	OU2	12/17/2018	7.83	583.84	591.667	
MW21	OU2	3/19/2019	7.45	584.217	591.667	
MW21	OU2	6/3/2019	6.86	584.81	591.667	
MW21	OU2	8/12/2019	8.29	583.377	591.667	
MW21R	OU2	3/16/2021	4.23	583.75	587.977	
MW22	OU2	6/14/2001	10.6	581.02	594.29	
MW22	OU2	9/27/2001	11.07	580.55	594.29	
MW22	OU2	11/27/2001	18.3	575.76	594.29	
MW22	OU2	3/21/2002	10.81	580.81	594.29	
MW22	OU2	6/5/2002	10.81	580.81	594.29	
MW22	OU2	8/20/2002	12.11	579.51	594.29	
MW22	OU2	11/18/2002	NM	NA	594.29	
MW22	OU2	1/26/2003	12	582.06	594.29	
MW22	OU2	3/17/2003	4.24	587.38	594.29	
MW22	OU2	5/14/2003	12.91	581.13	594.29	
MW22	OU2	7/8/2003	12.45	581.59	594.29	
MW22	OU2	10/15/2003	12.13	581.91	594.29	
MW22	OU2	1/26/2004	12	582.04	594.29	
MW22	OU2	5/18/2004	13.06	580.98	594.29	
MW22	OU2	7/22/2004	11.96	582.08	594.29	
MW22	OU2	10/21/2004	12.28	581.76	594.29	
MW22	OU2	1/26/2005	11.89	582.15	594.29	
MW22	OU2	5/11/2005	11.88	582.16	594.29	
MW22	OU2	8/24/2005	13.09	580.95	594.29	
MW22	OU2	3/28/2006	12.85	581.19	594.29	
MW22	OU2	6/29/2006	12.83	581.21	594.29	
MW22	OU2	9/27/2006	12.61	581.43	594.29	
MW22	OU2	12/18/2006	12.65	581.39	594.29	
MW22	OU2	3/26/2007	12.2	581.84	594.29	
MW22	OU2	6/8/2007	12.03	582.01	594.29	
MW22	OU2	8/22/2007	12.34	581.7	594.29	
MW22	OU2	12/17/2007	12.42	581.62	594.29	
MW22	OU2	5/14/2008	12.15	581.89	594.29	
MW22	OU2	11/5/2008	12.18	581.86	594.29	
MW22	OU2	4/1/2009	11.93	582.11	594.29	
MW22	OU2	11/19/2009	12.28	581.76	594.29	
MW22	OU2	6/1/2010	11.68	582.36	594.29	
MW22	OU2	11/11/2010	12.1	581.94	594.29	
MW22	OU2	8/7/2011	11.76	582.28	594.29	
MW22	OU2	11/11/2011	12.1	581.94	594.29	
MW22	OU2	6/11/2012	12.11	581.93	594.29	
MW22	OU2	11/8/2012	12.7	581.34	594.29	

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Historical Groundwater Elevations
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East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW22	OU2	6/20/2013	12.05	581.99	594.29	
MW22	OU2	11/14/2013	12.19	581.85	594.29	
MW22	OU2	5/21/2014	11.58	582.46	594.29	
MW22	OU2	11/5/2014	8.1	585.94	594.29	
MW22	OU2	6/8/2015	11.33	582.71	594.29	
MW22	OU2	11/16/2015	14.05	579.99	594.29	
MW22	OU2	6/21/2016	13.85	580.19	594.29	
MW22	OU2	12/20/2016	13.72	580.32	594.29	
MW22	OU2	5/30/2017	14.55	579.51	594.29	
MW22	OU2	12/19/2017	14.54	579.52	594.29	
MW22	OU2	6/18/2018	14.7	579.36	594.29	
MW22	OU2	7/31/2018	14.85	579.44	594.29	
MW22	OU2	8/27/2018	14.77	579.52	594.29	
MW22	OU2	9/25/2018	14.61	579.68	594.29	
MW22	OU2	10/2/2018	14.55	579.74	594.29	
MW22	OU2	11/28/2018	14.54	579.75	594.29	
MW22	OU2	12/12/2018	14.76	579.53	594.29	
MW22	OU2	12/17/2018	15.05	579.24	594.29	
MW22	OU2	3/19/2019	14.68	579.61	594.29	
MW22	OU2	6/3/2019	14.49	579.8	594.29	
MW22	OU2	8/12/2019	14.05	580.24	594.29	
MW23	OU2	6/14/2001	10.6	577.39	592.555	
MW23	OU2	9/27/2001	11.55	576.44	592.555	
MW23	OU2	11/27/2001	10.42	583.94	592.555	
MW23	OU2	3/21/2002	10.18	577.81	592.555	
MW23	OU2	6/5/2002	10.12	577.87	592.555	
MW23	OU2	8/20/2002	10.08	577.91	592.555	
MW23	OU2	11/18/2002	9.87	578.12	592.555	
MW23	OU2	1/26/2003	10.05	582.31	592.555	
MW23	OU2	3/17/2003	4.64	583.35	592.555	
MW23	OU2	5/14/2003	10.64	581.72	592.555	
MW23	OU2	7/8/2003	10.85	581.51	592.555	
MW23	OU2	10/15/2003	10.29	582.07	592.555	
MW23	OU2	1/26/2004	10.05	582.31	592.555	
MW23	OU2	5/18/2004	10.54	581.82	592.555	
MW23	OU2	7/22/2004	10.12	582.24	592.555	
MW23	OU2	10/21/2004	10.84	581.52	592.555	
MW23	OU2	1/26/2005	9.45	582.91	592.555	
MW23	OU2	5/11/2005	10.07	582.29	592.555	
MW23	OU2	8/24/2005	12.25	580.11	592.555	
MW23	OU2	3/28/2006	10.07	582.29	592.555	
MW23	OU2	6/29/2006	10.45	581.91	592.555	
MW23	OU2	9/27/2006	9.55	582.81	592.555	
MW23	OU2	12/18/2006	9.65	582.71	592.555	
MW23	OU2	3/26/2007	9.5	582.86	592.555	
MW23	OU2	6/8/2007	9.5	582.86	592.555	
MW23	OU2	8/22/2007	9.65	582.71	592.555	
MW23	OU2	12/17/2007	9.9	582.46	592.555	
MW23	OU2	5/14/2008	9.45	582.91	592.555	
MW23	OU2	11/5/2008	9.79	582.57	592.555	
MW23	OU2	4/1/2009	9.28	583.08	592.555	
MW23	OU2	11/19/2009	9.47	582.89	592.555	
MW23	OU2	6/1/2010	9.45	582.91	592.555	
MW23	OU2	11/11/2010	10.77	581.59	592.555	
MW23	OU2	8/7/2011	10.13	582.23	592.555	
MW23	OU2	11/11/2011	10.77	581.59	592.555	
MW23	OU2	6/11/2012	10.23	582.13	592.555	
MW23	OU2	11/8/2012	11.48	580.88	592.555	

Table C-1
Historical Groundwater Elevations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW23	OU2	6/20/2013	9.53	582.83	592.555	
MW23	OU2	11/14/2013	10.14	582.22	592.555	
MW23	OU2	5/21/2014	9.18	583.18	592.555	
MW23	OU2	11/5/2014	11.47	580.89	592.555	
MW23	OU2	6/8/2015	9.43	582.93	592.555	
MW23	OU2	11/16/2015	9.98	582.38	592.555	
MW23	OU2	6/21/2016	10.002	582.358	592.555	
MW23	OU2	12/20/2016	9.63	582.73	592.555	
MW23	OU2	5/30/2017	9.4	582.96	592.555	
MW23	OU2	12/19/2017	9.6	582.76	592.555	
MW23	OU2	6/18/2018	9.73	582.63	592.555	
MW23	OU2	7/31/2018	9.84	582.72	592.555	
MW23	OU2	8/27/2018	10.12	582.44	592.555	
MW23	OU2	9/25/2018	10.11	582.45	592.555	
MW23	OU2	10/2/2018	10.13	582.43	592.555	
MW23	OU2	11/28/2018	9.4	583.16	592.555	
MW23	OU2	12/12/2018	9.32	583.235	592.555	
MW23	OU2	12/17/2018	9.3	583.26	592.555	
MW23	OU2	3/19/2019	9.38	583.175	592.555	
MW23	OU2	6/3/2019	9.25	583.31	592.555	
MW23	OU2	8/12/2019	9.69	582.865	592.555	
MW24	OU2	6/14/2001	12.36	580.12	595.817	
MW24	OU2	9/27/2001	12.83	579.65	595.817	
MW24	OU2	11/27/2001	13.26	582.37	595.817	
MW24	OU2	3/21/2002	12.72	579.76	595.817	
MW24	OU2	6/5/2002	12.42	580.06	595.817	
MW24	OU2	8/20/2002	13.57	578.91	595.817	
MW24	OU2	11/18/2002	13.55	578.93	595.817	
MW24	OU2	1/26/2003	13.55	582.08	595.817	
MW24	OU2	3/17/2003	4.12	588.36	595.817	
MW24	OU2	5/14/2003	14.4	581.23	595.817	
MW24	OU2	7/8/2003	13.94	581.69	595.817	
MW24	OU2	10/15/2003	13.68	581.95	595.817	
MW24	OU2	1/26/2004	13.55	582.08	595.817	
MW24	OU2	5/18/2004	14.62	581.01	595.817	
MW24	OU2	7/22/2004	14.54	581.09	595.817	
MW24	OU2	10/21/2004	13.93	581.7	595.817	
MW24	OU2	1/26/2005	13.46	582.17	595.817	
MW24	OU2	5/11/2005	13.45	582.18	595.817	
MW24	OU2	8/24/2005	16.09	579.54	595.817	
MW24	OU2	3/28/2006	15.95	579.68	595.817	
MW24	OU2	6/29/2006	16.6	579.03	595.817	
MW24	OU2	9/27/2006	16.08	579.55	595.817	
MW24	OU2	12/18/2006	16.27	579.36	595.817	
MW24	OU2	3/26/2007	15.35	580.28	595.817	
MW24	OU2	6/8/2007	15.55	580.08	595.817	
MW24	OU2	8/22/2007	15.6	580.03	595.817	
MW24	OU2	12/17/2007	15.78	579.85	595.817	
MW24	OU2	5/14/2008	15.5	580.13	595.817	
MW24	OU2	11/5/2008	16.22	579.41	595.817	
MW24	OU2	4/1/2009	16.17	579.46	595.817	
MW24	OU2	11/19/2009	16.19	579.44	595.817	
MW24	OU2	6/1/2010	14.75	580.88	595.817	
MW24	OU2	11/11/2010	15.05	580.58	595.817	
MW24	OU2	8/7/2011	15.58	580.05	595.817	
MW24	OU2	11/11/2011	15.05	580.58	595.817	
MW24	OU2	6/11/2012	15.72	579.91	595.817	
MW24	OU2	11/8/2012	15.73	579.9	595.817	

Table C-1
Historical Groundwater Elevations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

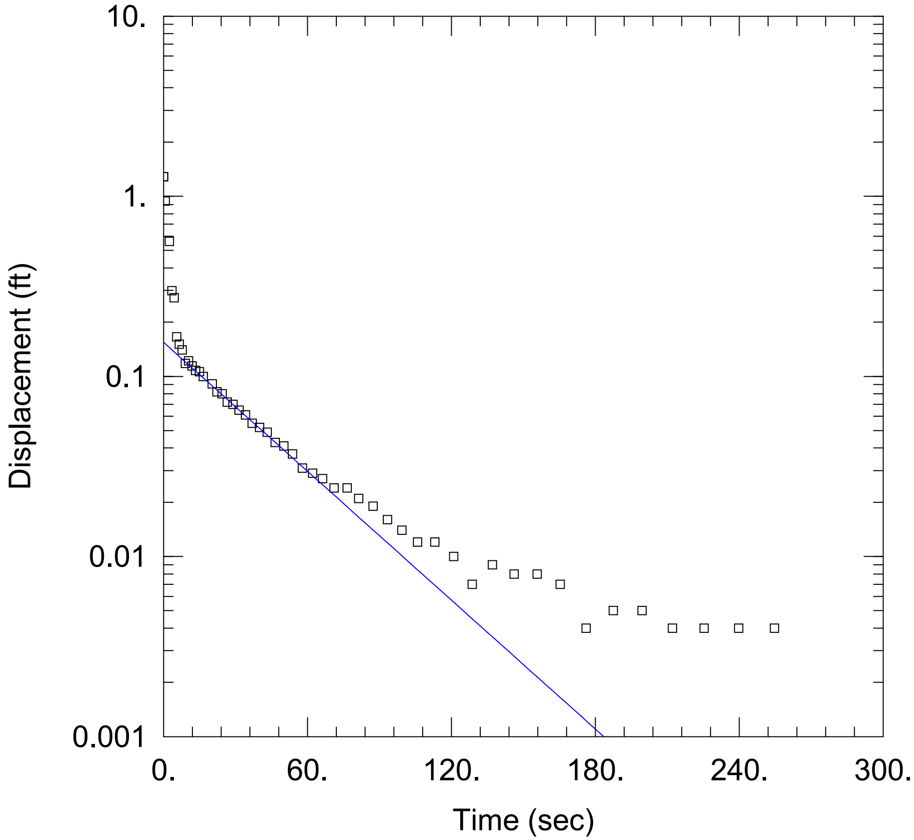
Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW24	OU2	6/20/2013	16.67	578.96	595.817	
MW24	OU2	11/14/2013	16.5	579.13	595.817	
MW24	OU2	5/21/2014	14.66	580.97	595.817	
MW24	OU2	11/5/2014	14.6	581.03	595.817	
MW24	OU2	6/8/2015	12.97	582.66	595.817	
MW24	OU2	11/16/2015	15.11	580.52	595.817	
MW24	OU2	6/21/2016	15.45	580.18	595.817	
MW24	OU2	12/20/2016	15.45	580.18	595.817	
MW24	OU2	5/30/2017	14.27	581.36	595.817	
MW24	OU2	12/19/2017	14.56	581.07	595.817	
MW24	OU2	6/18/2018	14.5	581.13	595.817	
MW24	OU2	7/31/2018	14.56	581.26	595.817	
MW24	OU2	8/27/2018	14.61	581.21	595.817	
MW24	OU2	9/25/2018	14.63	581.19	595.817	
MW24	OU2	10/2/2018	14.63	581.19	595.817	
MW24	OU2	11/28/2018	14.61	581.21	595.817	
MW24	OU2	12/12/2018	14.6	581.217	595.817	
MW24	OU2	12/17/2018	14.56	581.26	595.817	
MW24	OU2	3/19/2019	14.57	581.247	595.817	
MW24	OU2	6/3/2019	14.46	581.36	595.817	
MW24	OU2	8/12/2019	14.44	581.377	595.817	
MW25	OU2	6/14/2001	11.3	577.27	592.872	
MW25	OU2	9/27/2001	12.12	576.45	592.872	
MW25	OU2	11/27/2001	10.79	581.84	592.872	
MW25	OU2	3/21/2002	10.6	577.97	592.872	
MW25	OU2	6/5/2002	10.56	578.01	592.872	
MW25	OU2	8/20/2002	10.64	577.93	592.872	
MW25	OU2	11/18/2002	11.05	577.52	592.872	
MW25	OU2	1/26/2003	10.49	582.14	592.872	
MW25	OU2	3/17/2003	11.1	577.47	592.872	
MW25	OU2	5/14/2003	10.81	581.82	592.872	
MW25	OU2	7/8/2003	11.22	581.41	592.872	
MW25	OU2	10/15/2003	10.94	581.69	592.872	
MW25	OU2	1/26/2004	10.49	582.14	592.872	
MW25	OU2	5/18/2004	11.05	581.58	592.872	
MW25	OU2	7/22/2004	11.58	581.05	592.872	
MW25	OU2	10/21/2004	11.55	581.08	592.872	
MW25	OU2	1/26/2005	10.16	582.47	592.872	
MW25	OU2	5/11/2005	10.48	582.15	592.872	
MW25	OU2	8/24/2005	13.37	579.26	592.872	
MW25	OU2	3/28/2006	10.61	582.02	592.872	
MW25	OU2	6/29/2006	11.05	581.58	592.872	
MW25	OU2	9/27/2006	10.15	582.48	592.872	
MW25	OU2	12/18/2006	10.11	582.52	592.872	
MW25	OU2	3/26/2007	9.92	582.71	592.872	
MW25	OU2	6/8/2007	9.93	582.7	592.872	
MW25	OU2	8/22/2007	10.26	582.37	592.872	
MW25	OU2	12/17/2007	10.4	582.23	592.872	
MW25	OU2	5/14/2008	9.86	582.77	592.872	
MW25	OU2	11/5/2008	10.11	582.52	592.872	
MW25	OU2	4/1/2009	9.5	583.13	592.872	
MW25	OU2	11/19/2009	9.89	582.74	592.872	
MW25	OU2	6/1/2010	9.92	582.71	592.872	
MW25	OU2	11/11/2010	11.29	581.34	592.872	
MW25	OU2	8/7/2011	10.45	582.18	592.872	
MW25	OU2	11/11/2011	11.29	581.34	592.872	
MW25	OU2	6/11/2012	11.19	581.44	592.872	
MW25	OU2	11/8/2012	12.18	580.45	592.872	

Table C-1
Historical Groundwater Elevations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well ID	Area	Measurement Date	Measured Depth to Groundwater (ft.)	Groundwater Elevation (ft.)	TOC Elevation (ft.)	Comments
MW25	OU2	6/20/2013	9.91	582.72	592.872	
MW25	OU2	11/14/2013	10.52	582.11	592.872	
MW25	OU2	5/21/2014	9.6	583.03	592.872	
MW25	OU2	11/5/2014	10.05	582.58	592.872	
MW25	OU2	6/8/2015	9.81	582.82	592.872	
MW25	OU2	11/16/2015	10.31	582.32	592.872	
MW25	OU2	6/21/2016	10.34	582.29	592.872	
MW25	OU2	12/20/2016	10.01	582.62	592.872	
MW25	OU2	5/30/2017	9.8	582.83	592.872	
MW25	OU2	12/19/2017	9.96	582.67	592.872	
MW25	OU2	6/18/2018	10.07	582.56	592.872	
MW25	OU2	7/31/2018	10.22	582.65	592.872	
MW25	OU2	8/27/2018	10.47	582.4	592.872	
MW25	OU2	9/25/2018	10.49	582.38	592.872	
MW25	OU2	10/2/2018	10.51	582.36	592.872	
MW25	OU2	11/28/2018	9.89	582.98	592.872	
MW25	OU2	12/12/2018	9.87	583.002	592.872	
MW25	OU2	12/17/2018	9.81	583.06	592.872	
MW25	OU2	3/19/2019	9.79	583.082	592.872	
MW25	OU2	6/3/2019	9.71	583.16	592.872	
MW25	OU2	8/12/2019	10.05	582.822	592.872	
MW26	OU2	3/16/2021	1.12	583.68	584.80	

Notes:
ft = feet
NA = not applicable
NM = not measured
TOC = top of casing

APPENDIX D DECEMBER 2018 SLUG TEST RESULTS



OU1MW1_FH1

Data Set: P:\...\OU1MW1_FH1.aqt
Date: 12/27/18 Time: 15:06:44

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW1
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0009723 cm/sec
y0 = 0.1544 ft

AQUIFER DATA

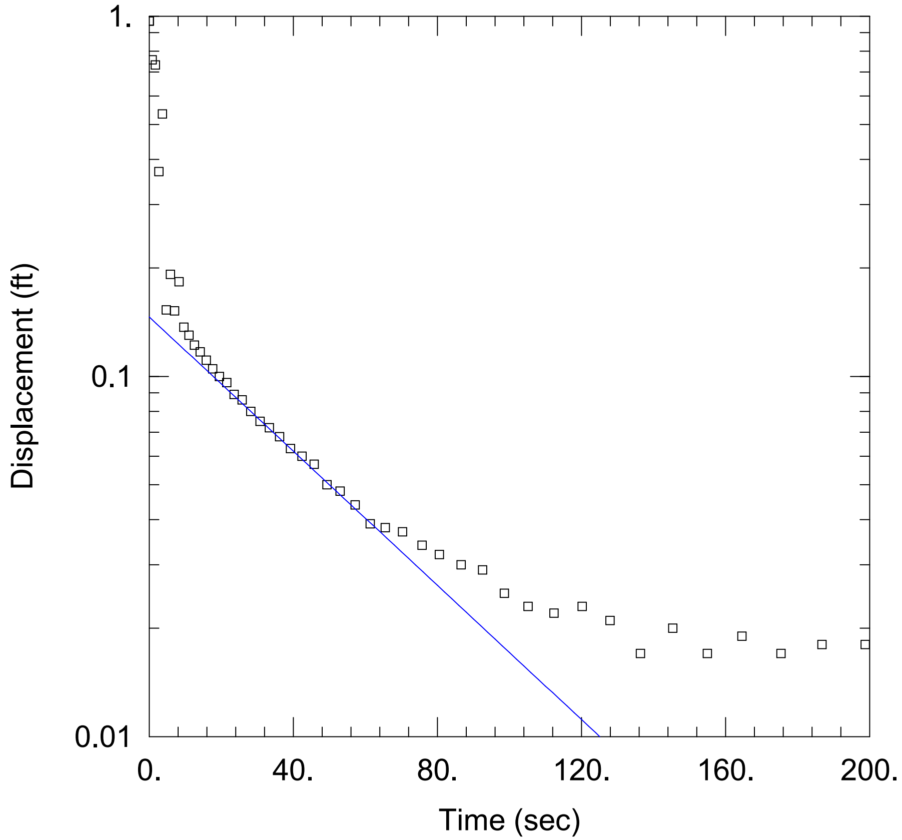
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW1)

Initial Displacement: 1.284 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 9.7 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW1_FH2

Data Set: P:\...\OU1MW1_FH2.aqt
Date: 12/27/18 Time: 15:07:14

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW1
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0007596 cm/sec
y0 = 0.1463 ft

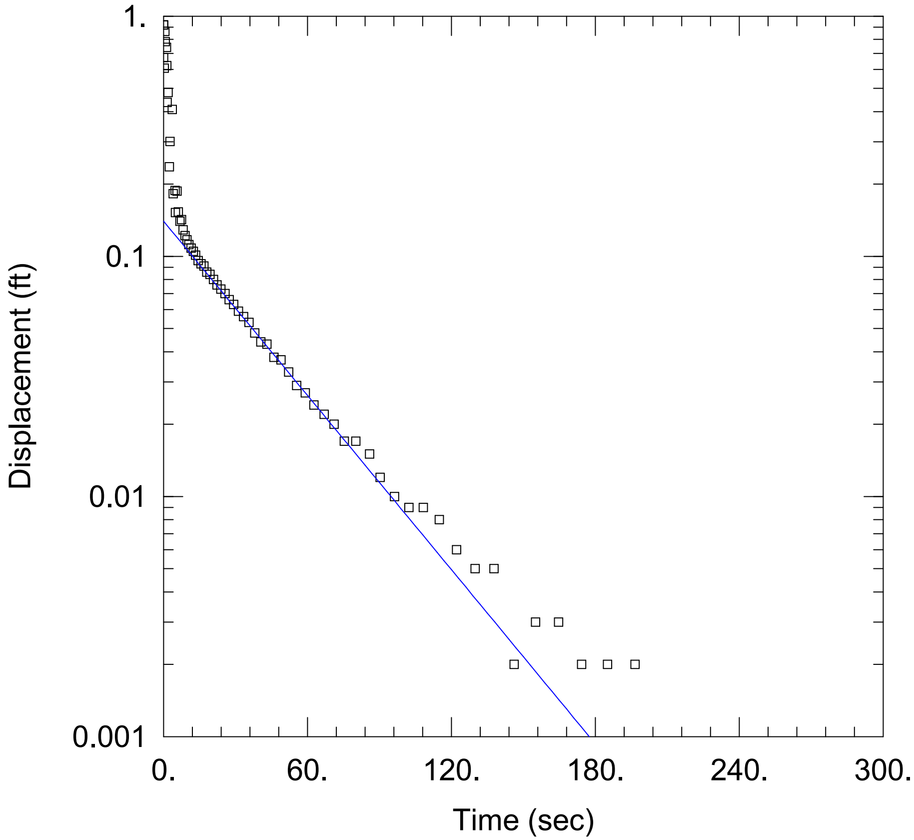
AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW1)

Initial Displacement: 0.968 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 9.7 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW1_FH3

Data Set: P:\...\OU1MW1_FH3.aqt
Date: 12/27/18 Time: 15:07:29

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW1
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0009859 cm/sec
y0 = 0.14 ft

AQUIFER DATA

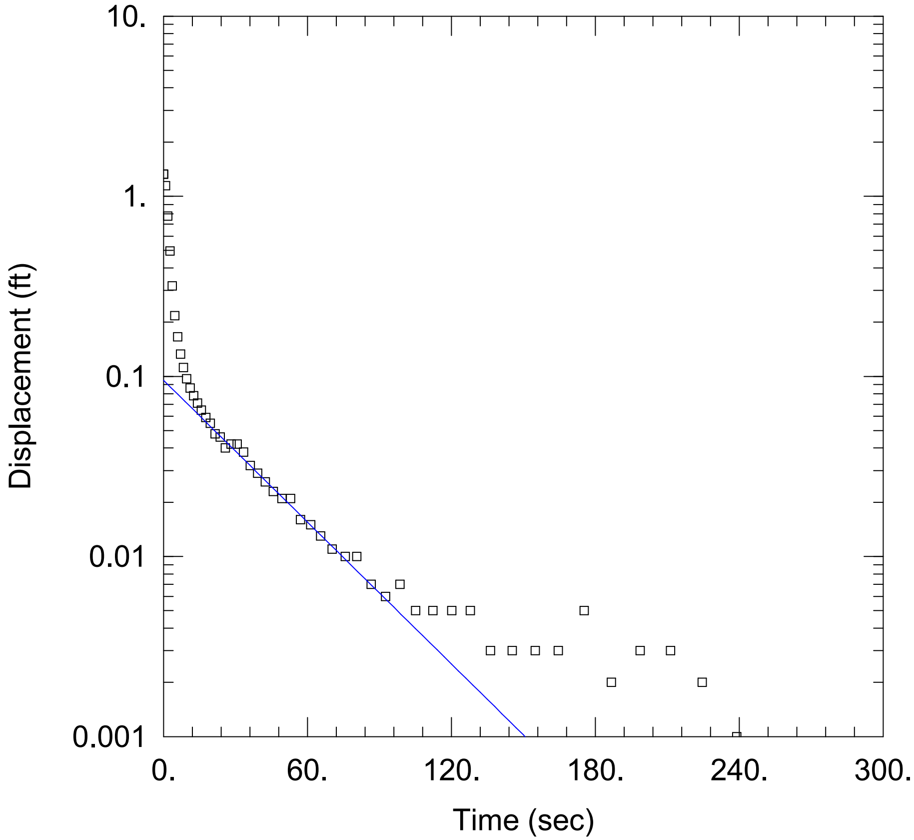
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW1)

Initial Displacement: 0.919 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 9.7 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW1_RH1

Data Set: P:\...\OU1MW1_RH1.aqt
Date: 12/27/18 Time: 15:06:10

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW1
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

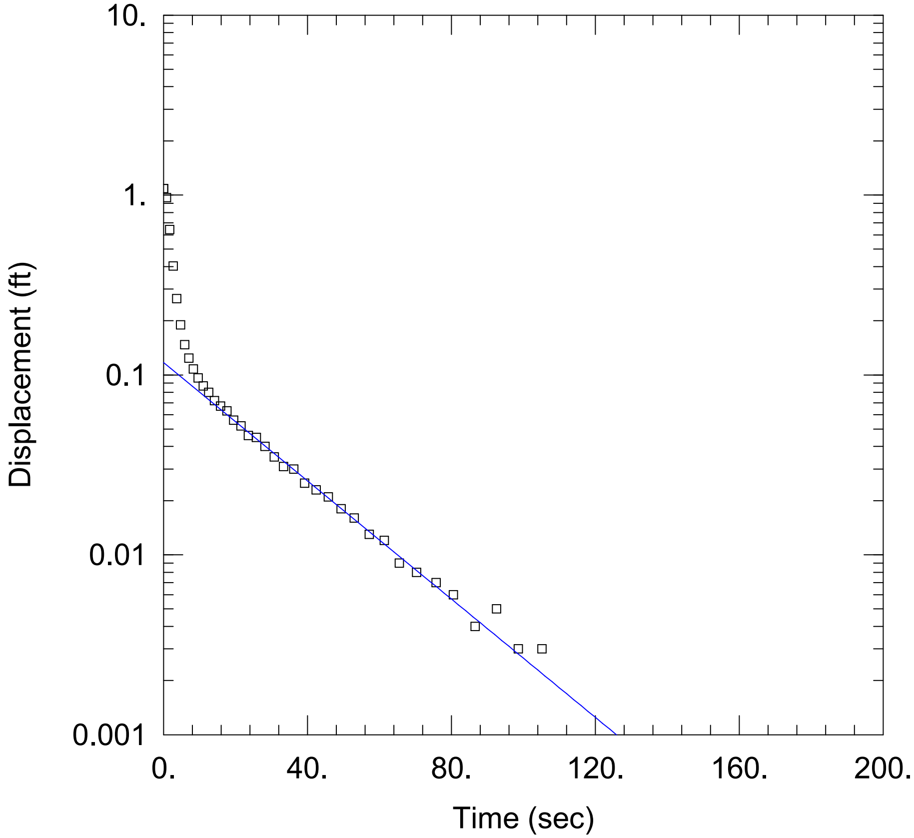
K = 0.00107 cm/sec
y0 = 0.09516 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW1)

Initial Displacement: 1.324 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 9.7 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW1_RH2

Data Set: P:\...\OU1MW1_RH2.aqt
Date: 12/27/18 Time: 15:08:03

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW1
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.00134 cm/sec
y0 = 0.1171 ft

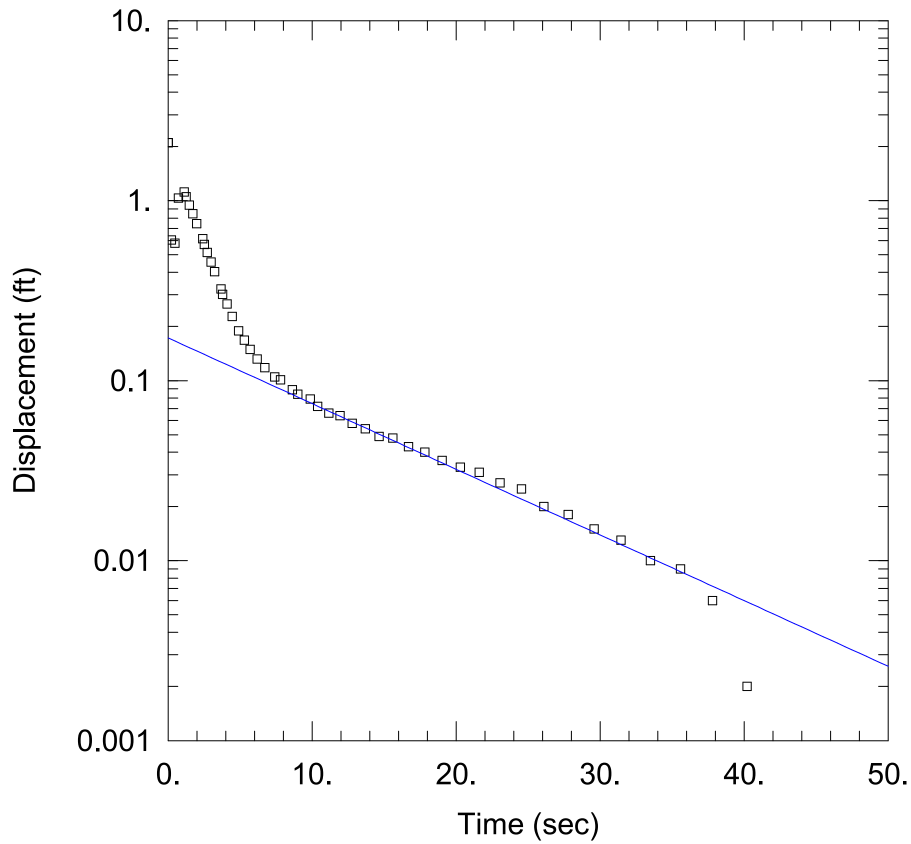
AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW1)

Initial Displacement: 1.085 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 9.7 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW1_RH3

Data Set: P:\...\OU1MW1_RH3.aqt
Date: 01/02/19 Time: 13:43:04

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW1
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.002975 cm/sec
y0 = 0.1727 ft

AQUIFER DATA

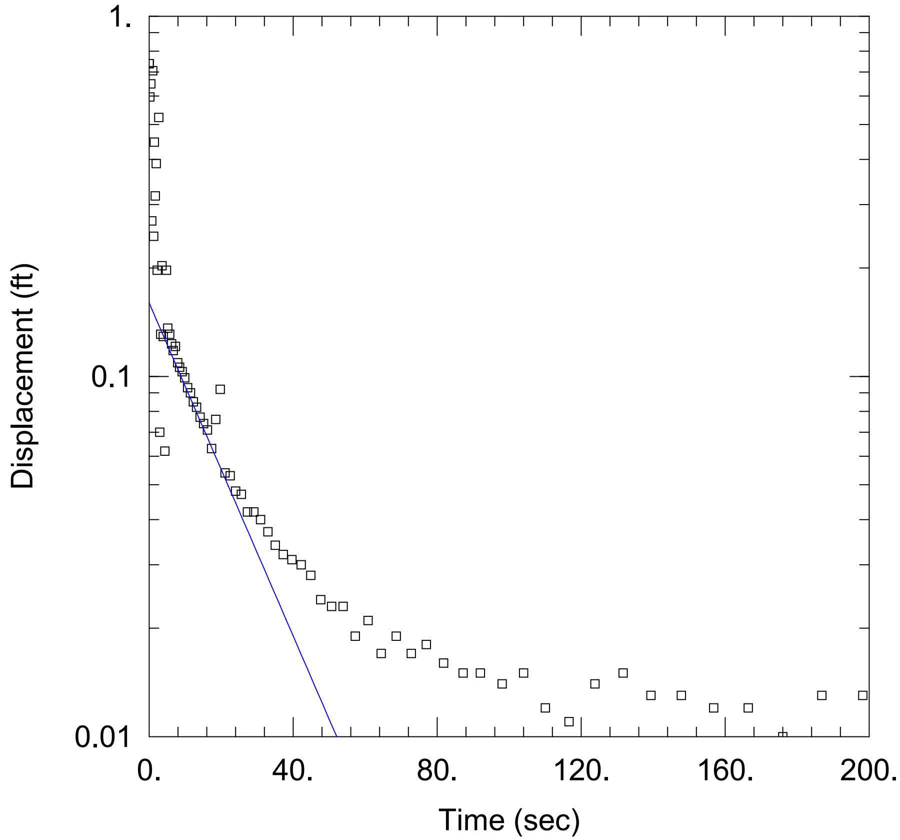
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW1)

Initial Displacement: 2.099 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 9.7 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW2_FH1

Data Set: P:\...\OU1MW2_FH1.aqt
Date: 01/02/19 Time: 12:26:13

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW2
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

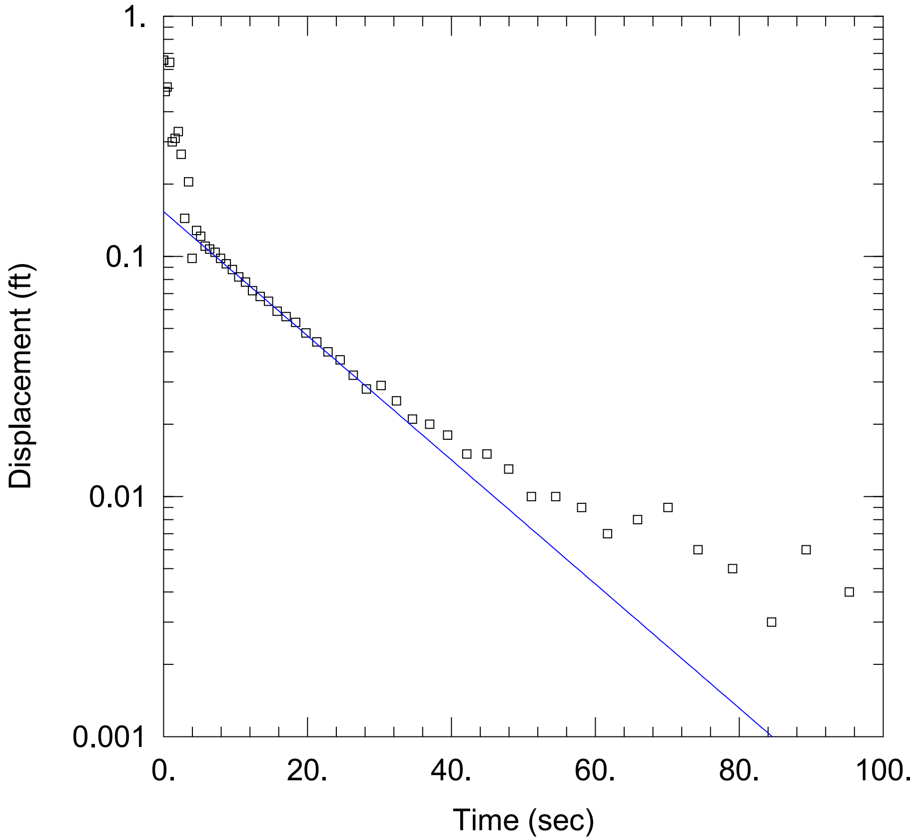
K = 0.001885 cm/sec
y0 = 0.16 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW2)

Initial Displacement: 0.738 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.93 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW2_FH2

Data Set: P:\...\OU1MW2_FH2.aqt
Date: 01/02/19 Time: 12:26:35

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW2
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

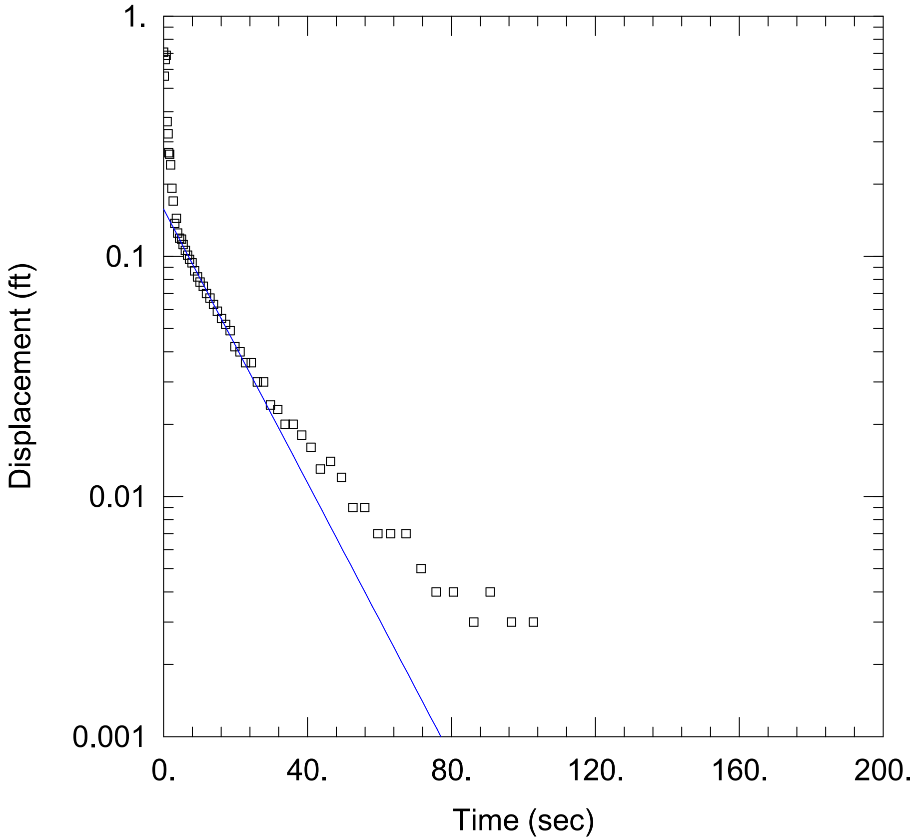
K = 0.002107 cm/sec
y0 = 0.1534 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW2)

Initial Displacement: 0.656 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.93 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW2_FH3

Data Set: P:\...\OU1MW2_FH3.aqt
Date: 01/02/19 Time: 12:27:09

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW2
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

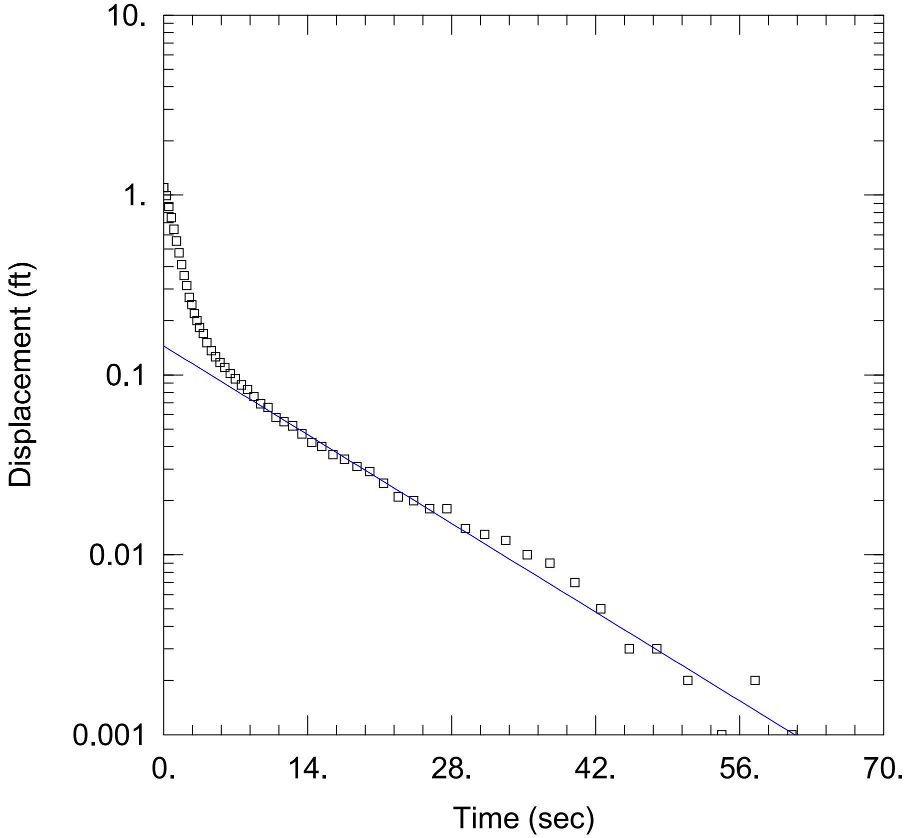
K = 0.002324 cm/sec
y0 = 0.1575 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW2)

Initial Displacement: 0.708 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.93 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW2_RH1

Data Set: P:\...\OU1MW2_RH1.aqt
Date: 01/02/19 Time: 12:27:39

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW2
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.002872 cm/sec
y0 = 0.1448 ft

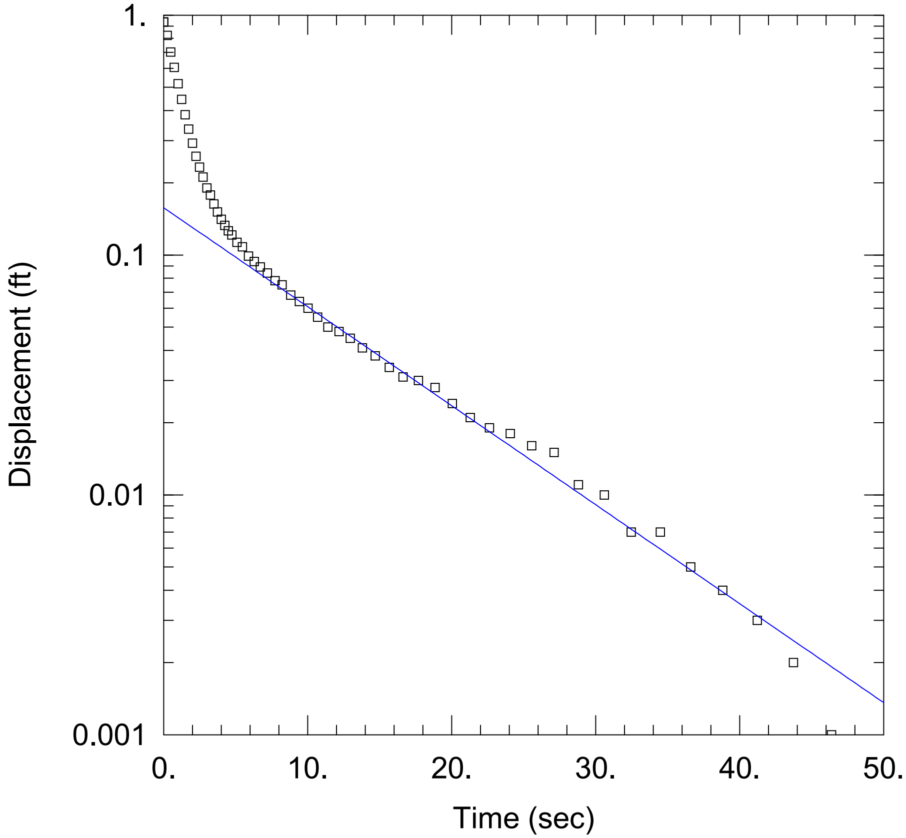
AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW2)

Initial Displacement: 1.097 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.93 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW2_RH2

Data Set: P:\...\OU1MW2_RH2.aqt
Date: 01/02/19 Time: 12:28:04

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW2
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.003365 cm/sec
y0 = 0.1575 ft

AQUIFER DATA

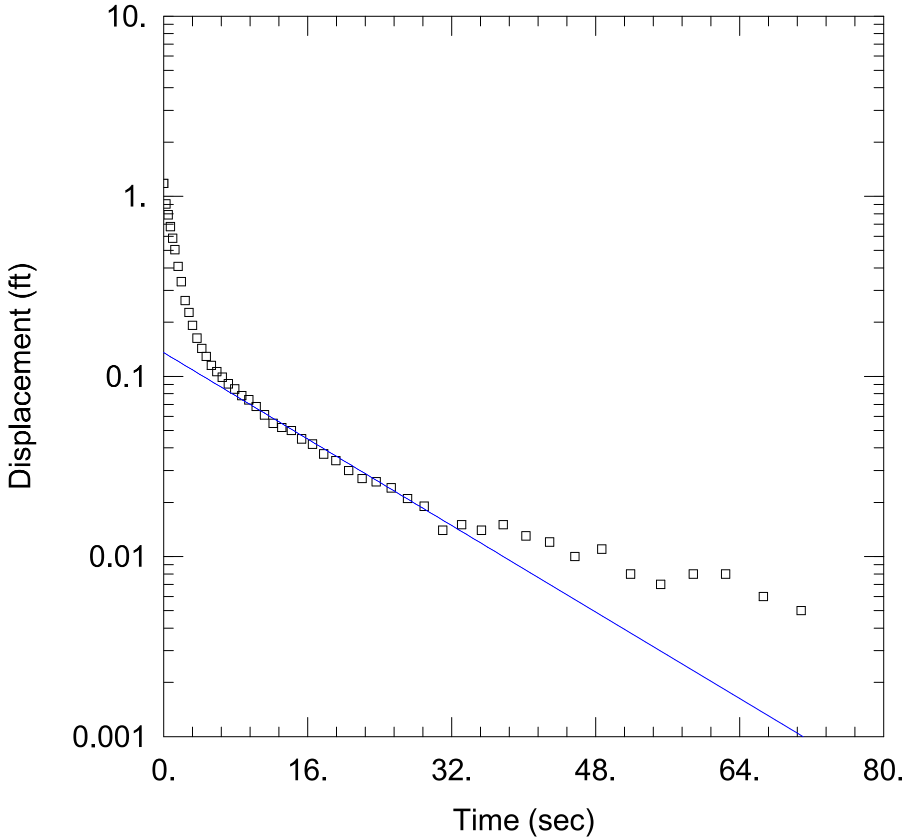
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW2)

Initial Displacement: 0.935 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.93 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW2_RH3

Data Set: P:\...\OU1MW2_RH3.aqt
Date: 01/02/19 Time: 12:28:29

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW2
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.002447 cm/sec
y0 = 0.1355 ft

AQUIFER DATA

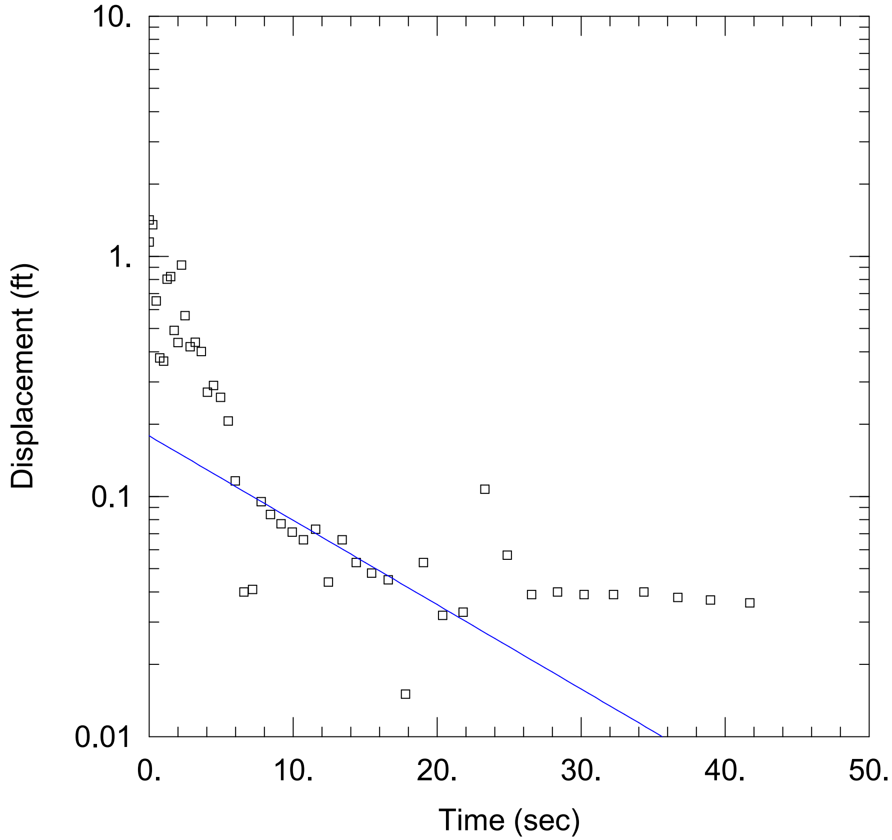
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW2)

Initial Displacement: 1.18 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.93 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW3_FH1

Data Set: P:\...\OU1MW3_FH1.aqt
Date: 01/02/19 Time: 12:32:27

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

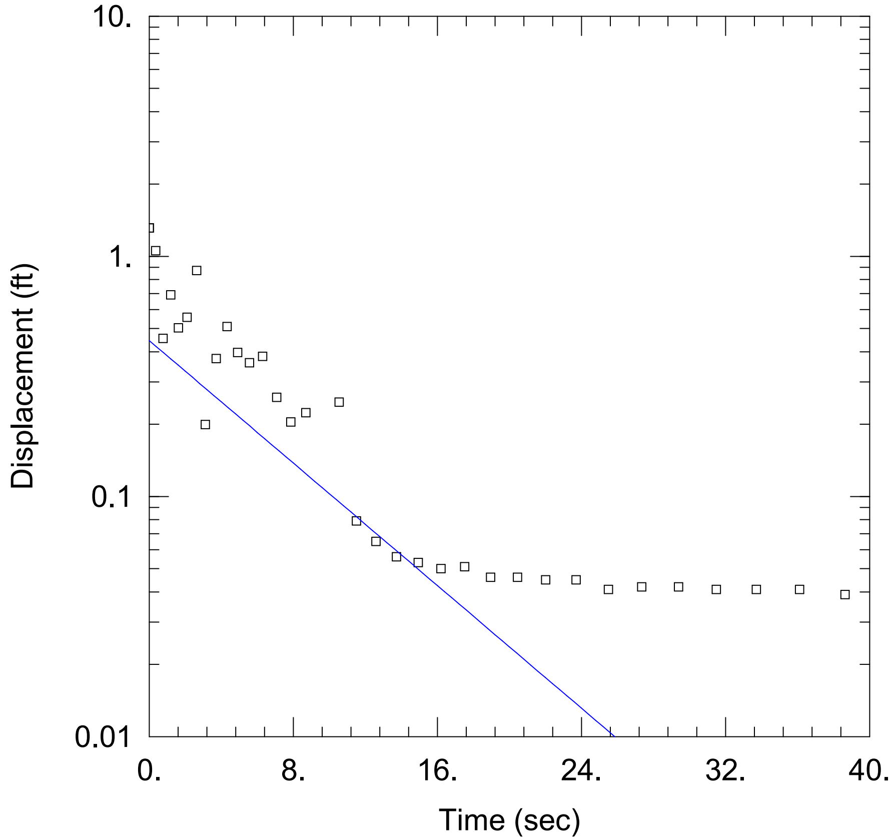
K = 0.002865 cm/sec
y0 = 0.1787 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3)

Initial Displacement: 1.146 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.28 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft



OU1MW3_FH2

Data Set: P:\...\OU1MW3_FH2.aqt
Date: 01/02/19 Time: 12:34:45

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.005199 cm/sec
y0 = 0.4457 ft

AQUIFER DATA

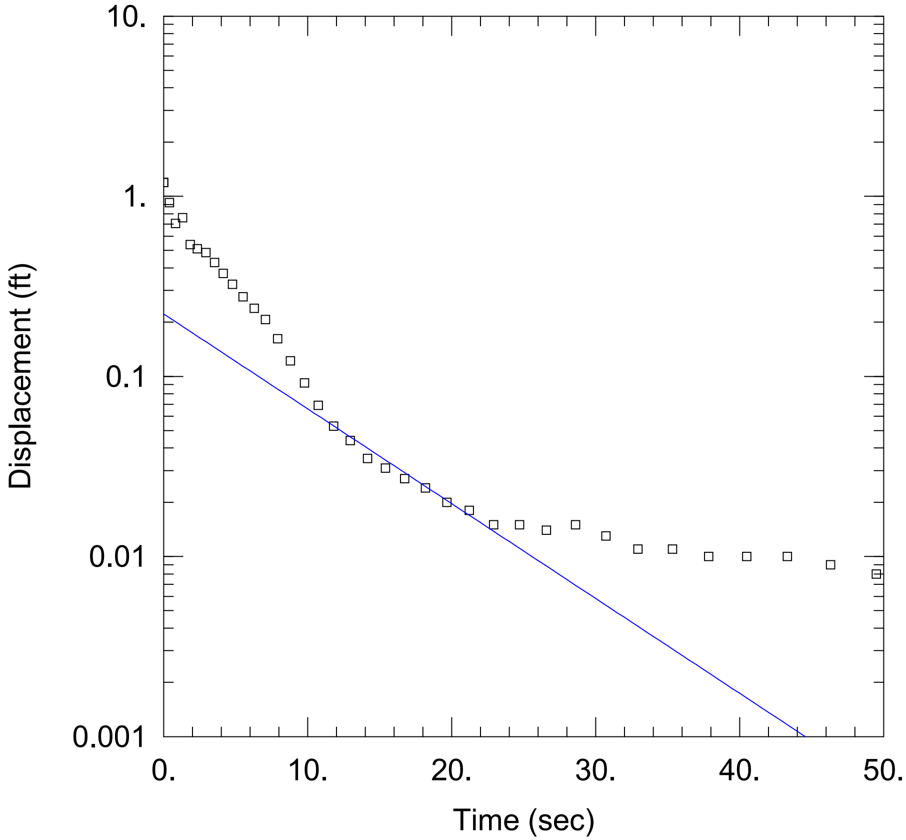
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3)

Initial Displacement: 1.313 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 10.28 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft



OU1MW3_FH3

Data Set: P:\...\OU1MW3_FH3.aqt
Date: 01/02/19 Time: 12:35:12

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

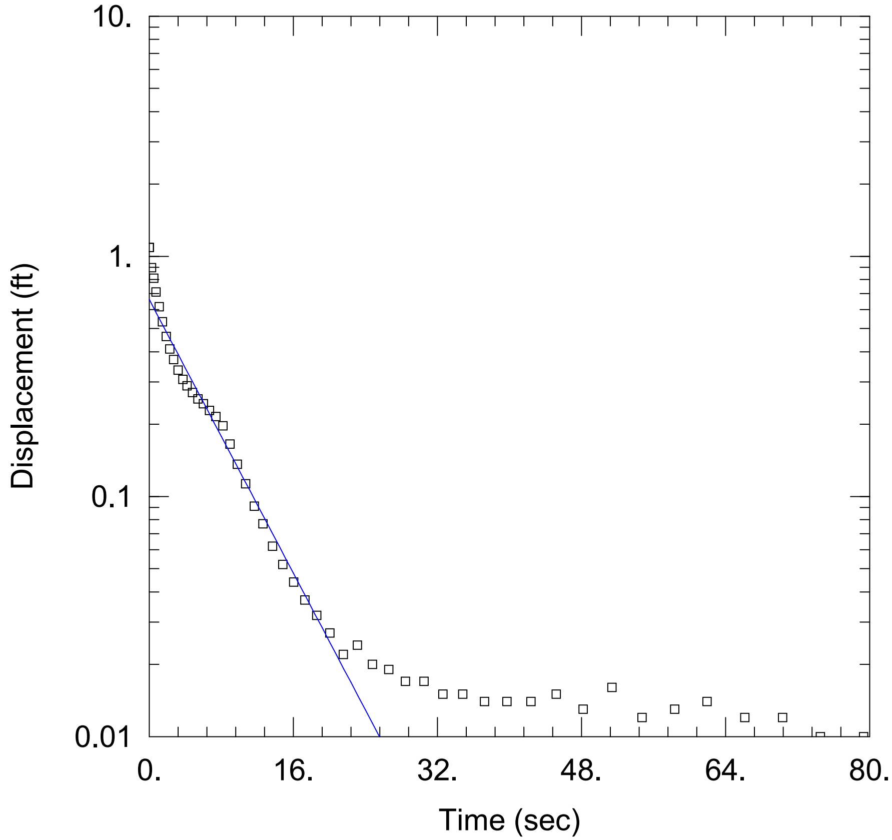
K = 0.004293 cm/sec
y0 = 0.2221 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3)

Initial Displacement: 1.191 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.28 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft



OU1MW3_RH1

Data Set: P:\...\OU1MW3_RH1.aqt
Date: 01/02/19 Time: 12:45:18

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

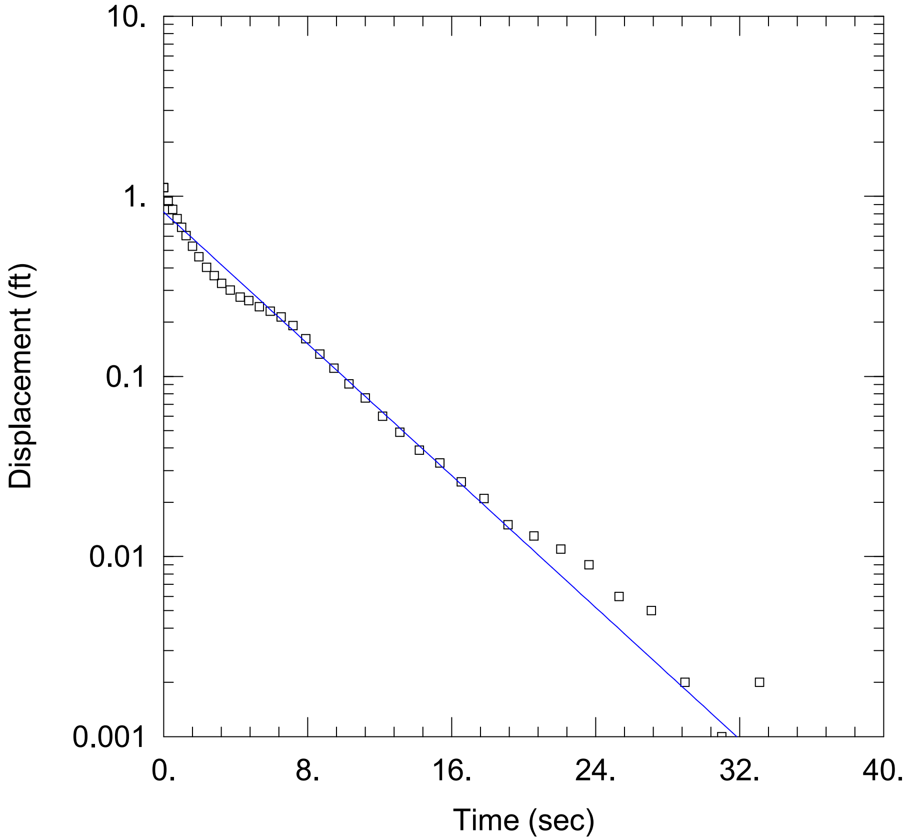
K = 0.005804 cm/sec
y0 = 0.6607 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3)

Initial Displacement: 1.088 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.28 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft



OU1MW2_RH2

Data Set: P:\...\OU1MW3_RH2.aqt
Date: 01/02/19 Time: 12:47:38

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

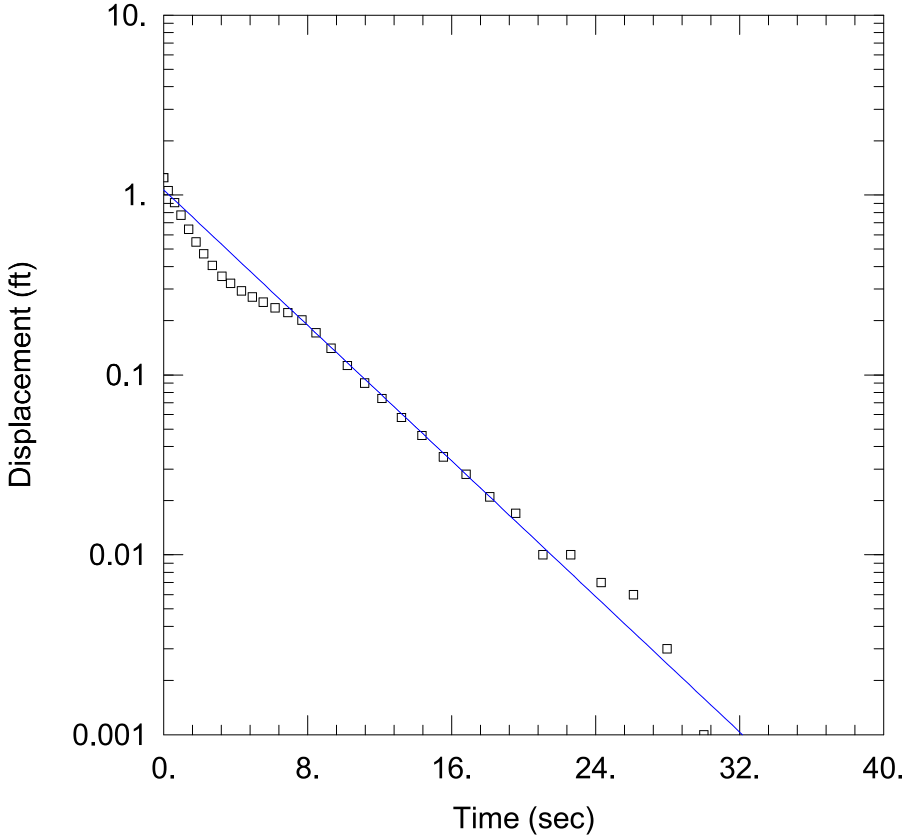
K = 0.007458 cm/sec
y0 = 0.8185 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3)

Initial Displacement: 1.119 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 10.28 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft



OU1MW3_RH3

Data Set: P:\...\OU1MW3_RH3.aqt
Date: 01/02/19 Time: 13:02:55

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

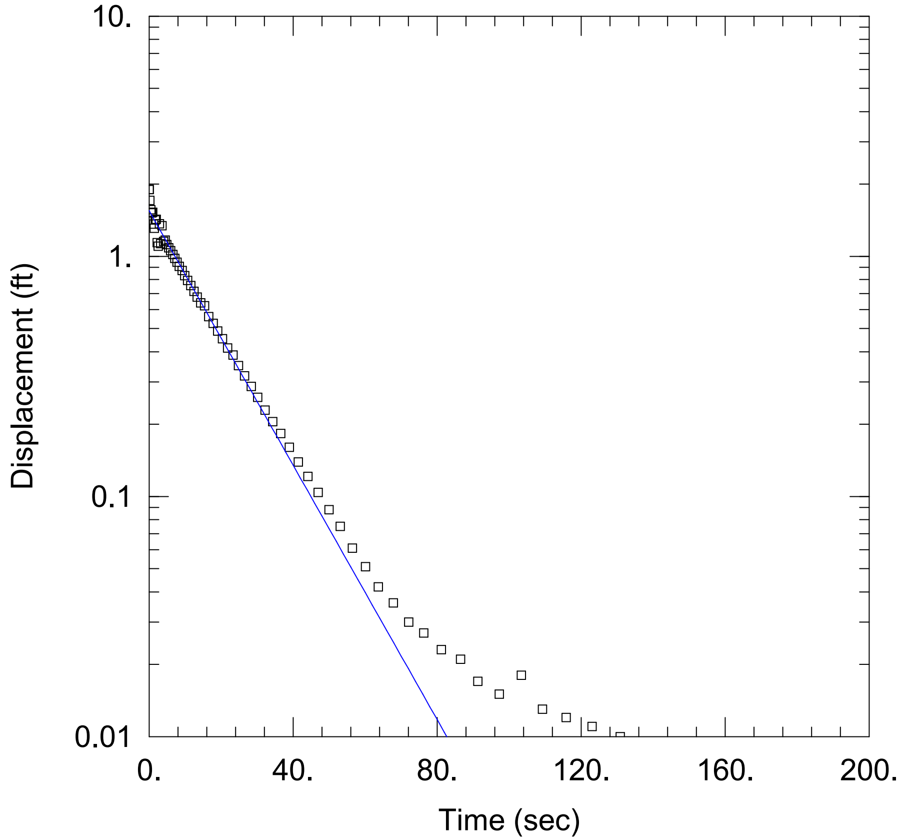
K = 0.007678 cm/sec
y0 = 1.069 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3)

Initial Displacement: 1.248 ft
Static Water Column Height: 10.28 ft
Total Well Penetration Depth: 13. ft
Screen Length: 10. ft
Casing Radius: 0.0833 ft
Well Radius: 0.0833 ft



OU1MW3D_FH1

Data Set: P:\...\OU1MW3D_FH1.aqt
Date: 01/02/19 Time: 12:49:39

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3D
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

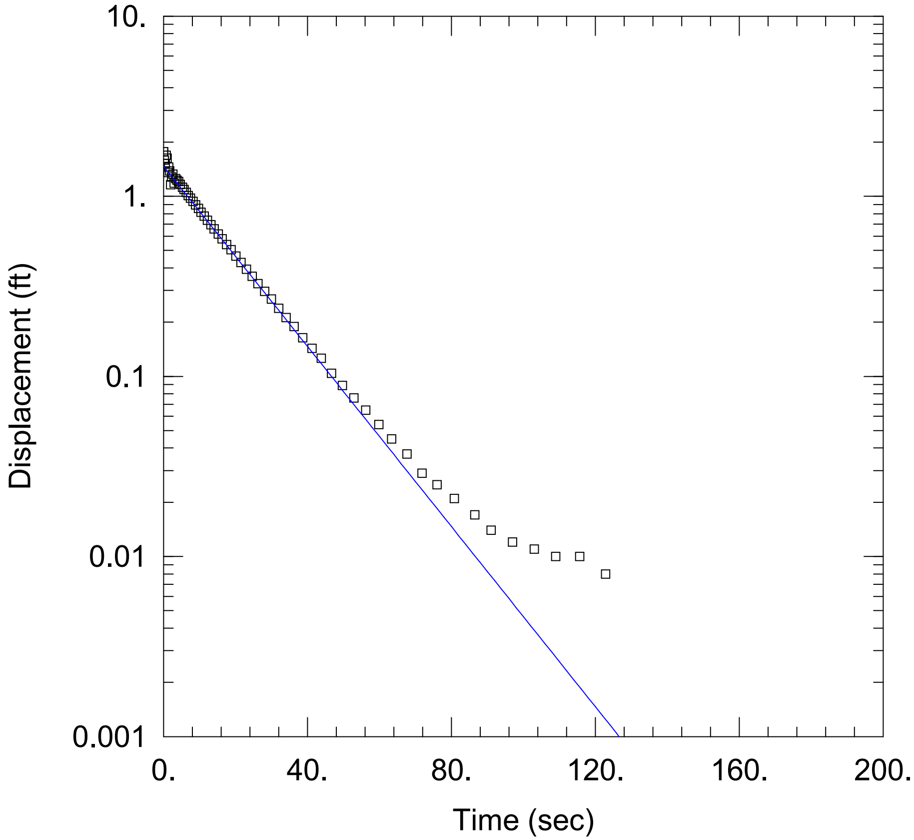
K = 0.0044 cm/sec
y0 = 1.547 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3D)

Initial Displacement: 1.895 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 26.64 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW3D_FH2

Data Set: P:\...\OU1MW3D_FH2.aqt
Date: 01/02/19 Time: 12:49:59

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3D
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

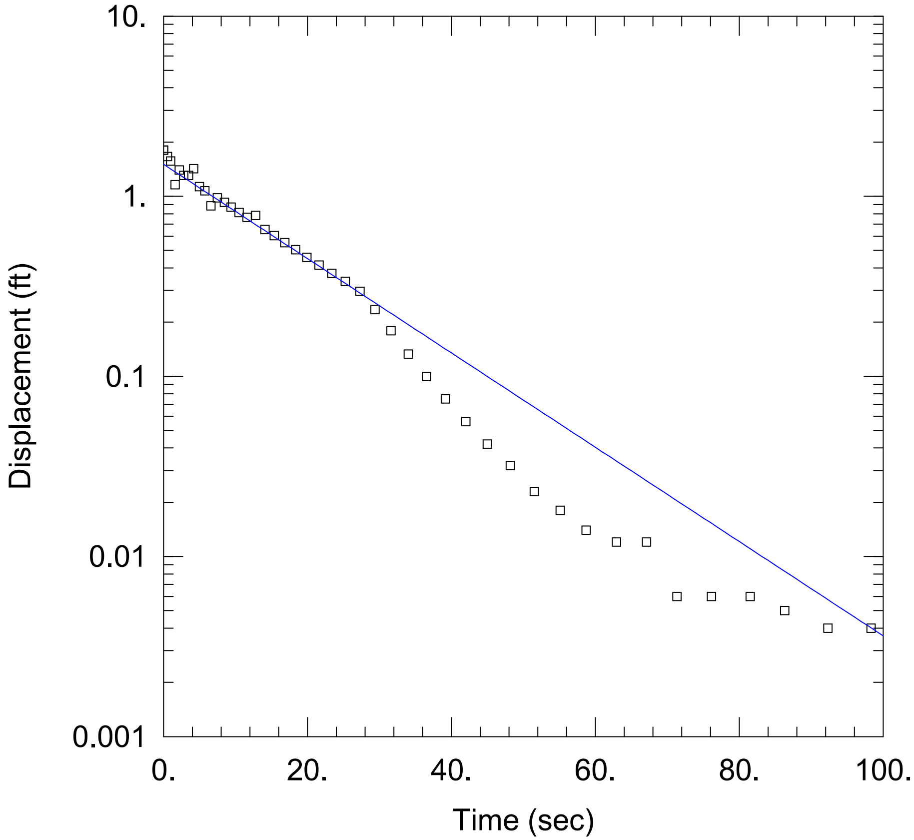
K = 0.004154 cm/sec
y0 = 1.468 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3D)

Initial Displacement: 1.766 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 26.64 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW3D_FH3

Data Set: P:\...\OU1MW3D_FH3.aqt
Date: 01/02/19 Time: 13:14:31

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3D
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

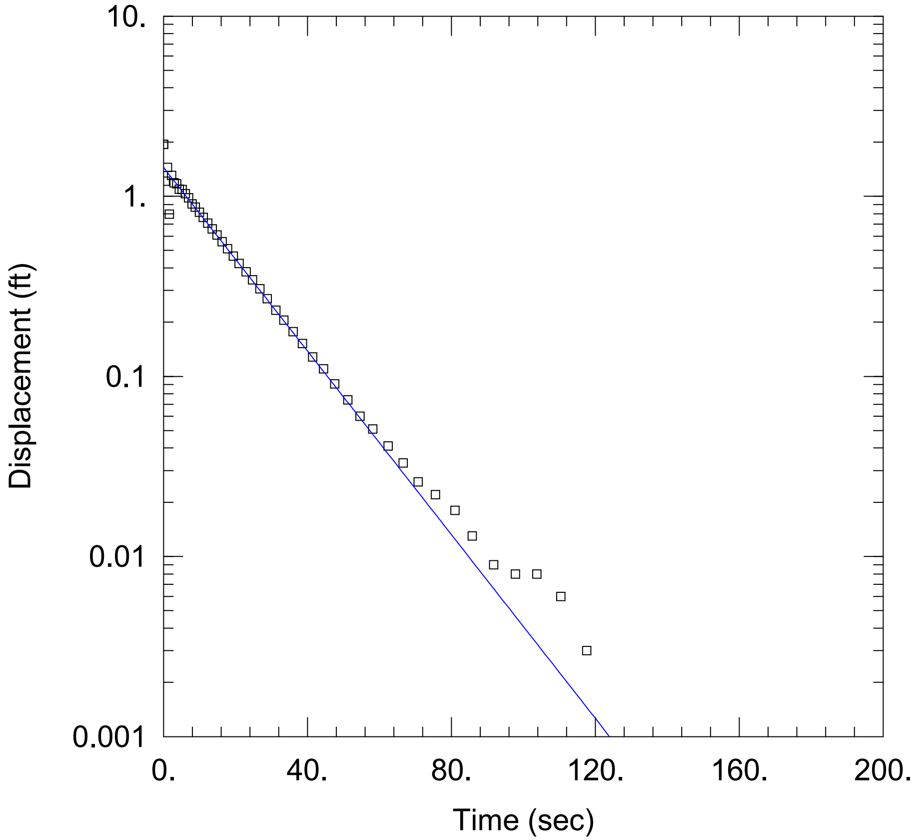
K = 0.004349 cm/sec
y0 = 1.505 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3D)

Initial Displacement: 1.801 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 26.64 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW3D_FH4

Data Set: P:\...\OU1MW3D_FH4.aqt
Date: 01/02/19 Time: 12:55:05

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3D
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

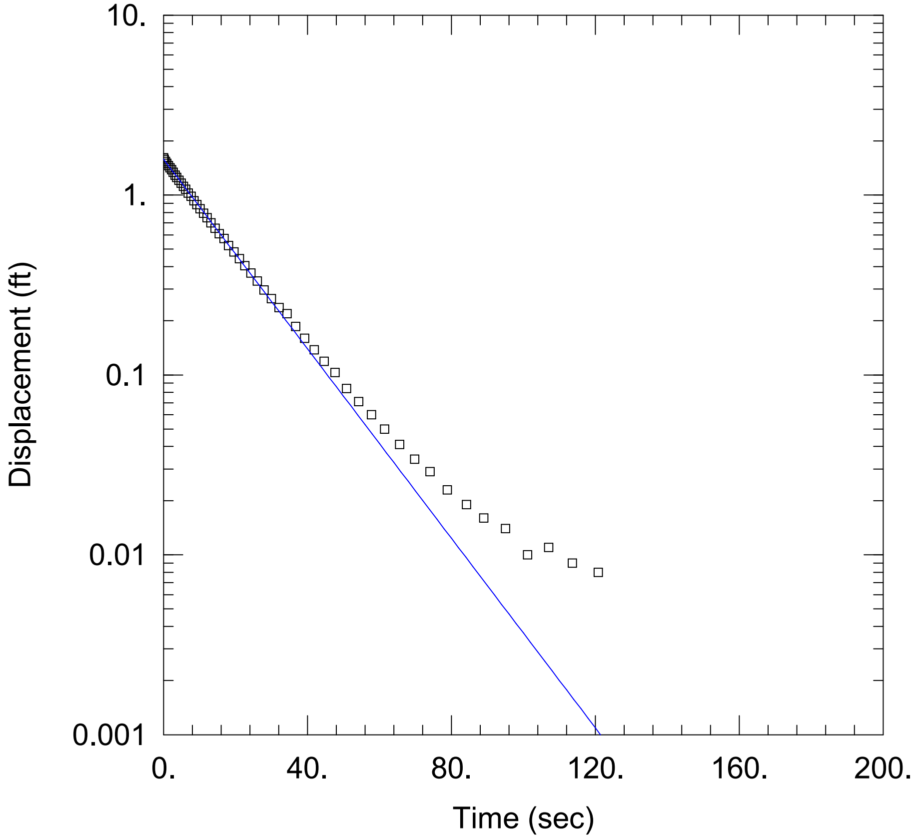
K = 0.004234 cm/sec
y0 = 1.446 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3D)

Initial Displacement: 1.938 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 26.64 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW3D_RH1

Data Set: P:\...\OU1MW3D_RH1.aqt
Date: 01/02/19 Time: 13:05:40

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3D
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

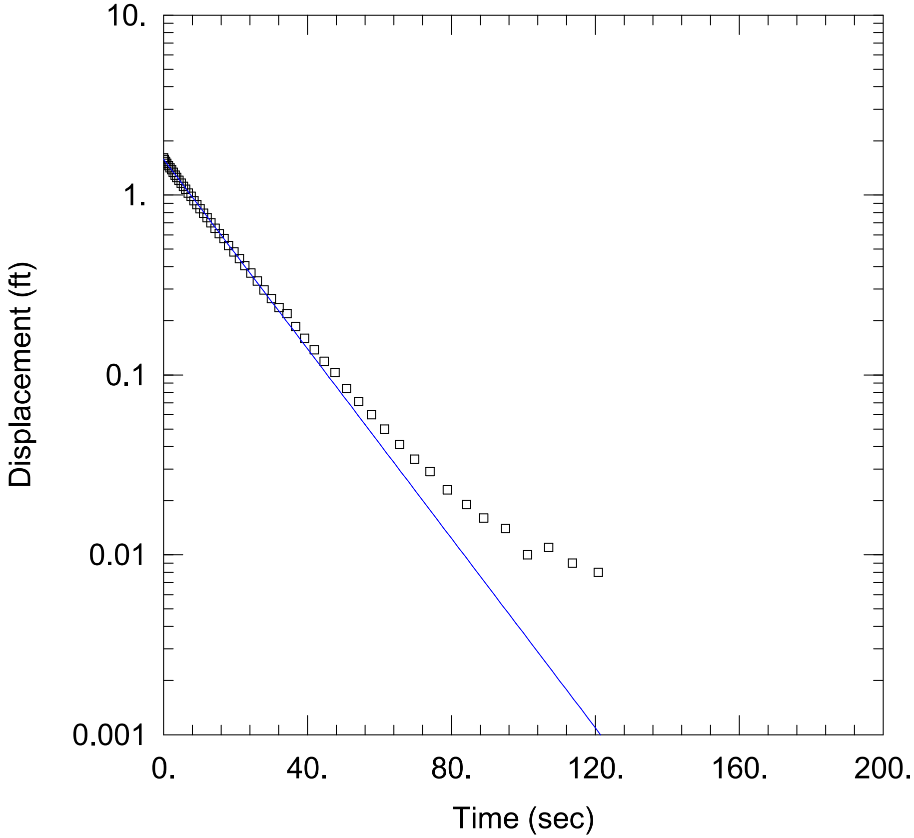
K = 0.004374 cm/sec
y0 = 1.58 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3D)

Initial Displacement: 1.611 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 26.64 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW3D_RH2

Data Set: P:\...\OU1MW3D_RH2.aqt
Date: 01/02/19 Time: 13:06:33

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3D
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

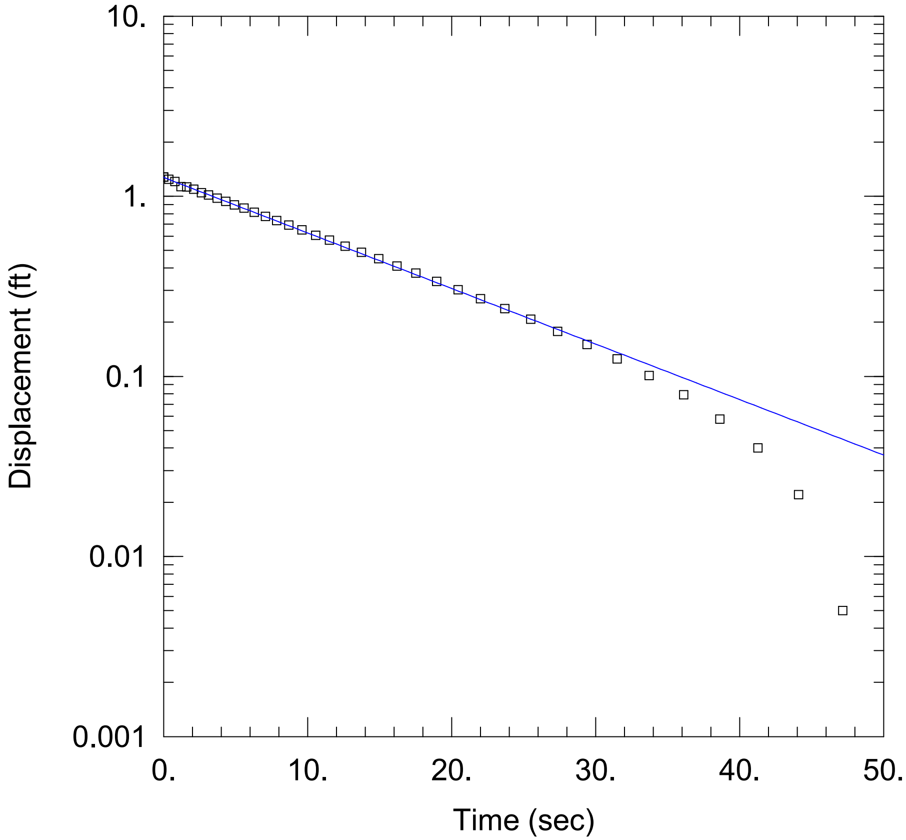
K = 0.004374 cm/sec
y0 = 1.58 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3D)

Initial Displacement: 1.611 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 26.64 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW3D_RH3

Data Set: P:\...\OU1MW3D_RH3.aqt
Date: 01/02/19 Time: 13:14:08

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3D
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

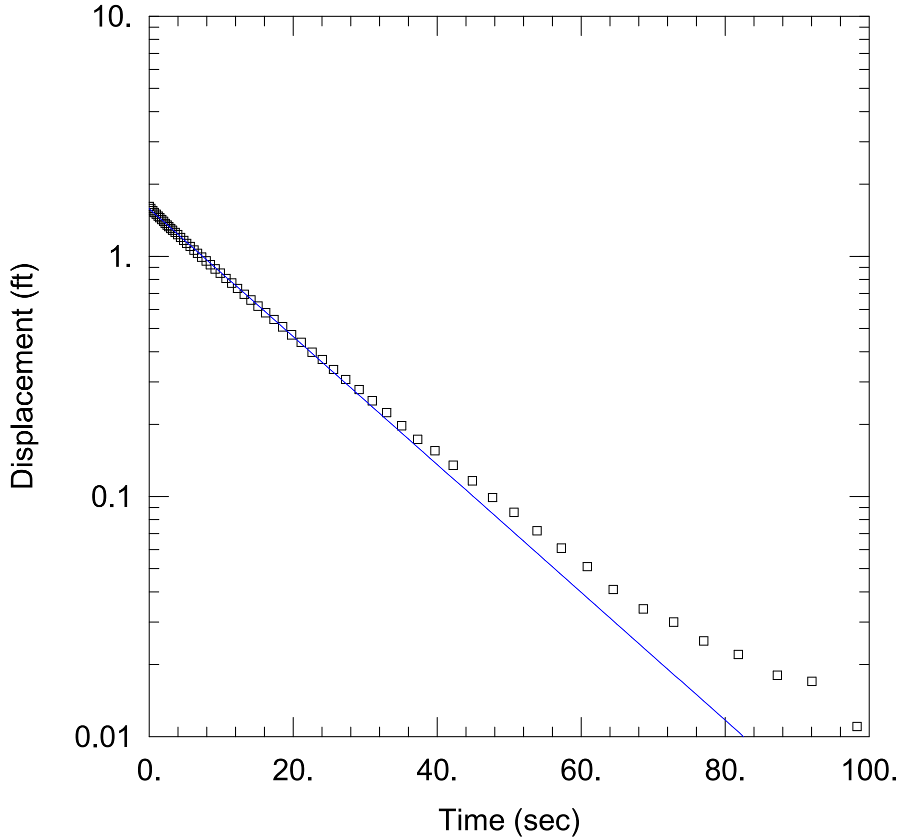
K = 0.00512 cm/sec
y0 = 1.271 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3D)

Initial Displacement: 1.28 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 26.64 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW3D_RH4

Data Set: P:\...\OU1MW3D_RH4.aqt
Date: 01/02/19 Time: 13:07:26

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW3D
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.004423 cm/sec
y0 = 1.578 ft

AQUIFER DATA

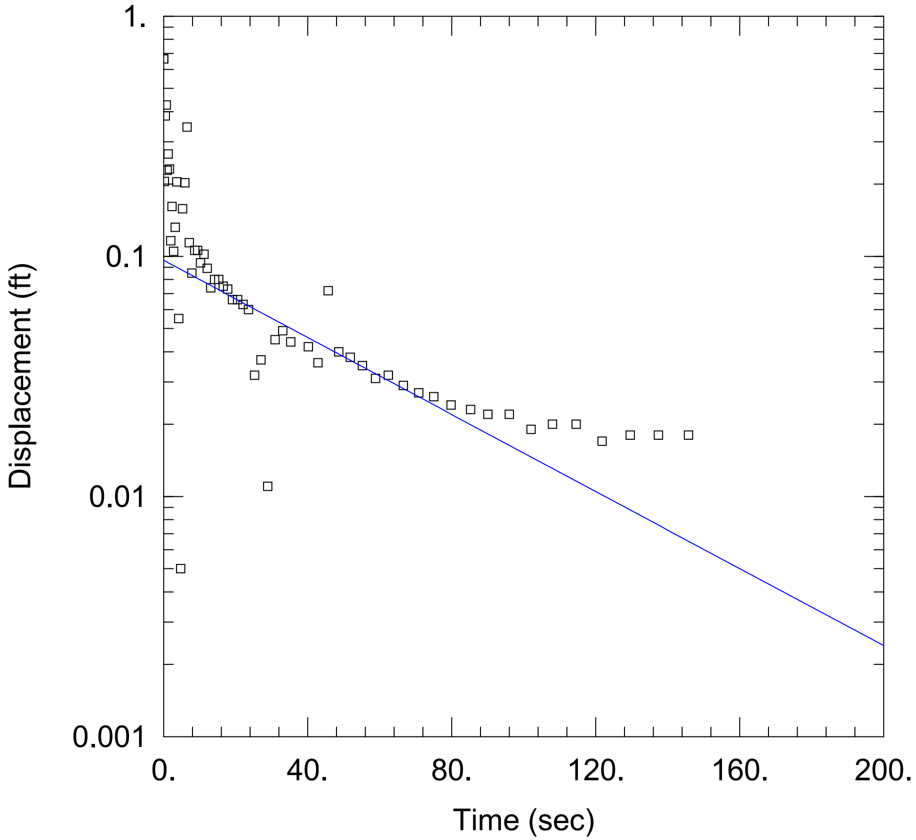
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW3D)

Initial Displacement: 1.611 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft

Static Water Column Height: 26.64 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW4_FH1

Data Set: P:\...\OU1MW4_FH1.aqt
Date: 01/02/19 Time: 13:08:31

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW4
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0006541 cm/sec
y0 = 0.09617 ft

AQUIFER DATA

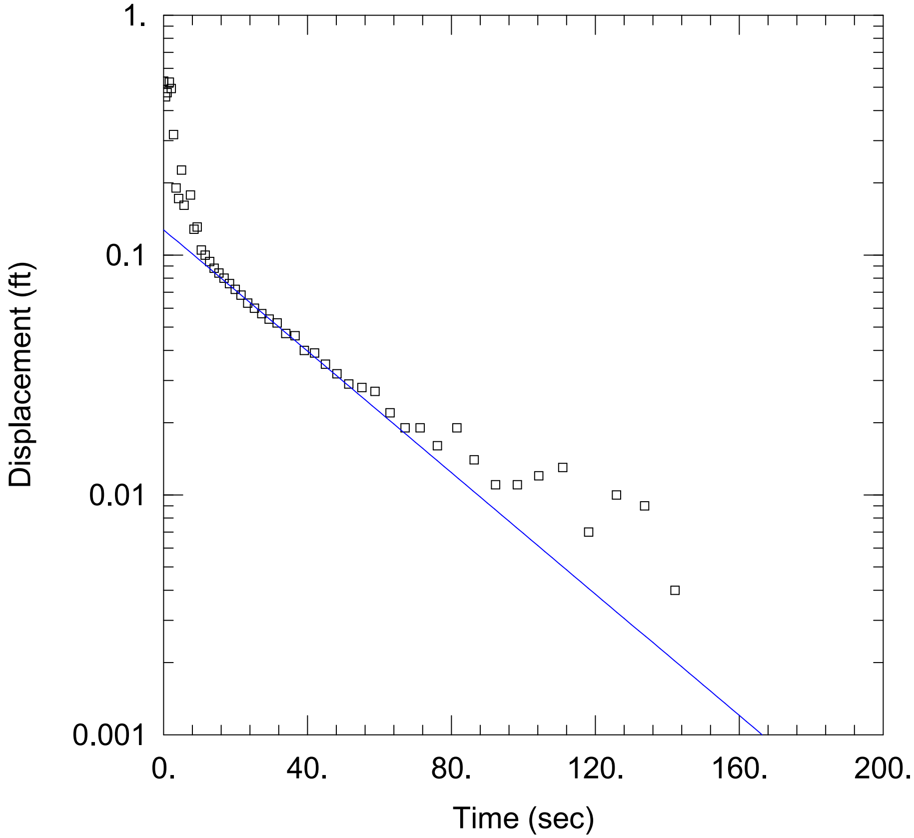
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW4)

Initial Displacement: 0.664 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 8.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW4_FH2

Data Set: P:\...\OU1MW4_FH2.aqt
Date: 01/02/19 Time: 13:09:01

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW4
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001032 cm/sec
y0 = 0.1274 ft

AQUIFER DATA

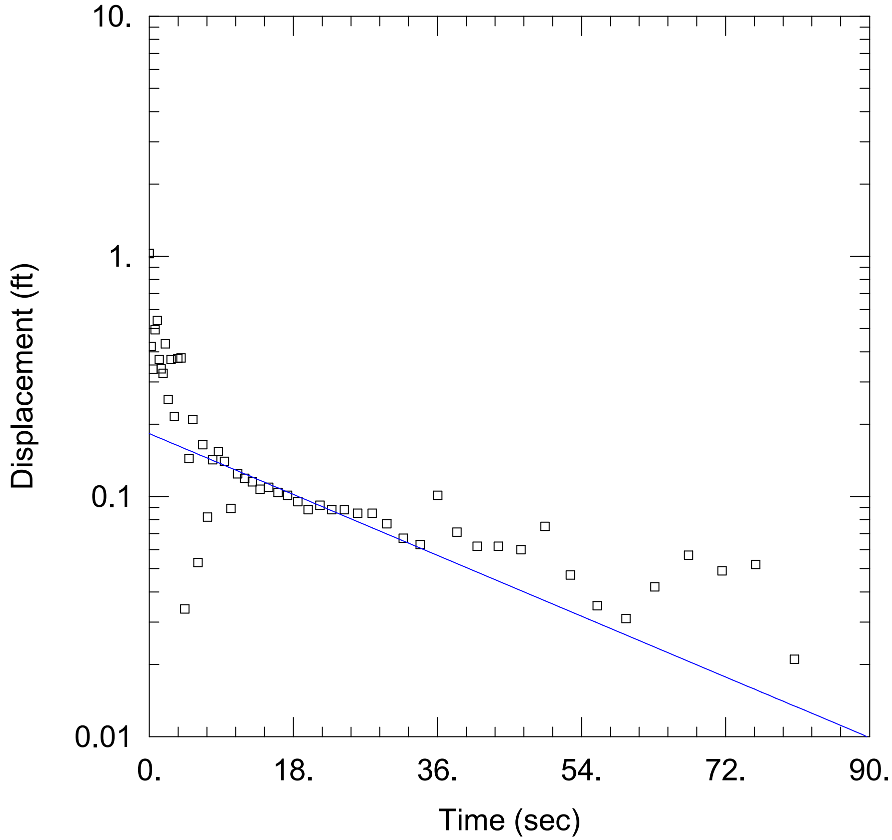
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW4)

Initial Displacement: 0.531 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 8.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW4_FH3

Data Set: P:\...\OU1MW4_FH3.aqt
Date: 01/02/19 Time: 13:09:47

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW4
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001147 cm/sec
y0 = 0.1826 ft

AQUIFER DATA

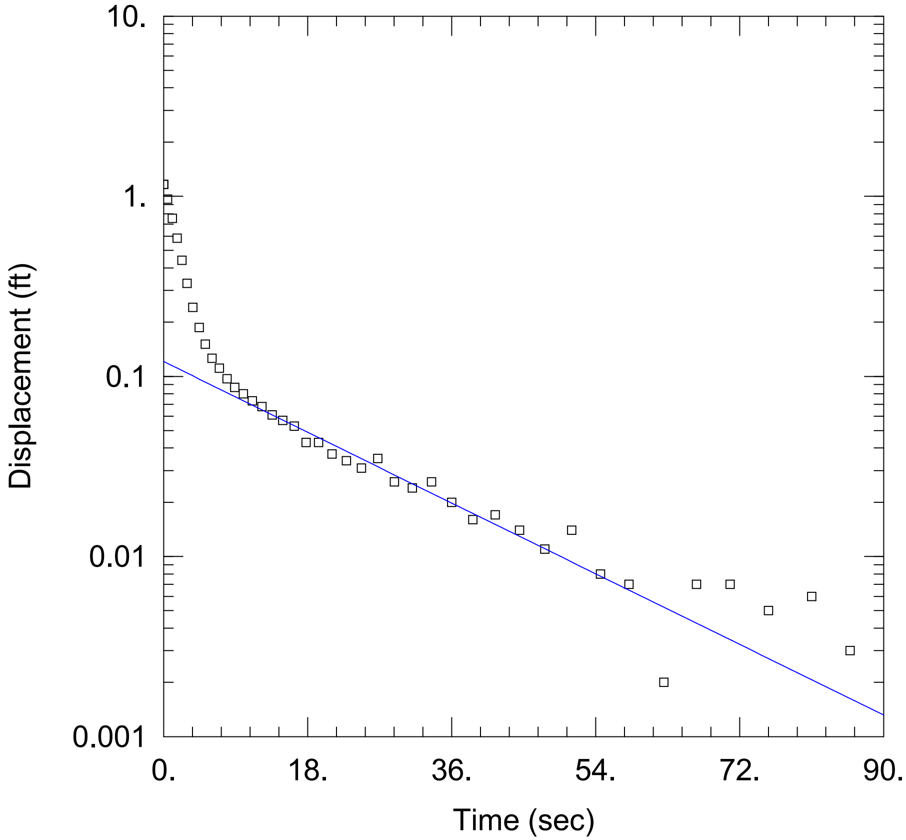
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW4)

Initial Displacement: 1.026 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 8.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW4_RH1

Data Set: P:\...\OU1MW4_RH1.aqt
Date: 01/02/19 Time: 13:10:20

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW4
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001778 cm/sec
y0 = 0.1208 ft

AQUIFER DATA

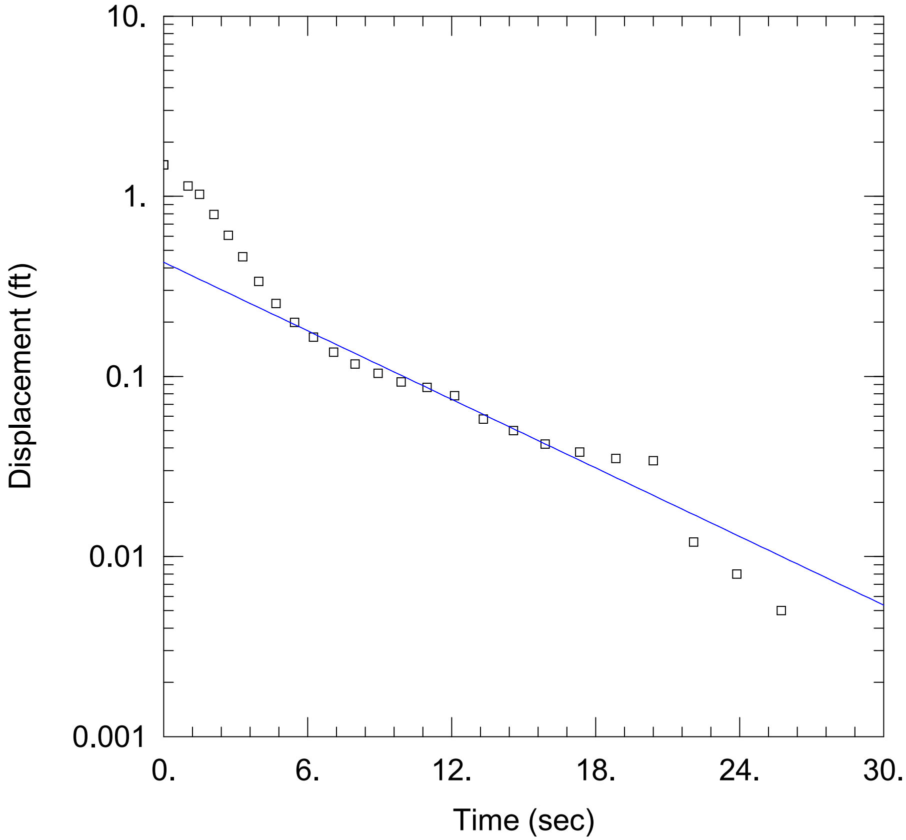
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW4)

Initial Displacement: 1.165 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 8.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW4_RH2

Data Set: P:\...\OU1MW4_RH2.aqt
Date: 01/02/19 Time: 13:10:57

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW4
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

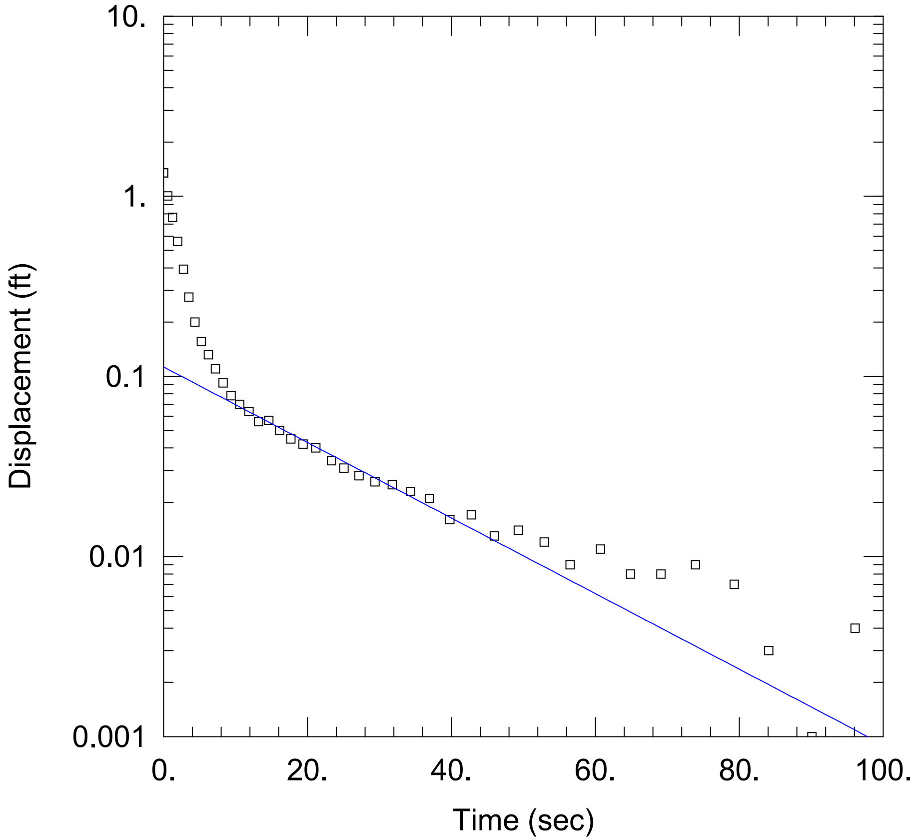
K = 0.005174 cm/sec
y0 = 0.4303 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW4)

Initial Displacement: 1.496 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 8.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW4_RH3

Data Set: P:\...\OU1MW4_RH3.aqt
Date: 01/02/19 Time: 13:11:47

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW4
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.00171 cm/sec
y0 = 0.1129 ft

AQUIFER DATA

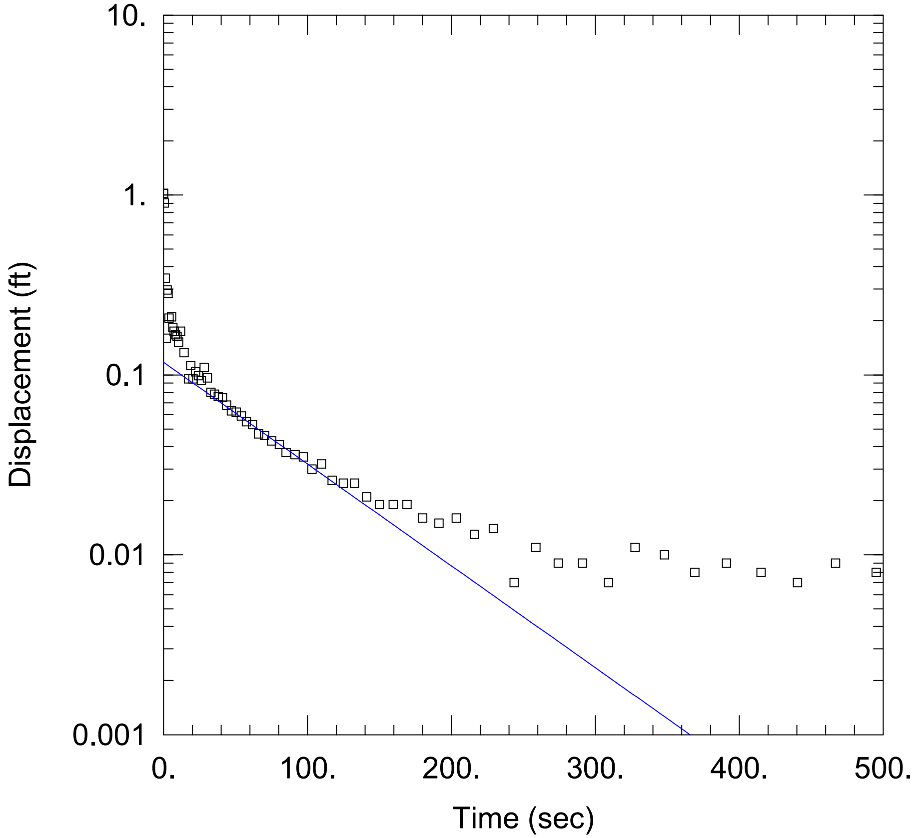
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW4)

Initial Displacement: 1.35 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 8.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW5_FH1

Data Set: P:\...\OU1MW5_FH1.aqt
Date: 01/02/19 Time: 13:15:55

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

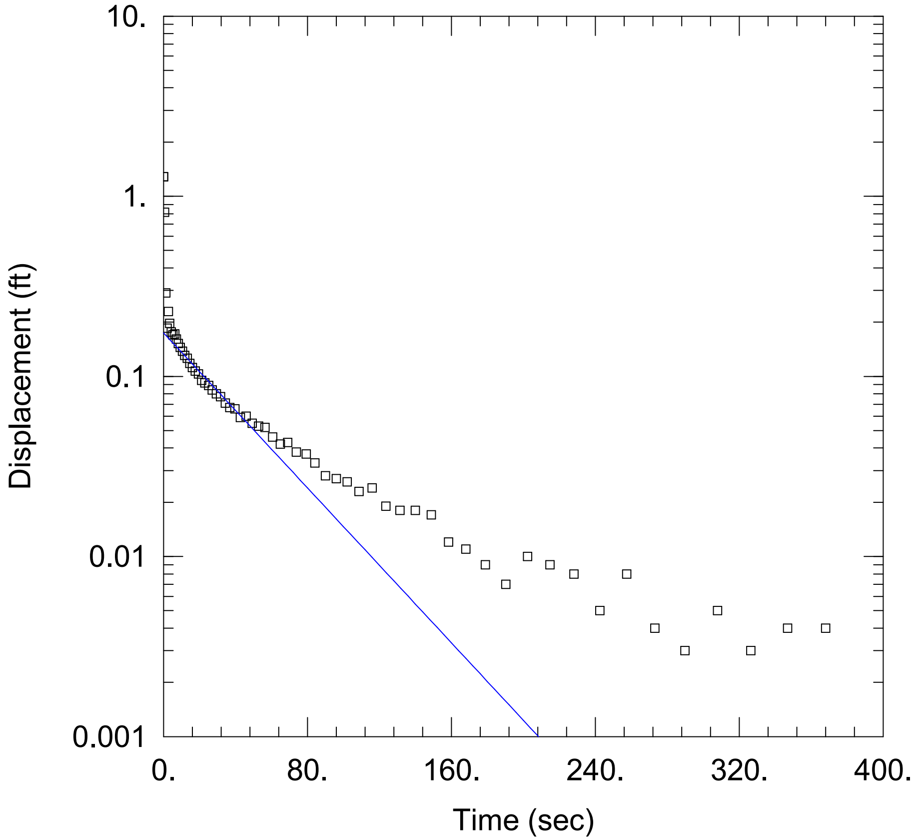
K = 0.0004615 cm/sec
y0 = 0.1176 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5)

Initial Displacement: 1.019 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW5_FH2

Data Set: P:\...\OU1MW5_FH2.aqt
Date: 01/02/19 Time: 13:16:17

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

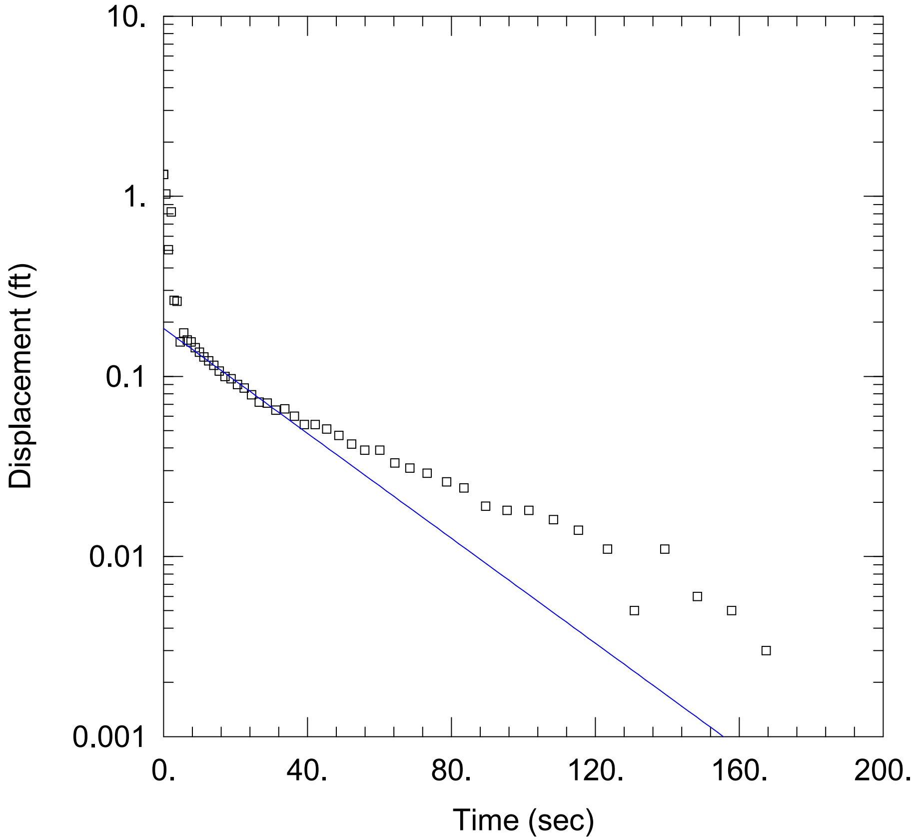
K = 0.0008767 cm/sec
y0 = 0.1742 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5)

Initial Displacement: 1.282 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW5_FH3

Data Set: P:\...\OU1MW5_FH3.aqt
Date: 01/02/19 Time: 13:16:44

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001188 cm/sec
y0 = 0.1845 ft

AQUIFER DATA

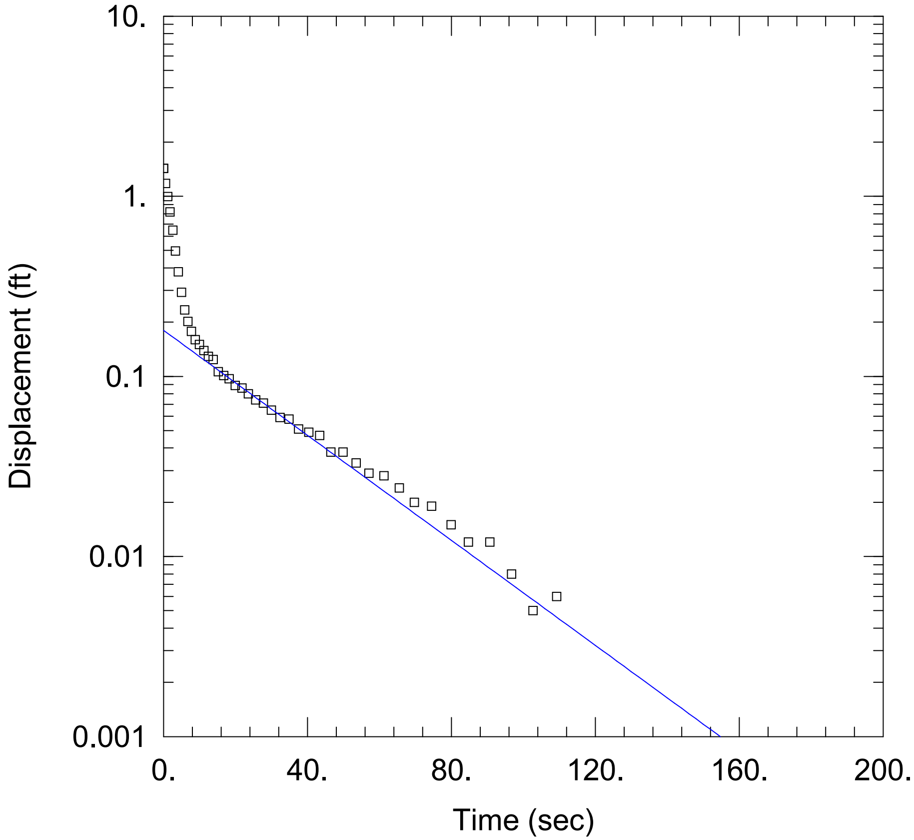
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5)

Initial Displacement: 1.319 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW5_RH1

Data Set: P:\...\OU1MW5_RH1.aqt
Date: 01/02/19 Time: 13:17:15

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

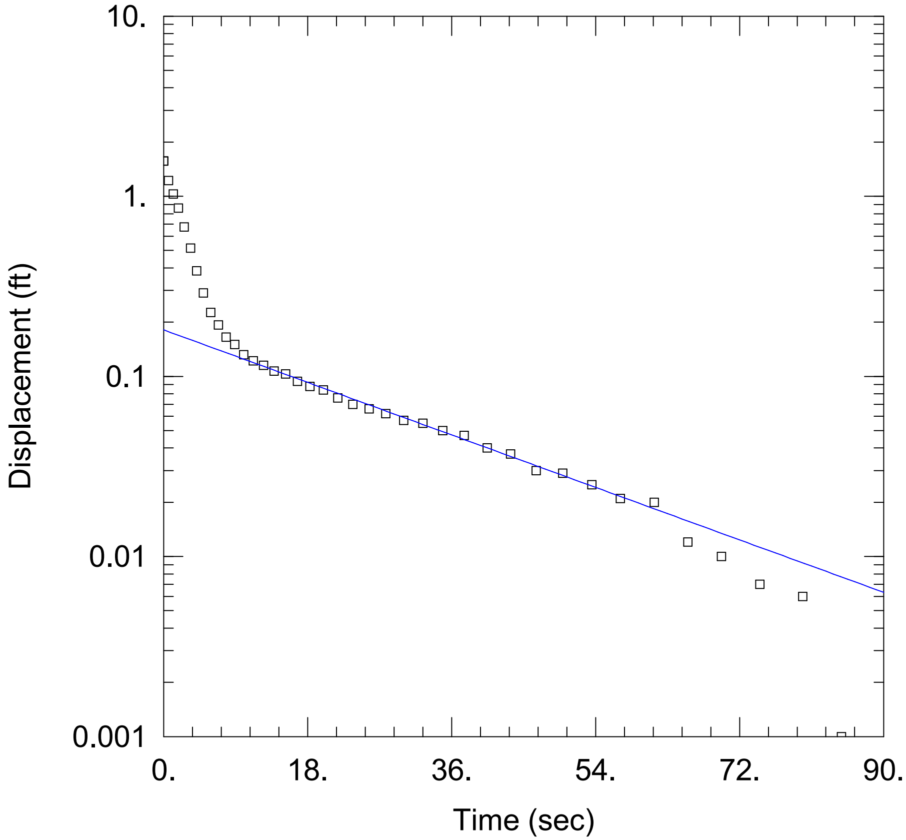
K = 0.001189 cm/sec
y0 = 0.1802 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5)

Initial Displacement: 1.43 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW5_RH2

Data Set: P:\...\OU1MW5_RH2.aqt
Date: 01/02/19 Time: 13:17:41

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.00132 cm/sec
y0 = 0.1811 ft

AQUIFER DATA

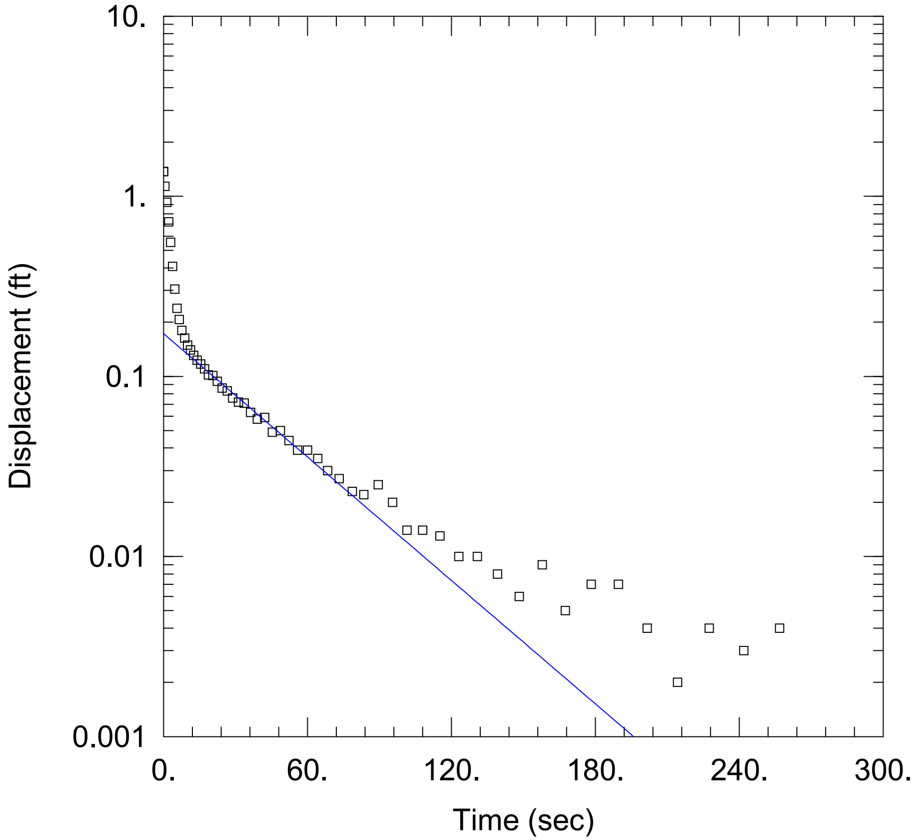
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5)

Initial Displacement: 1.567 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW5_RH3

Data Set: P:\...\OU1MW5_RH3.aqt
Date: 01/02/19 Time: 13:18:15

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

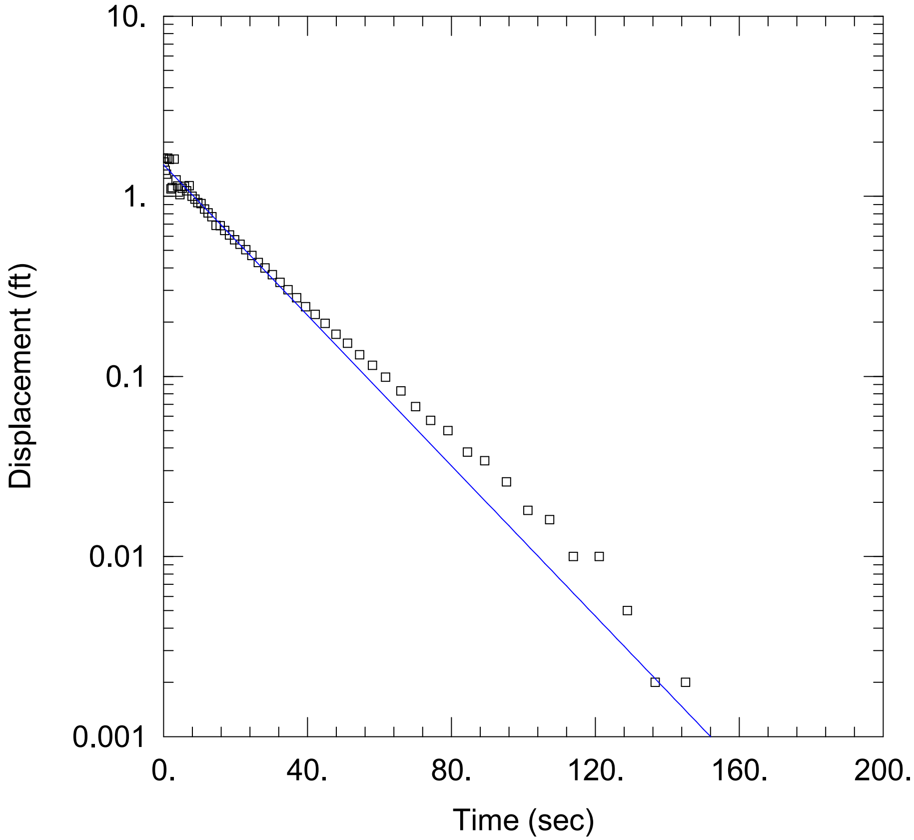
K = 0.0009309 cm/sec
y0 = 0.1726 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5)

Initial Displacement: 1.368 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.74 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW5D_FH1

Data Set: P:\...\OU1MW5D_FH1.aqt
Date: 01/02/19 Time: 13:23:06

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

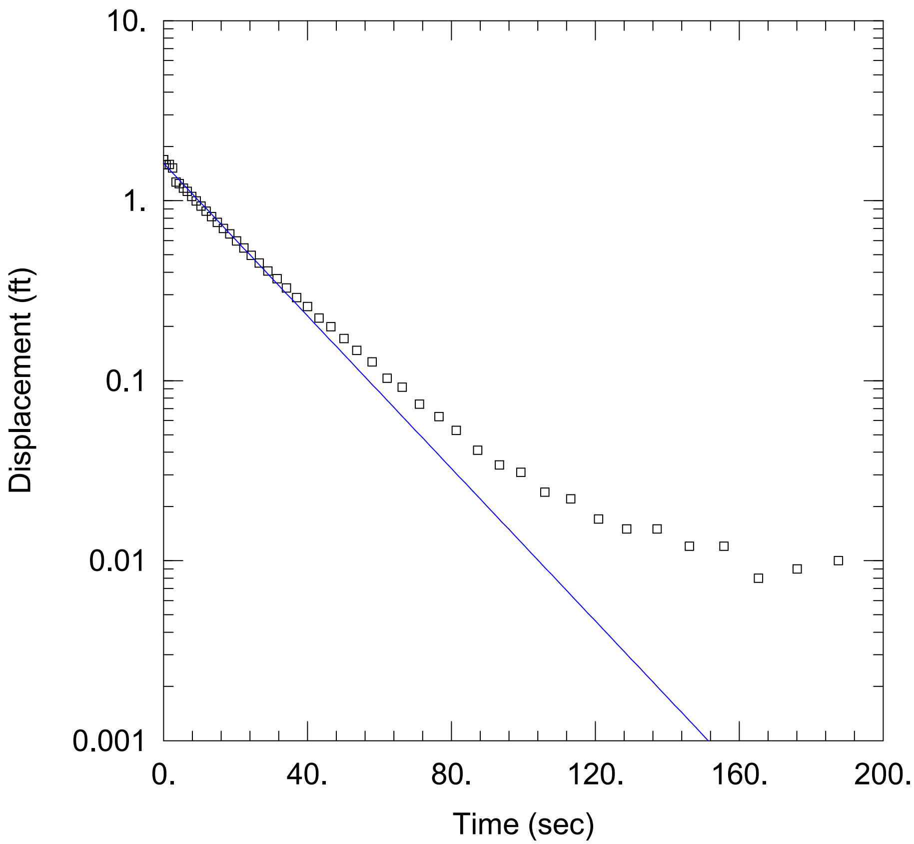
K = 0.003469 cm/sec
y0 = 1.494 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5D)

Initial Displacement: 1.629 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 24.25 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW5D_FH2

Data Set: P:\...\OU1MW5D_FH2.aqt
Date: 01/02/19 Time: 13:23:47

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

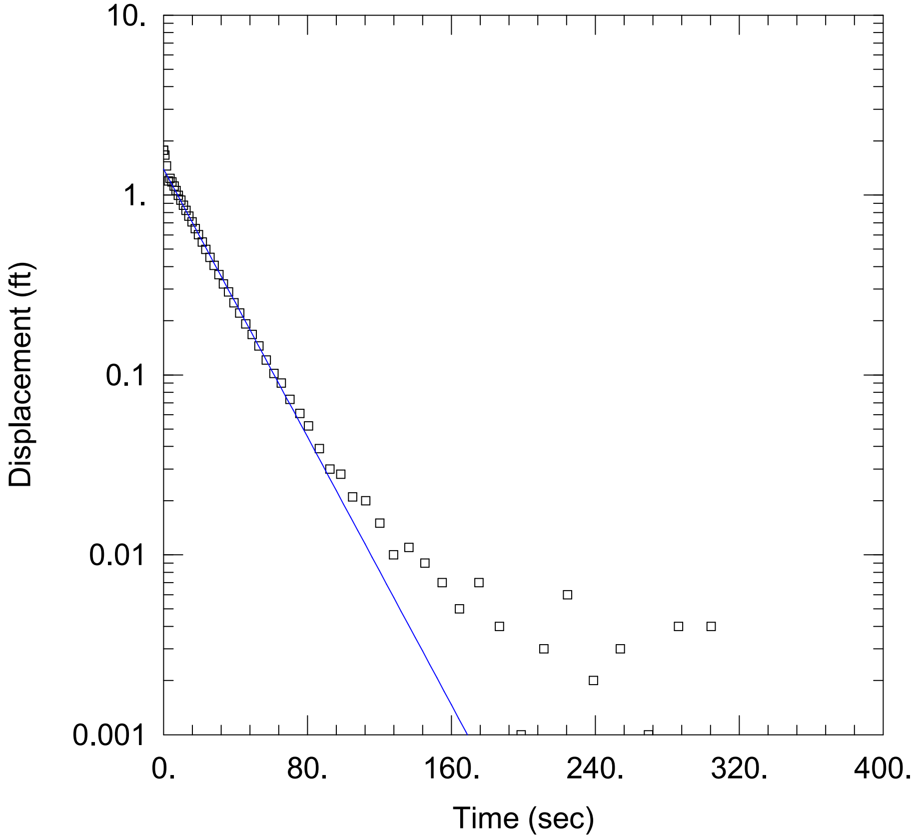
K = 0.003519 cm/sec
y0 = 1.612 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5D)

Initial Displacement: 1.691 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 24.25 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW5D_FH3

Data Set: P:\...\OU1MW5D_FH3.aqt
Date: 01/02/19 Time: 13:24:14

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

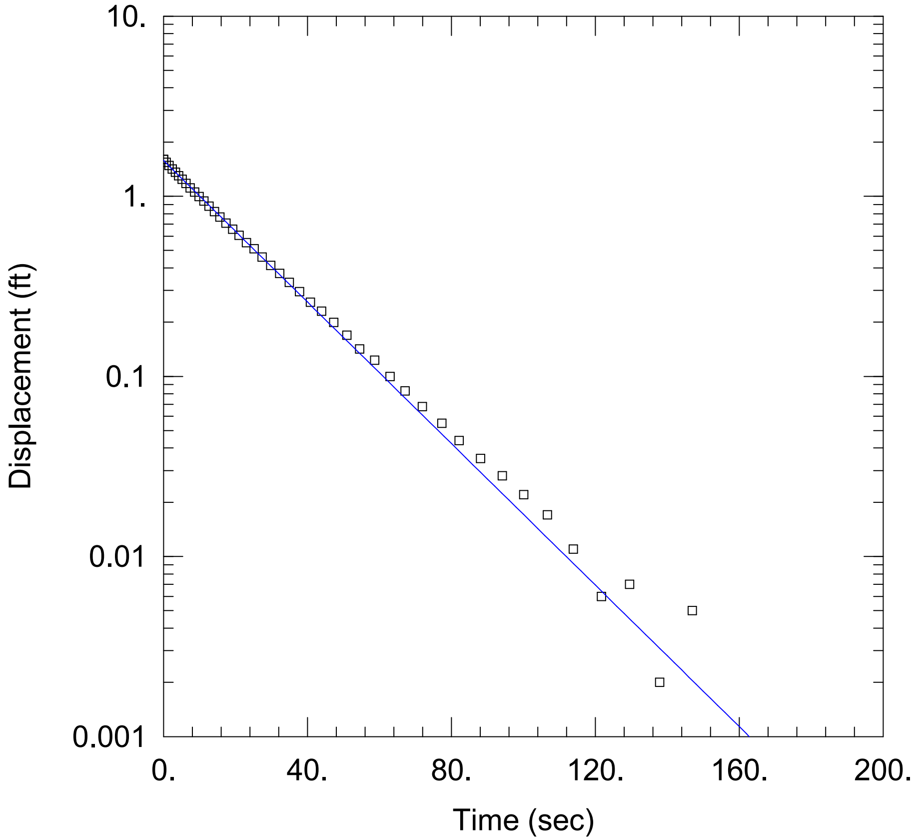
K = 0.003092 cm/sec
y0 = 1.395 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5D)

Initial Displacement: 1.772 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 24.25 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW5D_RH1

Data Set: P:\...\OU1MW5D_RH1.aqt
Date: 01/02/19 Time: 13:24:42

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.003263 cm/sec
y0 = 1.579 ft

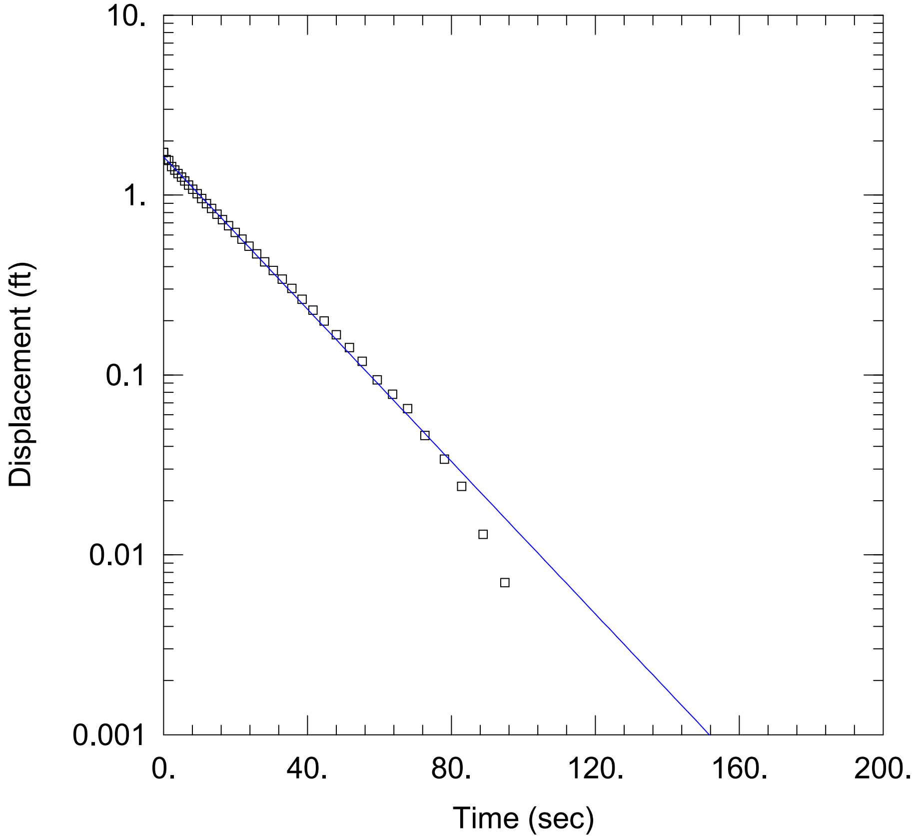
AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5D)

Initial Displacement: 1.604 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft

Static Water Column Height: 24.25 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW5D_RH2

Data Set: P:\...\OU1MW5D_RH2.aqt
Date: 01/02/19 Time: 13:25:08

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

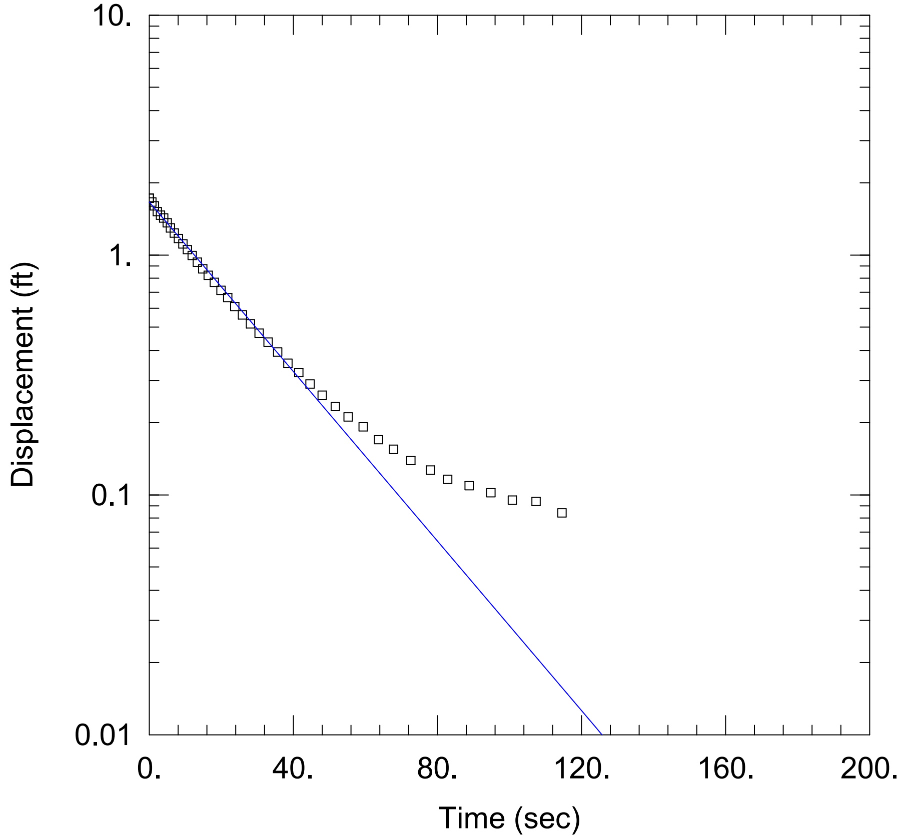
K = 0.003517 cm/sec
y0 = 1.63 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5D)

Initial Displacement: 1.722 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 24.25 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW5D_RH3

Data Set: P:\...\OU1MW5D_RH3.aqt
Date: 01/02/19 Time: 13:25:33

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW5D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

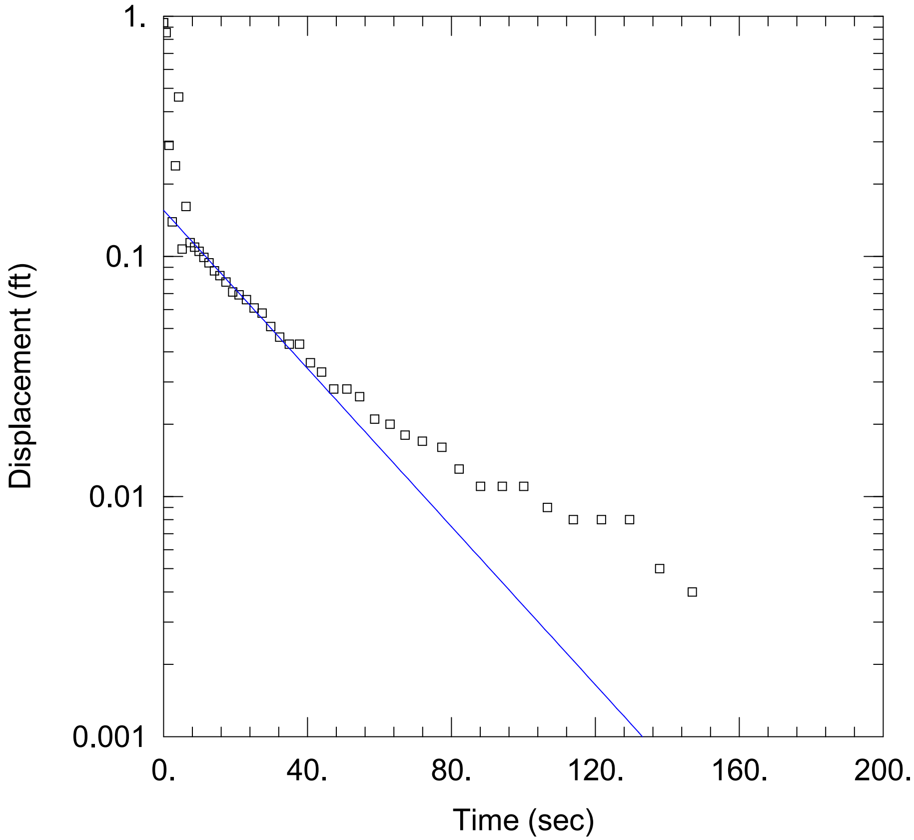
K = 0.002935 cm/sec
y0 = 1.664 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW5D)

Initial Displacement: 1.725 ft
Total Well Penetration Depth: 29.5 ft
Casing Radius: 0.0833 ft
Static Water Column Height: 24.25 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW6_FH1

Data Set: P:\...\OU1MW6_FH1.aqt
Date: 01/02/19 Time: 13:26:05

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

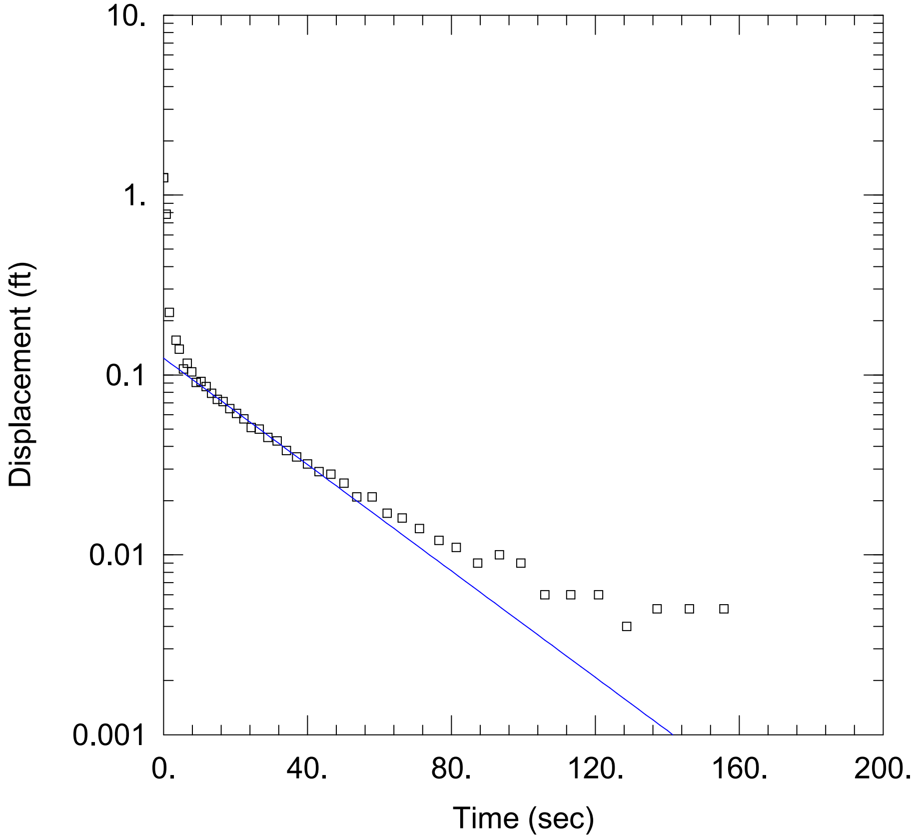
K = 0.001343 cm/sec
y0 = 0.1555 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6)

Initial Displacement: 0.938 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 9.01 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW6_FH2

Data Set: P:\...\OU1MW6_FH2.aqt
Date: 01/02/19 Time: 13:26:33

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001206 cm/sec
y0 = 0.1239 ft

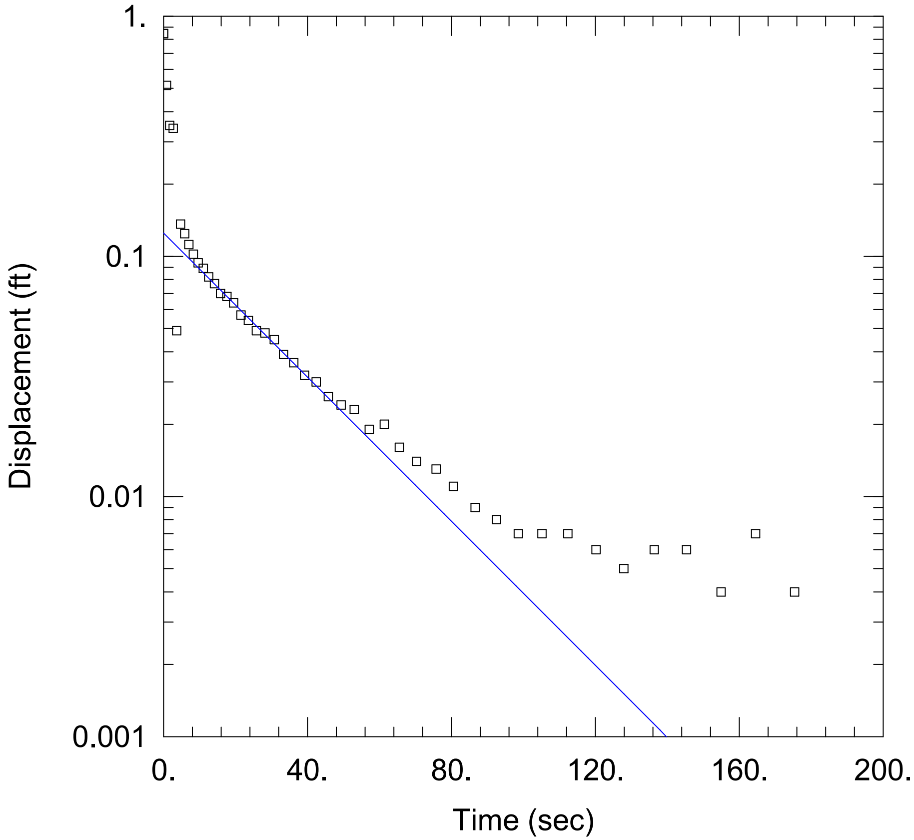
AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6)

Initial Displacement: 1.246 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 9.01 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW6_FH3

Data Set: P:\...\OU1MW6_FH3.aqt
Date: 01/02/19 Time: 13:29:15

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

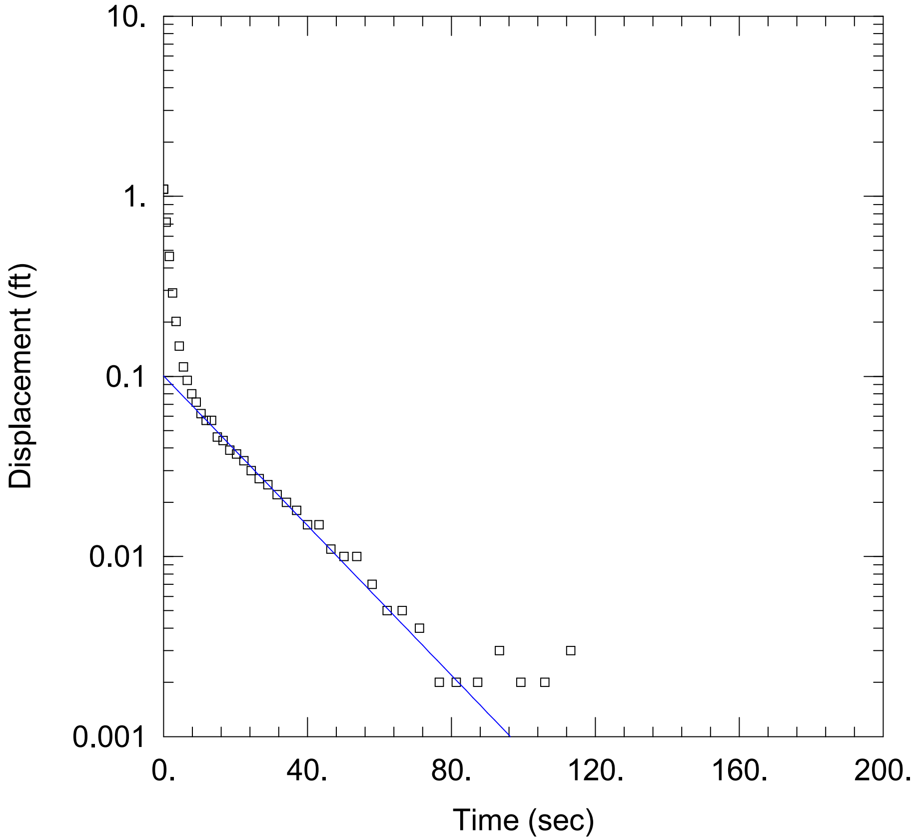
K = 0.001223 cm/sec
y0 = 0.1251 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6)

Initial Displacement: 0.845 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 9.01 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW6_RH1

Data Set: P:\...\OU1MW6_RH1.aqt
Date: 01/02/19 Time: 13:34:44

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

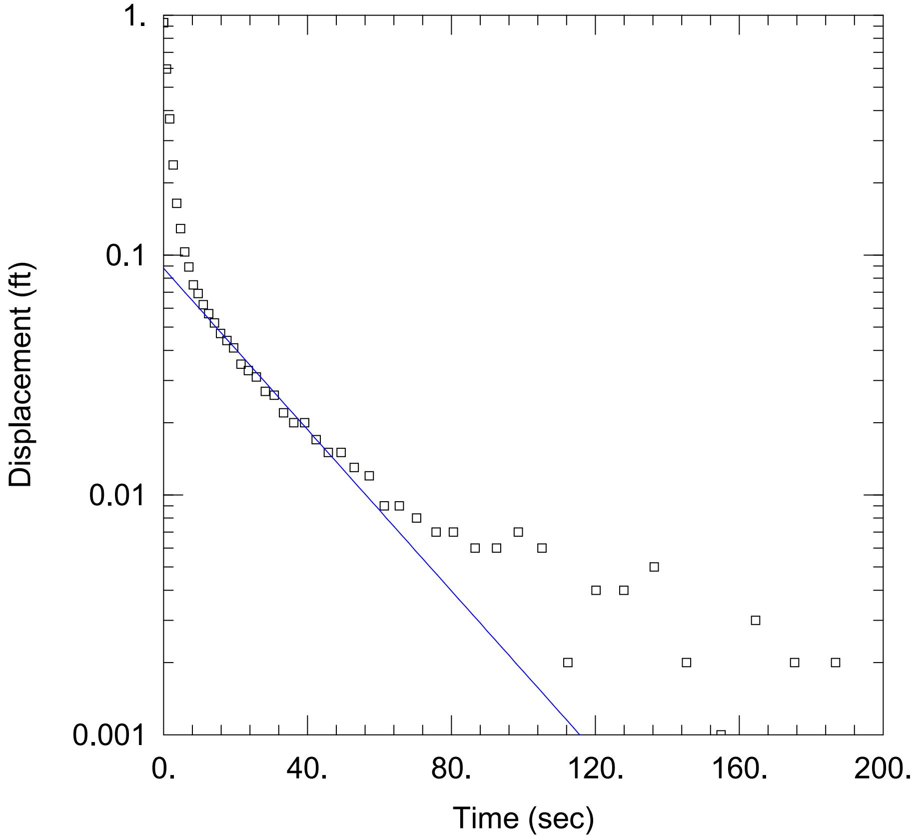
K = 0.001694 cm/sec
y0 = 0.1007 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6)

Initial Displacement: 1.094 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 9.01 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW6_RH2

Data Set: P:\...\OU1MW6_RH2.aqt
Date: 01/02/19 Time: 13:34:08

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001371 cm/sec
y0 = 0.08801 ft

AQUIFER DATA

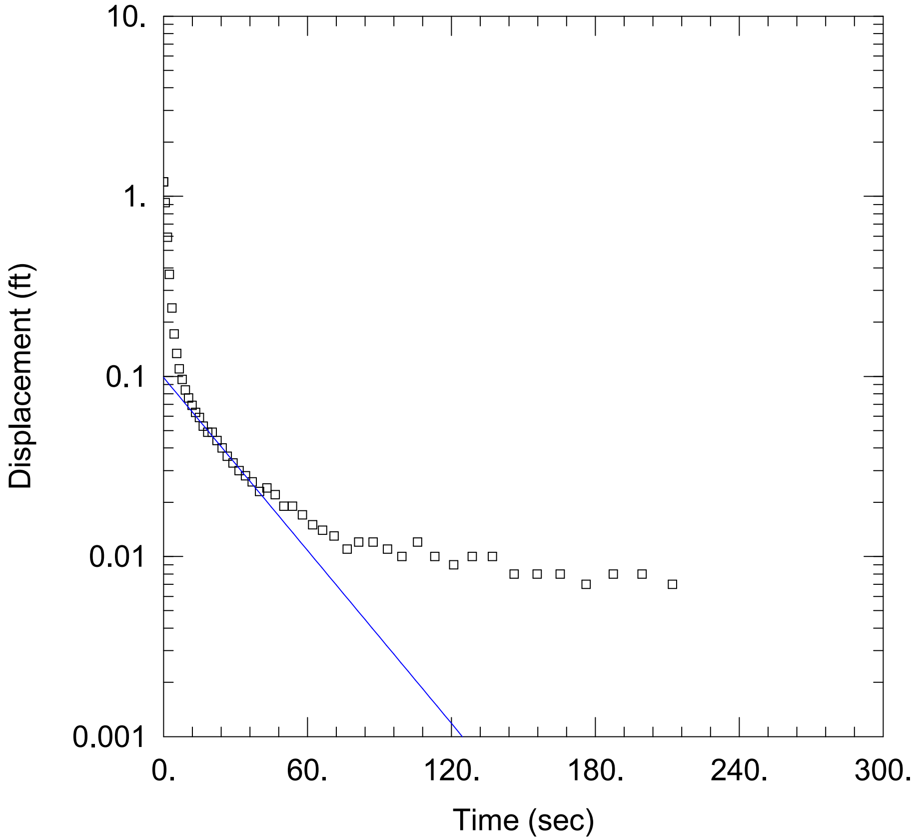
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6)

Initial Displacement: 0.931 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 9.01 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW6_RH3

Data Set: P:\...\OU1MW6_RH3.aqt
Date: 01/02/19 Time: 13:35:05

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

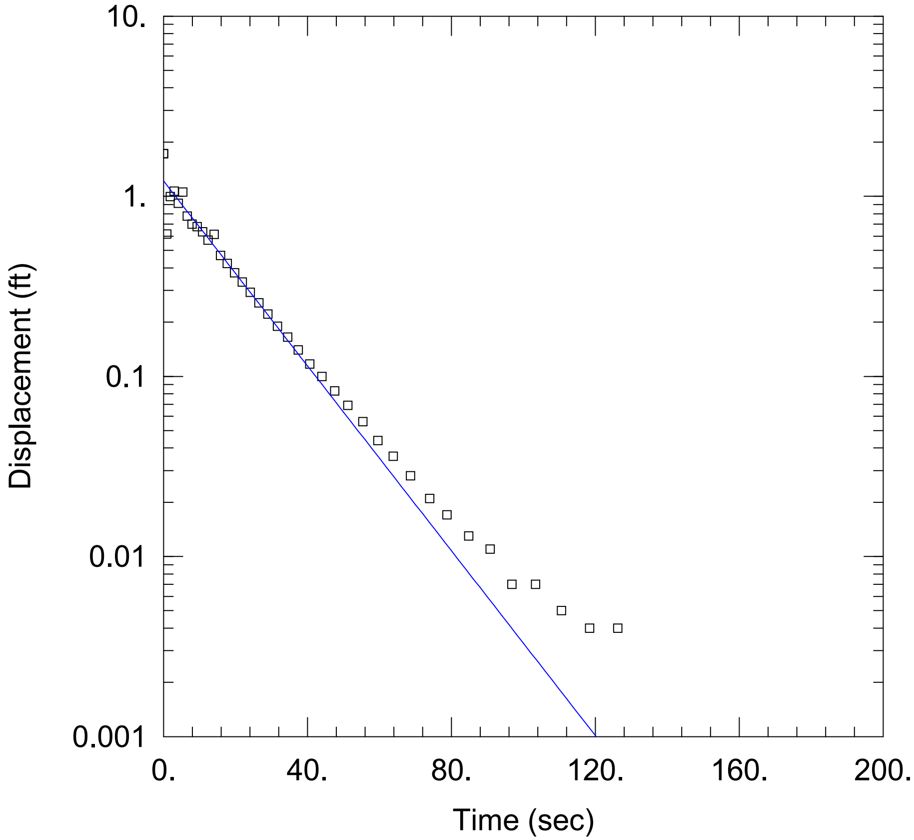
K = 0.001305 cm/sec
y0 = 0.09859 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6)

Initial Displacement: 1.203 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 9.01 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW6D_FH1

Data Set: P:\...\OU1MW6D_FH1.aqt
Date: 01/02/19 Time: 13:35:37

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

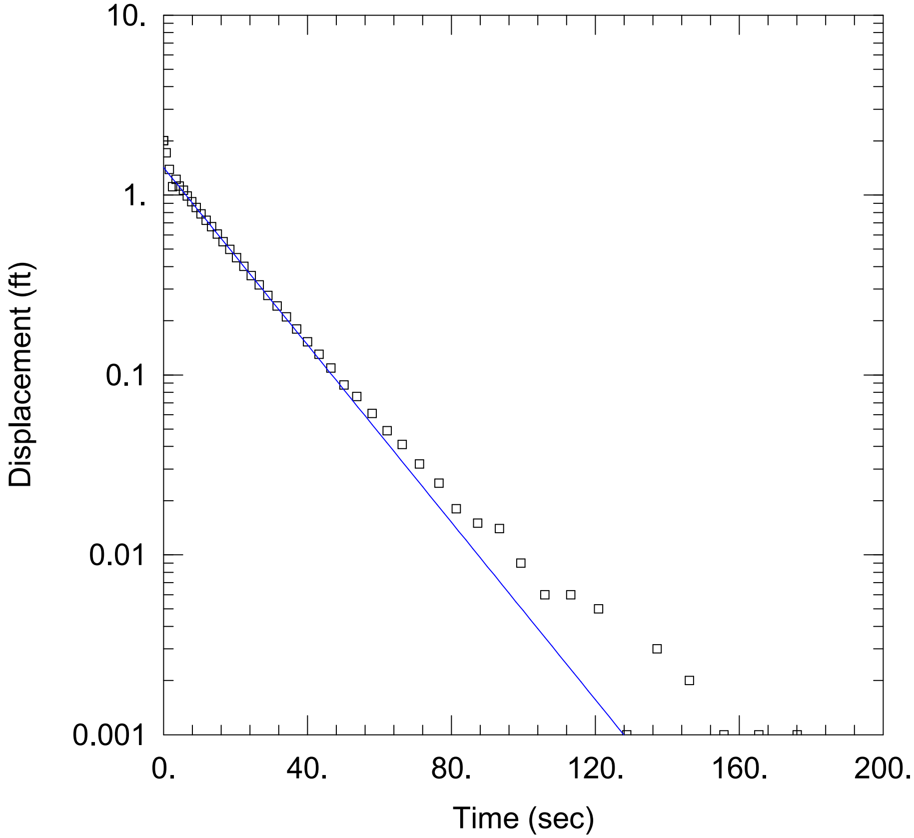
K = 0.004274 cm/sec
y0 = 1.217 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6D)

Initial Displacement: 1.721 ft
Total Well Penetration Depth: 30. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.74 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW6D_FH2

Data Set: P:\...\OU1MW6D_FH2.aqt
Date: 01/02/19 Time: 13:36:19

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

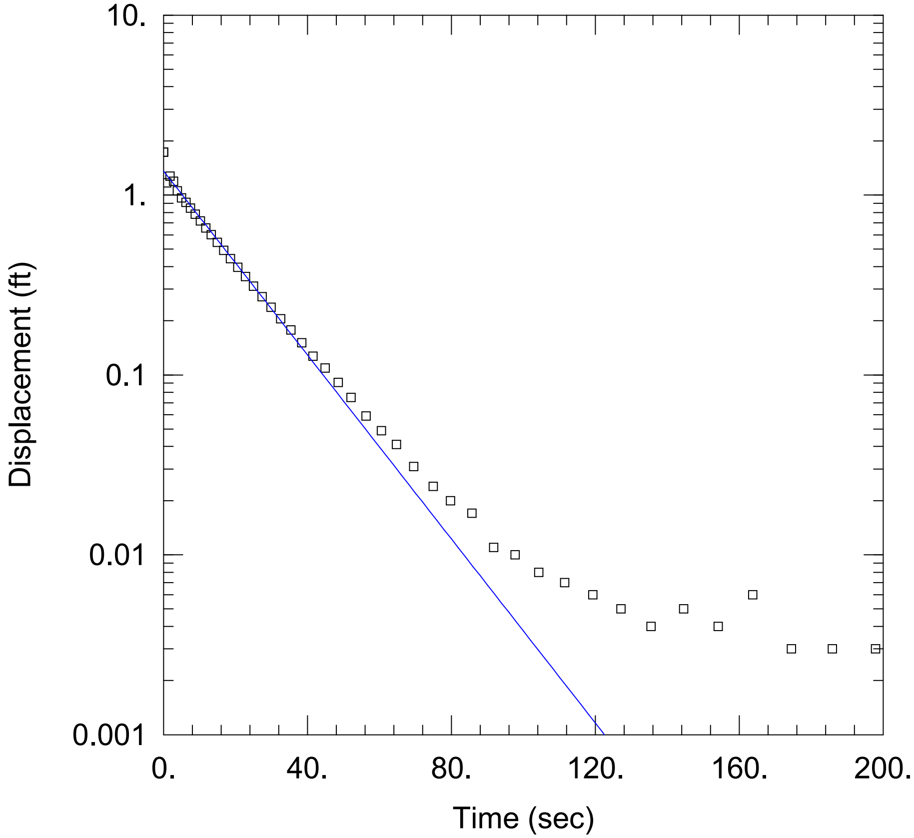
K = 0.004105 cm/sec
y0 = 1.422 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6D)

Initial Displacement: 2.008 ft
Total Well Penetration Depth: 30. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.74 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW6D_FH3

Data Set: P:\...\OU1MW6D_FH3.aqt
Date: 01/02/19 Time: 13:37:04

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

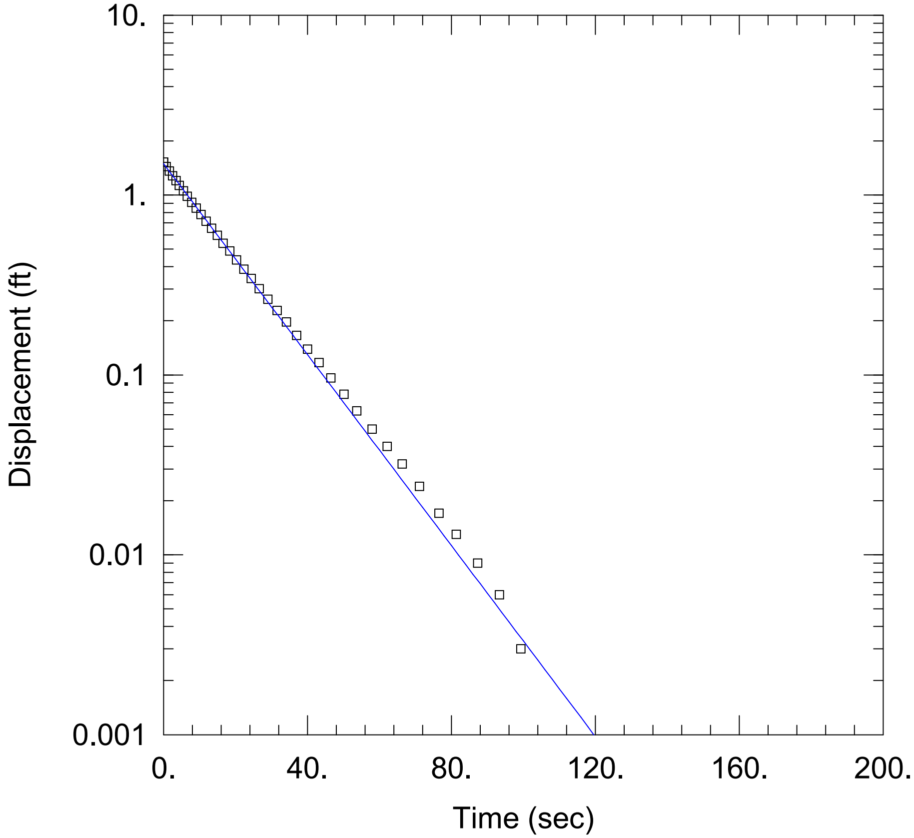
K = 0.004258 cm/sec
y0 = 1.361 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6D)

Initial Displacement: 1.733 ft
Total Well Penetration Depth: 30. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.74 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW6D_RH1

Data Set: P:\...\OU1MW6D_RH1.aqt
Date: 01/02/19 Time: 13:37:26

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

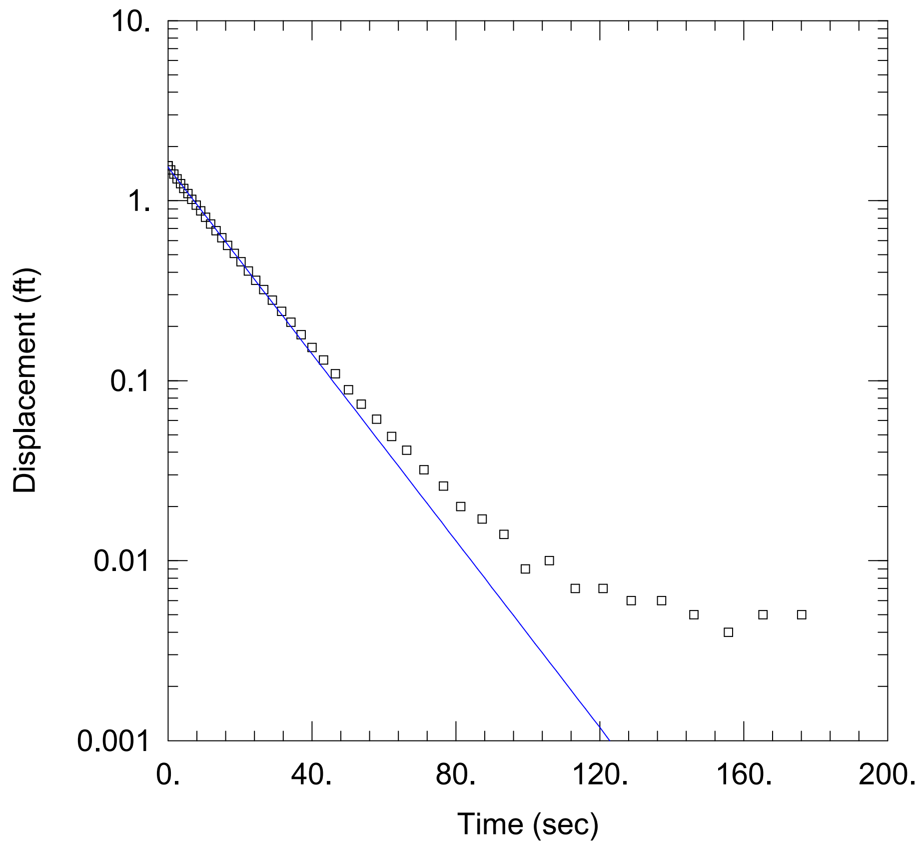
K = 0.00442 cm/sec
y0 = 1.495 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6D)

Initial Displacement: 1.527 ft
Total Well Penetration Depth: 30. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.74 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW6D_RH2

Data Set: P:\...\OU1MW6D_RH2.aqt
Date: 01/02/19 Time: 13:37:47

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

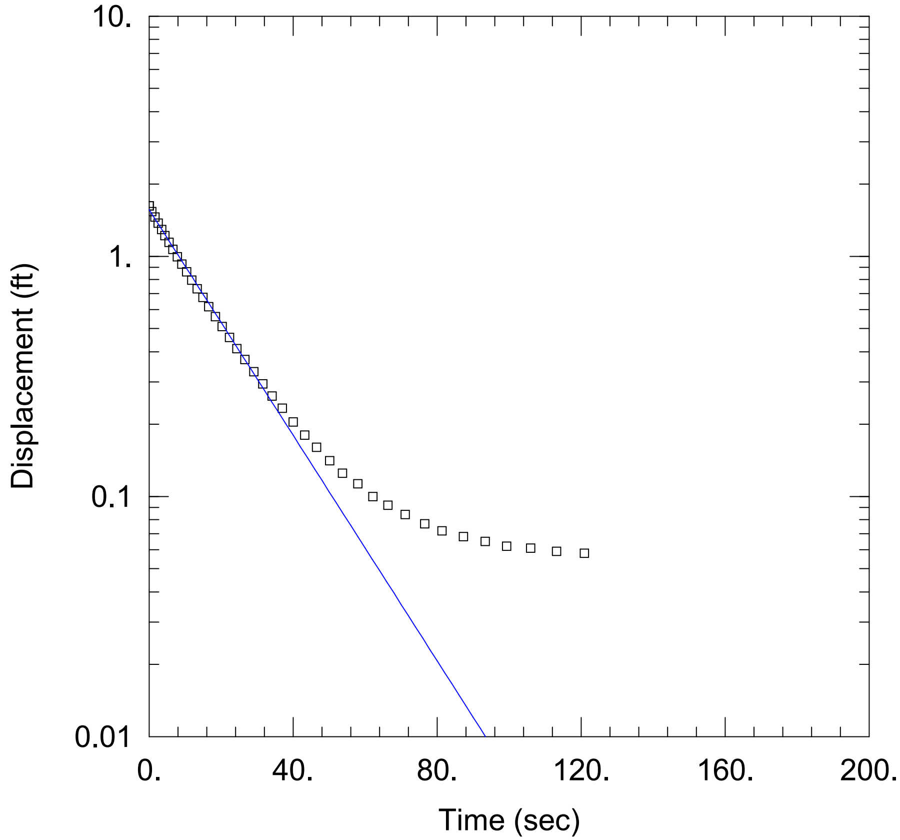
K = 0.004321 cm/sec
y0 = 1.535 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6D)

Initial Displacement: 1.564 ft
Total Well Penetration Depth: 30. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.74 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW6D_RH3

Data Set: P:\...\OU1MW6D_RH3.aqt
Date: 01/02/19 Time: 13:38:06

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW6D
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

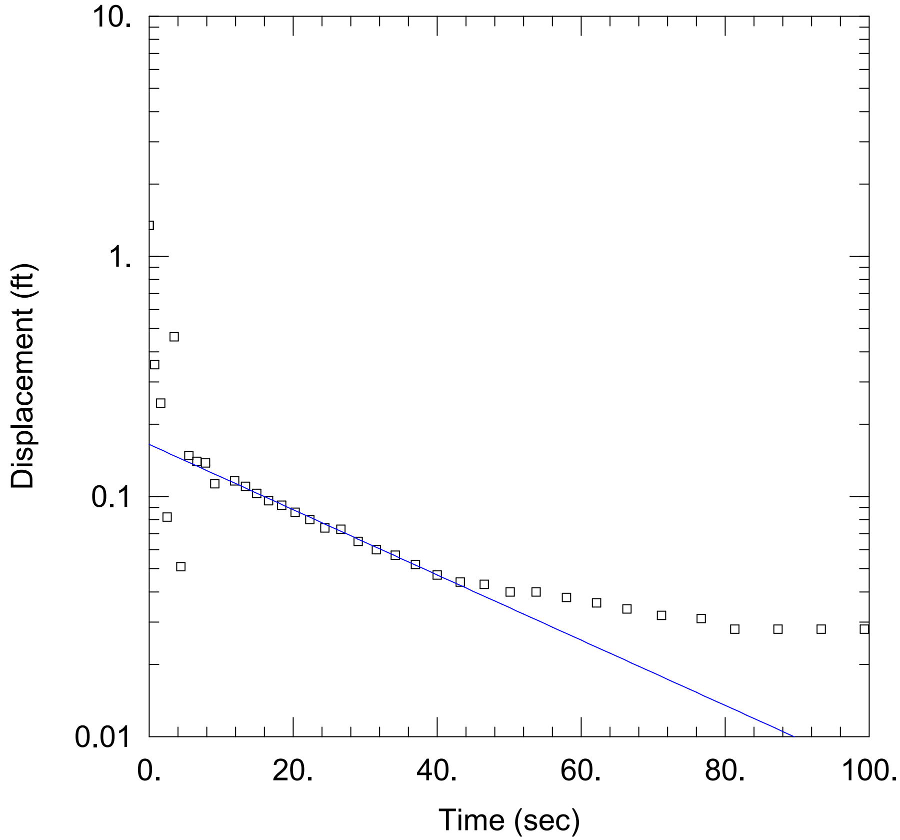
K = 0.003911 cm/sec
y0 = 1.563 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW6D)

Initial Displacement: 1.622 ft
Total Well Penetration Depth: 30. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 25.74 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft



OU1MW7_FH1

Data Set: P:\...\OU1MW7_FH1.aqt
Date: 01/02/19 Time: 13:39:01

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW7
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

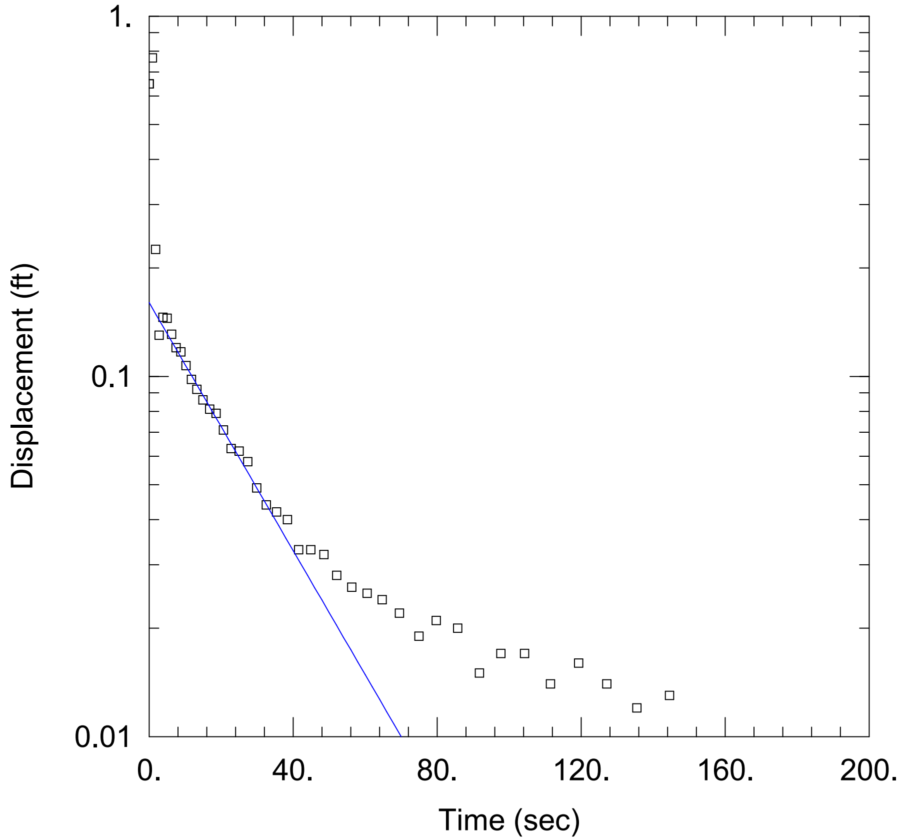
K = 0.001108 cm/sec
y0 = 0.1647 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW7)

Initial Displacement: 1.343 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.72 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW7_FH2

Data Set: P:\...\OU1MW7_FH2.aqt
Date: 01/02/19 Time: 13:39:19

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW7
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001403 cm/sec
y0 = 0.1602 ft

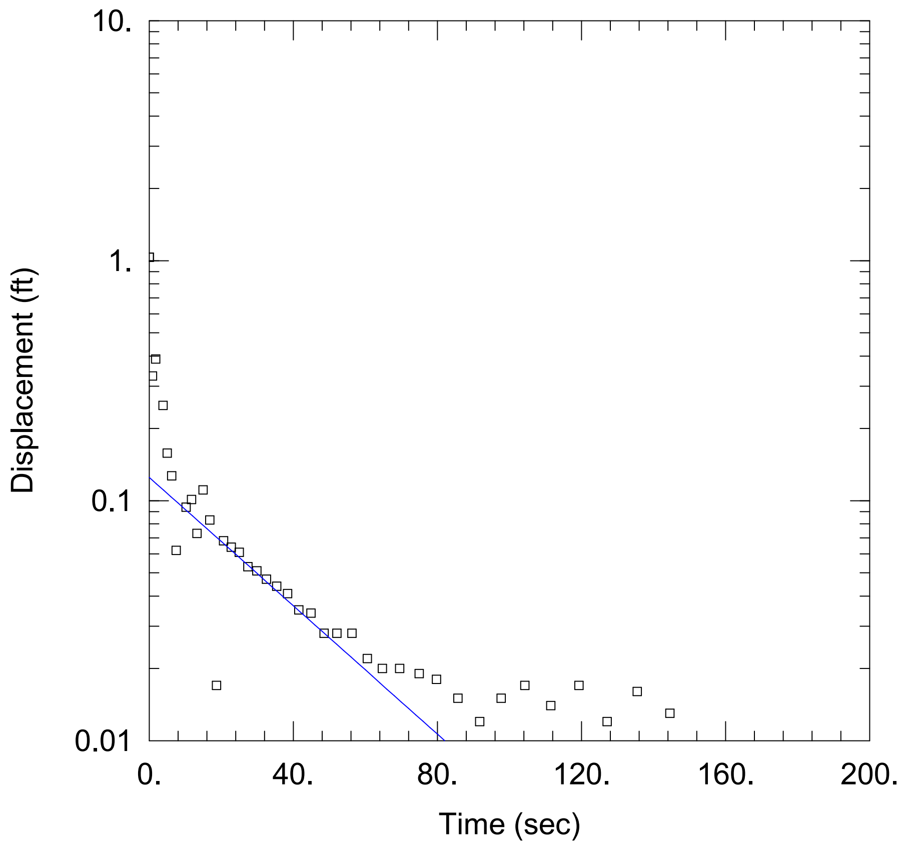
AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW7)

Initial Displacement: 0.649 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.72 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW7_FH3

Data Set: P:\...\OU1MW7_FH3.aqt
Date: 01/02/19 Time: 13:39:44

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW7
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001091 cm/sec
y0 = 0.1251 ft

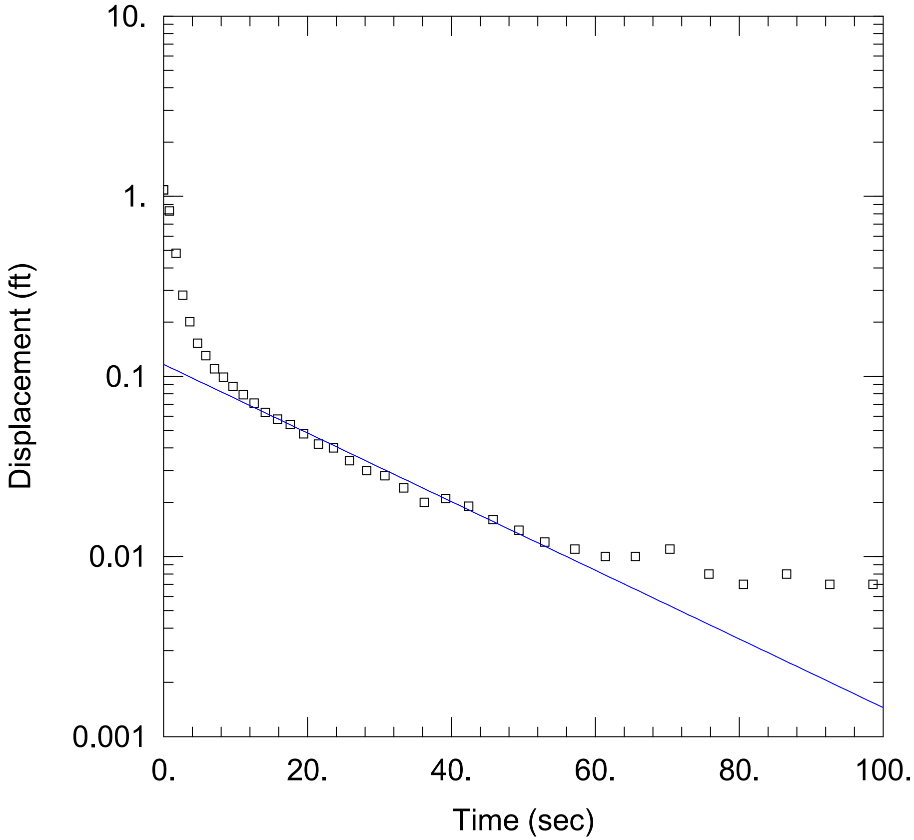
AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW7)

Initial Displacement: 1.032 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.72 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW7_RH1

Data Set: P:\...\OU1MW7_RH1.aqt
Date: 01/02/19 Time: 13:40:14

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW7
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001554 cm/sec
y0 = 0.1166 ft

AQUIFER DATA

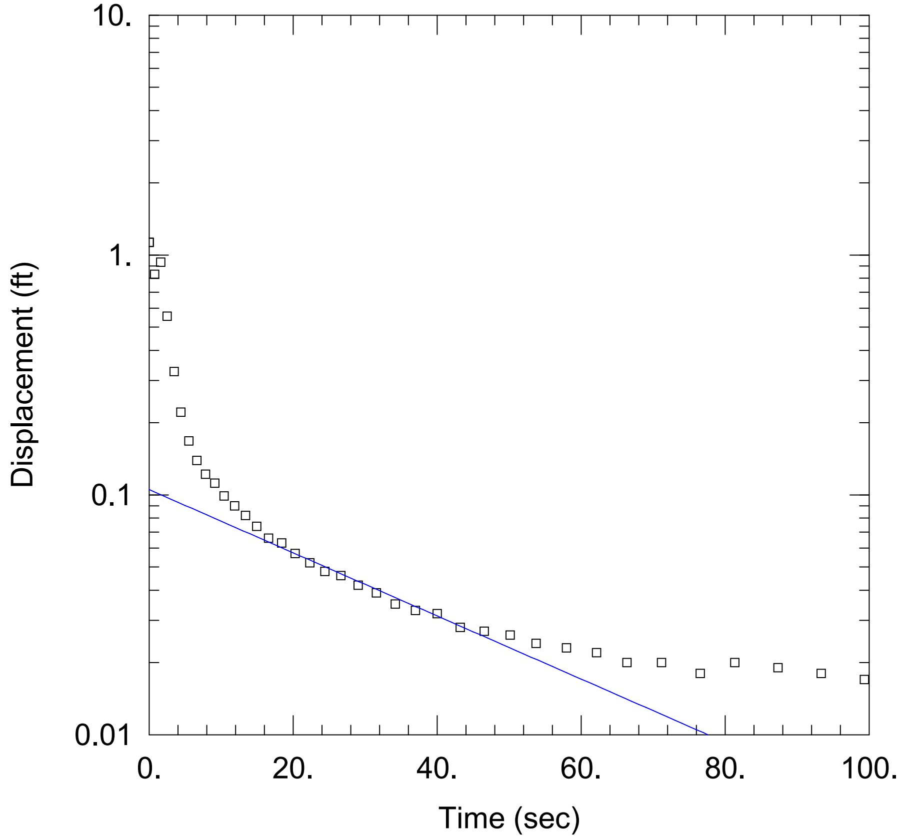
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW7)

Initial Displacement: 1.087 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.72 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW7_RH2

Data Set: P:\...\OU1MW7_RH2.aqt
Date: 01/02/19 Time: 13:40:37

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW7
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001073 cm/sec
y0 = 0.1051 ft

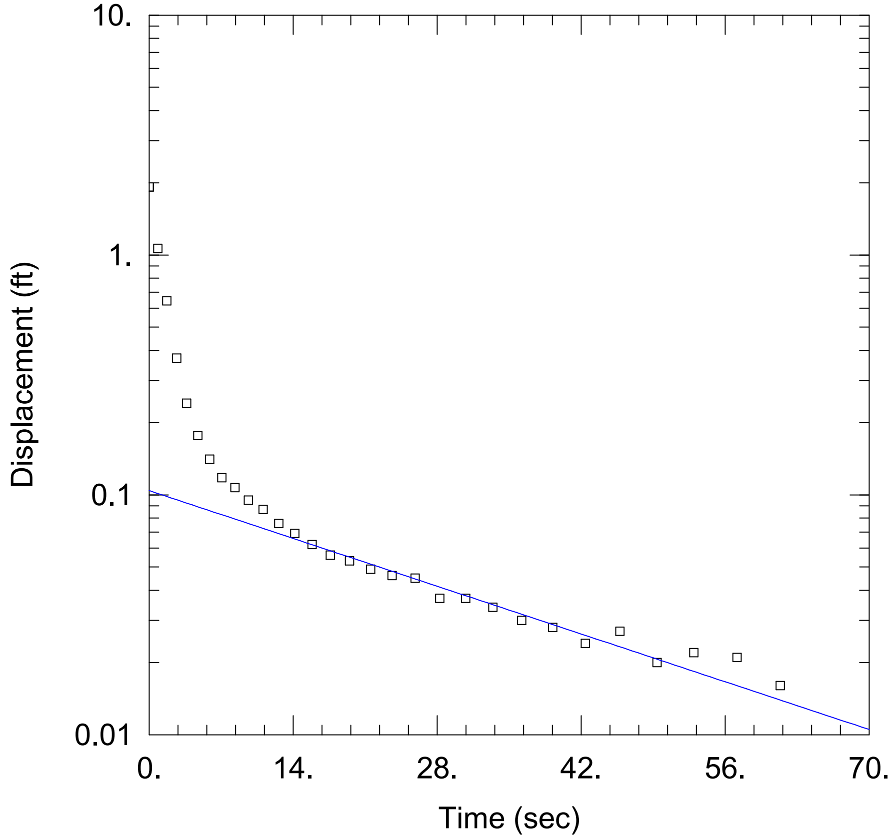
AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW7)

Initial Displacement: 1.13 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.72 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW7_RH3

Data Set: P:\...\OU1MW7_RH3.aqt
Date: 01/02/19 Time: 13:40:59

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW7
Test Date: 12/17/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.00116 cm/sec
y0 = 0.1041 ft

AQUIFER DATA

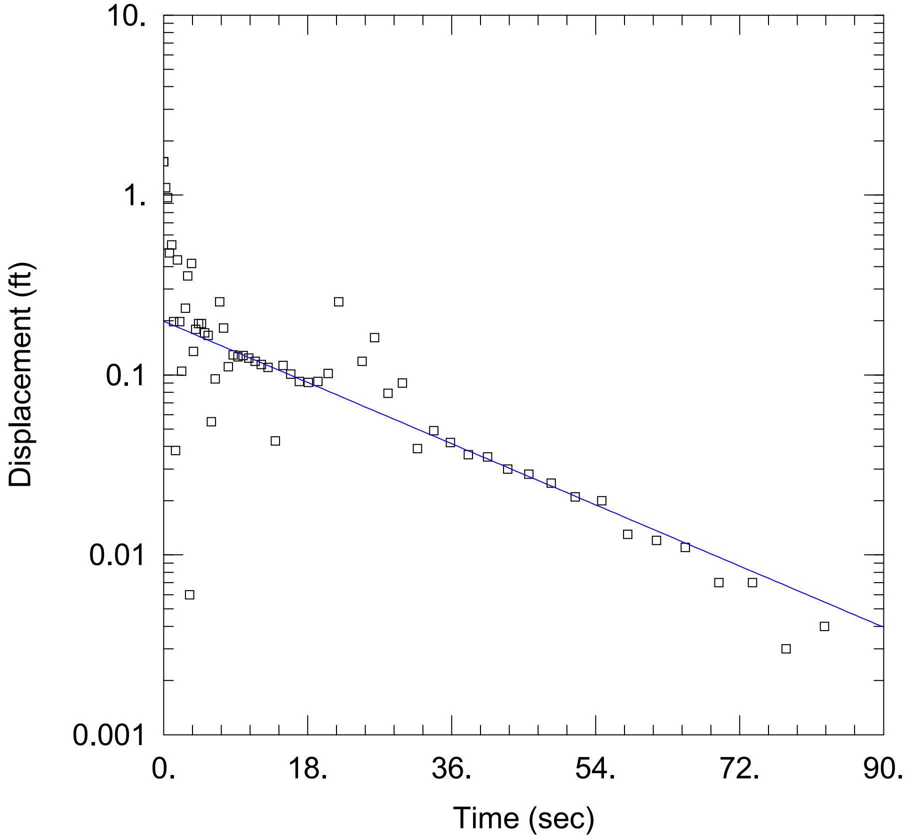
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW7)

Initial Displacement: 1.918 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.72 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW8_FH1

Data Set: P:\...\OU1MW8_FH1.aqt
Date: 01/02/19 Time: 12:21:10

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW8
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001541 cm/sec
y0 = 0.1987 ft

AQUIFER DATA

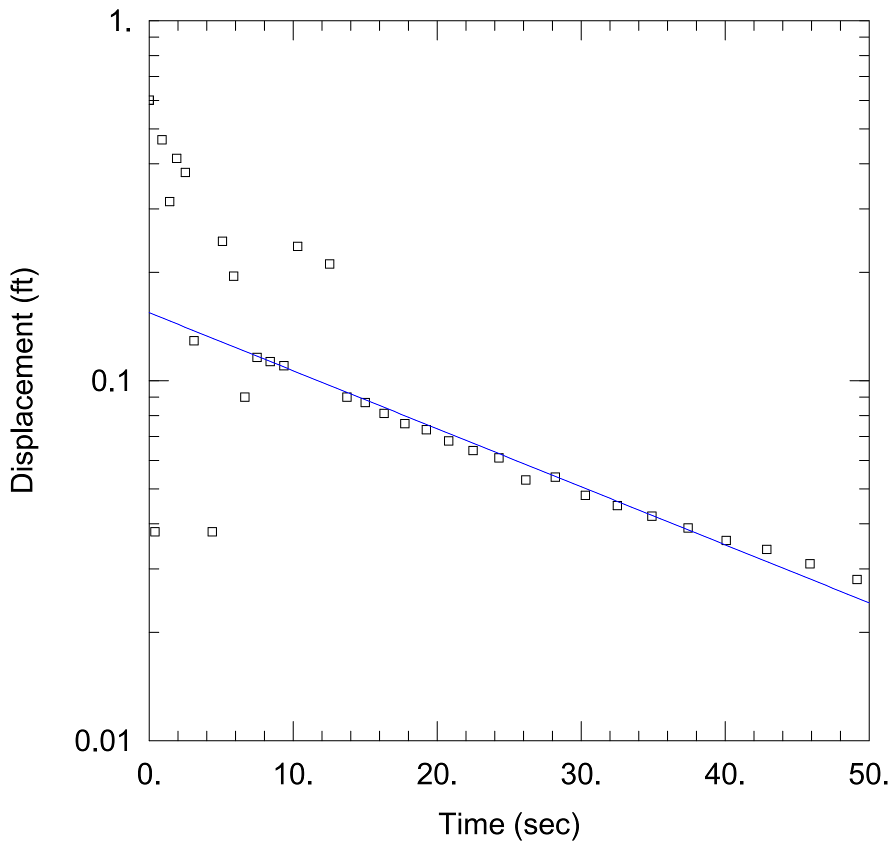
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW8)

Initial Displacement: 1.531 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.62 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW8_FH2

Data Set: P:\...\OU1MW8_FH2.aqt
Date: 01/02/19 Time: 12:22:37

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW8
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

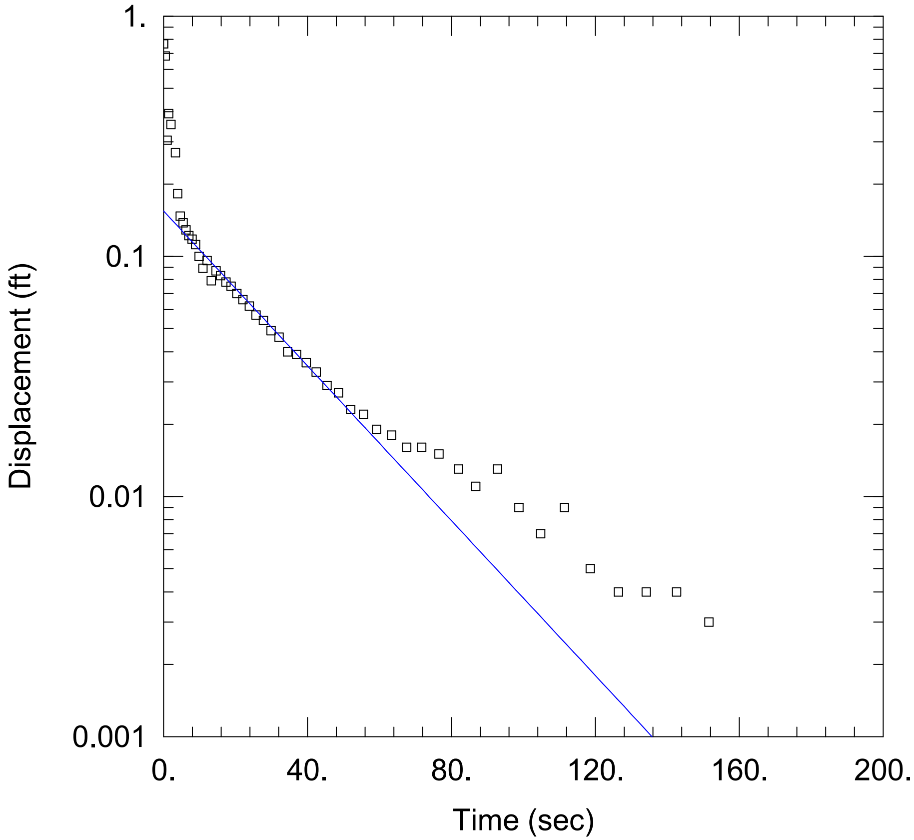
K = 0.001314 cm/sec
y0 = 0.1544 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW8)

Initial Displacement: 0.601 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.62 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW8_FH3

Data Set: P:\...\OU1MW8_FH3.aqt
Date: 01/02/19 Time: 12:23:21

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW8
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

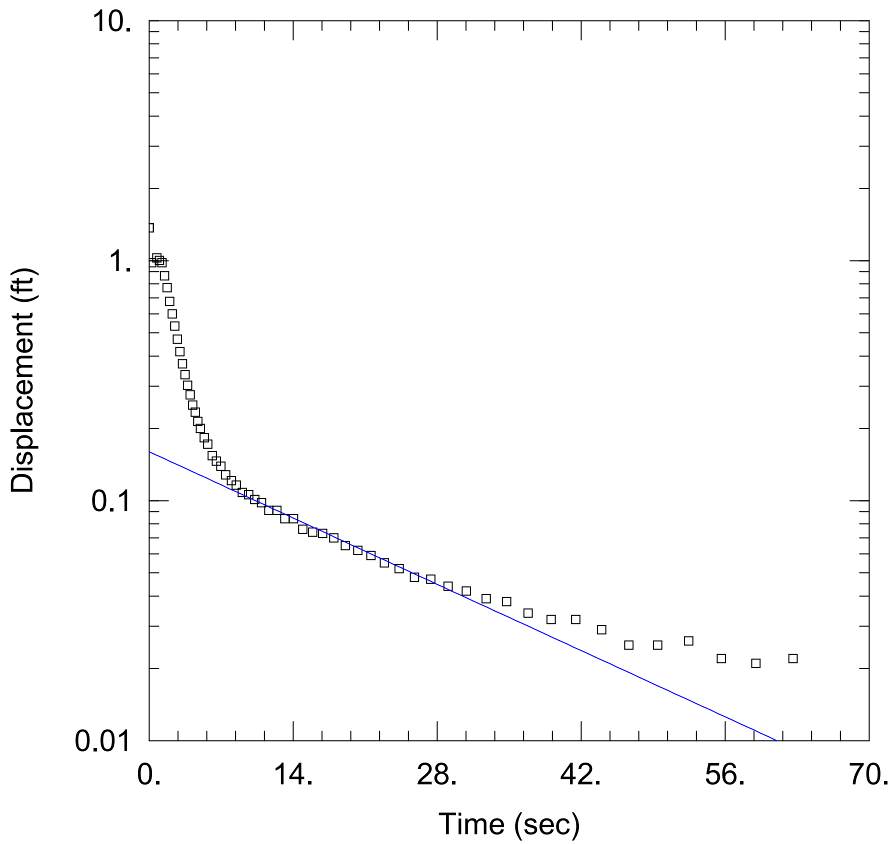
K = 0.001314 cm/sec
y0 = 0.1544 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW8)

Initial Displacement: 0.766 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.62 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW8_RH1

Data Set: P:\...\OU1MW8_RH1.aqt
Date: 01/02/19 Time: 12:23:46

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW8
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001608 cm/sec
y0 = 0.1599 ft

AQUIFER DATA

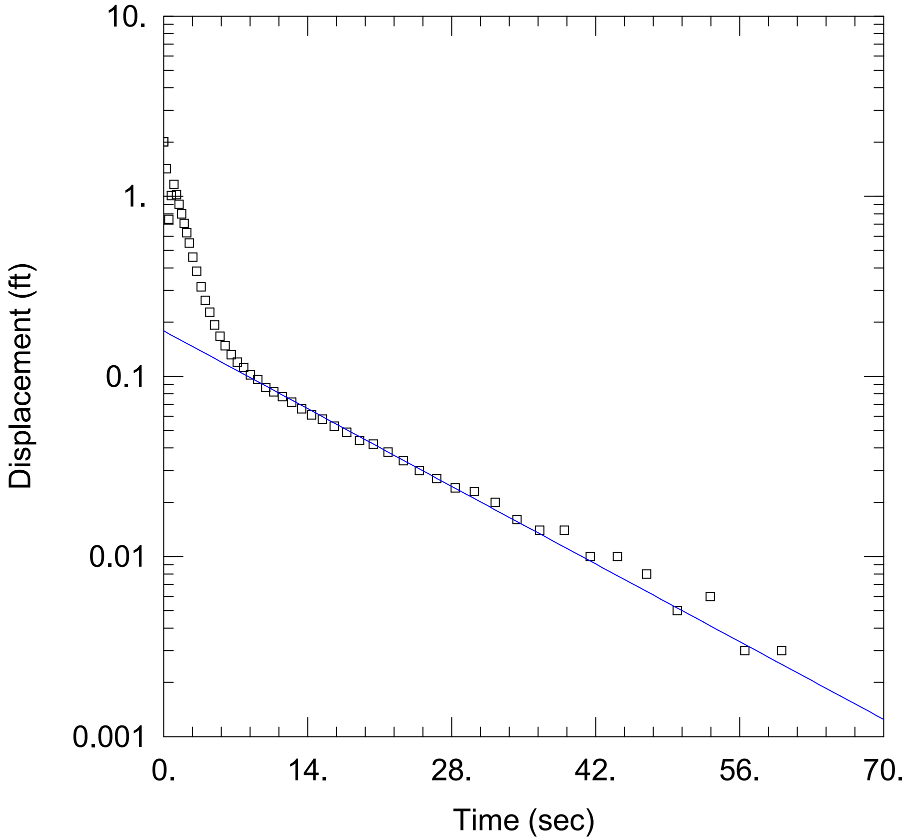
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW8)

Initial Displacement: 1.369 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.62 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW8_RH2

Data Set: P:\...\OU1MW8_RH2.aqt
Date: 01/02/19 Time: 12:24:44

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW8
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.002512 cm/sec
y0 = 0.1789 ft

AQUIFER DATA

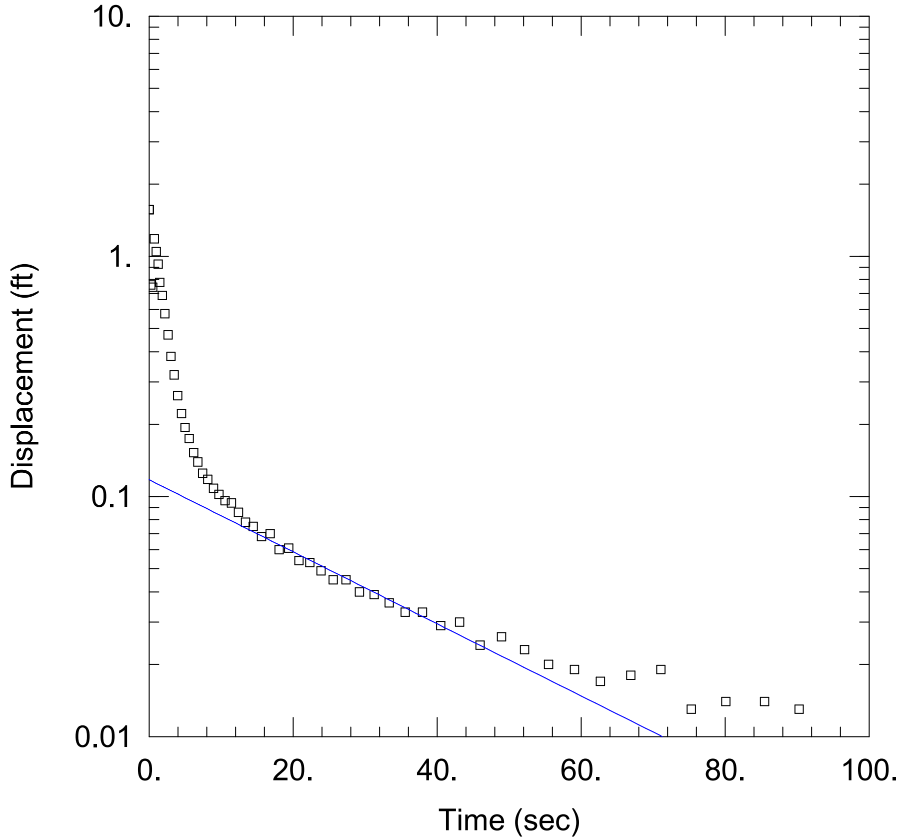
Saturated Thickness: 50. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW8)

Initial Displacement: 2.007 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft

Static Water Column Height: 7.62 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4



OU1MW8_RH3

Data Set: P:\...\OU1MW8_RH3.aqt
Date: 01/02/19 Time: 12:25:07

PROJECT INFORMATION

Company: ERM
Client: USS Lead
Project: 0432213
Location: East Chicago
Test Well: OU1MW8
Test Date: 12/14/2018

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001223 cm/sec
y0 = 0.1173 ft

AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (OU1MW8)

Initial Displacement: 1.563 ft
Total Well Penetration Depth: 13. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 7.62 ft
Screen Length: 10. ft
Well Radius: 0.0833 ft
Gravel Pack Porosity: 0.4

APPENDIX E THREATENED AND ENDANGERED SPECIES REPORTS

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Indiana Ecological Services Field Office
620 South Walker Street
Bloomington, IN 47403-2121
Phone: (812) 334-4261 Fax: (812) 334-4273
http://www.fws.gov/midwest/Endangered/section7/s7process/step1.html

In Reply Refer To: September 13, 2018
Consultation Code: 03E12000-2018-SLI-1866
Event Code: 03E12000-2018-E-06244
Project Name: USS Lead Environmental Assessment

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The attached species list identifies any federally threatened, endangered, proposed and candidate species that may occur within the boundary of your proposed project or may be affected by your proposed project. The list also includes designated critical habitat if present within your proposed project area or affected by your project. This list is provided to you as the initial step of the consultation process required under section 7(c) of the Endangered Species Act, also referred to as Section 7 Consultation.

Section 7 of the Endangered Species Act of 1973 requires that actions authorized, funded, or carried out by Federal agencies not jeopardize federally threatened or endangered species or adversely modify designated critical habitat. To fulfill this mandate, Federal agencies (or their designated non-federal representative) must consult with the Service if they determine their project “may affect” listed species or critical habitat.

Under 50 CFR 402.12(e) (the regulations that implement Section 7 of the Endangered Species Act) the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally. You may verify the list by visiting the ECOS-IPaC website http://ecos.fws.gov/ipac/ at regular intervals during project planning and implementation and completing the same process you used to receive the attached list. As an alternative, you may contact this Ecological Services Field Office for updates.

Please use the species list provided and visit the U.S. Fish and Wildlife Service's Region 3 Section 7 Technical Assistance website at - http://www.fws.gov/midwest/endangered/section7/s7process/index.html. This website contains step-by-step instructions which will help you determine if your project will have an adverse effect on listed species and will help lead you through the Section 7 process.

For all wind energy projects and projects that include installing towers that use guy wires or are over 200 feet in height, please contact this field office directly for assistance, even if no federally listed plants, animals or critical habitat are present within your proposed project or may be affected by your proposed project.

Although no longer protected under the Endangered Species Act, be aware that bald eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.) and Migratory Bird Treaty Act (16 U.S.C. 703 et seq), as are golden eagles. Projects affecting these species may require measures to avoid harming eagles or may require a permit. If your project is near an eagle nest or winter roost area, see our Eagle Permits website at http://www.fws.gov/midwest/midwestbird/EaglePermits/index.html to help you determine if you can avoid impacting eagles or if a permit may be necessary.

We appreciate your concern for threatened and endangered species. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Indiana Ecological Services Field Office
620 South Walker Street
Bloomington, IN 47403-2121
(812) 334-4261

Project Summary

Consultation Code: 03E12000-2018-SLI-1866

Event Code: 03E12000-2018-E-06244

Project Name: USS Lead Environmental Assessment

Project Type: LAND - RESTORATION / ENHANCEMENT

Project Description: Wetland delineation

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/41.61463618251194N87.46457880491778W

Counties: Lake, IN

Endangered Species Act Species

There is a total of 2 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 1 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Mammals

NAME	STATUS
Indiana Bat Myotis sodalis There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5949 Species survey guidelines: https://ecos.fws.gov/ipac/guideline/survey/population/1/office/31440.pdf	Endangered
Northern Long-eared Bat Myotis septentrionalis No critical habitat has been designated for this species. This species only needs to be considered under the following conditions: ▪ Incidental take of the NLEB is not prohibited here. Federal agencies may consult using the 4(d) rule streamlined process. Transportation projects may consult using the programmatic process. See www.fws.gov/midwest/endangered/mammals/nleb/index.html Species profile: https://ecos.fws.gov/ecp/species/9045 Species survey guidelines: https://ecos.fws.gov/ipac/guideline/survey/population/10043/office/31440.pdf	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

Division of Nature Preserves
402 W. Washington St., Rm W267
Indianapolis, IN 46204-2739

September 18, 2018

James Smit
Project Scientist
ERM
3352 128th Ave
Holland, MI 49424

Dear James Smit:

I am responding to your request for information on the endangered, threatened, or rare (ETR) species, high quality natural communities, and natural areas for a project located at 5300 Kennedy Avenue, East Chicago, Lake County, Indiana, Parcel ID 45-03-33-300-002.000-024. The Indiana Natural Heritage Data Center has been checked and included you will find a datasheet with information on the ETR species documented within 0.5 mile of the project area.

Additionally, Seidner Dune and Swale State Dedicated Nature Preserve and associated DNR property are located immediately adjacent across Kennedy Avenue from the site being investigated. The two sites are owned by the Department of Natural Resources' Division of Nature Preserves and Shirley Heinze Land Trust. Please contact DNR-DNP Regional Ecologist Emily Stork (estork@dnr.in.gov, (219) 688-0632) for more information about the properties and for impact coordination.

For more information on the animal species mentioned, please contact Christie Stanifer, Environmental Coordinator, Division of Fish and Wildlife, 402 W. Washington Room W273, Indianapolis, Indiana, 46204, (317)232-8163. The two vascular plant species documented are located within Seidner Dune and Swale Nature Preserve and not located precisely on the site being investigated.

The information I am providing does not preclude the requirement for further consultation with the U.S. Fish and Wildlife Service as required under Section 7 of the Endangered Species Act of 1973. If you have concerns about potential Endangered Species Act issues you should contact the Service at their Bloomington, Indiana office.

U.S. Fish and Wildlife Service
620 South Walker St.
Bloomington, Indiana 47403-2121
812-334-4261

At some point, you may need to contact the Department of Natural Resources' Environmental Review Coordinator so that other divisions within the department have the opportunity to review your proposal.

For more information, please contact:

Department of Natural Resources
Attn: Christie Stanifer
Environmental Coordinator
Division of Fish and Wildlife
402 W. Washington Street, Room W273
Indianapolis, IN 46204
(317)232-8163

Please note that the Indiana Natural Heritage Data Center relies on the observations of many individuals for our data. In most cases, the information is not the result of comprehensive field surveys conducted at particular sites. Therefore, our statement that there are no documented significant natural features at a site should not be interpreted to mean that the site does not support special plants or animals.

Due to the dynamic nature and sensitivity of the data, this information should not be used for any project other than that for which it was originally intended. It may be necessary for you to request updated material from us in order to base your planning decisions on the most current information.

Thank you for contacting the Indiana Natural Heritage Data Center. You may reach me at (317)232-3517 if you have any questions or need additional information.

Sincerely,

Teresa Clark

Teresa L. Clark
Indiana Natural Heritage Data Center

Enclosure: invoice
datasheet

September 18, 2018

INDIANA HERITAGE DATA WITHIN 0.5 MILES OF:

5300 Kennedy Avenue, East Chicago, Lake County, Parcel 45-03-33-300-002.000-024

Sci. Name	Com. Name	State	Fed.	Date	TRS	Site
Amphibian						
Acris blanchardi	Northern Cricket Frog	SSC		2008	037N009W 33	SEIDNER DUNE AND SWALE
Bird						
Chlidonias niger	Black Tern	SE		1991	037N009W 33 NH SEQ	GRAND CALUMET RIVER
Cistothorus palustris	Marsh Wren	SE		1987	037N009W 33 SEQ	SEIDNER DUNES
Rallus limicola	Virginia Rail	SE		2017	037N009W 33	SEIDNER DUNE AND SWALE NP
Ardea alba	Great Egret	SSC		1988	037N009W 33 NEQ SEQ	SEIDNER DUNES
Ardea alba	Great Egret	SSC		2017	037N009W 33	DUPONT NATURAL AREA
Haliaeetus leucocephalus	Bald Eagle	SSC		2016	037N009W 33	EAST CHICAGO
Insect Homoptera						
Cosmotettix bilineatus	Two-lined cosmotettix	ST		2003	037N009W 34	SEIDNER DUNE AND SWALE NATURE PRESERVE
Insect Lepidoptera						
Digrammia eremiata	The Goat's Rue Looper	SR		2001	037N009W 33 SEQ	SEIDNER DUNE AND SWALE
Grammia phyllira	The Sand Barrens Grammia	SR		2001	037N009W 33 SEQ	SEIDNER DUNE AND SWALE
Hesperia leonardus	Leonard's Skipper	SR		2001	037N009W 33 SEQ	SEIDNER DUNE AND SWALE
Peoria gemmatella	Gemmed Cordgrass Borer	SR		2001	037N009W 33 SEQ	SEIDNER DUNES AND SWALES

Fed: LE= Listed Federal endangered; C = Federal candidate species

State: SE = State endangered; ST= State threatened; SR = State rare; SSC = State species of special concern; SG = State significant; WL = watch list; no rank - not ranked but tracked to monitor status

Sci. Name	Com. Name	State	Fed.	Date	TRS	Site
Mammal						
Spermophilus franklinii	Franklin's Ground Squirrel	SE		2002	037N009W 33 SEQ	RESCO REFRACTORIES
Spermophilus franklinii	Franklin's Ground Squirrel	SE		1992	036N009W 4	GIBSON WOODS
Spermophilus franklinii	Franklin's Ground Squirrel	SE		1992	037N009W 33 SWQ NWQ	
Reptile						
Thamnophis proximus proximus	Western Ribbon Snake	SSC		2008	037N009W 33	SMITH WETLAND
Vascular Plant						
Juncus balticus var. littoralis	Baltic Rush	SR		2001	037N009W 33 SWQ	SEIDNER DUNE AND SWALE
Betula papyrifera	Paper Birch	WL		2017	037N009W 33	SEIDNER DUNE & SWALE NP

Fed: LE= Listed Federal endangered; C = Federal candidate species

State: SE = State endangered; ST= State threatened; SR = State rare; SSC = State species of special concern; SG = State significant; WL = watch list; no rank - not ranked but tracked to monitor status

APPENDIX F WASTE MANIFESTS

Please print or type.

Form Approved. OMB No. 2050-0039

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator ID Number: INCESQG
2. Page 1 of: 1
3. Emergency Response Phone: (877) 818-0087
4. Manifest Tracking Number: 001686565 VES

GENERATOR

5. Generator's Name and Mailing Address: NORM JOHNSON
USS LEAD C/O MINING REMEDIAL RECOVERY COMPANY
4780 CATERPILLAR ROAD
REDDING, CA 96003
Generator's Phone: 530 351-3314

Generator's Site Address (if different than mailing address):
5300 KENNEDY AVENUE
EAST CHICAGO, IN 46312

6. Transporter 1 Company Name: VEOLIA ES TECHNICAL SOLUTIONS
U.S. EPA ID Number: NJD080631369

7. Transporter 2 Company Name:
U.S. EPA ID Number:

8. Designated Facility Name and Site Address: VEOLIA ES TECHNICAL SOLUTIONS
W124 N9451 BOUNDARY RD.
MENOMONEE FALLS, WI 53051
Facility's Phone: 262 255-6655
U.S. EPA ID Number: WID003967148

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
X	1. NA3082, HAZARDOUS WASTE, LIQUID, n.o.s., (ARSENIC), 9, III, RQ (D004)	2	DM	110	G	D004
	2. NON-REGULATED MATERIAL, NON-RCRA, NON-DOT., (NON HAZARDOUS PURGE WATER)	~~[illegible]~~ 17	DM	~~[illegible]~~ 935	G	NONE
	3. NON-REGULATED MATERIAL, NON-RCRA, NON-DOT., (NON HAZARDOUS SOIL CUTTINGS)	15	DM	825	G	NONE
	4.					

14. Special Handling Instructions and Additional Information: ER Service Contracted by VESTS +OU36185 + 1) ERG:171 W:471450 A:CWDSGRHAZL OU36185 2) W:471449 A:CWDSGRNHL OU36185 3) W:471451 A:CWDSGRNHS OU36185

15. **GENERATOR'S/OFFEROR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent.
I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.

Generator's/Offeror's Printed/Typed Name: [illegible handwriting]
Signature: [signature]
Month 6 Day 11 Year 19

INT'L

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

TRANSPORTER

17. Transporter Acknowledgment of Receipt of Materials
Transporter 1 Printed/Typed Name: BONELL HANKINS
Signature: [signature]
Month 6 Day 11 Year 19

Transporter 2 Printed/Typed Name: Signature: Month Day Year

DESIGNATED FACILITY

18. Discrepancy
18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection
Manifest Reference Number:

18b. Alternate Facility (or Generator) U.S. EPA ID Number
Facility's Phone:

18c. Signature of Alternate Facility (or Generator) Month Day Year

19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)
1. 2. 3. 4.

20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in Item 18a
Printed/Typed Name Signature Month Day Year

VEOLIA
ENVIRONMENTAL SERVICES

SHIPPING DOCUMENT

1. Generator ID Number	INCESQG
2. Page 1 of	1
3. Emergency Response Phone	(877) 818-0087
4. Shipping Document Tracking Number	ZZ 00807976

GENERATOR

5. Generator's Name and Mailing Address
NORM JOHNSON
USS LEAD C/O MINING REMEDIAL RECOVERY COMPANY
4730 CATERPILLAR ROAD
REDDING, CA 96003
Generator's Phone: 530 351-2314

Generator's Site Address (if different than mailing address)
5300 KENNEDY AVENUE
EAST CHICAGO, IN 46312

6. Transporter 1 Company Name: VEOLIA ES TECHNICAL SOLUTIONS
U.S. EPA ID Number: NJD080631369

7. Transporter 2 Company Name:
U.S. EPA ID Number:

8. Designated Facility Name and Site Address
VEOLIA ES TECHNICAL SOLUTIONS,
W134 N9451 BOUNDARY
MENOMONEE FALLS, WI 53051
Facility's Phone: 262 255-6655
U.S. EPA ID Number: WID003967148

9a. HM	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	10. Containers Type	11. Total Quantity	12. Unit Wt./Vol.	13. Codes
	1. NON-REGULATED MATERIAL, NON-RCRA, NON-DOT	3	DM	165	G	NONE
	2.					
	3.					
	4.					

14. Special Handling Instructions and Additional Information
ER Service Contracted by VESTS + Contract retained by generator confers agency authority on initial transporter to add or substitute additional transporters on generator's behalf. + 1) W471449 A: CWDSGRNHL

15. **GENERATOR S/OFFEROR S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Generator's/Offeror's Printed/Typed Name: | Signature: | Month 10 Day 28 Year 19

INT'L

16. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit:
Transporter signature (for exports only): Date leaving U.S.:

TRANSPORTER

17. Transporter Acknowledgment of Receipt of Shipment
Transporter 1 Printed/Typed Name: MELISSA STICK | Signature: Melissa Stick | Month 10 Day 29 Year 19
Transporter 2 Printed/Typed Name: | Signature: | Month Day Year

DESIGNATED FACILITY

18. Discrepancy
18a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection
Shipping Document Tracking Number:
18b. Alternate Facility (or Generator) | U.S. EPA ID Number
Facility's Phone:
18c. Signature of Alternate Facility (or Generator) | Month Day Year

19. Report Management Method Codes (i.e., codes for treatment, disposal, and recycling systems)
1. 2. 3. 4.

20. Designated Facility Owner or Operator: Certification of receipt of shipment except as noted in Item 18a
Printed/Typed Name | Signature | Month Day Year

GENERATOR / SHIPPER'S INITIAL COPY

APPENDIX G SOIL ANALYTICAL DATA USED IN THIS REMEDIAL INVESTIGATION

Table G-1
Historical Soil Analytical Data
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical	Antimony		Arsenic		Cadmium		Iron		Lead		Selenium	
			Unit	mg/kg		mg/kg		mg/kg		mg/kg		mg/kg		mg/kg	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier
1532A-SP9	1532A-SP9_SO_20000106	N	06 Jan 2000	< 31								< 5			
SS-02-03	SS-02-03_SO_20000914	N	14 Sep 2000	78								438			
SS-02-04	SS-02-04_SO_20000914	N	14 Sep 2000	12								42			
SS-02-05	SS-02-05_SO_20000914	N	14 Sep 2000	30								365			
SS-02-06	SS-02-06_SO_20000914	N	14 Sep 2000	35								168			
SS-04-031	SS-04-031_SO_20000918	N	18 Sep 2000	< 5.7								< 148			
SS-04-041	SS-04-041_SO_20000918	N	18 Sep 2000	14								712			
SS-04-042	SS-04-042_SO_20000918	N	18 Sep 2000	< 5.3								19			
SS-04-043	SS-04-043_SO_20000918	N	18 Sep 2000	< 5.5								10			
SS-04-044	SS-04-044(3')_SO_20000918	N	18 Sep 2000	< 6.60								< 5.30			
SS-04-045	SS-04-045(4')_SO_20000918	N	18 Sep 2000	< 6.60								6.3			
SS-04-046	SS-04-046(5')_SO_20000918	N	18 Sep 2000	< 6.50								< 5.20			
SS-04-051	SS-04-051_SO_20000918	N	18 Sep 2000	12								762			
SS-04-052	SS-04-052_SO_20000918	N	18 Sep 2000	< 5.4								11			
SS-04-053	SS-04-053_SO_20000918	N	18 Sep 2000	< 6.4								< 5.1			
SS-05-04	SS-05-04_SE_20000919	N	19 Sep 2000									< 4.8			
SS-06-02	SS-06-02_SO_20000921	N	21 Sep 2000	< 6.4		69		< 0.64				5.2		< 1.9	
S-1A	S-1A_SO_20010320	N	20 Mar 2001									21.2			
S-1B	S-1B_SO_20010320	N	20 Mar 2001									47.3			
S-2A	S-2A_SO_20010320	N	20 Mar 2001									7.3			
S-2B	S-2B_SO_20010320	N	20 Mar 2001									< 3.9			
S-3A	S-3A_SO_20010320	N	20 Mar 2001									280			
S-3B	S-3B_SO_20010320	N	20 Mar 2001									11			
S-4A	S-4A_SO_20010320	N	20 Mar 2001									10.6			
S-4B	S-4B_SO_20010320	N	20 Mar 2001									12.5			
S-7A	S-7A_SO_20010320	N	20 Mar 2001									10.1			
S-7B	S-7B_SO_20010320	N	20 Mar 2001									5.3			
SS-21-04	SS-21-04_SO_20010405	N	05 Apr 2001	< 1.5		2.1		< 0.1				1.9			
SS-21-05	SS-21-05_SO_20010405	N	05 Apr 2001	< 1.6		2.1		< 0.11				1.7			
SS-21-06	SS-21-06_SO_20010405	N	05 Apr 2001	< 1.5		1.8		< 0.11				1.8			
SS-21-07	SS-21-07_SO_20010405	N	05 Apr 2001	2.3		1.7		< 0.11				1.8			
SS-21-11	SS-21-11_SO_20010405	N	05 Apr 2001	5.9		13.5		0.1				47			
SS-21-12	SS-21-12_SO_20010405	N	05 Apr 2001	11.4		17.6		0.81				331			
SS-30-01	SS-30-01_SO_20010719	N	19 Jul 2001	< 1.5		2		< 0.14				12.1			
SS-30-03	SS-30-03_SO_20010719	N	19 Jul 2001	< 1.3		2.9		< 0.16				10			
SS-30-05	SS-30-05_SO_20010719	N	19 Jul 2001	9		12.9		< 0.17				41.6			
SS-30-06	SS-30-06_SO_20010719	N	19 Jul 2001	< 1.9		1.8		< 0.096				5.1			
SS-30-07	SS-30-07_SO_20010719	N	19 Jul 2001	2		2.6		< 0.086				21.8			
SS-30-08	SS-30-08_SO_20010719	N	19 Jul 2001	5.3		7.7		0.21				187			
MRFI-SS-14	MRFI-SS-14_SO_20030709	N	09 Jul 2003	13		12		0.14				24			
MRFI-SS-16	MRFI-SS-16_SO_20030709	N	09 Jul 2003	10		19		0.75				63			
MRFI-SS-17	MRFI-SS-17_SO_20030709	N	09 Jul 2003	46		59		2.5				470			
MRFI-SS-18	MRFI-SS-18_SO_20030709	N	09 Jul 2003	16		15		1.1				150			
MRFI-SS-19	MRFI-SS-19_SO_20030709	N	09 Jul 2003	160		65		3.3				820			
MRFI-SS-20	MRFI-SS-20_SO_20030709	N	09 Jul 2003	75		81		6.1				950			
MRFI-SS-21	MRFI-SS-21_SO_20030709	N	09 Jul 2003	< 1.7		3.4		0.13				< 22		< 0.09	
MRFI-SS-22	MRFI-SS-22_SO_20030709	N	09 Jul 2003	29		25		2.8				580			
MRFI-SS-23	MRFI-SS-23_SO_20030709	N	09 Jul 2003	100		64		2.6				710			
MRFI-SS-24	MRFI-SS-24_SO_20030709	N	09 Jul 2003	< 4		7.5		0.12				< 22		< 0.16	
SP-SD-6	SP-SD-6_SE_20071113	N	13 Nov 2007	9.7		61		8.4		170000		860		5.8	
XRF 11	XRF 11_SO_20071113	N	13 Nov 2007									168			
WSP-28	WSP-28_SO_20071114	N	14 Nov 2007									1057			
USS-1	USS1-SOIL-0-6_SE_061015	N	10 Jun 2015	17.4		18.2		1.47				362		2.18	
USS-2	USS2-SOIL-0-6_SE_061015	N	10 Jun 2015	19.8		23.1		1.54				311		1.45	
USS-3	USS3-SOIL-0-6_SE_061015	N	10 Jun 2015	68.1		39.6		4.09				962		5.31	
USS-4	USS4-SOIL-0-6_SE_061015	N	10 Jun 2015	3.57		4.6		0.85				198		0.914	
USS-5	USS5-SOIL-0-6_SE_061015	N	10 Jun 2015	69.1		101		3.29				657		4.07	
RI1	RI1-SO1-0-24-112718	N	27 Nov 2018	13		49		1.0		3800		100	J	0.35	J
RI2	RI2-SO1-0-24-112718	N	27 Nov 2018	210		410		6.5		19000		1000	J	1.2	
RI3	RI3-SO1-0-24-112718	N	27 Nov 2018	8.3		9.5		0.18		2600		23	J	0.67	
RI4	QC-SO-FD-1-112718	FD	27 Nov 2018	14		12		5.1		2400		110	J	0.64	J
RI4	RI4-SO1-0-24-112718	N	27 Nov 2018	12		8.4		3.8		2400		100	J	0.62	J
RI5	RI5-SO1-0-24-112718	N	27 Nov 2018	3.5		3.3		0.27		3100		23	J	< 0.64	U
RI6	RI6-SO1-0-24-112718	N	27 Nov 2018	11		40		12		3100		39	J	0.35	J

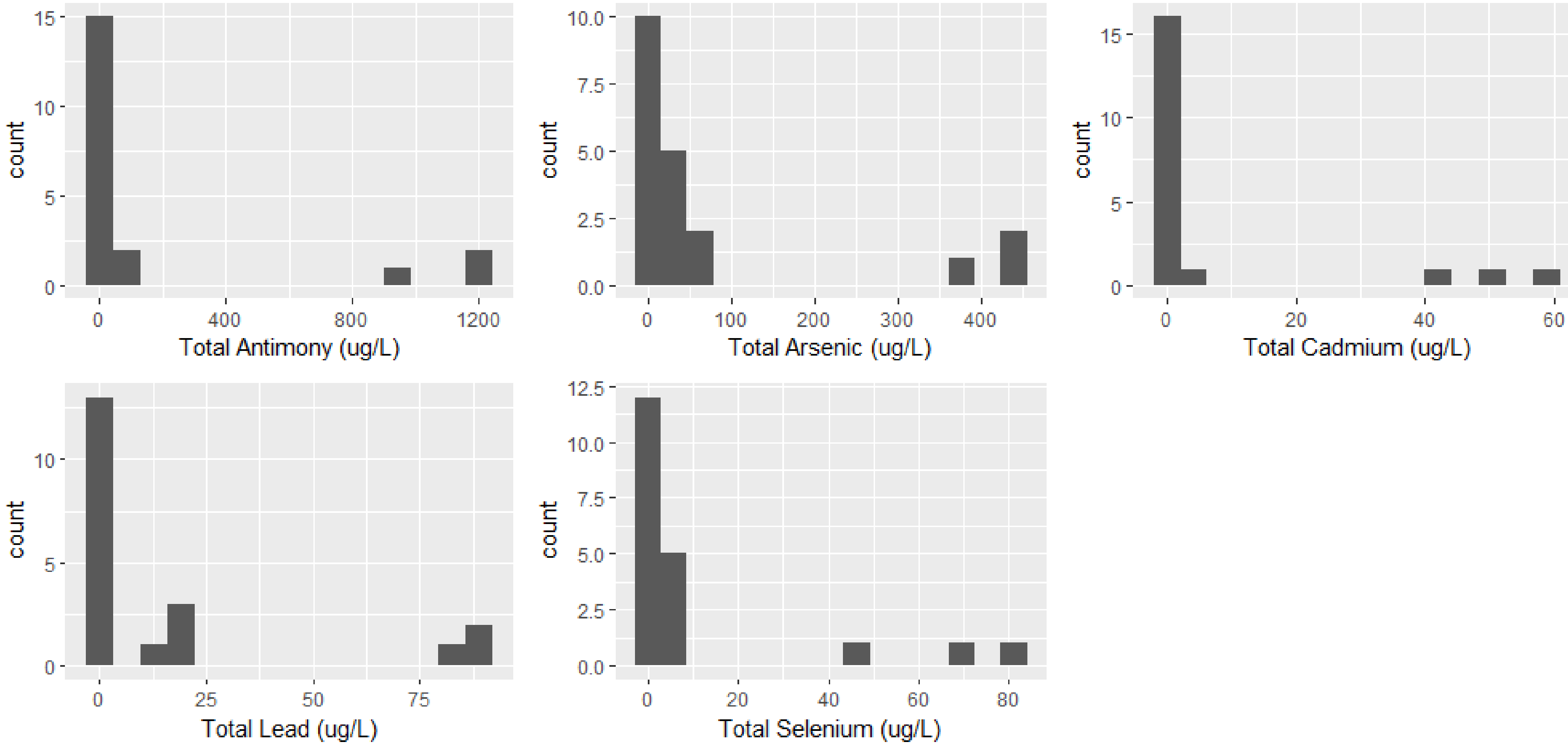
Table G-1
Historical Soil Analytical Data
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

RI7	RI7-SO1-0-24-112718	N	27 Nov 2018	17		3.1		1.7		3500		60	J	0.14	J
RI10	RI10-S01-0-24-091919	N	19 Sep 2019	65		630		2.9		13000	J+	580	J	1.3	
RI11	RI11-S01-0-24-091919	N	19 Sep 2019	77		340		2.2		6700	J+	710	J	0.76	
RI12	RI12-S01-0-24-091919	N	19 Sep 2019	9.3		82		12		2700	J+	35	J	< 0.60	U
RI13	RI13-S01-0-24-091919	N	19 Sep 2019	18		3.0		14		2400	J+	64	J	< 0.62	U
RI8	RI8-S01-0-24-091919	N	19 Sep 2019	33		36		0.73		5000	J+	270	J	0.38	J
RI9	QC-SO-FD-1-091919	FD	19 Sep 2019	220		140		1.9		10000	J+	820	J	0.97	
RI9	RI9-S01-0-24-091919	N	19 Sep 2019	210		150		1.9		9400	J+	1000	J	0.93	
MW21RE	MW21R(E)-S01-(0-2')-031121	N	11 Mar 2021	1.9		1.9		2.2		2200		34		< 0.39	U
MW21RE	MW21R(E)-S02-(2-4')-031121	N	11 Mar 2021	2.6	J-	1.8	J-	0.26	J-	2600	J-	4.7		< 0.60	UJ
MW21RE	MW21R(E)-S03-(4-6')-031121	N	11 Mar 2021	0.97	J-	1.3	J-	0.21	J-	2200	J-	1.4		< 0.61	UJ
MW21RE	QC-SO-FD-1-031121	FD	11 Mar 2021	2.7		1.9		2.5		2600		35	J-	< 0.44	U
MW21RW	MW21R(W)-S01-(0-2')-031121	N	11 Mar 2021	6.9		2.6		2.8		2900		1800	J-	0.18	
MW21RW	MW21R(W)-S02-(2-4')-031121	N	11 Mar 2021	3.4	J-	1.1	J-	6.6	J-	1200	J-	1500		< 0.61	UJ
MW21RW	MW21R(W)-S03-(4-6')-031121	N	11 Mar 2021	3.7	J-	0.87	J-	33	J-	1200	J-	1700		< 0.59	UJ
MW7N	MW7N -S01-(0-2')-031121	N	11 Mar 2021	34		13		0.23		3600		57	J-	0.28	
MW7N	MW7N -S02-(2-4')-031121	N	11 Mar 2021	11		10		0.076		2700		17		< 0.65	U
MW7N	MW7N -S03-(4-6')-031121	N	11 Mar 2021	9.6		11		0.032		3000		7.9		< 0.68	U
MW7NE	MW7 NE-S01-(0-2')-031121	N	11 Mar 2021	23		24		0.46		2600		41	J-	< 0.46	U
MW7NE	MW7 NE-S02-(2-4')-031121	N	11 Mar 2021	12		13		0.032		2100		2.8		0.20	
MW7NE	MW7 NE-S03-(4-6')-031121	N	11 Mar 2021	19		12		0.047		2500		4.4		0.22	
MW7SW	MW7 SW-S01-(0-2')-031121	N	11 Mar 2021	190		35		3.6		13000		800	J-	1.9	
MW7SW	MW7 SW-S02-(2-4')-031121	N	11 Mar 2021	10		16		0.16		2800		22		0.22	
MW7SW	MW7 SW-S03-(4-6')-031121	N	11 Mar 2021	9.2		12		0.091		4800		9.2		< 0.66	U
MW26B	MW26B-SO1-(0-2')-060321	N	03 Jun 2021	17	J	24	J-	3.8	J	5500	J	520	J	0.35	J
MW26B	MW26B-SO2-(2-4')-060321	N	03 Jun 2021	10	J	4.5	J-	73		3400	J	310	J	< 0.56	U
MW26B	MW26B-SO3-(4-6')-060321	N	03 Jun 2021	9.7	J	2.0	J-	80		2600	J	290	J	< 0.51	U
MW26B	QC-SO-FD-1-060321	FD	03 Jun 2021	12	J	29	J-	1.9	J	4900	J	640	J	0.34	J
MW26N	MW26N-SO1-(0-2')-060321	N	03 Jun 2021	11	J	5.5	J-	9.9		2900	J	88	J	0.30	J
MW26N	MW26N-SO2-(2-4')-060321	N	03 Jun 2021	110	J	130	J-	530		66000	J	250	J	< 15	U
MW26N	MW26N-SO3-(4-6')-060321	N	03 Jun 2021	3.6	J	4.4	J-	16		2500	J	11	J	< 0.52	U
MW26S	MW26S-SO1-(0-2')-060321	N	03 Jun 2021	6.1	J	5.2	J-	2.4		2400	J	600	J	< 0.44	U
MW26S	MW26S-SO2-(2-4')-060321	N	03 Jun 2021	5.2	J	2.4	J-	4.0		2200	J	130	J	< 0.45	U
MW26S	MW26S-SO3-(4-6')-060321	N	03 Jun 2021	5.0	J	1.4	J-	13		2600	J	49	J	< 0.53	U
MW26W	MW26W-SO1-(0-2')-060321	N	03 Jun 2021	5.8	J	4.1	J-	3.1		2600	J	320	J	< 0.50	U
MW26W	MW26W-SO2-(2-4')-060321	N	03 Jun 2021	3.8	J	2.3	J-	3.3		3600	J	21	J	< 0.60	U
MW26W	MW26W-SO3-(4-6')-060321	N	03 Jun 2021	2.8	J	1.5	J-	4.6		2400	J	9.3	J	< 0.56	U
MW7NW	MW7NW-SO1-(0-2')-060321	N	03 Jun 2021	54	J	31	J-	0.83		4300	J	160	J	0.51	J
MW7SSW	MW7SSW-SO1-(0-2')-060321	N	03 Jun 2021	1.9	J	67	J-	0.16		14000	J	31	J	0.11	J

Notes:
N = Normal (or investigative) sample
FD= Field Duplicate
J = (Estimated, Bias Indeterminate): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation. Bias is indeterminate.
J+ = (Estimated, High Bias): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated, displaying high bias, due to non-conformances discovered during data validation.
J- = (Estimated, Low Bias): The analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated, displaying low bias, due to non-conformances discovered during data validation.
U = (Non-detected): The analyte was analyzed for and positively identified by the laboratory; however the analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).
UJ = (Non-detected estimated): The analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.
mg/kg = milligrams per kilogram

Only data collected by ERM between 2018 and 2021 went through formal validation

APPENDIX H HISTOGRAMS



Legend

Groundwater OU1 Zone 1 Total Metal Histograms

Remedial Investigation Report - OU2 USS
Lead Superfund Site
East Chicago, Indiana

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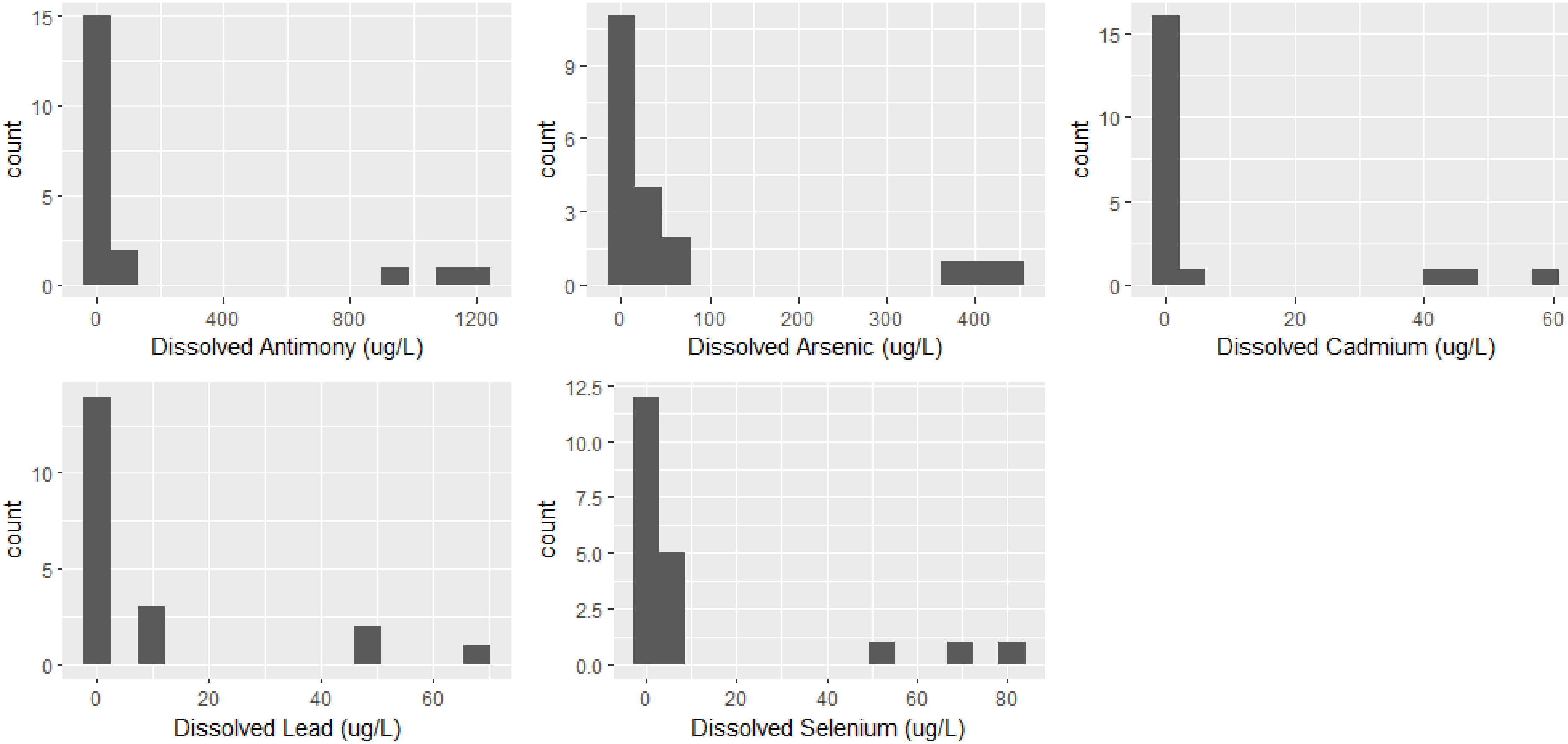
DRAWN BY: S. Vickery and A. Dillon



Legend

Groundwater OU1 Zone 1 Dissolved Metal Histograms

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USS Lead Superfund Site
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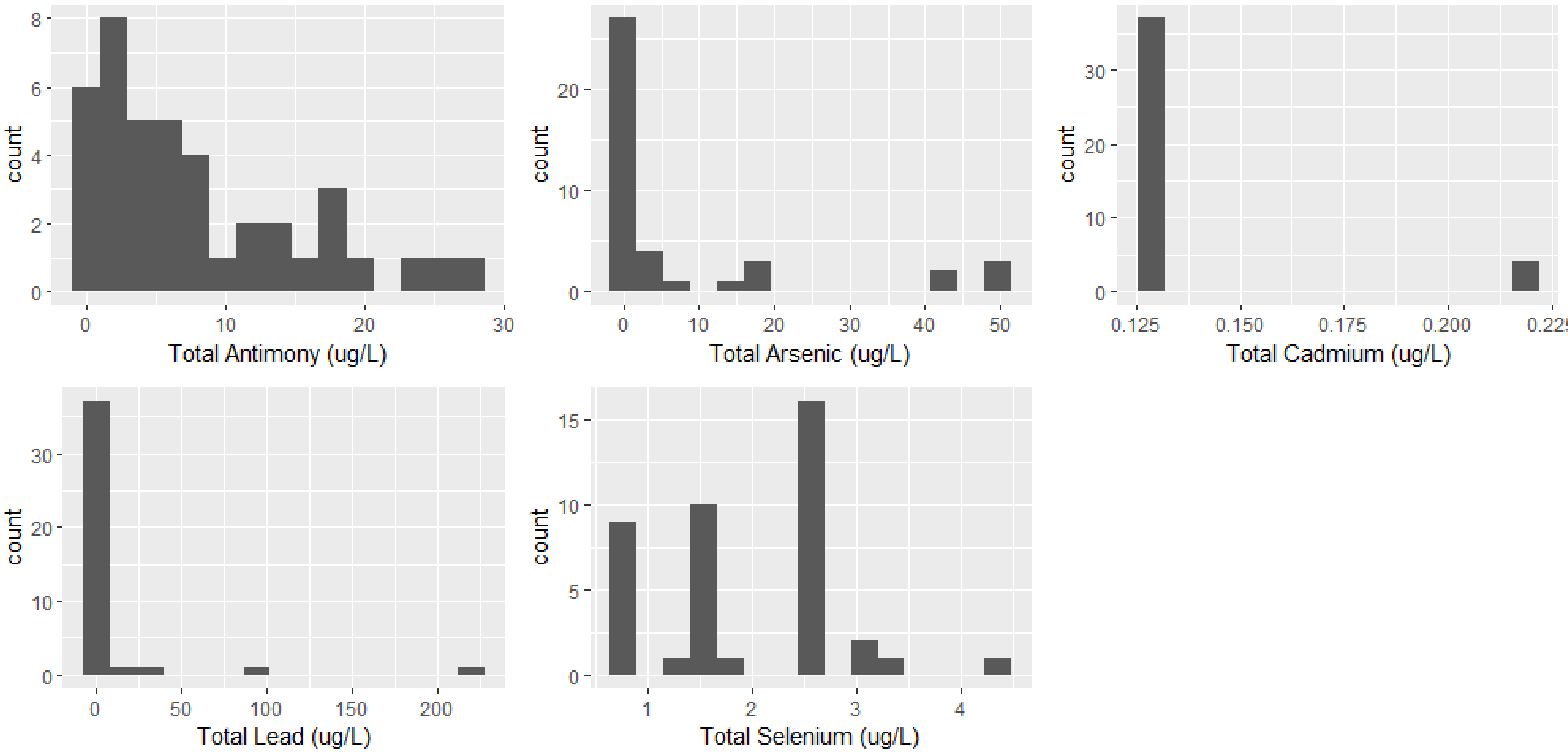

Legend

Groundwater OU1 Zone 2 & 3 Total Metal Histograms

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USS Lead Superfund Site
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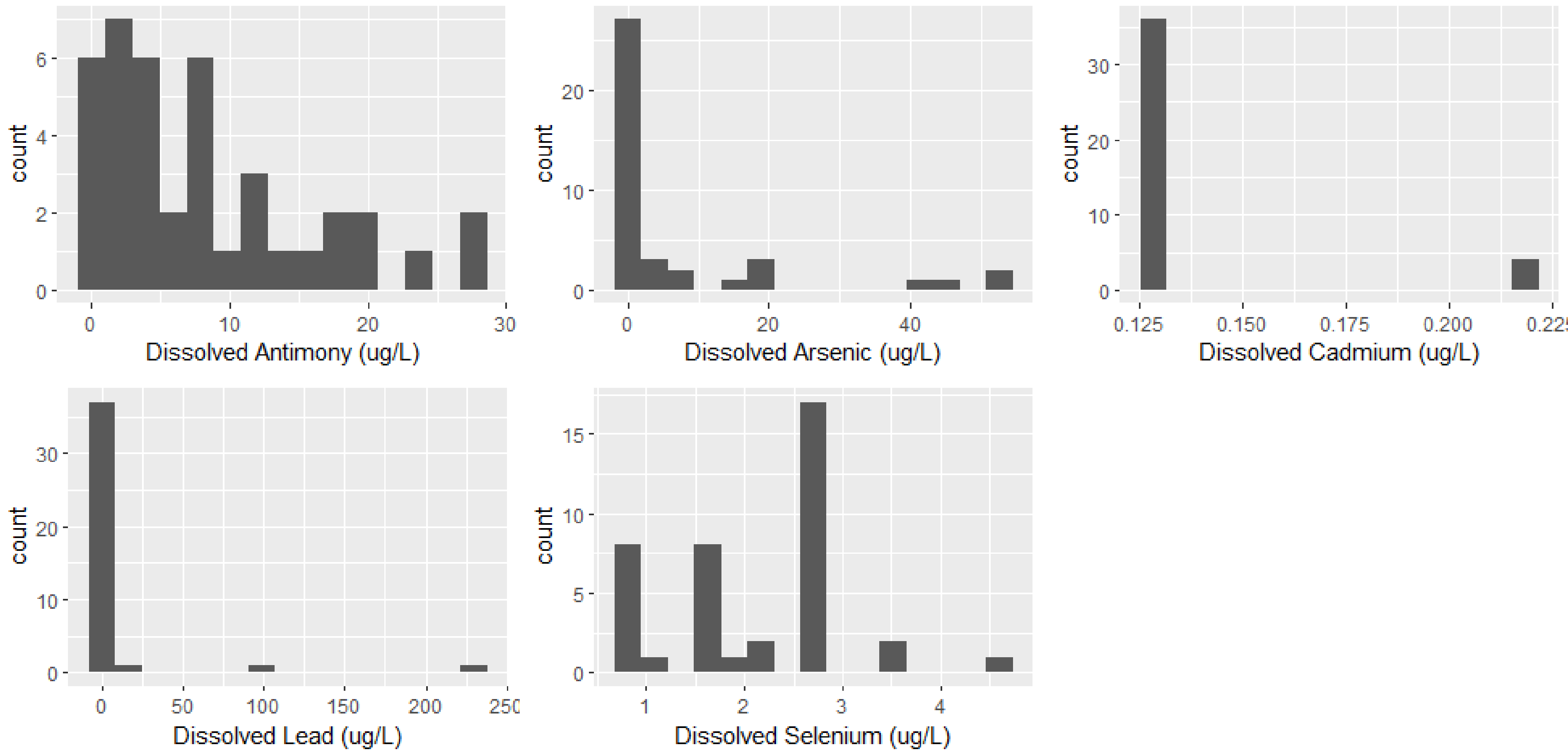

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Groundwater OU1 Zone 2 & 3 Dissolved Metal Histograms

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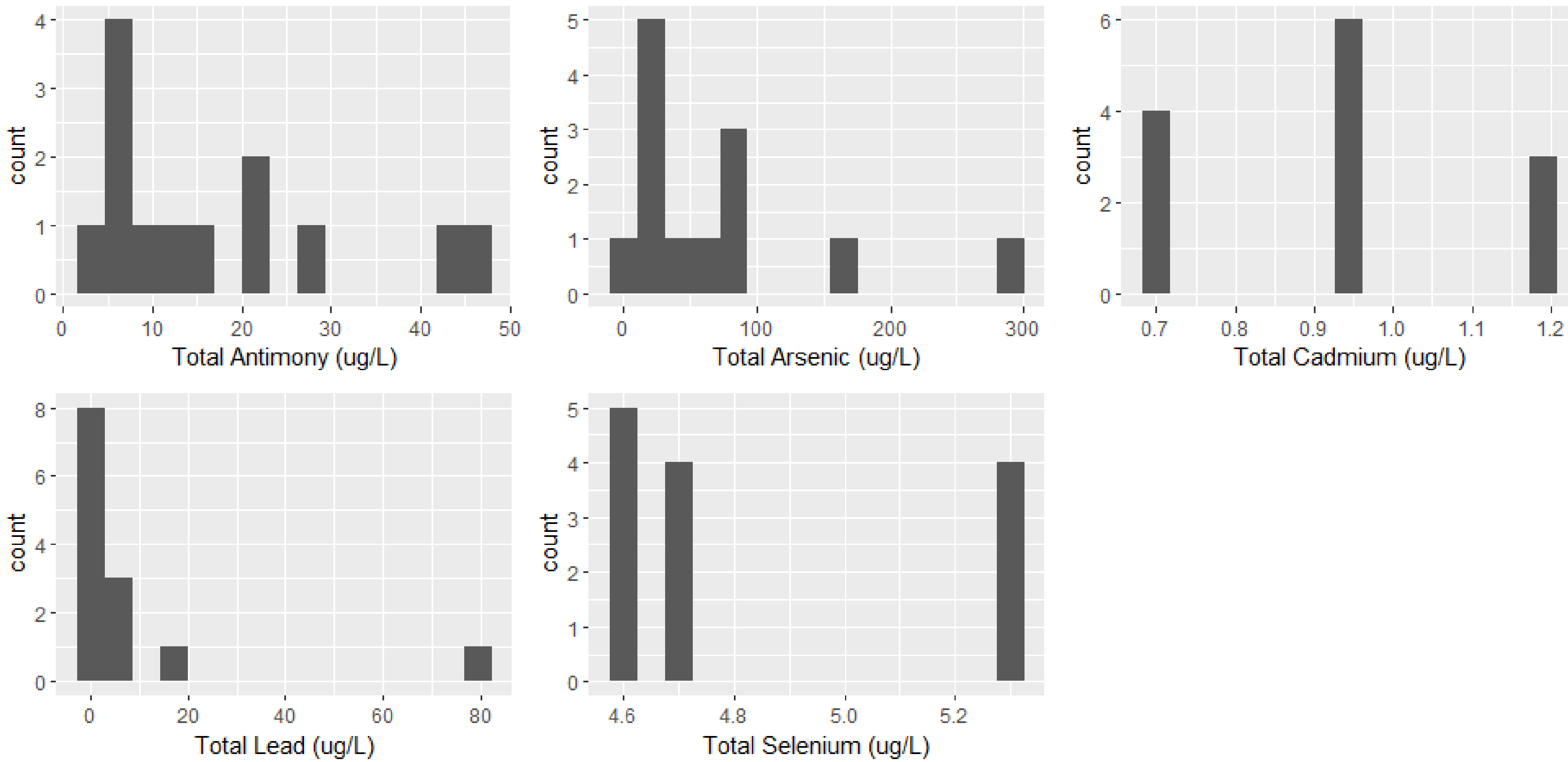

Legend

Surface Water Total Metal Histograms

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Superfund Site
East Chicago, Indiana

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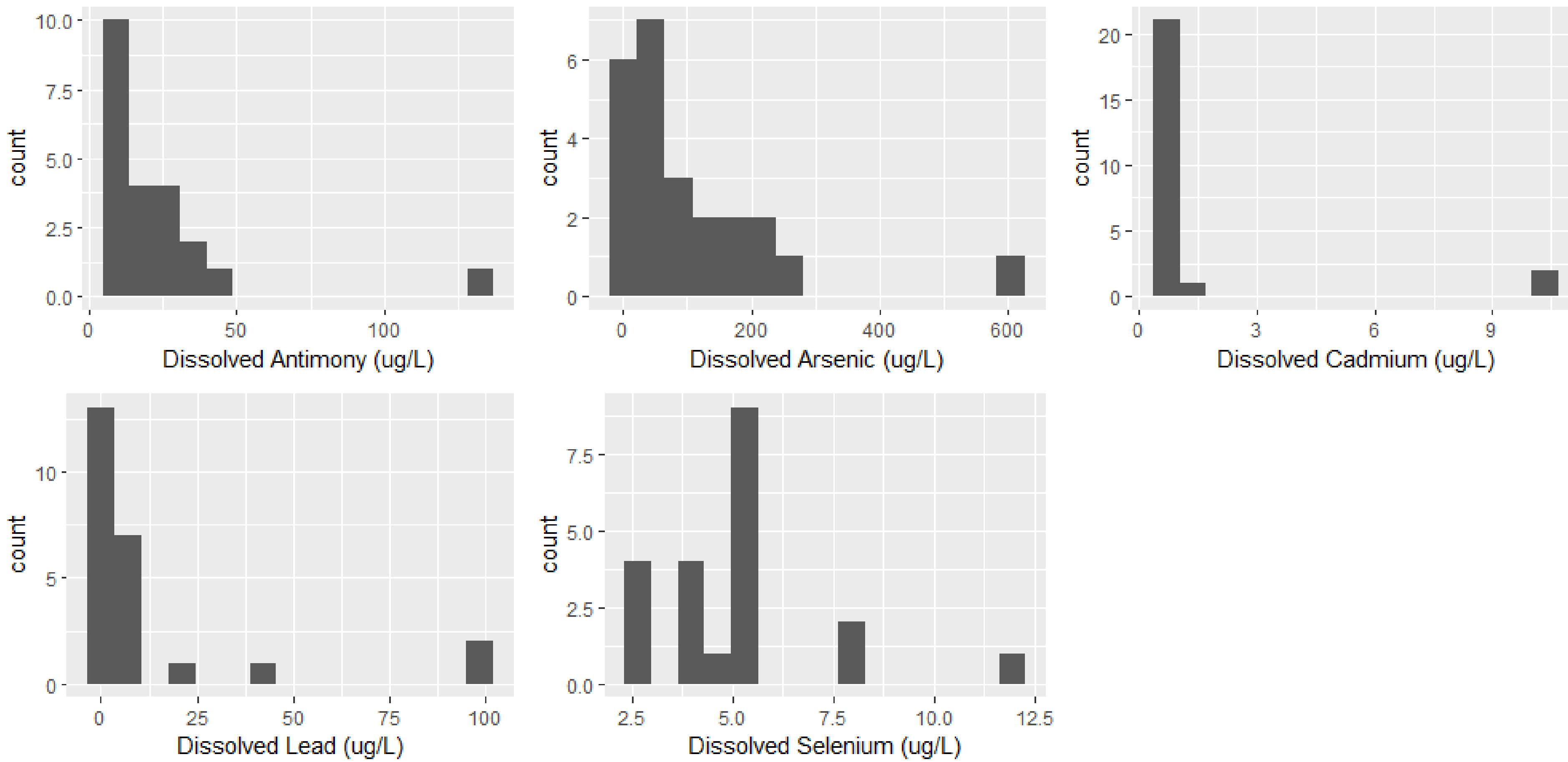
Source: Esri - World Topoographic Map;



Legend

Surface Water Dissolved Metal Histograms
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Superfund Site
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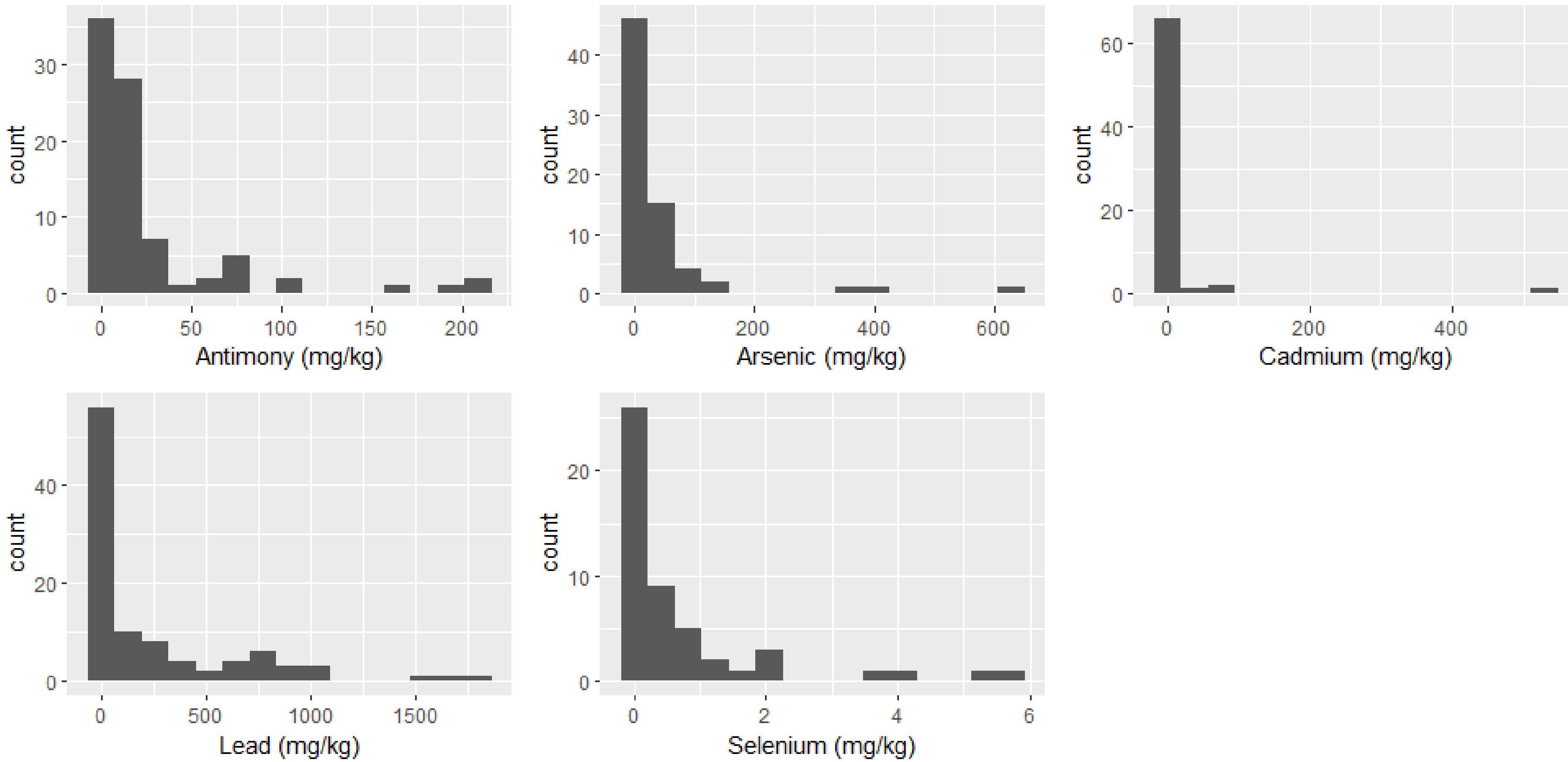

Legend

Soil Metal Histograms
Remedial Investigation Report - OU2 USS Lead
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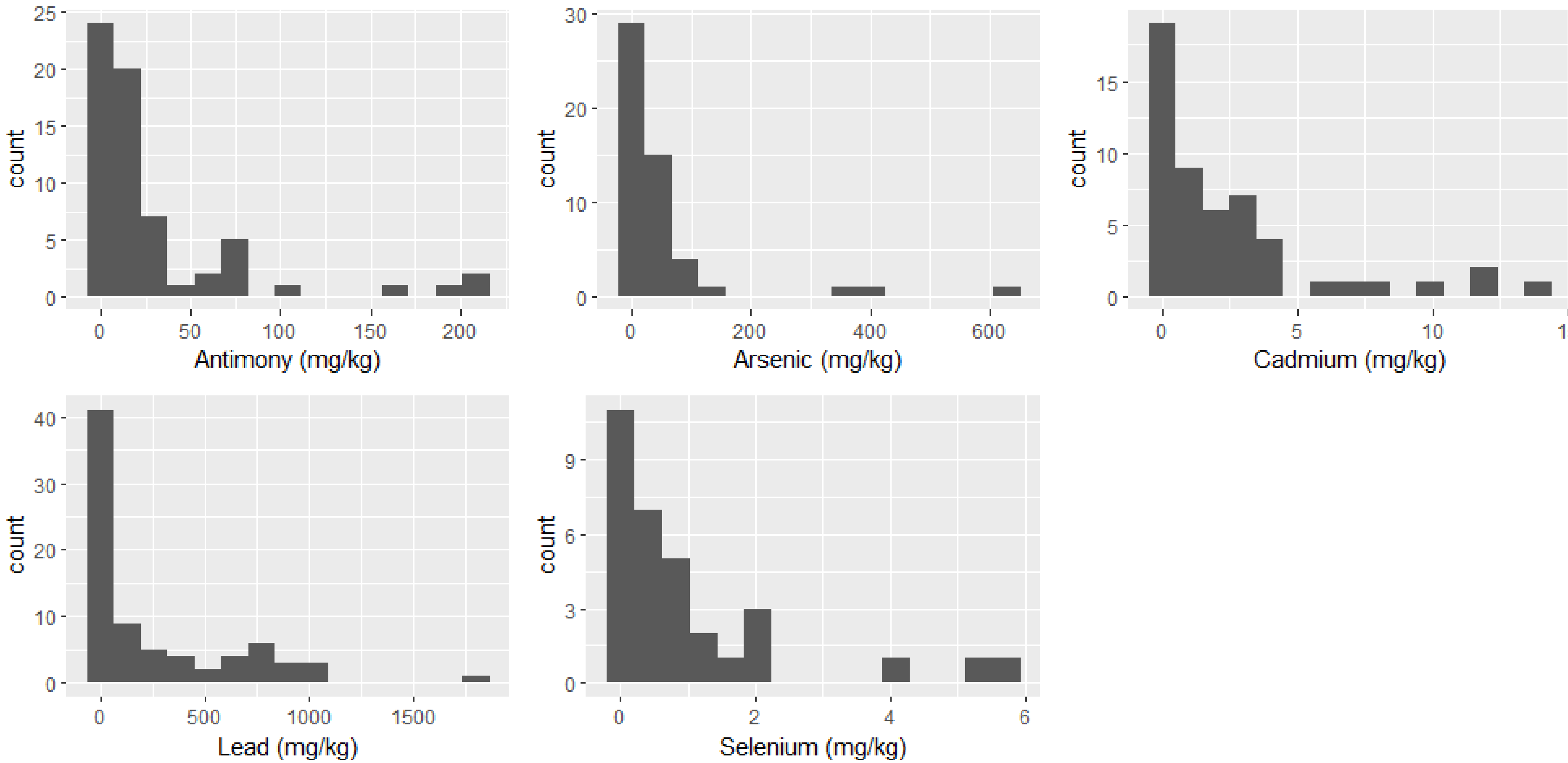
Source: Esri - World Topoographic Map;



Legend

Soil Shallow Metal Histograms
Remedial Investigation Report - OU2 USS Lead
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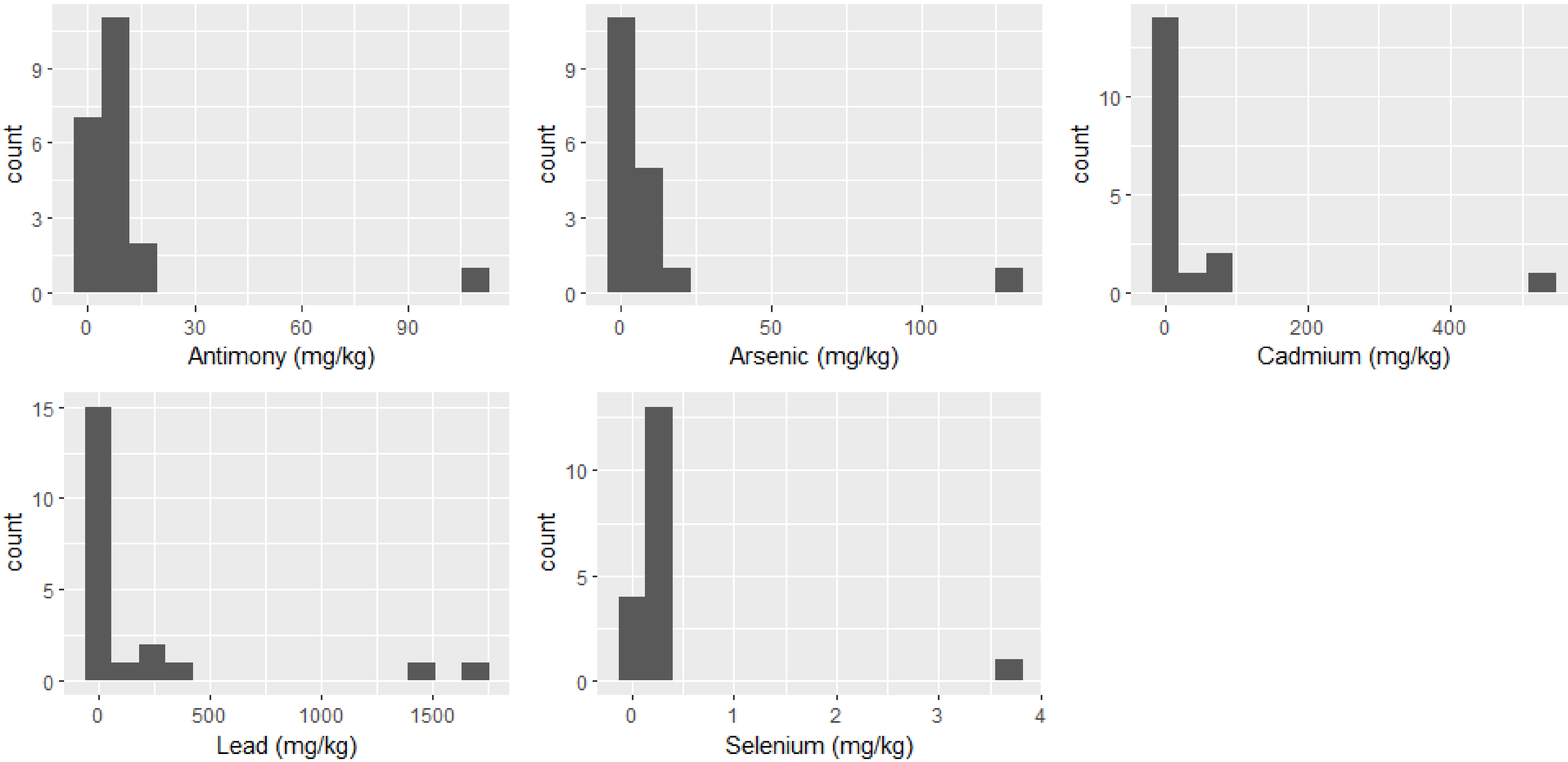
Source: Esri - World Topoographic Map;



Legend

Soil Deep Metal Histograms
Remedial Investigation Report - OU2 USS Lead
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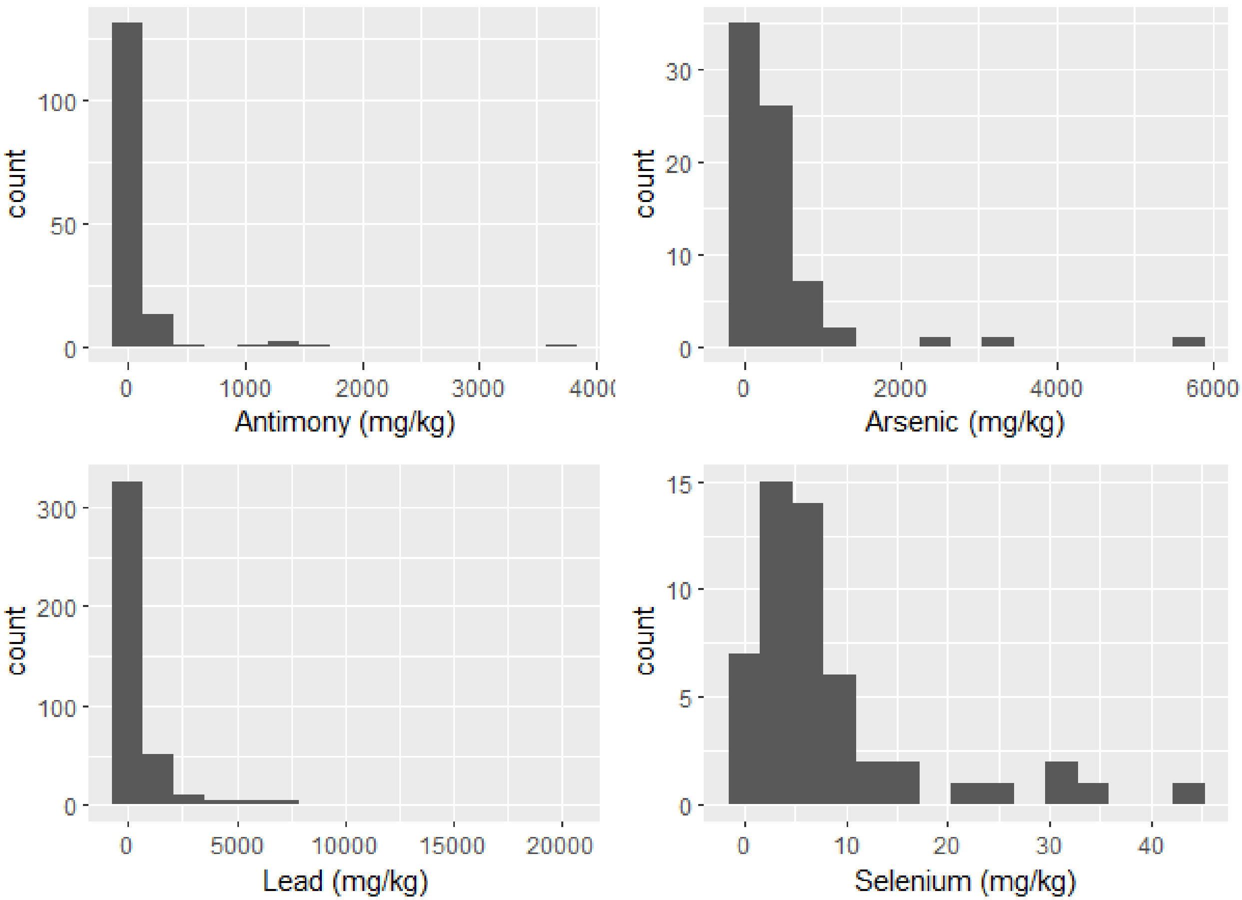
Source: Esri - World Topoographic Map;



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Sediment Shallow Metal Histograms
Remedial Investigation Report - OU2 USS Lead
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East Chicago, Indiana

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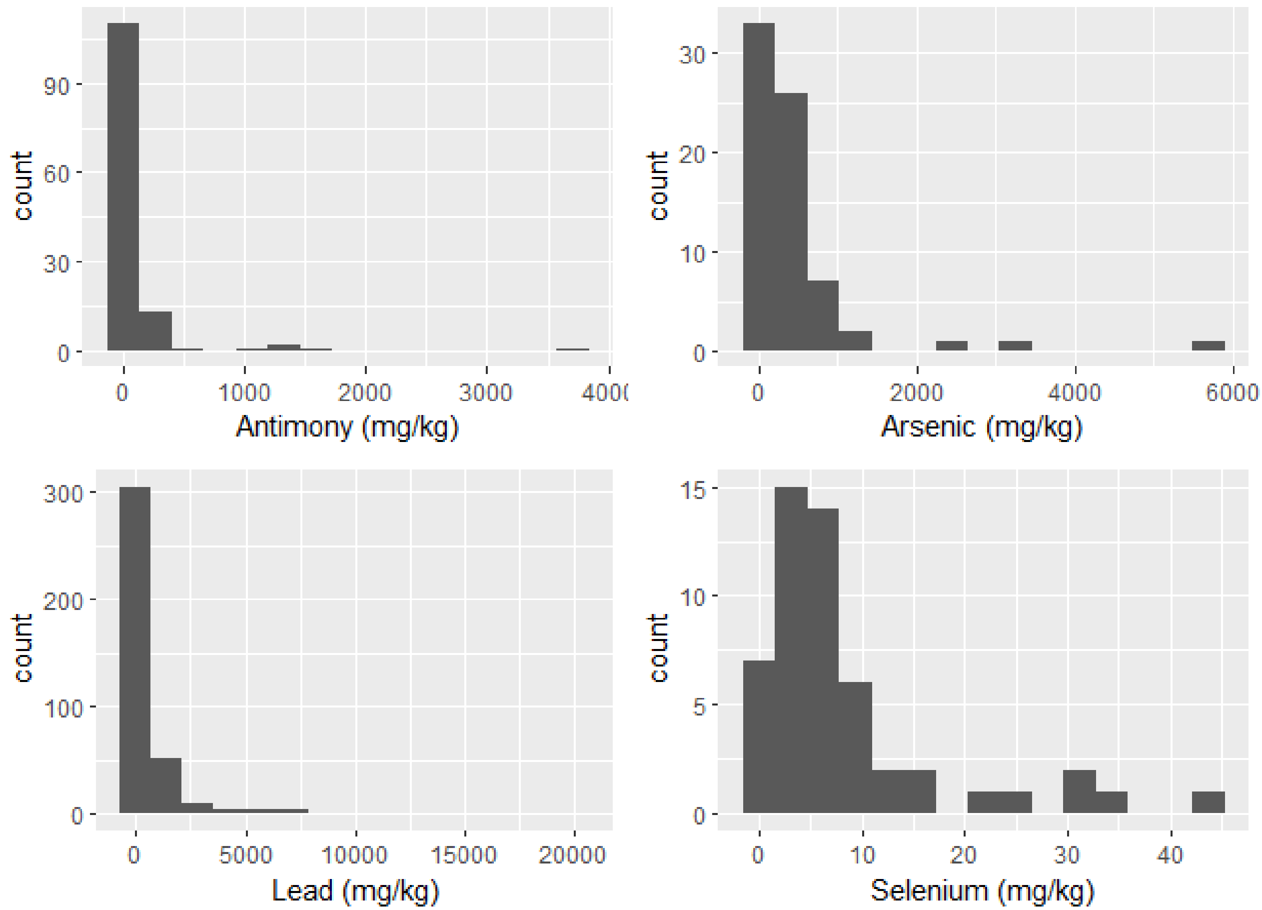
Source: Esri - World Topoographic Map;



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Sediment Shallow Metal Histograms
Remedial Investigation Report - OU2 USS Lead
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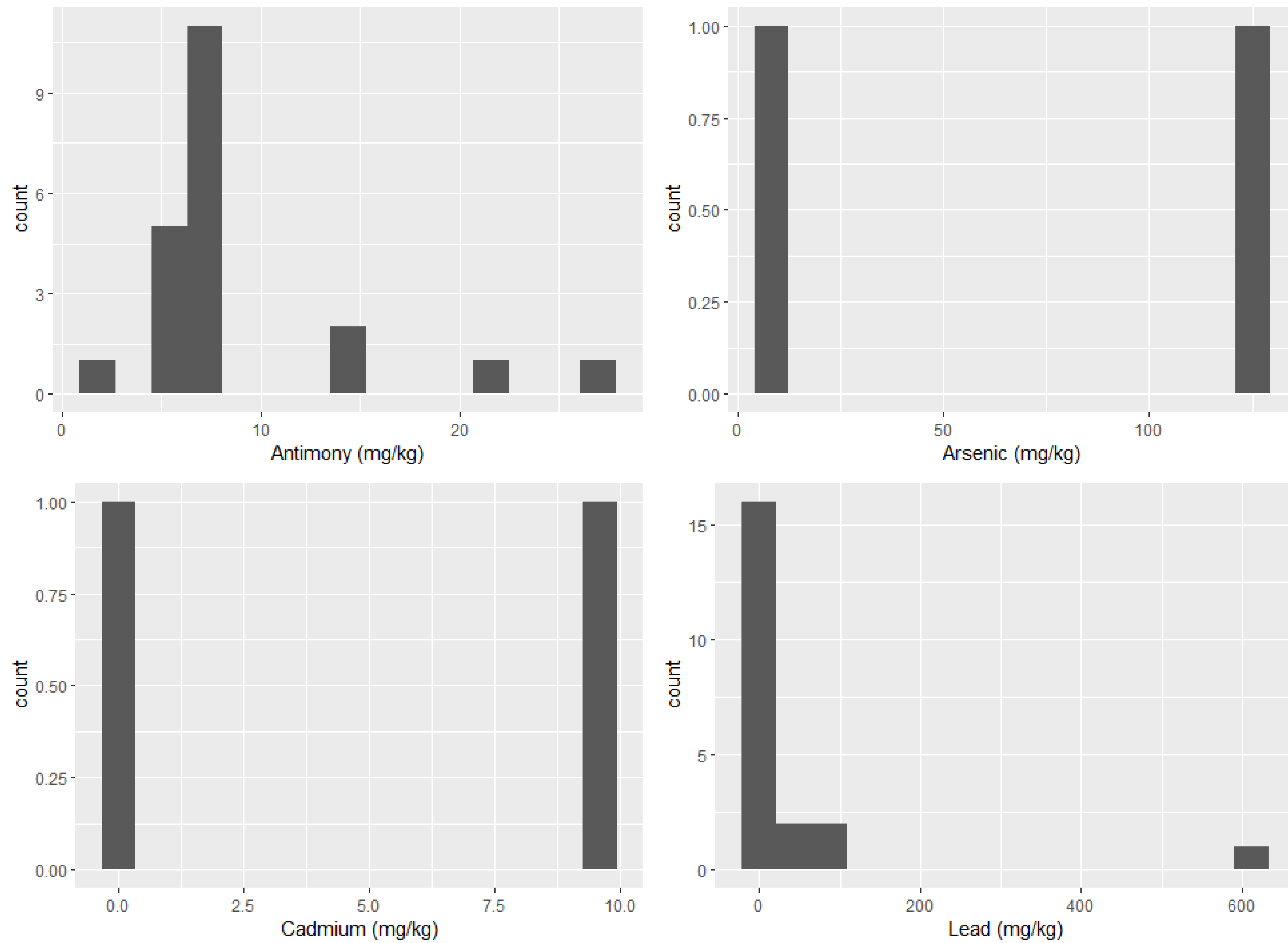

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Sediment Deep Metals Histograms
Remedial Investigation Report - OU2 USS Lead
Superfund Site
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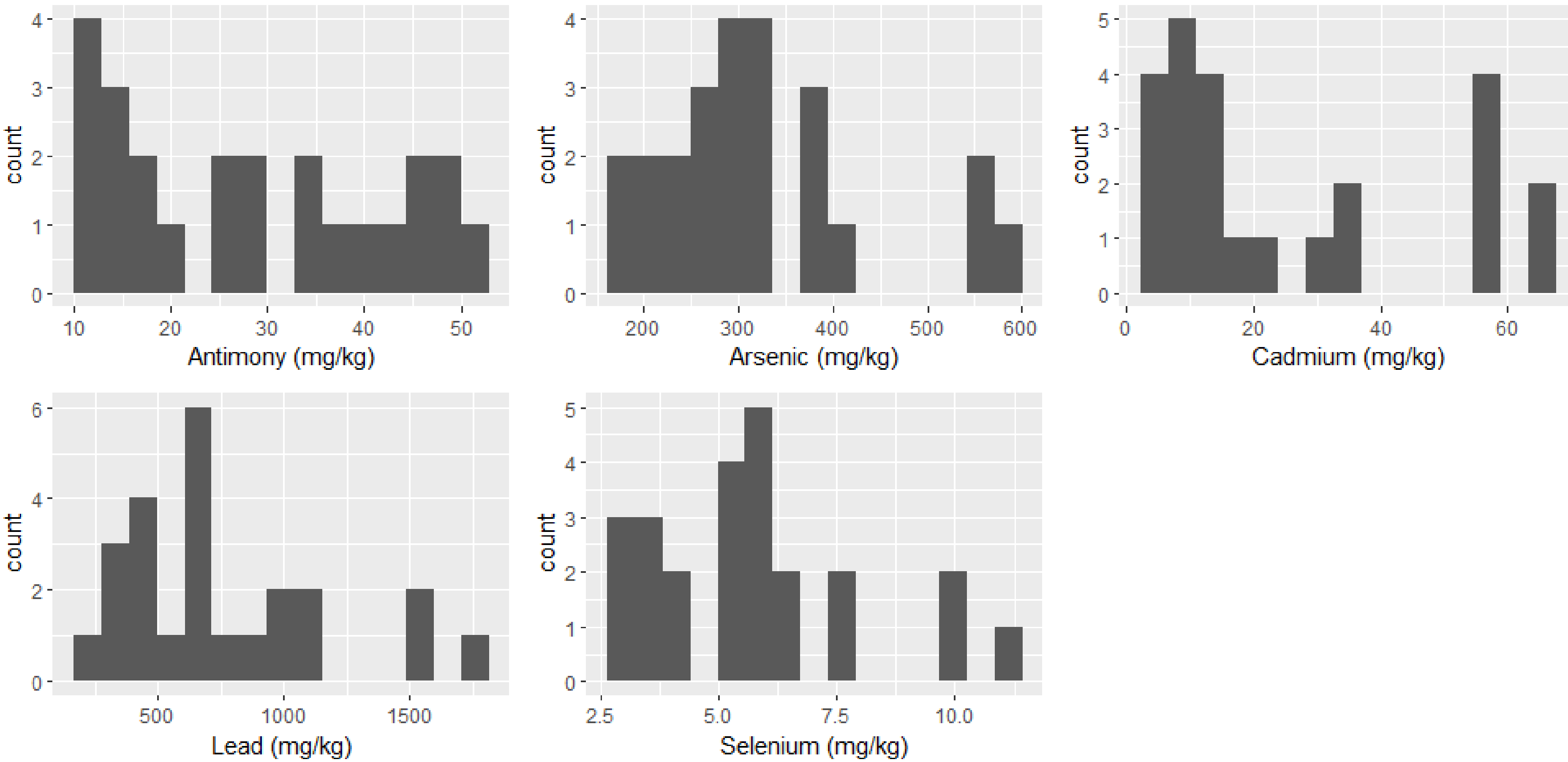

Legend

Sediment ISM Histograms
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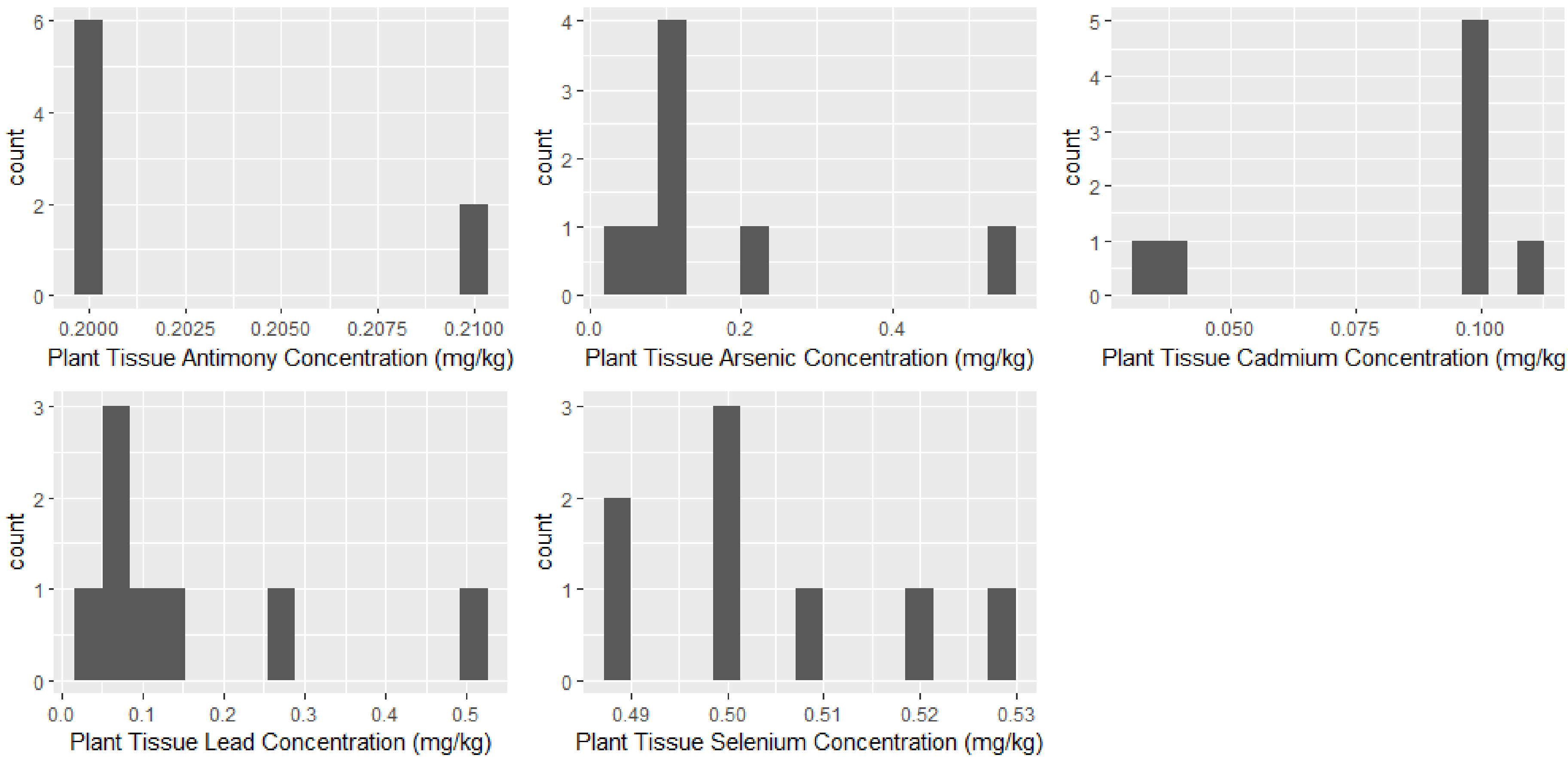

Legend

Plant Tissue Metal Histograms
Remedial Investigation Report - OU2 USS Lead
Superfund Site
East Chicago, Indiana

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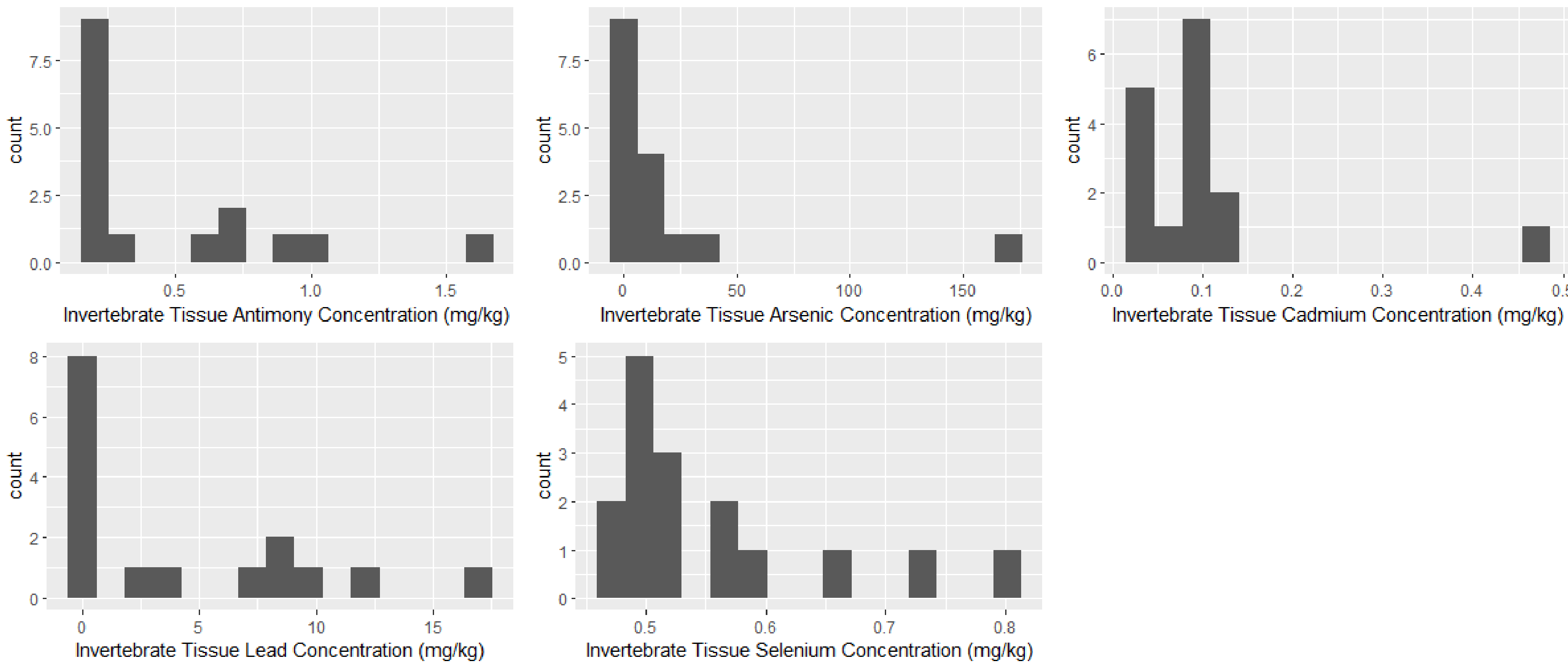
Source: Esri - World Topoographic Map;



Legend

Invertebrate Tissue Metal Histograms
Remedial Investigation Report - OU2 USS Lead
Superfund Site
East Chicago, Indiana

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Source: Esri - World Topoographic Map;

APPENDIX I STATISTICAL SUMMARY TABLES

Table I-1
OU1 & OU2 Discrete Sample Summary and 95UCL Results
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Media	Location	Depth	COI	Fraction	Number of Observations	Number of Detects	Units	Min of Detects	Max of Detects	Min of Non-Detects	Max of Non-Detects	Type of UCL	95UCL	Associated Mean	Distribution Type
Groundwater	OU1 Zone 1	All	Antimony	Dissolved	20	15	µg/L	1.9	1200	0.38	1.1	Kaplan-Meier (KM) Chebyshev UCL	734.8	180.1	Log Normal
			Antimony	Total	20	17	µg/L	0.42	1200	0.38	1.1	Kaplan-Meier (KM) Chebyshev UCL	748	183.5	Log Normal
			Arsenic	Dissolved	20	20	µg/L	0.6	440	-		Chebyshev UCL	278.7	128.9	Log Normal
			Arsenic	Total	20	20	µg/L	0.69	440	-		Adjusted Gamma UCL	180	77.57	Gamma Distribution
			Cadmium	Dissolved	20	7	µg/L	0.41	59	0.13	0.22	Gamma Adjusted KM UCL	25.13	7.783	Gamma Distribution
			Cadmium	Total	20	6	µg/L	0.5	59	0.13	0.22	KM (t) UCL	15.67	8.001	Normal Distribution
			Lead	Dissolved	20	10	µg/L	0.13	68	0.094	0.13	Gamma Adjusted KM UCL	26.82	9.597	Gamma Distribution
			Lead	Total	20	13	µg/L	0.14	89	0.094	0.13	Gamma Adjusted KM UCL	41.33	16.7	Gamma Distribution
			Selenium	Dissolved	20	9	µg/L	2.6	82	0.81	2.6	Kaplan-Meier (KM) Chebyshev UCL	36.98	11.83	No Discernible Distribution
			Selenium	Total	20	9	µg/L	2.3	82	0.81	2.6	Kaplan-Meier (KM) Chebyshev UCL	36.62	11.77	Log Normal
Groundwater	OU1 Zone 2 & 3	All	Antimony	Dissolved	40	34	µg/L	0.45	28	0.38	1.1	KM Adjusted Gamma UCL	10.7	8.011	Gamma Distribution
			Antimony	Total	41	33	µg/L	0.48	28	0.38	1.1	KM (t) UCL	9.751	7.731	Normal Distribution
			Arsenic	Dissolved	40	35	µg/L	0.33	53	0.31	0.32	Kaplan-Meier (KM) Chebyshev UCL	17.88	7.716	No Discernible Distribution
			Arsenic	Total	41	40	µg/L	0.32	50	0.31	0.31	Kaplan-Meier (KM) Chebyshev UCL	18.7	8.412	No Discernible Distribution
			Cadmium	Dissolved	40	0	µg/L	-							
			Cadmium	Total	41	0	µg/L	-							
			Lead	Dissolved	40	6	µg/L	0.25	230	0.094	0.13	Gamma Adjusted KM UCL	39.08	8.876	Gamma Distribution
			Lead	Total	41	12	µg/L	0.1	220	0.094	0.13	Kaplan-Meier (KM) Chebyshev UCL	46.29	8.826	No Discernible Distribution
			Selenium	Dissolved	40	7	µg/L	0.96	4.6	0.81	2.6	KM (t) UCL	1.513	1.231	Normal Distribution
			Selenium	Total	41	7	µg/L	1.3	4.4	0.81	2.6	KM (t) UCL	1.459	1.203	Normal Distribution
Groundwater	OU2	All	Antimony	Dissolved	49	23	µg/L	6.9	89	0.38	17	KM Adjusted Gamma UCL	26.62	17.44	Gamma Distribution
			Antimony	Total	27	21	µg/L	0.45	170	0.38	6	KM Adjusted Gamma UCL	68.01	45.48	Gamma Distribution
			Arsenic	Dissolved	49	23	µg/L	0.42	23000	2.1	6.7	Kaplan-Meier (KM) Chebyshev UCL	4067	755.8	Log Normal
			Arsenic	Total	27	25	µg/L	0.62	23000	3.7	3.7	Kaplan-Meier (KM) Chebyshev UCL	12738	1803	Log Normal
			Cadmium	Dissolved	49	23	µg/L	0.65	180	0.22	1.8	Kaplan-Meier (KM) Chebyshev UCL	24.31	7.077	No Discernible Distribution
			Cadmium	Total	27	23	µg/L	0.83	210	0.22	0.22	Kaplan-Meier (KM) Chebyshev UCL	74.74	29.32	No Discernible Distribution
			Lead	Dissolved	49	5	µg/L	0.13	7	0.13	140	Kaplan-Meier (KM) Chebyshev UCL	1.888	0.657	No Discernible Distribution
			Lead	Total	27	23	µg/L	0.17	1200	0.13	2.7	Gamma Adjusted KM UCL	353	139.1	Gamma Distribution
			Selenium	Dissolved	47	11	µg/L	2.1	11	1.5	5.7	KM (t) UCL	3.653	2.949	Normal Distrubution
			Selenium	Total	27	2	µg/L	2.2	5.6	1.5	5.3	Kaplan-Meier (KM) Chebyshev UCL	2.858	1.764	No Discernible Distribution
Groundwater	OU2	All (Excluding MW7)	Antimony	Dissolved	47	21	µg/L	6.9	89	0.38	17	KM Adjusted Gamma UCL	26.98	17.2	Gamma Distribution
			Antimony	Total	25	19	µg/L	0.45	170	0.38	6	KM (t) UCL	63.85	46.84	Normal Distrubution
			Arsenic	Dissolved	47	21	µg/L	0.42	650	2.1	6.7	Gamma Adjusted KM UCL	91.28	43.26	Gamma Distribution
			Arsenic	Total	25	23	µg/L	0.62	1300	3.7	3.7	Gamma Adjusted KM UCL	418.9	227.5	Gamma Distribution
			Cadmium	Dissolved	47	21	µg/L	0.65	60	0.22	1.8	Kaplan-Meier (KM) Chebyshev UCL	9.323	2.889	No Discernible Distribution
			Cadmium	Total	25	21	µg/L	0.83	210	0.22	0.22	Kaplan-Meier (KM) Chebyshev UCL	72.01	25.7	No Discernible Distribution
			Lead	Dissolved	47	5	µg/L	0.13	7	0.13	3.1	Kaplan-Meier (KM) Chebyshev UCL	1.924	0.668	No Discernible Distribution
			Lead	Total	25	22	µg/L	0.17	1200	0.13	2.7	Gamma Adjusted KM UCL	381.6	150	Gamma Distribution
			Selenium	Dissolved	45	10	µg/L	2.1	11	1.5	5.7	KM (t) UCL	3.605	2.887	Normal Distrubution
			Selenium	Total	25	2	µg/L	2.2	5.6	1.5	5.3	Kaplan-Meier (KM) Chebyshev UCL	2.926	1.776	No Discernible Distribution

Table I-1
OU1 & OU2 Discrete Sample Summary and 95UCL Results
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Media	Location	Depth	COI	Fraction	Number of Observations	Number of Detects	Units	Min of Detects	Max of Detects	Min of Non-Detects	Max of Non-Detects	Type of UCL	95UCL	Associated Mean	Distribution Type
Surface Water	OU2	All	Antimony	Dissolved	22	17	µg/L	7.4	130	6	17	KM Adjusted Gamma UCL	38.05	22.59	Gamma Distribution
			Antimony	Total	13	10	µg/L	7	46	2.7	6.4	KM (t) UCL	24.01	16.74	Normal Distrubution
			Arsenic	Dissolved	24	24	µg/L	5.8	610	-		Adjusted Gamma UCL	163.7	105.2	No Discernible Distribution
			Arsenic	Total	13	13	µg/L	9.9	300	-		Adjusted Gamma UCL	138.9	69.53	No Discernible Distribution
			Cadmium	Dissolved	24	7	µg/L	0.56	1.2	0.36	10	KM (t) UCL	0.585	0.496	Normal Distrubution
			Cadmium	Total	13	4	µg/L	0.95	1.2	0.71	0.94	KM (t) UCL	0.959	0.842	No Discernible Distribution
			Lead	Dissolved	24	14	µg/L	1.7	41	2.5	100	Gamma Adjusted KM UCL	11.23	5.945	Gamma Distribution
			Lead	Total	13	4	µg/L	2.9	19	2.5	82	KM (t) UCL	7.056	4.367	Normal Distrubution
			Selenium	Dissolved	21	3	µg/L	7.7	12	2.7	5.3	KM (t) UCL	4.768	3.648	Normal Distrubution
			Selenium	Total	13	1	µg/L	4.6	4.6	4.6	5.3	-			
Soil	OU2	All	Antimony	-	85	67	mg/kg	0.97	210	1.3	31	KM H UCL	39.13	25.33	Log Normal
			Arsenic		70	70	mg/kg	0.87	630	-		H UCL	61.76	41.96	No Discernible Distribution
			Cadmium		70	60	mg/kg	0.032	530	0.086	0.64	KM H UCL	22.95	12.73	Log Normal
			Lead		99	90	mg/kg	1.4	1800	3.9	148	Kaplan-Meier (KM) Chebyshev UCL	419.9	250.5	No Discernible Distribution
			Selenium		50	25	mg/kg	0.11	5.8	0.077	3.8	KM Approximate Gamma UCL	1.086	0.662	Gamma Distribution
Soil	OU2	Shallow	Antimony	-	49	42	mg/kg	1.9	210	1.3	31	KM H UCL	51.37	29.9	Log Normal
			Arsenic		52	51	mg/kg	1.7	630	17.6	17.6	KM H UCL	94.4	51.9	Log Normal
			Cadmium		52	42	mg/kg	0.1	14	0.086	0.64	KM Approximate Gamma UCL	3.458	2.445	Gamma Distribution
			Lead		78	71	mg/kg	1.7	1800	3.9	148	Kaplan-Meier (KM) Chebyshev UCL	440.9	262.1	No Discernible Distribution
			Selenium		22	20	mg/kg	0.11	5.8	0.077	1.9	Gamma Adjusted KM UCL	1.656	0.97	Gamma Distribution
Soil	OU2	Deep	Antimony	-	21	18	mg/kg	0.97	110	6.5	6.6	-			
			Arsenic		18	18	mg/kg	0.87	130	-		Gamma Adjusted KM UCL	25.25	12.64	Gamma Distribution
			Cadmium		18	18	mg/kg	0.032	530	-		Adjusted Gamma UCL	137.1	42.47	Gamma Distribution
			Lead		21	19	mg/kg	1.4	1700	5.2	5.3	Kaplan-Meier (KM) Chebyshev UCL	855.5	207.3	Gamma Distribution
			Selenium		18	3	mg/kg	0.2	0.22	0.11	3.8	KM (t) UCL	0.149	0.128	Normal Distribution
Sediment	OU2	All	Antimony	-	126	38	mg/kg	0.82	3710	0.026	380	KM Approximate Gamma UCL	200.8	103.6	Gamma Distribution
			Arsenic		49	49	mg/kg	1.51	5700	-		Chebyshev UCL	1365	471.2	No Discernible Distribution
			Cadmium		49	34	mg/kg	0.16	160	0.023	0.73	Gamma Adjusted KM UCL	27.16	16.21	Gamma Distribution
			Lead		379	336	mg/kg	1.9	20000	4	3200	Kaplan-Meier (KM) Chebyshev UCL	974.7	608.2	No Discernible Distribution
			Selenium		28	15	mg/kg	15	1.1	0.085	1.9	KM (t) UCL	14.21	9.947	Normal Distribution
Sediment	OU2	Shallow	Antimony	-	105	37	mg/kg	0.82	3710	0.026	380	KM Approximate Gamma UCL	240.1	124	Gamma Distribution
			Arsenic		47	47	mg/kg	1.51	5700	-		Chebyshev UCL	1417	488.6	No Discernible Distribution
			Cadmium		47	33	mg/kg	0.16	160	0.023	0.73	Gamma Adjusted KM UCL	28.15	16.69	Gamma Distribution
			Lead		358	254	mg/kg	1.9	20000	4	3200	KM H UCL	1302	640.5	Log Normal
			Selenium		28	15	mg/kg	1.1	43.9	0.085	1.9	KM (t) UCL	14.21	9.979	Normal Distrubution
Sediment	OU2	Deep	Antimony	-	21	2	mg/kg	1.3	26.5	6.3	21	Kaplan-Meier (KM) Chebyshev UCL	12.84	2.5	No Discernible Distribution
			Arsenic		2	2	mg/kg	5.2	122	-					
			Cadmium		2	1	mg/kg	-							
			Lead		21	10	mg/kg	5.3	617	5	5.3	Gamma Adjusted KM UCL	192.6	45.57	Gamma Distribution

Notes
Shallow depth is 0 to 2 feet below ground surface
Deep is > 2 feet below ground surface

Table I-2
OU2 ISM Sample Summary and 95UCL Results
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Media	Location	COI	Number of Samples	Min	Max	Arithmetic Mean	Type of UCL	95UCL
Sediment	OU2	Antimony	24	11	51	29.1	Student's-t UCL	32.1
		Arsenic	24	180	590	320.2	Student's-t UCL	341.1
		Cadmium	24	4	65	24.6	Student's-t UCL	25.7
		Lead	24	260	1800	776.4	Student's-t UCL	829.1
		Selenium	24	2.8	11	5.8	Student's-t UCL	6.2

8 DUs with 3 Samples per DU

Table I-3
Discrete Soil Sample SPLP Summary Statistic Table
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Metals	Depth Interval	Number of Samples	Units	Number of Non-Detects	Median	Minimum	Maximum
Antimony	All	42	µg/L	0	93	6.5	1200
Arsenic		42	µg/L	0	21	0.47	850
Cadmium		42	µg/L	7	0.695	0.22	300
Iron		42	µg/L	0	1700	180	7500
Lead		42	µg/L	0	82.5	1.4	2400
Selenium		42	µg/L	32	1.5	0.81	3.6
Antimony	Shallow	24	µg/L	0	110	9.3	1200
Arsenic		24	µg/L	0	30	2.2	850
Cadmium		24	µg/L	1	0.645	0.22	45
Iron		24	µg/L	0	1900	410	7500
Lead		24	µg/L	0	94.5	1.6	1600
Selenium		24	µg/L	14	1.5	0.81	3.6
Antimony	Deep	18	µg/L	0	42.5	6.5	220
Arsenic		18	µg/L	0	8.65	0.47	34
Cadmium		18	µg/L	6	3.8	0.22	300
Iron		18	µg/L	0	1210	180	4200
Lead		18	µg/L	0	59	1.4	2400
Selenium		18	µg/L	18	1.5	1.5	1.5

Notes:

Table I-4

Groundwater Sample Polyaromatic Hydrocarbon Summary Statistic Tab

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

Polyaromatic Hydrocarbon	Number of Samples	Units	Number of Non-Detects	Minimum	Maximum
2-Methylnaphthalene	25	µg/L	25	0.18	0.22
Acenaphthene	46	µg/L	46	0.18	0.86
Acenaphthylene	46	µg/L	46	0.18	0.86
Anthracene	46	µg/L	46	0.18	0.86
Benzo(a)anthracene	46	µg/L	45	0.042	0.22
Benzo(a)pyrene	46	µg/L	45	0.074	0.22
Benzo(b)fluoranthene	46	µg/L	45	0.06	0.22
Benzo(g,h,i)perylene	46	µg/L	46	0.18	0.86
Benzo(k)fluoranthene	46	µg/L	46	0.48	0.22
Chrysene	46	µg/L	45	0.051	0.22
Fluoranthene	46	µg/L	46	0.18	0.86
Fluorene	46	µg/L	46	0.18	0.86
Indeno(1,2,3-cd)pyrene	46	µg/L	46	0.056	0.22
Naphthalene	46	µg/L	46	0.18	0.86
Phenanthrene	46	µg/L	17	0.53	0.86
Pyrene	46	µg/L	45	0.057	0.86

Notes:

ug/L = Micrograms per liter

Table I-5
Plant Tissue Sample Metal Summary Statistic Table
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Analyte	Tissue Type	Number of Samples	Number of Non-Detects	Units	Median	Min	Max
Antimony	Plant	8	8	mg/kg	0.2	0.18	0.21
Arsenic	Plant	8	0	mg/kg	0.11	0.051	0.56
Cadmium	Plant	8	6	mg/kg	0.099	0.033	0.11
Iron	Plant	8	0	mg/kg	8.1	5.1	25
Lead	Plant	8	0	mg/kg	0.084	0.035	0.51
Selenium	Plant	8	8	mg/kg	0.5	0.49	0.53
Lipids	Plant	8	0	mg/kg	0.24	0.19	0.27
Moisture Content	Plant	8	0	percent	87	85	88
Solids	Plant	8	0	percent	13	12	15

Notes:
mg/kg = Milligrams per kilogram

Table I-6
Invertebrate Sample Metal Summary Statistic Table
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Analyte	Tissue Type	Number of Samples	Number of Non-Detects	Units	Median	Min	Max
Antimony	Invertebrate	8	0	mg/kg	0.73	0.18	1.6
Arsenic	Invertebrate	8	0	mg/kg	12	4.1	170
Cadmium	Invertebrate	8	0	mg/kg	0.075	0.021	0.46
Iron	Invertebrate	8	0	mg/kg	590	490	3500
Lead	Invertebrate	8	0	mg/kg	8.4	2.7	17
Selenium	Invertebrate	8	0	mg/kg	0.58	0.46	0.79
Lipids	Invertebrate	8	0	mg/kg	0.66	0.53	1.2
Moisture Content	Invertebrate	8	0	percent	76	67	84
Solids	Invertebrate	8	0	percent	24	16	33

Notes:
mg/kg = Milligrams per kilogram

Table I-7
Groundwater Sample Field Screening Results Summary Table
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well	Sample Date	Location	Field Parameter	Unit	Result
ECHA-MW-01	3/20/2019	OU1	Dissolved Oxygen, Field	mg/L	0.53
ECHA-MW-01	3/20/2019	OU1	pH, Field	pH units	7.43
ECHA-MW-01	3/20/2019	OU1	Specific Conductivity	uS/cm	760
ECHA-MW-01	3/20/2019	OU1	Temperature, Field	deg C	6.86
ECHA-MW-01	3/20/2019	OU1	Turbidity, Field	NTU	8.8
ECHA-MW-01	3/20/2019	OU1	Volume	gal	4.75
ECHA-MW-01	6/3/2019	OU1	Dissolved Oxygen, Field	mg/L	0
ECHA-MW-01	6/3/2019	OU1	pH, Field	pH units	7.14
ECHA-MW-01	6/3/2019	OU1	Specific Conductivity	uS/cm	692
ECHA-MW-01	6/3/2019	OU1	Temperature, Field	deg C	12.92
ECHA-MW-01	6/3/2019	OU1	Turbidity, Field	NTU	3.8
ECHA-MW-01	8/12/2019	OU1	Dissolved Oxygen, Field	mg/L	0.85
ECHA-MW-01	8/12/2019	OU1	Oxidation-Reduction Potential, Field	mV	179
ECHA-MW-01	8/12/2019	OU1	pH, Field	pH units	6.69
ECHA-MW-01	8/12/2019	OU1	Specific Conductivity	uS/cm	734
ECHA-MW-01	8/12/2019	OU1	Temperature, Field	deg C	17.34
ECHA-MW-01	8/12/2019	OU1	Turbidity, Field	NTU	0
ECHA-MW-09	3/20/2019	OU1	Dissolved Oxygen, Field	mg/L	0
ECHA-MW-09	3/20/2019	OU1	pH, Field	pH units	7.03
ECHA-MW-09	3/20/2019	OU1	Specific Conductivity	uS/cm	660
ECHA-MW-09	3/20/2019	OU1	Temperature, Field	deg C	6.98
ECHA-MW-09	3/20/2019	OU1	Turbidity, Field	NTU	18.7
ECHA-MW-09	3/20/2019	OU1	Volume	gal	5.5
ECHA-MW-09	6/3/2019	OU1	Dissolved Oxygen, Field	mg/L	0
ECHA-MW-09	6/3/2019	OU1	pH, Field	pH units	7.4
ECHA-MW-09	6/3/2019	OU1	Specific Conductivity	uS/cm	788
ECHA-MW-09	6/3/2019	OU1	Temperature, Field	deg C	12.87
ECHA-MW-09	6/3/2019	OU1	Turbidity, Field	NTU	2.4
ECHA-MW-09	8/12/2019	OU1	Dissolved Oxygen, Field	mg/L	0.5
ECHA-MW-09	8/12/2019	OU1	Oxidation-Reduction Potential, Field	mV	-64
ECHA-MW-09	8/12/2019	OU1	pH, Field	pH units	5.58
ECHA-MW-09	8/12/2019	OU1	Specific Conductivity	uS/cm	1580
ECHA-MW-09	8/12/2019	OU1	Temperature, Field	deg C	17.31
ECHA-MW-09	8/12/2019	OU1	Turbidity, Field	NTU	4.9
ECHA-MW-35	3/20/2019	OU1	Dissolved Oxygen, Field	mg/L	0
ECHA-MW-35	3/20/2019	OU1	pH, Field	pH units	7.25
ECHA-MW-35	3/20/2019	OU1	Specific Conductivity	uS/cm	698
ECHA-MW-35	3/20/2019	OU1	Temperature, Field	deg C	6.97
ECHA-MW-35	3/20/2019	OU1	Turbidity, Field	NTU	16.8
ECHA-MW-35	3/20/2019	OU1	Volume	gal	5
ECHA-MW-35	6/3/2019	OU1	Dissolved Oxygen, Field	mg/L	0
ECHA-MW-35	6/3/2019	OU1	pH, Field	pH units	7.35
ECHA-MW-35	6/3/2019	OU1	Specific Conductivity	uS/cm	813
ECHA-MW-35	6/3/2019	OU1	Temperature, Field	deg C	12.74
ECHA-MW-35	6/3/2019	OU1	Turbidity, Field	NTU	4.6
ECHA-MW-35	8/12/2019	OU1	Dissolved Oxygen, Field	mg/L	0.78
ECHA-MW-35	8/12/2019	OU1	Oxidation-Reduction Potential, Field	mV	8
ECHA-MW-35	8/12/2019	OU1	pH, Field	pH units	6.6
ECHA-MW-35	8/12/2019	OU1	Specific Conductivity	uS/cm	697
ECHA-MW-35	8/12/2019	OU1	Temperature, Field	deg C	16.5
ECHA-MW-35	8/12/2019	OU1	Turbidity, Field	NTU	0
OU1MW1	12/13/2018	OU1	Dissolved Oxygen, Field	mg/L	1.6

Table I-7
Groundwater Sample Field Screening Results Summary Table
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Well	Sample Date	Location	Field Parameter	Unit	Result
OU1MW1	12/13/2018	OU1	Oxidation-Reduction Potential, Field	mV	-27
OU1MW1	12/13/2018	OU1	pH, Field	pH units	7.09
OU1MW1	12/13/2018	OU1	Specific Conductivity	uS/cm	723
OU1MW1	12/13/2018	OU1	Temperature, Field	deg C	11.04
OU1MW1	12/13/2018	OU1	Turbidity, Field	NTU	0.6
OU1MW1	12/13/2018	OU1	Volume	gal	4.25
OU1MW1	3/21/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW1	3/21/2019	OU1	pH, Field	pH units	7.22
OU1MW1	3/21/2019	OU1	Specific Conductivity	uS/cm	696
OU1MW1	3/21/2019	OU1	Temperature, Field	deg C	6.68
OU1MW1	3/21/2019	OU1	Turbidity, Field	NTU	6.9
OU1MW1	3/21/2019	OU1	Volume	gal	5
OU1MW1	6/5/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW1	6/5/2019	OU1	pH, Field	pH units	7.07
OU1MW1	6/5/2019	OU1	Specific Conductivity	uS/cm	717
OU1MW1	6/5/2019	OU1	Temperature, Field	deg C	17.32
OU1MW1	6/5/2019	OU1	Turbidity, Field	NTU	0.2
OU1MW1	8/12/2019	OU1	Dissolved Oxygen, Field	mg/L	0.66
OU1MW1	8/12/2019	OU1	Oxidation-Reduction Potential, Field	mV	-33
OU1MW1	8/12/2019	OU1	pH, Field	pH units	6.79
OU1MW1	8/12/2019	OU1	Specific Conductivity	uS/cm	589
OU1MW1	8/12/2019	OU1	Temperature, Field	deg C	16.97
OU1MW1	8/12/2019	OU1	Turbidity, Field	NTU	0.1
OU1MW13	3/18/2021	OU1	Oxidation-Reduction Potential, Field	mV	7.6
OU1MW13	3/18/2021	OU1	pH, Field	pH units	6.98
OU1MW13	3/18/2021	OU1	Dissolved Oxygen, Field	mg/L	0.26
OU1MW13	3/18/2021	OU1	Temperature, Field	deg C	7.2
OU1MW13	3/18/2021	OU1	Turbidity, Field	NTU	11.5
OU1MW14	3/18/2021	OU1	Oxidation-Reduction Potential, Field	mV	-101.7
OU1MW14	3/18/2021	OU1	pH, Field	pH units	7.18
OU1MW14	3/18/2021	OU1	Dissolved Oxygen, Field	mg/L	0.27
OU1MW14	3/18/2021	OU1	Temperature, Field	deg C	7.7
OU1MW14	3/18/2021	OU1	Turbidity, Field	NTU	49.7
OU1MW15	3/17/2021	OU1	Oxidation-Reduction Potential, Field	mV	7.11
OU1MW15	3/17/2021	OU1	pH, Field	pH units	7.11
OU1MW15	3/17/2021	OU1	Dissolved Oxygen, Field	mg/L	0.45
OU1MW15	3/17/2021	OU1	Temperature, Field	deg C	8.3
OU1MW15	3/17/2021	OU1	Turbidity, Field	NTU	15.7
OU1MW2	12/13/2018	OU1	Dissolved Oxygen, Field	mg/L	1.88
OU1MW2	12/13/2018	OU1	Oxidation-Reduction Potential, Field	mV	85
OU1MW2	12/13/2018	OU1	pH, Field	pH units	7.83
OU1MW2	12/13/2018	OU1	Specific Conductivity	uS/cm	463
OU1MW2	12/13/2018	OU1	Temperature, Field	deg C	12.35
OU1MW2	12/13/2018	OU1	Turbidity, Field	NTU	2.2
OU1MW2	12/13/2018	OU1	Volume	gal	4
OU1MW2	3/21/2019	OU1	Dissolved Oxygen, Field	mg/L	1.66
OU1MW2	3/21/2019	OU1	pH, Field	pH units	7.58
OU1MW2	3/21/2019	OU1	Specific Conductivity	uS/cm	555
OU1MW2	3/21/2019	OU1	Temperature, Field	deg C	7.89
OU1MW2	3/21/2019	OU1	Turbidity, Field	NTU	6.5
OU1MW2	3/21/2019	OU1	Volume	gal	4.5
OU1MW2	6/5/2019	OU1	Dissolved Oxygen, Field	mg/L	2.86

Table I-7
Groundwater Sample Field Screening Results Summary Table
Remedial Investigation Report - OU2
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Well	Sample Date	Location	Field Parameter	Unit	Result
OU1MW2	6/5/2019	OU1	pH, Field	pH units	7.43
OU1MW2	6/5/2019	OU1	Specific Conductivity	uS/cm	543
OU1MW2	6/5/2019	OU1	Temperature, Field	deg C	13.85
OU1MW2	6/5/2019	OU1	Turbidity, Field	NTU	0
OU1MW2	8/12/2019	OU1	Dissolved Oxygen, Field	mg/L	1.95
OU1MW2	8/12/2019	OU1	Oxidation-Reduction Potential, Field	mV	193
OU1MW2	8/12/2019	OU1	pH, Field	pH units	5.93
OU1MW2	8/12/2019	OU1	Specific Conductivity	uS/cm	1040
OU1MW2	8/12/2019	OU1	Temperature, Field	deg C	17.34
OU1MW2	8/12/2019	OU1	Turbidity, Field	NTU	2.7
OU1MW3	12/13/2018	OU1	Dissolved Oxygen, Field	mg/L	0.59
OU1MW3	12/13/2018	OU1	pH, Field	pH units	6.9
OU1MW3	12/13/2018	OU1	Specific Conductivity	uS/cm	1300
OU1MW3	12/13/2018	OU1	Temperature, Field	deg C	10.86
OU1MW3	12/13/2018	OU1	Turbidity, Field	NTU	0.8
OU1MW3	12/13/2018	OU1	Volume	gal	3.5
OU1MW3	3/20/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW3	3/20/2019	OU1	pH, Field	pH units	6.74
OU1MW3	3/20/2019	OU1	Specific Conductivity	uS/cm	1240
OU1MW3	3/20/2019	OU1	Temperature, Field	deg C	6.31
OU1MW3	3/20/2019	OU1	Turbidity, Field	NTU	3.8
OU1MW3	3/20/2019	OU1	Volume	gal	5.25
OU1MW3	6/4/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW3	6/4/2019	OU1	pH, Field	pH units	7.04
OU1MW3	6/4/2019	OU1	Specific Conductivity	uS/cm	1100
OU1MW3	6/4/2019	OU1	Temperature, Field	deg C	12.15
OU1MW3	6/4/2019	OU1	Turbidity, Field	NTU	4.2
OU1MW3	8/13/2019	OU1	Dissolved Oxygen, Field	mg/L	0.31
OU1MW3	8/13/2019	OU1	Oxidation-Reduction Potential, Field	mV	-125
OU1MW3	8/13/2019	OU1	pH, Field	pH units	6.84
OU1MW3	8/13/2019	OU1	Specific Conductivity	uS/cm	1230
OU1MW3	8/13/2019	OU1	Temperature, Field	deg C	17.68
OU1MW3	8/13/2019	OU1	Turbidity, Field	NTU	4.7
OU1MW3D	12/21/2018	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW3D	12/21/2018	OU1	Oxidation-Reduction Potential, Field	mV	-195
OU1MW3D	12/21/2018	OU1	pH, Field	pH units	7.36
OU1MW3D	12/21/2018	OU1	Specific Conductivity	uS/cm	2620
OU1MW3D	12/21/2018	OU1	Temperature, Field	deg C	10.13
OU1MW3D	12/21/2018	OU1	Turbidity, Field	NTU	0.5
OU1MW3D	12/21/2018	OU1	Volume	gal	12.5
OU1MW3D	3/20/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW3D	3/20/2019	OU1	pH, Field	pH units	7.37
OU1MW3D	3/20/2019	OU1	Specific Conductivity	uS/cm	2660
OU1MW3D	3/20/2019	OU1	Temperature, Field	deg C	9.92
OU1MW3D	3/20/2019	OU1	Turbidity, Field	NTU	93.4
OU1MW3D	3/20/2019	OU1	Volume	gal	13
OU1MW3D	6/4/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW3D	6/4/2019	OU1	pH, Field	pH units	7.1
OU1MW3D	6/4/2019	OU1	Specific Conductivity	uS/cm	2880
OU1MW3D	6/4/2019	OU1	Temperature, Field	deg C	12.83
OU1MW3D	6/4/2019	OU1	Turbidity, Field	NTU	0
OU1MW3D	8/13/2019	OU1	Dissolved Oxygen, Field	mg/L	0.52

Table I-7
Groundwater Sample Field Screening Results Summary Table
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Well	Sample Date	Location	Field Parameter	Unit	Result
OU1MW3D	8/13/2019	OU1	Oxidation-Reduction Potential, Field	mV	-141
OU1MW3D	8/13/2019	OU1	pH, Field	pH units	6.43
OU1MW3D	8/13/2019	OU1	Specific Conductivity	uS/cm	2560
OU1MW3D	8/13/2019	OU1	Temperature, Field	deg C	14.07
OU1MW3D	8/13/2019	OU1	Turbidity, Field	NTU	5
OU1MW4	12/14/2018	OU1	Dissolved Oxygen, Field	mg/L	1.45
OU1MW4	12/14/2018	OU1	Oxidation-Reduction Potential, Field	mV	-71
OU1MW4	12/14/2018	OU1	pH, Field	pH units	6.73
OU1MW4	12/14/2018	OU1	Specific Conductivity	uS/cm	1330
OU1MW4	12/14/2018	OU1	Temperature, Field	deg C	11.59
OU1MW4	12/14/2018	OU1	Turbidity, Field	NTU	3.3
OU1MW4	12/14/2018	OU1	Volume	gal	4
OU1MW4	3/20/2019	OU1	Volume	gal	4.5
OU1MW4	3/20/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW4	3/20/2019	OU1	pH, Field	pH units	7
OU1MW4	3/20/2019	OU1	Specific Conductivity	uS/cm	1090
OU1MW4	3/20/2019	OU1	Temperature, Field	deg C	7.71
OU1MW4	3/20/2019	OU1	Turbidity, Field	NTU	0.5
OU1MW4	6/5/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW4	6/5/2019	OU1	pH, Field	pH units	7.09
OU1MW4	6/5/2019	OU1	Specific Conductivity	uS/cm	941
OU1MW4	6/5/2019	OU1	Temperature, Field	deg C	13.65
OU1MW4	6/5/2019	OU1	Turbidity, Field	NTU	2.4
OU1MW4	8/13/2019	OU1	Dissolved Oxygen, Field	mg/L	0.32
OU1MW4	8/13/2019	OU1	Oxidation-Reduction Potential, Field	mV	-71
OU1MW4	8/13/2019	OU1	pH, Field	pH units	7.06
OU1MW4	8/13/2019	OU1	Specific Conductivity	uS/cm	902
OU1MW4	8/13/2019	OU1	Temperature, Field	deg C	20.36
OU1MW4	8/13/2019	OU1	Turbidity, Field	NTU	12
OU1MW5	12/14/2018	OU1	Dissolved Oxygen, Field	mg/L	3.37
OU1MW5	12/14/2018	OU1	Oxidation-Reduction Potential, Field	mV	-98
OU1MW5	12/14/2018	OU1	pH, Field	pH units	13.9
OU1MW5	12/14/2018	OU1	Specific Conductivity	uS/cm	7700
OU1MW5	12/14/2018	OU1	Temperature, Field	deg C	12.06
OU1MW5	12/14/2018	OU1	Turbidity, Field	NTU	36.4
OU1MW5	12/14/2018	OU1	Volume	gal	4.75
OU1MW5	3/21/2019	OU1	Dissolved Oxygen, Field	mg/L	0.38
OU1MW5	3/21/2019	OU1	pH, Field	pH units	12.75
OU1MW5	3/21/2019	OU1	Specific Conductivity	uS/cm	3570
OU1MW5	3/21/2019	OU1	Temperature, Field	deg C	8.85
OU1MW5	3/21/2019	OU1	Turbidity, Field	NTU	4.2
OU1MW5	3/21/2019	OU1	Volume	gal	5.5
OU1MW5	6/4/2019	OU1	Dissolved Oxygen, Field	mg/L	6.86
OU1MW5	6/4/2019	OU1	pH, Field	pH units	12.83
OU1MW5	6/4/2019	OU1	Specific Conductivity	uS/cm	7650
OU1MW5	6/4/2019	OU1	Temperature, Field	deg C	12.74
OU1MW5	6/4/2019	OU1	Turbidity, Field	NTU	1.1
OU1MW5	8/13/2019	OU1	Dissolved Oxygen, Field	mg/L	0.2
OU1MW5	8/13/2019	OU1	Oxidation-Reduction Potential, Field	mV	-135
OU1MW5	8/13/2019	OU1	pH, Field	pH units	11.36
OU1MW5	8/13/2019	OU1	Specific Conductivity	uS/cm	725
OU1MW5	8/13/2019	OU1	Temperature, Field	deg C	16.72

Table I-7
Groundwater Sample Field Screening Results Summary Table
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Well	Sample Date	Location	Field Parameter	Unit	Result
OU1MW5	8/13/2019	OU1	Turbidity, Field	NTU	337
OU1MW5D	12/14/2018	OU1	Dissolved Oxygen, Field	mg/L	1.48
OU1MW5D	12/14/2018	OU1	Oxidation-Reduction Potential, Field	mV	-156
OU1MW5D	12/14/2018	OU1	pH, Field	pH units	7.18
OU1MW5D	12/14/2018	OU1	Specific Conductivity	uS/cm	2150
OU1MW5D	12/14/2018	OU1	Temperature, Field	deg C	12.55
OU1MW5D	12/14/2018	OU1	Turbidity, Field	NTU	0.7
OU1MW5D	12/14/2018	OU1	Volume	gal	10.5
OU1MW5D	3/21/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW5D	3/21/2019	OU1	pH, Field	pH units	7.16
OU1MW5D	3/21/2019	OU1	Specific Conductivity	uS/cm	2370
OU1MW5D	3/21/2019	OU1	Temperature, Field	deg C	11.89
OU1MW5D	3/21/2019	OU1	Turbidity, Field	NTU	0
OU1MW5D	3/21/2019	OU1	Volume	gal	12
OU1MW5D	6/4/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW5D	6/4/2019	OU1	pH, Field	pH units	7.05
OU1MW5D	6/4/2019	OU1	Specific Conductivity	uS/cm	2090
OU1MW5D	6/4/2019	OU1	Temperature, Field	deg C	14.01
OU1MW5D	6/4/2019	OU1	Turbidity, Field	NTU	1.8
OU1MW5D	8/13/2019	OU1	Dissolved Oxygen, Field	mg/L	0.62
OU1MW5D	8/13/2019	OU1	Oxidation-Reduction Potential, Field	mV	-134
OU1MW5D	8/13/2019	OU1	pH, Field	pH units	6.36
OU1MW5D	8/13/2019	OU1	Specific Conductivity	uS/cm	2200
OU1MW5D	8/13/2019	OU1	Temperature, Field	deg C	13.62
OU1MW5D	8/13/2019	OU1	Turbidity, Field	NTU	2.8
OU1MW5E	3/17/2021	OU1	Oxidation-Reduction Potential, Field	mV	143.9
OU1MW5E	3/17/2021	OU1	pH, Field	pH units	7.32
OU1MW5E	3/17/2021	OU1	Dissolved Oxygen, Field	mg/L	0.58
OU1MW5E	3/17/2021	OU1	Temperature, Field	deg C	8.2
OU1MW5E	3/17/2021	OU1	Turbidity, Field	NTU	4.41
OU1MW5N	3/17/2021	OU1	Oxidation-Reduction Potential, Field	mV	-21.1
OU1MW5N	3/17/2021	OU1	pH, Field	pH units	7.25
OU1MW5N	3/17/2021	OU1	Dissolved Oxygen, Field	mg/L	0.24
OU1MW5N	3/17/2021	OU1	Temperature, Field	deg C	9.2
OU1MW5N	3/17/2021	OU1	Turbidity, Field	NTU	1.1
OU1MW5S	3/17/2021	OU1	Oxidation-Reduction Potential, Field	mV	-155
OU1MW5S	3/17/2021	OU1	pH, Field	pH units	7.19
OU1MW5S	3/17/2021	OU1	Dissolved Oxygen, Field	mg/L	0.96
OU1MW5S	3/17/2021	OU1	Temperature, Field	deg C	7.9
OU1MW5S	3/17/2021	OU1	Turbidity, Field	NTU	22.2
OU1MW5W	3/17/2021	OU1	Oxidation-Reduction Potential, Field	mV	145.3
OU1MW5W	3/17/2021	OU1	pH, Field	pH units	7.19
OU1MW5W	3/17/2021	OU1	Dissolved Oxygen, Field	mg/L	0.79
OU1MW5W	3/17/2021	OU1	Temperature, Field	deg C	8.2
OU1MW5W	3/17/2021	OU1	Turbidity, Field	NTU	9.5
OU1MW6	12/14/2018	OU1	Dissolved Oxygen, Field	mg/L	6.24
OU1MW6	12/14/2018	OU1	Oxidation-Reduction Potential, Field	mV	-55
OU1MW6	12/14/2018	OU1	pH, Field	pH units	7.95
OU1MW6	12/14/2018	OU1	Specific Conductivity	uS/cm	1080
OU1MW6	12/14/2018	OU1	Temperature, Field	deg C	12.34
OU1MW6	12/14/2018	OU1	Turbidity, Field	NTU	4.8
OU1MW6	12/14/2018	OU1	Volume	gal	5

Table I-7
Groundwater Sample Field Screening Results Summary Table
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Well	Sample Date	Location	Field Parameter	Unit	Result
OU1MW6	3/21/2019	OU1	Dissolved Oxygen, Field	mg/L	0.36
OU1MW6	3/21/2019	OU1	pH, Field	pH units	6.81
OU1MW6	3/21/2019	OU1	Specific Conductivity	uS/cm	802
OU1MW6	3/21/2019	OU1	Temperature, Field	deg C	7.71
OU1MW6	3/21/2019	OU1	Turbidity, Field	NTU	0
OU1MW6	3/21/2019	OU1	Volume	gal	4
OU1MW6	6/3/2019	OU1	Dissolved Oxygen, Field	mg/L	1.33
OU1MW6	6/3/2019	OU1	pH, Field	pH units	7.45
OU1MW6	6/3/2019	OU1	Specific Conductivity	uS/cm	1290
OU1MW6	6/3/2019	OU1	Temperature, Field	deg C	13.05
OU1MW6	6/3/2019	OU1	Turbidity, Field	NTU	1.8
OU1MW6	8/13/2019	OU1	Dissolved Oxygen, Field	mg/L	0.52
OU1MW6	8/13/2019	OU1	Oxidation-Reduction Potential, Field	mV	-62
OU1MW6	8/13/2019	OU1	pH, Field	pH units	6.97
OU1MW6	8/13/2019	OU1	Specific Conductivity	uS/cm	1540
OU1MW6	8/13/2019	OU1	Temperature, Field	deg C	17.33
OU1MW6	8/13/2019	OU1	Turbidity, Field	NTU	4.7
OU1MW6D	12/14/2018	OU1	Dissolved Oxygen, Field	mg/L	2.47
OU1MW6D	12/14/2018	OU1	Oxidation-Reduction Potential, Field	mV	-151
OU1MW6D	12/14/2018	OU1	pH, Field	pH units	7.22
OU1MW6D	12/14/2018	OU1	Specific Conductivity	uS/cm	1120
OU1MW6D	12/14/2018	OU1	Temperature, Field	deg C	12.71
OU1MW6D	12/14/2018	OU1	Turbidity, Field	NTU	1
OU1MW6D	12/14/2018	OU1	Volume	gal	11.75
OU1MW6D	3/21/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW6D	3/21/2019	OU1	pH, Field	pH units	7.33
OU1MW6D	3/21/2019	OU1	Specific Conductivity	uS/cm	1170
OU1MW6D	3/21/2019	OU1	Temperature, Field	deg C	11.99
OU1MW6D	3/21/2019	OU1	Turbidity, Field	NTU	0
OU1MW6D	3/21/2019	OU1	Volume	gal	13
OU1MW6D	6/3/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW6D	6/3/2019	OU1	pH, Field	pH units	7.52
OU1MW6D	6/3/2019	OU1	Specific Conductivity	uS/cm	1600
OU1MW6D	6/3/2019	OU1	Temperature, Field	deg C	13.96
OU1MW6D	6/3/2019	OU1	Turbidity, Field	NTU	2.8
OU1MW6D	8/13/2019	OU1	Dissolved Oxygen, Field	mg/L	0.47
OU1MW6D	8/13/2019	OU1	Oxidation-Reduction Potential, Field	mV	-154
OU1MW6D	8/13/2019	OU1	pH, Field	pH units	6.51
OU1MW6D	8/13/2019	OU1	Specific Conductivity	uS/cm	1230
OU1MW6D	8/13/2019	OU1	Temperature, Field	deg C	14.06
OU1MW6D	8/13/2019	OU1	Turbidity, Field	NTU	1.2
OU1MW7	12/13/2018	OU1	Dissolved Oxygen, Field	mg/L	1.55
OU1MW7	12/13/2018	OU1	Oxidation-Reduction Potential, Field	mV	40
OU1MW7	12/13/2018	OU1	pH, Field	pH units	7.83
OU1MW7	12/13/2018	OU1	Specific Conductivity	uS/cm	812
OU1MW7	12/13/2018	OU1	Temperature, Field	deg C	13.03
OU1MW7	12/13/2018	OU1	Turbidity, Field	NTU	0.7
OU1MW7	12/13/2018	OU1	Volume	gal	3.5
OU1MW7	3/21/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW7	3/21/2019	OU1	pH, Field	pH units	7.52
OU1MW7	3/21/2019	OU1	Specific Conductivity	uS/cm	841
OU1MW7	3/21/2019	OU1	Temperature, Field	deg C	8.57

Table I-7
Groundwater Sample Field Screening Results Summary Table
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Well	Sample Date	Location	Field Parameter	Unit	Result
OU1MW7	3/21/2019	OU1	Turbidity, Field	NTU	0
OU1MW7	3/21/2019	OU1	Volume	gal	4
OU1MW7	6/4/2019	OU1	Dissolved Oxygen, Field	mg/L	3.02
OU1MW7	6/4/2019	OU1	pH, Field	pH units	7.28
OU1MW7	6/4/2019	OU1	Specific Conductivity	uS/cm	776
OU1MW7	6/4/2019	OU1	Temperature, Field	deg C	12.47
OU1MW7	6/4/2019	OU1	Turbidity, Field	NTU	3.5
OU1MW7	8/13/2019	OU1	Dissolved Oxygen, Field	mg/L	0.76
OU1MW7	8/13/2019	OU1	Oxidation-Reduction Potential, Field	mV	12
OU1MW7	8/13/2019	OU1	pH, Field	pH units	6.7
OU1MW7	8/13/2019	OU1	Specific Conductivity	uS/cm	712
OU1MW7	8/13/2019	OU1	Temperature, Field	deg C	18.16
OU1MW7	8/13/2019	OU1	Turbidity, Field	NTU	1.7
OU1MW8	12/13/2018	OU1	Dissolved Oxygen, Field	mg/L	1.56
OU1MW8	12/13/2018	OU1	Oxidation-Reduction Potential, Field	mV	-1
OU1MW8	12/13/2018	OU1	pH, Field	pH units	7.35
OU1MW8	12/13/2018	OU1	Specific Conductivity	uS/cm	1070
OU1MW8	12/13/2018	OU1	Temperature, Field	deg C	14.6
OU1MW8	12/13/2018	OU1	Turbidity, Field	NTU	1.5
OU1MW8	12/13/2018	OU1	Volume	gal	4
OU1MW8	3/21/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW8	3/21/2019	OU1	pH, Field	pH units	7.09
OU1MW8	3/21/2019	OU1	Specific Conductivity	uS/cm	943
OU1MW8	3/21/2019	OU1	Temperature, Field	deg C	9.46
OU1MW8	3/21/2019	OU1	Turbidity, Field	NTU	0.3
OU1MW8	3/21/2019	OU1	Volume	gal	4
OU1MW8	6/5/2019	OU1	Dissolved Oxygen, Field	mg/L	0
OU1MW8	6/5/2019	OU1	pH, Field	pH units	6.87
OU1MW8	6/5/2019	OU1	Specific Conductivity	uS/cm	1690
OU1MW8	6/5/2019	OU1	Temperature, Field	deg C	15.5
OU1MW8	6/5/2019	OU1	Turbidity, Field	NTU	4
OU1MW8	8/13/2019	OU1	Dissolved Oxygen, Field	mg/L	4.35
OU1MW8	8/13/2019	OU1	Oxidation-Reduction Potential, Field	mV	-21
OU1MW8	8/13/2019	OU1	pH, Field	pH units	6.77
OU1MW8	8/13/2019	OU1	Specific Conductivity	uS/cm	2230
OU1MW8	8/13/2019	OU1	Temperature, Field	deg C	19.94
OU1MW8	8/13/2019	OU1	Turbidity, Field	NTU	1.7
MW10	12/18/2018	OU2	Oxidation-Reduction Potential, Field	millivolts	-110
MW10	12/18/2018	OU2	pH, Field	pH units	7.23
MW10	12/18/2018	OU2	Specific Conductivity	uS/cm	2160
MW10	12/18/2018	OU2	Temperature, Field	deg C	13.18
MW10	12/18/2018	OU2	Volume	gal	5
MW10	6/4/2019	OU2	Oxidation-Reduction Potential, Field	mV	-112
MW10	6/4/2019	OU2	pH, Field	pH units	7.27
MW10	6/4/2019	OU2	Specific Conductivity	uS/cm	1920
MW10	6/4/2019	OU2	Temperature, Field	deg C	13.59
MW12	12/17/2018	OU2	Oxidation-Reduction Potential, Field	mV	-78
MW12	12/17/2018	OU2	pH, Field	pH units	7.75
MW12	12/17/2018	OU2	Specific Conductivity	uS/cm	2840
MW12	12/17/2018	OU2	Temperature, Field	deg C	10.78
MW12	12/17/2018	OU2	Volume	gal	4
MW15	12/18/2018	OU2	Oxidation-Reduction Potential, Field	mV	99

Table I-7
Groundwater Sample Field Screening Results Summary Table
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Well	Sample Date	Location	Field Parameter	Unit	Result
MW15	12/18/2018	OU2	pH, Field	pH units	7.77
MW15	12/18/2018	OU2	Specific Conductivity	uS/cm	278
MW15	12/18/2018	OU2	Temperature, Field	deg C	9.34
MW15	12/18/2018	OU2	Volume	gal	6
MW15	6/5/2019	OU2	Oxidation-Reduction Potential, Field	mV	47
MW15	6/5/2019	OU2	pH, Field	pH units	7.62
MW15	6/5/2019	OU2	Specific Conductivity	uS/cm	311
MW15	6/5/2019	OU2	Temperature, Field	deg C	13.82
MW18	12/17/2018	OU2	Oxidation-Reduction Potential, Field	mV	-100
MW18	12/17/2018	OU2	pH, Field	pH units	7.14
MW18	12/17/2018	OU2	Specific Conductivity	uS/cm	621
MW18	12/17/2018	OU2	Temperature, Field	deg C	13.91
MW18	12/17/2018	OU2	Volume	gal	4
MW18	6/4/2019	OU2	Oxidation-Reduction Potential, Field	mV	-87
MW18	6/4/2019	OU2	pH, Field	pH units	7.36
MW18	6/4/2019	OU2	Specific Conductivity	uS/cm	488
MW18	6/4/2019	OU2	Temperature, Field	deg C	13.04
MW21	12/18/2018	OU2	Oxidation-Reduction Potential, Field	mV	102
MW21	12/18/2018	OU2	pH, Field	pH units	7.7
MW21	12/18/2018	OU2	Specific Conductivity	uS/cm	306
MW21	12/18/2018	OU2	Temperature, Field	deg C	7.81
MW21	12/18/2018	OU2	Volume	gal	5
MW21	6/5/2019	OU2	Oxidation-Reduction Potential, Field	mV	121
MW21	6/5/2019	OU2	pH, Field	pH units	7.66
MW21	6/5/2019	OU2	Specific Conductivity	uS/cm	243
MW21	6/5/2019	OU2	Temperature, Field	deg C	16.35
MW23	12/18/2018	OU2	Oxidation-Reduction Potential, Field	mV	137
MW23	12/18/2018	OU2	pH, Field	pH units	7.35
MW23	12/18/2018	OU2	Specific Conductivity	uS/cm	253
MW23	12/18/2018	OU2	Temperature, Field	deg C	8.16
MW23	12/18/2018	OU2	Volume	gal	5
MW23	6/5/2019	OU2	Oxidation-Reduction Potential, Field	mV	156
MW23	6/5/2019	OU2	pH, Field	pH units	7.29
MW23	6/5/2019	OU2	Specific Conductivity	uS/cm	251
MW23	6/5/2019	OU2	Temperature, Field	deg C	17.87
MW25	12/18/2018	OU2	Oxidation-Reduction Potential, Field	mV	76
MW25	12/18/2018	OU2	pH, Field	pH units	7.44
MW25	12/18/2018	OU2	Specific Conductivity	uS/cm	362
MW25	12/18/2018	OU2	Temperature, Field	deg C	10.63
MW25	12/18/2018	OU2	Volume	gal	6
MW25	6/5/2019	OU2	Oxidation-Reduction Potential, Field	mV	138
MW25	6/5/2019	OU2	pH, Field	pH units	7.7
MW25	6/5/2019	OU2	Specific Conductivity	uS/cm	280
MW25	6/5/2019	OU2	Temperature, Field	deg C	16
MW5	12/18/2018	OU2	Oxidation-Reduction Potential, Field	mV	-61
MW5	12/18/2018	OU2	pH, Field	pH units	6.82
MW5	12/18/2018	OU2	Specific Conductivity	uS/cm	636
MW5	12/18/2018	OU2	Temperature, Field	deg C	10.44
MW5	12/18/2018	OU2	Volume	gal	10
MW5	6/4/2019	OU2	Oxidation-Reduction Potential, Field	mV	-65
MW5	6/4/2019	OU2	pH, Field	pH units	6.84
MW5	6/4/2019	OU2	Specific Conductivity	uS/cm	673

Table I-7
Groundwater Sample Field Screening Results Summary Table
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Well	Sample Date	Location	Field Parameter	Unit	Result
MW5	6/4/2019	OU2	Temperature, Field	deg C	13.25
MW6	12/17/2018	OU2	Oxidation-Reduction Potential, Field	mV	-105
MW6	12/17/2018	OU2	pH, Field	pH units	7.93
MW6	12/17/2018	OU2	Specific Conductivity	uS/cm	585
MW6	12/17/2018	OU2	Temperature, Field	deg C	11.21
MW6	12/17/2018	OU2	Volume	gal	4
MW6	6/4/2019	OU2	Oxidation-Reduction Potential, Field	mV	-117
MW6	6/4/2019	OU2	pH, Field	pH units	7.45
MW6	6/4/2019	OU2	Specific Conductivity	uS/cm	473
MW6	6/4/2019	OU2	Temperature, Field	deg C	12.55
MW7	12/18/2018	OU2	Oxidation-Reduction Potential, Field	mV	-99
MW7	12/18/2018	OU2	pH, Field	pH units	7.14
MW7	12/18/2018	OU2	Specific Conductivity	uS/cm	1120
MW7	12/18/2018	OU2	Temperature, Field	deg C	12.05
MW7	12/18/2018	OU2	Volume	gal	8
MW7	6/4/2019	OU2	Oxidation-Reduction Potential, Field	mV	-111
MW7	6/4/2019	OU2	pH, Field	pH units	7.2
MW7	6/4/2019	OU2	Specific Conductivity	uS/cm	951
MW7	6/4/2019	OU2	Temperature, Field	deg C	13.37
MW8	12/17/2018	OU2	Oxidation-Reduction Potential, Field	mV	-77
MW8	12/17/2018	OU2	pH, Field	pH units	7.84
MW8	12/17/2018	OU2	Specific Conductivity	uS/cm	1840
MW8	12/17/2018	OU2	Temperature, Field	deg C	9.26
MW8	12/17/2018	OU2	Volume	gal	5
MW8	6/4/2019	OU2	Oxidation-Reduction Potential, Field	mV	-98
MW8	6/4/2019	OU2	pH, Field	pH units	7.22
MW8	6/4/2019	OU2	Specific Conductivity	uS/cm	936
MW8	6/4/2019	OU2	Temperature, Field	deg C	11.29

Notes:
deg C = degree Celsius

APPENDIX J SEDIMENT ANALYTICAL DATA USED IN THIS REMEDIAL INVESTIGATION

Table J-1
Historical and Recent Sediment Analytical Data
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			Chemical Unit	Antimony mg/kg		Arsenic mg/kg		Cadmium mg/kg		Iron mg/kg		Lead mg/kg		Selenium mg/kg	
Sample Location	**Sample Name**	**Sample Type**	**Sample Date**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**
1532A-SP1	1532A-SP1_SO_20000106	N	06 Jan 2000	< 32								44			
1532A-SP2	1532A-SP2_SO_20000106	N	06 Jan 2000	< 34								529			
1532A-SP3A	1532A-SP3A_SO_20000106	N	06 Jan 2000	< 32								10.8			
1532A-SP3B	1532A-SP3B_SO_20000106	N	06 Jan 2000	< 34								78.4			
1532A-SP4	1532A-SP4_SO_20000106	N	06 Jan 2000	< 33								46.5			
1532A-SP5	1532A-SP5_SO_20000106	N	06 Jan 2000	< 35								18.2			
1532A-SP7	1532A-SP7_SO_20000106	N	06 Jan 2000	< 33								7.85			
1532A-SP8	1532A-SP8_SO_20000106	N	06 Jan 2000	< 32								22.6			
1532A-SP10	1532A-SP10_SO_20000107	N	07 Jan 2000	< 34								24.7			
1532A-SP11	1532A-SP11_SO_20000107	N	07 Jan 2000	< 32								36.8			
1532A-SP12	1532A-SP12_SO_20000107	N	07 Jan 2000	< 36								79.3			
1532A-SP13	1532A-SP13_SO_20000107	N	07 Jan 2000	< 32								12.8			
1532A-SP14	1532A-SP14_SO_20000107	N	07 Jan 2000	< 40								13.4			
1532A-SP15	1532A-SP15_SO_20000107	N	07 Jan 2000	< 31								12.2			
1532A-SP16	1532A-SP16_SO_20000107	N	07 Jan 2000	< 32								9.32			
1532A-SP6	1532A-SP6_SO_20000107	N	07 Jan 2000	201								13.5			
SS-03-01	SS-03-01_SE_20000913	N	13 Sep 2000									60			
SS-01-03	SS-01-03_SO_20000914	N	14 Sep 2000	1660								7470			
SS-01-05	SS-01-05_SO_20000914	N	14 Sep 2000	1330								1130			
SS-01-06	SS-01-06_SO_20000914	N	14 Sep 2000	3710								4080			
SS-01-15	SS-01-15_SO_20000914	N	14 Sep 2000	278								512			
SS-02-01	SS-02-01_SO_20000914	N	14 Sep 2000	85								655			
SS-03-011	SS-03-011(0.5')_SE_20000915	N	15 Sep 2000	< 5.40											
SS-03-014	SS-03-014(3')_SE_20000915	N	15 Sep 2000	< 6.70								< 5.30			
SS-03-015	SS-03-015(4')_SE_20000915	N	15 Sep 2000	< 6.70								< 5.30			
SS-03-016	SS-03-016(5')_SE_20000915	N	15 Sep 2000	< 6.50								< 5.20			
SS-03-021	SS-03-021(0.5')_SE_20000915	N	15 Sep 2000	< 5.30											
SS-03-024	SS-03-024(3')_SE_20000915	N	15 Sep 2000	< 6.30								< 5			
SS-03-025	SS-03-025(4')_SE_20000915	N	15 Sep 2000	< 6.80								43			
SS-03-026	SS-03-026(5')_SE_20000915	N	15 Sep 2000	< 6.70								8.7			
SS-03-031	SS-03-031(0.5')_SE_20000915	N	15 Sep 2000	6.5								343			
SS-03-032	SS-03-032(1')_SE_20000915	N	15 Sep 2000	< 5.90		7.5		< 0.59				5.2		< 1.80	
SS-03-034	SS-03-034(3')_SE_20000915	N	15 Sep 2000	< 6.30								< 5			
SS-03-035	SS-03-035(4')_SE_20000915	N	15 Sep 2000	< 6.60								< 5.30			
SS-03-036	SS-03-036(5')_SE_20000915	N	15 Sep 2000	< 6.30								< 5.10			
SS-04-014	SS-04-014(3')_SE_20000918	N	18 Sep 2000	< 6.30								70			
SS-04-015	SS-04-015(4')_SE_20000918	N	18 Sep 2000	< 6.50								< 5.20			
SS-04-016	SS-04-016(5')_SE_20000918	N	18 Sep 2000	< 6.40								< 5.10			
SS-04-024	SS-04-024(3')_SE_20000918	N	18 Sep 2000	< 21								87			
SS-04-025	SS-04-025(4')_SE_20000918	N	18 Sep 2000	< 14								17			
SS-04-026	SS-04-026(5')_SE_20000918	N	18 Sep 2000	< 14								18			
SS-04-054	SS-04-054(3')_SE_20000918	N	18 Sep 2000	< 6.30								8.4			
SS-04-055	SS-04-055(4')_SE_20000918	N	18 Sep 2000	< 6.60								5.3			
SS-04-056	SS-04-056(5')_SE_20000918	N	18 Sep 2000	< 6.60								< 5.30			
SS-04-061	SS-04-061(5')_SE_20000918	N	18 Sep 2000	< 6.50								< 5.20			
SS-05-01	SS-05-01_SE_20000919	N	19 Sep 2000									< 4.7			
SS-05-02	SS-05-02_SE_20000919	N	19 Sep 2000	2.76		5		< 0.58						< 1.7	
SS-05-03	SS-05-03_SE_20000919	N	19 Sep 2000									33			
SS-06-03	SS-06-03(2')_SE_20000921	N	21 Sep 2000	< 6.20		72		< 0.62				< 5		< 1.9	
CT1-PE1	CT1-PE1_SE_20000928	N	28 Sep 2000			5.7		< 0.53				5.3		< 1.6	
CT1-PN1	CT1-PN1_SE_20000928	N	28 Sep 2000	< 14								12			
CT1-PS1	CT1-PS1_SE_20000928	N	28 Sep 2000	< 0.028								9.9			
CT1-PW1	CT1-PW1_SE_20000928	N	28 Sep 2000	24								243			
CT2-PE1	CT2-PE1_SE_20000928	N	28 Sep 2000	1.06								8			
CT2-PN1	CT2-PN1_SE_20000928	N	28 Sep 2000	< 0.027								7.5			
CT2-PS1	CT2-PS1_SE_20000928	N	28 Sep 2000	< 0.027								< 5.5			
CT2-PW1	CT2-PW1_SE_20000928	N	28 Sep 2000	< 0.027								8.7			
CT3-PE1	CT3-PE1_SE_20000928	N	28 Sep 2000	< 13								11			
CT3-PN1	CT3-PN1_SE_20000928	N	28 Sep 2000	2.2								24			
CT3-PS1	CT3-PS1_SE_20000928	N	28 Sep 2000	< 13								17			
CT3-PW1	CT3-PW1_SE_20000928	N	28 Sep 2000	< 0.026								7.5			
CT5-PE1	CT5-PE1_SE_20000929	N	29 Sep 2000	< 14								7.2			
CT5-PN1	CT5-PN1_SE_20000929	N	29 Sep 2000	< 14								< 5.5			
CT5-PS1	CT5-PS1_SE_20000929	N	29 Sep 2000	< 13								< 5.4			
CT5-PW1	CT5-PW1_SE_20000929	N	29 Sep 2000	< 14								< 5.6			
CT6-PE1	CT6-PE1_SE_20000929	N	29 Sep 2000	< 14								< 5.5			
CT6-PN1	CT6-PN1_SE_20000929	N	29 Sep 2000	< 14								7.2			
CT6-PS1	CT6-PS1_SE_20000929	N	29 Sep 2000	< 14								5.6			
CT6-PW1	CT6-PW1_SE_20000929	N	29 Sep 2000			7		< 0.58				10		< 1.7	
CT7-PE1	CT7-PE1_SE_20000929	N	29 Sep 2000	< 16								64			
CT7-PN1	CT7-PN1_SE_20000929	N	29 Sep 2000	< 13								7.3			
CT7-PS1	CT7-PS1_SE_20000929	N	29 Sep 2000	< 14								13			
CT7-PW1	CT7-PW1_SE_20000929	N	29 Sep 2000	< 13								< 5.4			
CT10-PE1	CT10-PE1_SE_20001006	N	06 Oct 2000	< 13								< 5.2			
CT10-PN1	CT10-PN1_SE_20001006	N	06 Oct 2000	< 14								33			

Table J-1
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			Chemical Unit	Antimony mg/kg		Arsenic mg/kg		Cadmium mg/kg		Iron mg/kg		Lead mg/kg		Selenium mg/kg	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier
CT10-PS1	CT10-PS1_SE_20001006	N	06 Oct 2000	< 14								84			
CT10-PW1	CT10-PW1_SE_20001006	N	06 Oct 2000	< 13								7.2			
CT4-PE1	CT4-PE1_SE_20001006	N	06 Oct 2000	< 12		10		1.2				< 5		< 1.9	
CT4-PN1	CT4-PN1_SE_20001006	N	06 Oct 2000	< 13								< 5.2			
CT4-PS1	CT4-PS1_SE_20001006	N	06 Oct 2000	< 13								< 5.2			
CT4-PW1	CT4-PW1_SE_20001006	N	06 Oct 2000	< 13								< 5.1			
CT8-PE1	CT8-PE1_SE_20001006	N	06 Oct 2000	< 13								< 5.4			
CT8-PN1	CT8-PN1_SE_20001006	N	06 Oct 2000	< 13								< 5.1			
CT8-PS1	CT8-PS1_SE_20001006	N	06 Oct 2000	< 13								< 4			
CT8-PW1	CT8-PW1_SE_20001006	N	06 Oct 2000	< 13								< 5.4			
CT9-PE1	CT9-PE1_SE_20001006	N	06 Oct 2000	< 13								< 5.1			
CT9-PN1	CT9-PN1_SE_20001006	N	06 Oct 2000	< 12								< 5			
CT9-PS1	CT9-PS1_SE_20001006	N	06 Oct 2000	< 12		5.6		< 0.62				< 5		< 1.9	
CT9-PW1	CT9-PW1_SE_20001006	N	06 Oct 2000	< 14								< 5.5			
SS-21-01	SS-21-01_SO_20010405	N	05 Apr 2001	2.1		102		22.1				11			
SS-21-02	SS-21-02_SO_20010405	N	05 Apr 2001	2.3		3		< 0.12				6.3			
SS-21-03	SS-21-03_SO_20010405	N	05 Apr 2001	< 1.5		35.1		7.4				5.3			
SS-22-01	SS-22-01(3.25')_SE_20010419	N	19 Apr 2001	26.5		122		9.7				617			
SS-22-02	SS-22-02_SE_20010419	N	19 Apr 2001	< 1		2.8		< 0.074				10.5			
SS-22-03	SS-22-03(3.5')_SE_20010419	N	19 Apr 2001	1.3		5.2		< 0.098				27.5			
SS-22-04	SS-22-04_SE_20010419	N	19 Apr 2001	2.4		4.2		0.16				3			
SS-22-05	SS-22-05_SE_20010419	N	19 Apr 2001	< 0.12		6.7		< 0.12				5.2			
SS-22-06	SS-22-06_SE_20010419	N	19 Apr 2001	10.8		11.7		0.67				227			
SS-22-07	SS-22-07_SE_20010419	N	19 Apr 2001	< 1		9.5		< 0.73				2.6			
SS-23-01	SS-23-01_SO_20010419	N	19 Apr 2001									434			
SS-42-01A	SS-42-01A_SO_20020627	N	27 Jun 2002									2000			
SS-42-01B	SS-42-01B_SO_20020627	N	27 Jun 2002									1700			
WEX-1	WEX-1-LAB_SO_20020819	N	19 Aug 2002									1800			
WEX-1	WEX-1-XRF_SO_20020819	N	19 Aug 2002									944			
WEX-2B	WEX-2B-LAB_SO_20020819	N	19 Aug 2002									5100			
WEX-2B	WEX-2B-XRF_SO_20020819	N	19 Aug 2002									1800			
WEX-4B	WEX-4B_SO_20020819	N	19 Aug 2002									947			
WEX-7B	WEX-7B-LAB_SO_20020819	N	19 Aug 2002									16			
WEX-11	WEX-11_SO_20020820	N	20 Aug 2002									370			
WEX-12	WEX-12_SO_20020820	N	20 Aug 2002									707			
WEX-13	WEX-13_SO_20020820	N	20 Aug 2002									635			
WEX-15	WEX-15_SO_20020820	N	20 Aug 2002									204			
WEX-16	WEX-16_SO_20020820	N	20 Aug 2002									125			
WEX-17	WEX-17_SO_20020820	N	20 Aug 2002									237			
WEX-18	WEX-18_SO_20020820	N	20 Aug 2002									822			
WEX-6C	WEX-6C_SO_20020820	N	20 Aug 2002									63			
WEX-9	WEX-9_SO_20020820	N	20 Aug 2002									268			
WEX-19	WEX-19_SO_20020821	N	21 Aug 2002									83			
WEX-20B	WEX-20B_SO_20020821	N	21 Aug 2002									39			
WEX-21	WEX-21_SO_20020821	N	21 Aug 2002									172			
WEX-23	WEX-23_SO_20020821	N	21 Aug 2002									736			
WEX-24	WEX-24_SO_20020821	N	21 Aug 2002									164			
WEX-26	WEX-26_SO_20020822	N	22 Aug 2002									1197			
WEX-27	WEX-27_SO_20020822	N	22 Aug 2002									125			
WEX-28	WEX-28_SO_20020822	N	22 Aug 2002									45			
WEX-29	WEX-29_SO_20020822	N	22 Aug 2002									1095			
WEX-31	WEX-31_SO_20020822	N	22 Aug 2002									236			
WEX-32	WEX-32_SO_20020822	N	22 Aug 2002									2564			
WEX-35	WEX-35_SO_20020823	N	23 Aug 2002									105			
WEX-36B	WEX-36B_SO_20020823	N	23 Aug 2002									133			
WEX-37	WEX-37-LAB_SO_20020823	N	23 Aug 2002									850			
WEX-37	WEX-37-XRF_SO_20020823	N	23 Aug 2002									498			
WEX-38	WEX-38_SO_20020823	N	23 Aug 2002									538			
WEX-39	WEX-39_SO_20020823	N	23 Aug 2002									1516			
WEX-40	WEX-40_SO_20020823	N	23 Aug 2002									41			
WEX-41	WEX-41-LAB_SO_20020823	N	23 Aug 2002									230			
WEX-43S	WEX-43S_SO_20020823	N	23 Aug 2002									2544			
WEX-44	WEX-44-LAB_SO_20020823	N	23 Aug 2002									38			
WEX-50B	WEX-50B_SO_20020826	N	26 Aug 2002									82			
WEX-51B	WEX-51B_SO_20020826	N	26 Aug 2002									226			
WEX-52	WEX-52_SO_20020826	N	26 Aug 2002									497			
WEX-53B	WEX-53B_SO_20020826	N	26 Aug 2002									31			
WEX-54B	WEX-54B_SO_20020826	N	26 Aug 2002									16			
WEX-55	WEX-55_SO_20020826	N	26 Aug 2002									25			
WEX-56	WEX-56_SO_20020826	N	26 Aug 2002									311			
WEX-57	WEX-57_SO_20020826	N	26 Aug 2002									221			
WEX-58	WEX-58_SO_20020826	N	26 Aug 2002									98			
WEX-59	WEX-59_SO_20020826	N	26 Aug 2002									433			
WEX-62	WEX-62_SO_20020827	N	27 Aug 2002									84			
WEX-64	WEX-64_SO_20020827	N	27 Aug 2002									407			

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			Chemical Unit	Antimony mg/kg		Arsenic mg/kg		Cadmium mg/kg		Iron mg/kg		Lead mg/kg		Selenium mg/kg	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier
WEX-65	WEX-65_SO_20020827	N	27 Aug 2002									1305			
WEX-66	WEX-66_SO_20020827	N	27 Aug 2002									1459			
WEX-67	WEX-67_SO_20020827	N	27 Aug 2002									368			
WEX-70	WEX-70_SO_20020827	N	27 Aug 2002									100			
WEX-71	WEX-71_SO_20020827	N	27 Aug 2002									83			
WEX-72	WEX-72_SO_20020827	N	27 Aug 2002									411			
WEX-60B	WEX-60B_SO_20020828	N	28 Aug 2002									82			
WEX-73	WEX-73_SO_20020828	N	28 Aug 2002									170			
WEX-74	WEX-74_SO_20020828	N	28 Aug 2002									746			
WEX-75	WEX-75_SO_20020828	N	28 Aug 2002									308			
WEX-76	WEX-76_SO_20020828	N	28 Aug 2002									78			
WEX-79	WEX-79_SO_20020828	N	28 Aug 2002									150			
WEX-80B	WEX-80B_SO_20020828	N	28 Aug 2002									26			
WEX-81	WEX-81_SO_20020828	N	28 Aug 2002									1660			
WEX-82	WEX-82_SO_20020828	N	28 Aug 2002									353			
WEX-83	WEX-83_SO_20020828	N	28 Aug 2002									1152			
WEX-85	WEX-85_SO_20020829	N	29 Aug 2002									24			
WEX-87	WEX-87_SO_20020829	N	29 Aug 2002									803			
WEX-88	WEX-88_SO_20020829	N	29 Aug 2002									41			
WEX-89	WEX-89_SO_20020829	N	29 Aug 2002									347			
WEX-90	WEX-90_SO_20020829	N	29 Aug 2002									694			
WEX-91	WEX-91_SO_20020829	N	29 Aug 2002									1043			
WEX-93	WEX-93_SO_20020829	N	29 Aug 2002									1612			
WEX-94	WEX-94-LAB_SO_20020829	N	29 Aug 2002									260			
WEX-94	WEX-94-XRF_SO_20020829	N	29 Aug 2002									47			
WEX-95	WEX-95_SO_20020829	N	29 Aug 2002									143			
WEX-96	WEX-96_SO_20020829	N	29 Aug 2002									14			
WEX-97	WEX-97_SO_20020829	N	29 Aug 2002									198			
WEX-98	WEX-98-LAB_SO_20020829	N	29 Aug 2002									79			
WEX-98	WEX-98-XRF_SO_20020829	N	29 Aug 2002									51			
WEX-99	WEX-99_SO_20020829	N	29 Aug 2002									340			
WEX-100B	WEX-100B_SO_20020830	N	30 Aug 2002									449			
WEX-101B	WEX-101B_SO_20020830	N	30 Aug 2002									28			
WEX-102	WEX-102_SO_20020830	N	30 Aug 2002									199			
WEX-103	WEX-103_SO_20020830	N	30 Aug 2002									238			
WEX-105	WEX-105_SO_20020830	N	30 Aug 2002									62			
WEX-107	WEX-107_SO_20020830	N	30 Aug 2002									275			
WEX-108	WEX-108_SO_20020830	N	30 Aug 2002									228			
WEX-109	WEX-109_SO_20020830	N	30 Aug 2002									238			
WEX-110	WEX-110_SO_20020830	N	30 Aug 2002									228			
WEX-111	WEX-111_SO_20020830	N	30 Aug 2002									134			
WEX-112	WEX-112_SO_20020830	N	30 Aug 2002									87			
WEX-92B	WEX-92B_SO_20020830	N	30 Aug 2002									219			
WEX-113	WEX-113_SO_20020902	N	02 Sep 2002									491			
WEX-114	WEX-114_SO_20020902	N	02 Sep 2002									427			
WEX-115	WEX-115_SO_20020902	N	02 Sep 2002									82			
WEX-116	WEX-116_SO_20020902	N	02 Sep 2002									191			
WEX-117	WEX-117_SO_20020902	N	02 Sep 2002									341			
WEX-118	WEX-118_SO_20020902	N	02 Sep 2002									21			
WEX-119	WEX-119_SO_20020902	N	02 Sep 2002									892			
WEX-120	WEX-120_SO_20020902	N	02 Sep 2002									599			
WEX-121B	WEX-121B_SO_20020905	N	05 Sep 2002									22			
WEX-122B	WEX-122B_SO_20020905	N	05 Sep 2002									87			
WEX-123B	WEX-123B_SO_20020905	N	05 Sep 2002									191			
WEX-124B	WEX-124B_SO_20020905	N	05 Sep 2002									74			
WEX-125B	WEX-125B_SO_20020905	N	05 Sep 2002									370			
WEX-128	WEX-128_SO_20020905	N	05 Sep 2002									691			
WEX-129	WEX-129_SO_20020905	N	05 Sep 2002									458			
WEX-130	WEX-130_SO_20020905	N	05 Sep 2002									538			
WEX-131	WEX-131_SO_20020905	N	05 Sep 2002									98			
WEX-132	WEX-132_SO_20020905	N	05 Sep 2002									1906			
WEX-133	WEX-133_SO_20020905	N	05 Sep 2002									100			
WEX-134	WEX-134_SO_20020905	N	05 Sep 2002									175			
WEX-135B	WEX-135B_SO_20020905	N	05 Sep 2002									95			
WEX-136	WEX-136_SO_20020905	N	05 Sep 2002									2628			
WEX-137	WEX-137-LAB_SO_20020905	N	05 Sep 2002									28			
WEX-137	WEX-137-XRF_SO_20020905	N	05 Sep 2002									19			
WEX-138	WEX-138-LAB_SO_20020905	N	05 Sep 2002									180			
WEX-138	WEX-138-XRF_SO_20020905	N	05 Sep 2002									171			
WEX-139	WEX-139-LAB_SO_20020905	N	05 Sep 2002									130			
WEX-139	WEX-139-XRF_SO_20020905	N	05 Sep 2002									151			
WEX-140	WEX-140_SO_20020905	N	05 Sep 2002									23			
WEX-141	WEX-141_SO_20020905	N	05 Sep 2002									278			
WEX-142	WEX-142_SO_20020905	N	05 Sep 2002									23			
WEX-148	WEX-148_SO_20020905	N	05 Sep 2002									143			

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			Chemical Unit	Antimony mg/kg		Arsenic mg/kg		Cadmium mg/kg		Iron mg/kg		Lead mg/kg		Selenium mg/kg	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier
WEX-149	WEX-149_SO_20020905	N	05 Sep 2002									85			
WEX-8B	WEX-8B_SO_20020906	N	06 Sep 2002									33			
WEX-150	WEX-150_SO_20020907	N	07 Sep 2002									255			
WEX-151	WEX-151_SO_20020907	N	07 Sep 2002									281			
WEX-152	WEX-152_SO_20020907	N	07 Sep 2002									56			
WEX-153	WEX-153_SO_20020907	N	07 Sep 2002									77			
WEX-154	WEX-154_SO_20020907	N	07 Sep 2002									135			
WEX-155	WEX-155_SO_20020907	N	07 Sep 2002									64			
WEX-156	WEX-156_SO_20020907	N	07 Sep 2002									40			
WEX-158	WEX-158_SO_20020910	N	10 Sep 2002									185			
WEX-159	WEX-159_SO_20020910	N	10 Sep 2002									170			
WEX-160	WEX-160_SO_20020910	N	10 Sep 2002									235			
WEX-161	WEX-161_SO_20020910	N	10 Sep 2002									467			
WEX-162	WEX-162_SO_20020910	N	10 Sep 2002									45			
WEX-163	WEX-163_SO_20020910	N	10 Sep 2002									35			
WEX-164	WEX-164_SO_20020910	N	10 Sep 2002									72			
WEX-165	WEX-165_SO_20020910	N	10 Sep 2002									55			
WEX-167	WEX-167_SO_20020911	N	11 Sep 2002									1164			
WEX-168	WEX-168_SO_20020911	N	11 Sep 2002									515			
WEX-169	WEX-169_SO_20020911	N	11 Sep 2002									58			
WEX-170	WEX-170_SO_20020911	N	11 Sep 2002									520			
WEX-171	WEX-171_SO_20020911	N	11 Sep 2002									257			
WEX-172	WEX-172_SO_20020911	N	11 Sep 2002									836			
WEX-173	WEX-173_SO_20020911	N	11 Sep 2002									1229			
WEX-174	WEX-174_SO_20020911	N	11 Sep 2002									2659			
WEX-175	WEX-175_SO_20020911	N	11 Sep 2002									298			
WEX-177	WEX-177_SO_20020911	N	11 Sep 2002									463			
WEX-178	WEX-178_SO_20020911	N	11 Sep 2002									1042			
WEX-179	WEX-179_SO_20020911	N	11 Sep 2002									260			
WEX-180	WEX-180_SO_20020913	N	13 Sep 2002									229			
WEX-181	WEX-181_SO_20020913	N	13 Sep 2002									571			
WEX-182	WEX-182_SO_20020913	N	13 Sep 2002									63			
WEX-183	WEX-183_SO_20020913	N	13 Sep 2002									29			
WEX-184	WEX-184_SO_20020913	N	13 Sep 2002									896			
WEX-185	WEX-185_SO_20020913	N	13 Sep 2002									112			
WEX-186	WEX-186_SO_20020913	N	13 Sep 2002									216			
WEX-187	WEX-187_SO_20020913	N	13 Sep 2002									137			
WEX-188	WEX-188_SO_20020913	N	13 Sep 2002									16			
WEX-189	WEX-189_SO_20020913	N	13 Sep 2002									18			
WEX-190	WEX-190_SO_20020913	N	13 Sep 2002									161			
WEX-191	WEX-191_SO_20020913	N	13 Sep 2002									142			
WEX-192	WEX-192_SO_20020913	N	13 Sep 2002									32			
WEX-193	WEX-193_SO_20020913	N	13 Sep 2002									20			
WEX-194	WEX-194_SO_20020916	N	16 Sep 2002									249			
WEX-195	WEX-195_SO_20020916	N	16 Sep 2002									20			
WEX-196	WEX-196_SO_20020916	N	16 Sep 2002									372			
WEX-197	WEX-197_SO_20020916	N	16 Sep 2002									854			
WEX-198	WEX-198_SO_20020916	N	16 Sep 2002									1540			
WEX-199	WEX-199_SO_20020916	N	16 Sep 2002									867			
WEX-200	WEX-200_SO_20020916	N	16 Sep 2002									264			
WEX-201	WEX-201_SO_20020916	N	16 Sep 2002									171			
WEX-202	WEX-202_SO_20020916	N	16 Sep 2002									320			
WEX-203	WEX-203_SO_20020916	N	16 Sep 2002									195			
WEX-204	WEX-204_SO_20020916	N	16 Sep 2002									146			
WEX-205	WEX-205_SO_20020916	N	16 Sep 2002									498			
WEX-206	WEX-206_SO_20020916	N	16 Sep 2002									301			
WEX-207	WEX-207_SO_20020916	N	16 Sep 2002									127			
WEX-208	WEX-208_SO_20020916	N	16 Sep 2002									39			
WEX-209	WEX-209_SO_20020916	N	16 Sep 2002									398			
WEX-210	WEX-210_SO_20020917	N	17 Sep 2002									332			
WEX-211	WEX-211_SO_20020917	N	17 Sep 2002									721			
WEX-212	WEX-212_SO_20020917	N	17 Sep 2002									469			
WEX-213	WEX-213_SO_20020917	N	17 Sep 2002									277			
WEX-214	WEX-214_SO_20020917	N	17 Sep 2002									38			
WEX-215	WEX-215_SO_20020917	N	17 Sep 2002									87			
WEX-217	WEX-217_SO_20020917	N	17 Sep 2002									423			
WEX-218	WEX-218-LAB_SO_20020917	N	17 Sep 2002									270			
WEX-218	WEX-218-XRF_SO_20020917	N	17 Sep 2002									164			
WEX-216B	WEX-216B_SO_20020918	N	18 Sep 2002									14			
WEX-219	WEX-229_SO_20020918	N	18 Sep 2002									93			
WEX-220	WEX-220-LAB_SO_20020918	N	18 Sep 2002									20			
WEX-221	WEX-221_SO_20020918	N	18 Sep 2002									33			
WEX-222	WEX-222-LAB_SO_20020918	N	18 Sep 2002									30			
WEX-222	WEX-222-XRF_SO_20020918	N	18 Sep 2002									20			
WEX-224	WEX-224-LAB_SO_20020918	N	18 Sep 2002									590			

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			Chemical Unit	Antimony mg/kg		Arsenic mg/kg		Cadmium mg/kg		Iron mg/kg		Lead mg/kg		Selenium mg/kg	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier
WEX-224	WEX-224-XRF_SO_20020918	N	18 Sep 2002									397			
WEX-225	WEX-225_SO_20020918	N	18 Sep 2002									305			
WEX-226	WEX-226_SO_20020918	N	18 Sep 2002									1251			
WEX-227	WEX-227_SO_20020918	N	18 Sep 2002									73			
WEX-228	WEX-228_SO_20020918	N	18 Sep 2002									78			
MRFI-F-12	MRFI-F-12_SO_20030708	N	08 Jul 2003	< 2.9		7.3		< 0.28				< 14		< 0.63	
MRFI-F-13	MRFI-F-13_SO_20030708	N	08 Jul 2003	13		36		0.27				< 24			
MRFI-F-6	MRFI-F-6_SO_20030708	N	08 Jul 2003	< 40		37		1.5				< 500		< 0.34	
MRFI-SS-1	MRFI-SS-1_SO_20030708	N	08 Jul 2003	< 2		5.5		0.24				< 8.5			
MRFI-SS-2	MRFI-SS-2_SO_20030708	N	08 Jul 2003	< 6.4		15		0.3				< 7.8			
MRFI-SS-10A	MRFI-SS-10A_SO_20030709	N	09 Jul 2003	< 7.2		11		< 0.44				< 62		< 0.16	
MRFI-SS-10B	MRFI-SS-10B_SO_20030709	N	09 Jul 2003	< 9.2		20		2.2				< 84		< 0.22	
MRFI-SS-11A	MRFI-SS-11A_SO_20030709	N	09 Jul 2003	< 380		650		24				< 3200		6.2	
MRFI-SS-11B	MRFI-SS-11B_SO_20030709	N	09 Jul 2003	< 38		61		0.73				< 200		1.1	
MRFI-SS-15A	MRFI-SS-15A_SO_20030709	N	09 Jul 2003	4.8		12		0.61				5.6			
MRFI-SS-15B	MRFI-SS-15B_SO_20030709	N	09 Jul 2003	0.82		2.1		< 0.023				1.9			
MRFI-SS-5A	MRFI-SS-5A_SO_20030709	N	09 Jul 2003	< 15		20		1.2				< 200		< 0.32	
MRFI-SS-5B	MRFI-SS-5B_SO_20030709	N	09 Jul 2003	< 2.9		6		< 0.38				< 37		< 0.085	
MRFI-SS-7A	MRFI-SS-7A_SO_20030709	N	09 Jul 2003	1200		5700		30				20000			
MRFI-SS-7B	MRFI-SS-7B_SO_20030709	N	09 Jul 2003	330		880		92				2600			
MRFI-SS-8A	MRFI-SS-8A_SO_20030709	N	09 Jul 2003	260		940		160				5200			
MRFI-SS-8B	MRFI-SS-8B_SO_20030709	N	09 Jul 2003	88		920		57				1700			
MRFI-SS-9A	MRFI-SS-9A_SO_20030709	N	09 Jul 2003	230		530		20				7700			
MRFI-SS-9B	MRFI-SS-9B_SO_20030709	N	09 Jul 2003	53		360		92				1300			
SP-SD-1	SP-SD-1_SE_20071113	N	13 Nov 2007	56		250		18		89000		2000		8.1	
SP-SD-2	SP-SD-2_SE_20071113	N	13 Nov 2007	160		700		13		23000		4000		10	
SP-SD-3	SP-SD-3_SE_20071113	N	13 Nov 2007	79		200		31		120000		3700		9	
SP-SD-4	SP-SD-4_SE_20071113	N	13 Nov 2007	560		2500		8.6		250000		6500		17	
SP-SD-5	SP-SD-5_SE_20071113	N	13 Nov 2007	1100		3400		13		180000		14000		22	
XRF 8	XRF 8_SO_20071113	N	13 Nov 2007									287			
SP-SD-11M	SP-SD-11M_SE_20071114	N	14 Nov 2007	110		400		8.8		60000		3400		9.6	
SP-SD-A	SP-SD-A_SE_20071114	N	14 Nov 2007	240		980		21		31000		6500		16	
SP-SS-B	SP-SS-B_SE_20071114	N	14 Nov 2007	160		1100		10		48000		3600		11	
WSP-1	WSP-1_SO_20071114	N	14 Nov 2007									22			
WSP-10	WSP-10_SO_20071114	N	14 Nov 2007									5052			
WSP-2	WSP-2_SO_20071114	N	14 Nov 2007									241			
WSP-25	WSP-25_SO_20071114	N	14 Nov 2007									1718			
WSP-26	WSP-26_SO_20071114	N	14 Nov 2007									970			
WSP-27	WSP-27_SO_20071114	N	14 Nov 2007									258			
WSP-29	WSP-29_SO_20071114	N	14 Nov 2007									198			
WSP-3	WSP-3_SO_20071114	N	14 Nov 2007									307			
WSP-30	WSP-30_SO_20071114	N	14 Nov 2007									161			
WSP-31	WSP-31_SO_20071114	N	14 Nov 2007									347			
WSP-32	WSP-32_SO_20071114	N	14 Nov 2007									467			
WSP-33	WSP-33_SO_20071114	N	14 Nov 2007									347			
WSP-34	WSP-34_SO_20071114	N	14 Nov 2007									1161			
WSP-35	WSP-35_SO_20071114	N	14 Nov 2007									1600			
WSP-36	WSP-36_SO_20071114	N	14 Nov 2007									71			
WSP-37	WSP-37_SO_20071114	N	14 Nov 2007									230			
WSP-38	WSP-38_SO_20071114	N	14 Nov 2007									165			
WSP-39	WSP-39_SO_20071114	N	14 Nov 2007									554			
WSP-4	WSP-4_SO_20071114	N	14 Nov 2007									96			
WSP-40	WSP-40_SO_20071114	N	14 Nov 2007									212			
WSP-41	WSP-41_SO_20071114	N	14 Nov 2007									329			
WSP-42	WSP-42_SO_20071114	N	14 Nov 2007									1124			
WSP-43	WSP-43_SO_20071114	N	14 Nov 2007									198			
WSP-44	WSP-44_SO_20071114	N	14 Nov 2007									40			
WSP-45	WSP-45_SO_20071114	N	14 Nov 2007									253			
WSP-46	WSP-46_SO_20071114	N	14 Nov 2007									200			
WSP-47	WSP-47_SO_20071114	N	14 Nov 2007									235			
WSP-48	WSP-48_SO_20071114	N	14 Nov 2007									191			
WSP-5	WSP-5_SO_20071114	N	14 Nov 2007									667			
WSP-6	WSP-6_SO_20071114	N	14 Nov 2007									71			
WSP-7	WSP-7_SO_20071114	N	14 Nov 2007									1084			
WSP-8	WSP-8_SO_20071114	N	14 Nov 2007									285			
WSP-9	WSP-9_SO_20071114	N	14 Nov 2007									672			
XRF 25	XRF 25_SO_20071114	N	14 Nov 2007									146			
XRF 26	XRF 26_SO_20071114	N	14 Nov 2007									559			
XRF 27	XRF 27_SO_20071114	N	14 Nov 2007									212			
XRF 28	XRF 28_SO_20071114	N	14 Nov 2007									329			
XRF 29	XRF 29_SO_20071114	N	14 Nov 2007									1124			
XRF 30	XRF 30_SO_20071114	N	14 Nov 2007									198			
XRF 31	XRF 31_SO_20071114	N	14 Nov 2007									40			
XRF 32	XRF 32_SO_20071114	N	14 Nov 2007									253			
XRF 33	XRF 33_SO_20071114	N	14 Nov 2007									200			

Table J-1
Historical and Recent Sediment Analytical Data
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Unit	Antimony mg/kg		Arsenic mg/kg		Cadmium mg/kg		Iron mg/kg		Lead mg/kg		Selenium mg/kg	
Sample Location	**Sample Name**	**Sample Type**	**Sample Date**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**	**Result**	**Interpreted Qualifier**
XRF 34	XRF 34_SO_20071114	N	14 Nov 2007									235			
XRF 35	XRF 35_SO_20071114	N	14 Nov 2007									191			
USS-6	USS6-SOIL-0-6_SE_061015	N	10 Jun 2015	119		1150		31.1				2790		43.9	
USS-7	USS7-SOIL-0-6_SE_061015	N	10 Jun 2015	239		1.51		17.1				5110		33.9	
USS-10	USS10-SOIL-0-6_SE_061115	N	11 Jun 2015	233		555		3.18				5970		32.4	
USS-8	USS8-SOIL-0-6_SE_061115	N	11 Jun 2015	182		407		63.6				2640		31.1	
USS-9	USS9-SOIL-0-6_SE_061115	N	11 Jun 2015	145		819		31.1				2760		26	
DU1-SE1	DU1-SE1-0-6-112818	N	28 Nov 2018	47		320		12		53000		980		2.8	
DU1-SE2	DU1-SE2-0-6-112818	N	28 Nov 2018	49		390		14		53000		1100		3.3	
DU1-SE3	DU1-SE3-0-6-112818	N	28 Nov 2018	51		390		13		54000		1100		3.2	
DU2-SE1	DU2-SE1-0-6-112918	N	29 Nov 2018	39		410		6.0		23000		710		7.4	
DU2-SE2	DU2-SE2-0-6-112918	N	29 Nov 2018	20		270		4.0		22000		390		4.3	
DU2-SE3	DU2-SE3-0-6-112918	N	29 Nov 2018	27		290		4.6		22000		450		5.0	
DU8-SE1	DU8-SE1-0-6-113018	N	30 Nov 2018	46		310		64		76000		1800		6.0	
DU8-SE2	DU8-SE2-0-6-113018	N	30 Nov 2018	44		300		56		64000		1500		6.1	
DU8-SE3	DU8-SE3-0-6-113018	N	30 Nov 2018	48		280		58		52000		1500		5.4	
DU7-SE1	DU7-SE1-0-6-120318	N	03 Dec 2018	16		200		33		36000		640		3.7	
DU7-SE2	DU7-SE2-0-6-120318	N	03 Dec 2018	12		180		29		34000		590		3.1	
DU7-SE3	DU7-SE3-0-6-120318	N	03 Dec 2018	15		180		33		37000		690		3.4	
DU6-SE1	DU6-SE1-0-6-120418	N	04 Dec 2018	26		320		56		36000		680		6.1	
DU6-SE2	DU6-SE2-0-6-120418	N	04 Dec 2018	28		320		57		43000		890		5.8	
DU6-SE3	DU6-SE3-0-6-120418	N	04 Dec 2018	30		380		65		44000		950		6.6	
DU3-SE1	DU3-SE1-0-6-120518	N	05 Dec 2018	11	J-	240		5.4		27000		260		5.3	
DU3-SE2	DU3-SE2-0-6-120518	N	05 Dec 2018	15	J-	290		7.4		27000		340		7.4	
DU3-SE3	DU3-SE3-0-6-120518	N	05 Dec 2018	12	J-	260		7.0		28000		400		6.2	
DU4-SE1	DU4-SE1-0-6-120618	N	06 Dec 2018	15		230		7.3		25000		350		5.3	
DU4-SE2	DU4-SE2-0-6-120618	N	06 Dec 2018	11		200		7.3		24000		290		4.1	
DU4-SE3	DU4-SE3-0-6-120618	N	06 Dec 2018	16		270		7.9		23000		420		5.6	
DU5-SE1	DU5-SE1-0-6-120718	N	07 Dec 2018	34		550		21		21000		660		10	
DU5-SE2	DU5-SE2-0-6-120718	N	07 Dec 2018	36		590		19		22000		800		11	
DU5-SE3	DU5-SE3-0-6-120718	N	07 Dec 2018	33		570		15		21000		640		10	

Notes:
N = Normal (or investigative) sample
J = The result is an estimated quantity. The associated numerical value is the approximate concentration of the analyte in the sample.
J- = The result is an estimated quantity, but the result may be biased low.
U = The analyte was analyzed for, but was not detected above the level of the reported detection limit.
mg/kg = milligrams per kilogram

Only data collected by ERM between 2018 and 2019 went through formal validation

APPENDIX K SURFACE WATER ANALYTICAL DATA USED IN THIS REMEDIAL INVESTIGATION

Table K-1
Historical and Recent Surface Water Analytical Data
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical / Unit / Fraction	Antimony ug/L Dissolved		Antimony ug/L Total		Arsenic ug/L Dissolved		Arsenic ug/L Total		Cadmium ug/L Dissolved		Cadmium ug/L Total		Iron ug/L Total		Lead ug/L Dissolved		Lead ug/L Total		Selenium ug/L Dissolved		Selenium ug/L Total	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier	Result	Interpreted Qualifier
SW-A	SW-A_WS_20000921	N	21 Sep 2000					35.5				10	U					100	U			5	U		
SW-B	SW-B_WS_20000921	N	21 Sep 2000					104				10	U					100	U			5	U		
MRFI-SW-1	MRFI-SW-1_WS_20030708	N	08 Jul 2003	17	U			69				0.44	U					2							
MRFI-SW-13	MRFI-SW-13_WS_20030708	N	08 Jul 2003	30				220				0.44	U					8.8							
MRFI-SW-2	MRFI-SW-2_WS_20030708	N	08 Jul 2003	12	U			610				0.44	U					1.7				5	U		
MRFI-SW-6	MRFI-SW-6_WS_20030708	N	08 Jul 2003	15	U			240				0.44	U					2.8							
MRFI-SW-10	MRFI-SW-10_WS_20030709	N	09 Jul 2003	27				38				0.87	U					5.2				5	U		
SW-A	SW-A_WS_20070326	N	26 Mar 2007	34				14				0.36	U					20				4.2	U		
SW-B	SW-B_WS_20070326	N	26 Mar 2007	14				230				0.36	U					2.6	U			4.2	U		
SW-C	SW-C_WS_20070326	N	26 Mar 2007	7.4				5.8				0.36	U					2.6	U			4.2	U		
SW-CANAL	SW-CANAL_WS_20070326	N	26 Mar 2007	22				50				0.36	U					7.7				4.2	U		
SW-B	SW-B_WS_20070508	N	08 May 2007			28				300				0.71	U					4.9				4.7	U
SW-C	SW-C_WS_20070508	N	08 May 2007			11				9.9				0.71	U					2.9				4.7	U
SW-A	SW-A_WS_20070509	N	09 May 2007			46				13				0.71	U					19				4.7	U
SW-CANAL	SW-CANAL_WS_20070509	N	09 May 2007			22				85				0.71	U					5.6				4.7	U
SW-A	SW-A_WS_20120612	N	12 Jun 2012	36				56				0.61						5.4				2.7	U		
SW-B	SW-B_WS_20120612	N	12 Jun 2012	8.1				130				0.84						2				2.7	U		
SW-C	SW-C_WS_20120612	N	12 Jun 2012	9.8				7.3				0.71						2				2.7	U		
SW-CANAL	SW-CANAL_WS_20120612	N	12 Jun 2012	25				37				0.56						4.2				2.7	U		
SW-A	SW-A_WS_20151006	N	06 Oct 2015			22				47				0.94	U	100	U			2.5	U			4.6	U
SW-B	SW-B_WS_20151006	N	06 Oct 2015			7				11				0.94	U	100	U			2.5	U			4.6	
SW-C	SW-C_WS_20151006	N	06 Oct 2015			6.4	U			12				0.94	U	100	U			2.5	U			4.6	U
SW-CANAL	SW-CANAL_WS_20151006	N	06 Oct 2015			14				25				0.94	U	100	U			2.5	U			4.6	U
SW-RAMP	SW-RAMP_WS_20151006	N	06 Oct 2015			7.5				76				0.94	U	100	U			2.5	U			4.6	U
SW-CANAL	SW-CANAL_WS_20160622	N	22 Jun 2016	13				29				0.94	U					2.5	U			4.6	U		
SW-CANAL	SW-CANAL_WS_20170601	N	01 Jun 2017	11				21				1.2						2.7	U			5.3	U		
SW-B	SW-B_WS_20170706	N	06 Jul 2017	6	U			170				0.43	U					2.7	U			5.3	U		
SW-B	AREA B-20181218	N	18 Dec 2018			6	U			52				1.2		360				2.7	U			5.3	U
SW-CANAL	CANAL-20181218	N	18 Dec 2018			42				11				1.2		230				2.7	U			5.3	U
SW-B	SW-AREA B	N	05 Jun 2019			20	U			170				1.2		490				5	U			10	U
SW-CANAL	SW-CANAL	N	05 Jun 2019			10				92				0.95		440				5	U			10	U
SW-B	SW-AREA B-20200122	N	22 Jan 2020	8.3				160				0.43	U					4.2				8.3			
SW-CANAL	SW-CANAL-20200122	N	22 Jan 2020	46				45				0.66						41				12			
SW-B	SW-AREA B-20200514	N	14 May 2020	6	U			130				0.73						8.4				5.3	U		
SW-CANAL	SW-CANAL-20200514	N	14 May 2020	27				13				0.43	U					2.7	U			5.3	U		
SW-B	SW-AREA B-20210316	N	16 Mar 2021	9.7				100				0.43	U					2.7	U			5.3	U		
SW-CANAL	SW-CANAL-20210316	N	16 Mar 2021	130				11				0.43	U					2.7	U			7.7			

Notes:
N = Normal (or investigative) sample
U = The analyte was analyzed for, but was not detected above the level of the reported detection limit.
ug/L = Microgram per liters
Only data collected by ERM 2018-2019 went through formal validation

APPENDIX L GROUNDWATER ANALYTICAL DATA USED IN REMEDIAL INVESTIGATION

Table L-1
Historical and Recent Groundwater Analytical Data
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Unit Fraction	Antimony ug/L D		Antimony ug/L T		Arsenic ug/L D		Arsenic ug/L T		Cadmium ug/L D		Cadmium ug/L T		Iron ug/L D		Iron ug/L T		Lead ug/L D		Lead ug/L T		Selenium ug/L D		Selenium ug/L T		Alkalinity, Total as CaCO3 ug/L T		Hardness as CaCO3 ug/L T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
ECHA-MW-01	MW-01-GW-032019	N	20 Mar 2019			920				380				49				14	U			20				48		280000		250000	
ECHA-MW-01	MW-01-GW-FF-032019	N	20 Mar 2019	960				390				46				14	U			8.4				54							
ECHA-MW-01	ECHA-MW-01-GW-060319	N	03 Jun 2019			1200				440				44				39	J			21				72		250000		250000	
ECHA-MW-01	ECHA-MW-01-GW-FF-060319	N	03 Jun 2019	1100				400				43				14	U			10				70							
ECHA-MW-01	MW-01-GW-081219	N	12 Aug 2019			1200				440				59				20	J			15				82		240000		240000	
ECHA-MW-01	MW-01-GW-FF-081219	N	12 Aug 2019	1200				440				59				20	U			9.9				82							
ECHA-MW-09	MW-09-GW-032019	N	20 Mar 2019			120				17				4.7				67				89				3.8	J	300000		270000	
ECHA-MW-09	MW-09-GW-FF-032019	N	20 Mar 2019	120				14				4.3				14	U			68				3.3	J						
ECHA-MW-09	ECHA-MW-09-GW-060319	N	03 Jun 2019			25				25				1.0				670				80				2.6	U	250000		280000	
ECHA-MW-09	ECHA-MW-09-GW-FF-060319	N	03 Jun 2019	24				23				0.75	J			540				47				2.6	U						
ECHA-MW-09	MW-09-GW-081219	N	12 Aug 2019			34				30				0.50	J			930				89				1.5	U	270000		290000	
ECHA-MW-09	MW-09-GW-FF-081219	N	12 Aug 2019	31				26				0.41	J			890				47				1.5	U						
ECHA-MW-35	MW-35-GW-032019	N	20 Mar 2019			68				1.1				0.13	U			150				0.13	U			3.3	J	360000		350000	
ECHA-MW-35	MW-35-GW-FF-032019	N	20 Mar 2019	68				1.0				0.13	U			68				0.13	U			3.3	J						
ECHA-MW-35	ECHA-MW-35-GW-060319	N	03 Jun 2019			36				1.7				0.13	U			240				0.64	J			2.6	U	320000		320000	
ECHA-MW-35	ECHA-MW-35-GW-FF-060319	N	03 Jun 2019	34				1.7				0.13	U			180				0.15	J			2.6	U						
ECHA-MW-35	MW-35-GW-081219	N	12 Aug 2019			5.9				2.0				0.13	U			340				0.28	J			1.5	U	330000		360000	
ECHA-MW-35	MW-35-GW-FF-081219	N	12 Aug 2019	5.3				1.7				0.13	U			250				0.13	U			1.5	U						
MW1	MW1_WG_20001115	N	15 Nov 2000			320				5.2				2	U							5	U			5	U				
MW1	MW1_WG_20010215	N	15 Feb 2001			20	U			10	U			2	U							5	U			5	U				
MW1	MW1_WG_20010614	N	14 Jun 2001			28.2				5.3	U			0.32	U							4.7	U			4.9	U				
MW1	MW1_WG_20010927	N	27 Sep 2001			28.9				5.3	U			0.32	U							4.7	U			4.9	U				
MW1	MW1_WG_20011128	N	28 Nov 2001			37.2				5.3	U			0.32	U							4.7	U			5					
MW1	MW1_WG_20020321	N	21 Mar 2002			26.8				5.3	U			0.32												5.4					
MW1	MW1_WG_20020605	N	05 Jun 2002			40				5.2	U			0.55								1.9	U			5	U				
MW1	MW1_WG_20020820	N	20 Aug 2002			31				5.2	U			0.44	U							2.9	U			5	U				
MW1	MW1_WG_20021119	N	19 Nov 2002			14				5.2	U			0.44	U							2.9	U			5	U				
MW1	MW1_WG_20030317	N	17 Mar 2003			19				5.2	U			0.44	U							2.9	U			6.8					
MW1	MW1_WG_20030515	N	15 May 2003			24				5.2	U			0.44	U							2.9	U			7.8					
MW1	MW1_WG_20030709	N	09 Jul 2003			30				5.2	U			0.44	U							0.53	U			5	U				
MW1	MW1_WG_20031016	N	16 Oct 2003			48				5.2	U			0.44	U							2.9	U			5.7	U				
MW1	MW1_WG_20040127	N	27 Jan 2004			27				5.2	U			0.44	U							2.9	U			5	U				
MW1	MW1_WG_20040519	N	19 May 2004			38				5.2	U			0.44	U							2.9	U			7.6	U				
MW1	MW1_WG_20040722	N	22 Jul 2004			44				5.2	U			0.44	U							2.9	U			7	U				
MW1	MW1_WG_20041021	N	21 Oct 2004			26				5.2	U			0.44	U							2.9	U			7.2	U				
MW1	MW1_WG_20050127	N	27 Jan 2005			30				3.5	U			0.4	U							2.5	U			4.1	U				
MW1	MW1_WG_20050512	N	12 May 2005			36				2.1	U			0.36	U							2.6	U			4.2	U				
MW1	MW1_WG_20050824	N	24 Aug 2005			30				2.1	U			0.36	U							2.6	U			4.2	U				
MW1	MW1_WG_20051216	N	16 Dec 2005			23				2.1	U			0.36	U							2.6	U			4.2	U				
MW1	MW1_WG_20060327	N	27 Mar 2006			28				2.1	U			0.36	U							2.8	U			4.2	U				
MW1	MW1_WG_20060628	N	28 Jun 2006			32				2.1	U			0.36	U							2.6	U			4.2	U				
MW1	MW1_WG_20060926	N	26 Sep 2006			40				2.1	U			0.36	U							2.7	U			4.2	U				
MW1	MW1_WG_20061219	N	19 Dec 2006			38				2.1	U			0.36	U							2.6	U								
MW1	MW1_WG_20070326	N	26 Mar 2007			39				2.1	U			0.36	U							2.6	U			5.3	U				
MW1	MW1_WG_20070508	N	08 May 2007			43				2.7	U			0.71	U							2.2	U			4.7	U				
MW1	MW1_WG_20070823	N	23 Aug 2007			36				2.7	U			0.71	U							2.2	U			4.7	U				
MW1	MW1_WG20071217	N	17 Dec 2007			27				2.7	U			0.71	U							2.2	U			4.7	U				
MW10	MW10_WG_20001115	N	15 Nov 2000			1.9	U			476				4	U							5	U			5	U				
MW10	MW10_WG_20010215	N	15 Feb 2001			20	U			49.6				2	U							5	U			5	U				
MW10	MW10_WG_20010615	N	15 Jun 2001			11.1	U			332				0.32	U							4.7	U			10.4					
MW10	MW10_WG_20010928	N	28 Sep 2001			11.1	U			428				0.32	U							4.7	U			4.9	U				
MW10	MW10_WG_20011127	N	27 Nov 2001			11.1	U			644				0.32	U							4.7	U			11.1					
MW10	MW10_WG_20020321	N	21 Mar 2002			11.1	U			318				0.64												8					
MW10	MW10_WG_20020606	N	06 Jun 2002			12	U			300				0.44	U							1.9	U			6.5					
MW10	MW10_WG_20020820	N	20 Aug 2002			12	U			530				0.44	U							2.9	U			5					
MW10	MW10_WG_20021119	N	19 Nov 2002			12	U			720				0.44	U							2.9	U			5	U				
MW10	MW10_WG_20030317	N	17 Mar 2003			12	U			430				0.44	U							2.9	U			11					
MW10	MW10_WG_20030514	N	14 May 2003			12	U			1400				1.8								2.9	U			11					
MW10	MW10_WG_20030710	N	10 Jul 2003			12	U			1700				0.98	U							1.2	U			5	U				
MW10	MW10_WG_20031016	N	16 Oct 2003			12	U			460				0.44	U							2.9	U			5.3	U				
MW10	MW10_WG_20040127	N	27 Jan 2004			12	U			790				0.44	U							2.9	U			5	U				
MW10	MW10_WG_20040519	N	19 May 2004			12	U			1500				0.55	U							2.9	U			7.3	U				
MW10	MW10_WG_20040723	N	23 Jul 2004			12	U			1900				0.44	U							2.9	U			9.8	U				
MW10	MW10_WG_20041022	N	22 Oct 2004			12	U			1200				0.44	U							2.9	U			15					
MW10	MW10_WG_20050126	N	26 Jan 2005			4.5	U			1700				1.2	U							2.5	U			3.7	U				
MW10	MW10_WG_20050511	N	11 May 2005			2.8	U			280				0.36	U							2.6	U			4.2	U				
MW10	MW10_WG_20050823	N	23 Aug 2005			2.8	U			370				0.36	U							2.6	U			4.2	U				
MW10	MW10_WG_20051215	N	15 Dec 2005			4.2	U			170				0.36	U							2.6	U			4.2	U				
MW10	MW10_WG_20050328	N	28 Mar 2006			2.8	U			220				0.36	U							2.6	U			4.2	U				
MW10	MW10_WG_20060629	N	29 Jun 2006			2.8	U			220				0.36	U							2.6	U			4.2	U				
MW10	MW10_WG_20060927	N	27 Sep 2006			2.8	U			1500				0.36	U							3.1	U			4.2	U				
MW10	MW10_WG_20061219	N	19 Dec 2006			2.8	U			1600				0.36	U							2.6	U								
MW10	MW10_WG_20070327	N	27 Mar 2007			2.8	U			790				0.36	U							2.6	U			4.2	U				
MW10	MW10_WG_20070509	N	09 May 2007			4.5	U			150				0.71	U							2.2	U			4.7	U				
MW10	MW10_WG_20070822	N	22 Aug 2007			4.5	U			210				0.71	U							2.2	U			4.7	U				
MW10	MW10_WG_20071218	N	18 Dec 2007			4.5	U			130				0.71	U							2.2	U			4.7	U				
MW10	MW10_WG_20080514	N	14 May 2008			4.2	U			570				0.46	U							2.3	U			4.2	U				
MW10	MW10_WG_20081106	N	06 Nov 2008			4.2	U			100				0.46	U							1.8	U			4.2	U				
MW10	MW10_WG_20090624	N	24 Jun 2009			2.3	U			120				0.34	U							2.1	U			3.1	U				
MW10	MW10_WG_20091120	N	20 Nov 2009			2.3	U			100				0.34	U							2.1	U			3.1	U				
MW10	MW10_WG_20100602	N	02 Jun 2010			3.4	U			40				0.19	U							1.7	U			2.8	U				
MW10	MW10_WG_20101112	N	12 Nov 2010			3.6	U			77				0.89	U							1.7	U			2.4	U				
MW10	MW10_WG_20110721	N	21 Jul 2011			2.8	U			63				0.36	U							2	U			2.5	U				
MW10	MW10_WG_20111220	N	20 Dec 2011			2.8	U			150				1.4	U							2	U			2.5	U				
MW10	MW10_WG_20120612	N	12 Jun 2012			2.6	U			57				0.68	U							1.8	U			2.7	U				

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			Chemical	Antimony		Antimony		Arsenic		Arsenic		Cadmium		Cadmium		Iron		Iron		Lead		Lead		Selenium		Selenium		Alkalinity, Total as CaCO3		Hardness as CaCO3	
			Unit	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
			Fraction	D		T		D		T		D		T		D		T		D		T		D		T		T		T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
MW10	MW10_WG_20130620	N	20 Jun 2013			3.9	U			120				0.76	U							5.6				4.6	U				
MW10	MW10_WG_20131115	N	15 Nov 2013			6	U			410				0.79	U							2.3	U			4.6	U				
MW10	MW10_WG_20140521	N	21 May 2014			3.9	U			130				1	U							2.3	U			4.6	U				
MW10	MW10_WG_20141105	N	05 Nov 2014			3.9	U			77				1.2	U							2.3	U			4.6	U				
MW10	MW10_WG_20150609	N	09 Jun 2015			6.4	U			300				3.8								6.3				4.6	U				
MW10	MW10_WG_20151116	N	16 Nov 2015			6.4	U			150				3.6								2.5	U			4.6	U				
MW10	MW10_WG_20160620	N	20 Jun 2016			6.4	U			97				0.94	U							2.5	U			4.6	U				
MW10	MW10_WG_20161220	N	20 Dec 2016			6.4	U			210				0.94	U							2.5	U			5.1	U				
MW10	MW10_WG_20170531	N	31 May 2017			6	U			150				2.9	U							2.7	U			5.3	U				
MW10	MW10-20181218	N	18 Dec 2018	6.9		6	U	650		920		0.83		3.2		15000		21000		2.7	U	2.7	U	5.9		5.3	U	240000		1000000	
MW10	MW-10	N	04 Jun 2019	6	U	6	U	220		730		1.6		3.4		5300		20000		6.4		6.0		5.3	U	5.3	U	230000			
MW11	MW11_WG_20001117	N	17 Nov 2000			1.9	U			5	U			2	U							5	U			5	U				
MW11	MW11_WG_20010216	N	16 Feb 2001			20	U			10	U			2	U							5	U			8.7					
MW11	MW11_WG_20010615	N	15 Jun 2001			11.1	U			12.9				0.32	U							4.7	U			23.6					
MW11	MW11_WG_20010928	N	28 Sep 2001			11.1	U			5.3	U			0.32	U							4.7	U			4.9	U				
MW11	MW11_WG_20011128	N	28 Nov 2001			11.1	U			5.3	U			0.57								4.7	U			13.9					
MW11	MW11_WG_20020322	N	22 Mar 2002			11.1	U			6.5				0.32	U											18.8					
MW11	MW11_WG_20020605	N	05 Jun 2002			12	U			5.2				0.93								1.9	U			9.1					
MW11	MW11_WG_20020820	N	20 Aug 2002			12	U			11				0.44	U							2.9	U			25					
MW11	MW11_WG_20021119	N	19 Nov 2002			12	U			6.1				0.44	U							2.9	U			14					
MW11	MW11_WG_20030317	N	17 Mar 2003			12	U			15				0.44	U							2.9	U			33					
MW11	MW11_WG_20030514	N	14 May 2003			12	U			14				1.9								2.9	U			43					
MW11	MW11_WG_20030709	N	09 Jul 2003			12	U			5.2	U			1.7	U							0.88	U			5	U				
MW11	MW11_WG_20031015	N	15 Oct 2003			13	U			13				0.44	U							2.9	U			24					
MW11	MW11_WG_20040126	N	26 Jan 2004			12	U			7	U			0.44	U							2.9	U			8.5	U				
MW11	MW11_WG_20040519	N	19 May 2004																							14					
MW11	MW11_WG_20140519	N	19 May 2004			12	U			7.6	U			0.91	U							2.9	U								
MW11	MW11_WG_20041021	N	21 Oct 2004			20	U			16				0.44	U							2.9	U			64					
MW11	MW11_WG_20050126	N	26 Jan 2005			4.5	U			3.5	U			1.6	U							2.5	U			5.7	U				
MW11	MW11_WG_20050512	N	12 May 2005			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW11	MW11_WG_20050823	N	23 Aug 2005			2.9	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW11	MW11_WG_20051216	N	16 Dec 2005			2.8	U			2.1	U			1.8	U							2.6	U			4.2	U				
MW11	MW11_WG_20060327	N	27 Mar 2006			2.8	U			2.1	U			1.2	U							2.8	U			4.2	U				
MW11	MW11_WG_20060628	N	28 Jun 2006			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW11	MW11_WG_20061219	N	19 Dec 2006			2.8	U			2.1	U			0.36	U							2.6	U								
MW11	MW11_WG_20070326	N	26 Mar 2007			7.5	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW11	MW11_WG_20070508	N	08 May 2007			5.7	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW11	MW11_WG_20071217	N	17 Dec 2007			4.5	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW12	MW12_WG_20001116	N	16 Nov 2000			3.1				47				2	U							5	U			5	U				
MW12	MW12_WG_20010216	N	16 Feb 2001			20	U			10	U			2	U							5	U			7.2					
MW12	MW12_WG_20010615	N	15 Jun 2001			11.1	U			14.4				0.32	U							4.7	U			21.5					
MW12	MW12_WG_20010928	N	28 Sep 2001			11.1	U			5.3	U			0.32	U							4.7	U			4.9	U				
MW12	MW12_WG_20011128	N	28 Nov 2001			11.1	U			15.6				0.32	U							4.7	U			28.2					
MW12	MW12_WG_20020322	N	22 Mar 2002			11.1	U			9.4				0.32	U											24.1					
MW12	MW12_WG_20020605	N	05 Jun 2002			12	U			7.1				0.46								1.9	U			16					
MW12	MW12_WG_20020820	N	20 Aug 2002			12	U			12				0.44	U							2.9	U			26					
MW12	MW12_WG_20021119	N	19 Nov 2002			12	U			5.8				0.44	U							2.9	U			13					
MW12	MW12_WG_20030317	N	17 Mar 2003			12	U			14				0.44	U							2.9	U			30					
MW12	MW12_WG_20030514	N	14 May 2003			12	U			22				1.1								2.9	U			45					
MW12	MW12_WG_20030709	N	09 Jul 2003			12	U			5.2	U			0.84	U							0.7	U			5	U				
MW12	MW12_WG_20031015	N	15 Oct 2003			12	U			6.4	U			0.44	U							2.9	U			18					
MW12	MW12_WG_20040126	N	26 Jan 2004			12	U			6.3	U			0.44	U							2.9	U			7.6	U				
MW12	MW12_WG_20040519	N	19 May 2004			12	U			8.2	U			0.44	U							2.9	U			25					
MW12	MW12_WG_20040723	N	23 Jul 2004			12	U			5.2	U			0.44	U							2.9	U			11					
MW12	MW12_WG_20041021	N	21 Oct 2004			20	U			18				0.44	U							2.9	U			51					
MW12	MW12_WG_20050126	N	26 Jan 2005			4.5	U			3.5	U			1.2	U							2.5	U			5.6	U				
MW12	MW12_WG_20050512	N	12 May 2005			2.9	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW12	MW12_WG_20050823	N	23 Aug 2005			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW12	MW12_WG_20051216	N	16 Dec 2005			5.1	U			2.1	U			0.63	U							2.6	U			4.2	U				
MW12	MW12_WG_20060327	N	27 Mar 2006			4.3	U			2.1	U			0.36	U							3.2	U			4.2	U				
MW12	MW12_WG_20060628	N	28 Jun 2006			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW12	MW12_WG_20060926	N	26 Sep 2006			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW12	MW12_WG_20061219	N	19 Dec 2006			3.5	U			2.1	U			0.36	U							2.6	U								
MW12	MW12_WG_20070326	N	26 Mar 2007			3	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW12	MW12_WG_20070508	N	08 May 2007			5.9	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW12	MW12_WG_20070823	N	23 Aug 2007			4.5	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW12	MW12_WG_20071217	N	17 Dec 2007			4.5	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW12	MW12_WG_20080514	N	14 May 2008			5.9	U			2.8	U			0.46	U							3.4	U			4.2	U				
MW12	MW12_WG_20081105	N	05 Nov 2008			4.2	U			5.9	U			0.46	U							1.8	U			4.2	U				
MW12	MW12_WG_20091119	N	19 Nov 2009			2.3	U			2.2	U			0.34	U							2.7	U			3.1	U				
MW12	MW12_WG_20100601	N	01 Jun 2010			3.4	U			2.3	U			1	U							1.7	U			2.8	U				
MW12	MW12_WG_20101111	N	11 Nov 2010			8.1	U			1.7	U			0.95	U							1.7	U			2.6	U				
MW12	MW12_WG_20110720	N	20 Jul 2011			2.8	U			2.5	U			0.36	U							2.4	U			2.5	U				
MW12	MW12_WG_20131115	N	15 Nov 2013			8.1	U			2.6	U			1.3	U							2.3	U			4.6	U				
MW12	MW12_WG_20140522	N	22 May 2014			3.9	U			4.8	U			0.47	U							2.3	U			4.6	U				
MW12	MW12_WG_20141105	N	05 Nov 2014			5.5	U			2.6	U			2.3	U							6.2				4.6	U				
MW12	MW12_WG_20150609	N	09 Jun 2015			6.4	U			3.8	U			1	U							5.9				4.6	U				
MW12	MW12_WG_20151116	N	16 Nov 2015			6.4	U			3.8	U			1.5	U							2.7	U			4.6	U				
MW12	MW12_WG_20161221	N	21 Dec 2016			6.4	U			3.8	U			0.94	U							2.5	U			5.1	U				
MW12	MW12-20181217	N	17 Dec 2018	7.1		7.7		3.8		3.7	U	0.99		1.7		40000		110000		2.7	U	34		11		5.3	U	380000		940000	
MW13	MW13_WG_20001116	N	16 Nov 2000			14				5	U			2	U							7				5	U				
MW13	MW13_WG_20010216	N	16 Feb 2001			20	U			10	U			2	U							5	U			5	U				
MW13	MW13_WG_20010614	N	14 Jun 2001			11.1	U			5.5				0.32	U							4.7	U			5.7					
MW13	MW13_WG_20010927	N	27 Sep 2001			11.1	U			5.3	U			0.32	U							4.7	U			4.9	U				
MW13	MW13_WG_20011129	N	29 Nov 2001			11.1	U			6.8				0.32	U							4.7	U			14.5					

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			Chemical Unit Fraction	Antimony ug/L D		Antimony ug/L T		Arsenic ug/L D		Arsenic ug/L T		Cadmium ug/L D		Cadmium ug/L T		Iron ug/L D		Iron ug/L T		Lead ug/L D		Lead ug/L T		Selenium ug/L D		Selenium ug/L T		Alkalinity, Total as CaCO3 ug/L T		Hardness as CaCO3 ug/L T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
MW13	MW13_WG_20020321	N	21 Mar 2002			17.6				5.3	U			0.32	U											7.1					
MW13	MW13_WG_20020605	N	05 Jun 2002			22				5.2	U			0.44	U							1.9	U			8.2					
MW13	MW13_WG_20020820	N	20 Aug 2002			12	U			5.2	U			0.44	U							2.9	U			12					
MW13	MW13_WG_20021118	N	18 Nov 2002			12	U			5.2	U			0.44	U							2.9	U			6.1					
MW13	MW13_WG_20030317	N	17 Mar 2003			12	U			6.6				0.44	U							2.9	U			14					
MW13	MW13_WG_20030515	N	15 May 2003			13				5.2	U			0.44	U							2.9	U			9.6					
MW13	MW13_WG_20030709	N	09 Jul 2003			12	U			5.2	U			0.44	U							2.9				5	U				
MW13	MW13_WG_20031015	N	15 Oct 2003			12	U			6.4	U			0.44	U							2.9	U			5.1	U				
MW13	MW13_WG_20040126	N	26 Jan 2004			12	U			5.9	U			0.44	U							2.9	U			5	U				
MW13	MW13_WG_20040518	N	18 May 2004			17	U			5.2	U			0.44	U							2.9	U			7.5	U				
MW13	MW13_WG_20040722	N	22 Jul 2004			12	U			5.2	U			0.44	U							2.9	U			5	U				
MW13	MW13_WG_20041021	N	21 Oct 2004			12	U			5.2	U			0.44	U							2.9	U			12					
MW13	MW13_WG_20050127	N	27 Jan 2005			17	U			3.5	U			0.3	U							2.5	U			3	U				
MW13	MW13_WG_20050511	N	11 May 2005			12	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW13	MW13_WG_20050824	N	24 Aug 2005			3.5	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW13	MW13_WG_20051215	N	15 Dec 2005			11	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW13	MW13_WG_20060327	N	27 Mar 2006			11	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW13	MW13_WG_20060628	N	28 Jun 2006			7.8	U			2.1	U			0.36	U							3.1	U			4.2	U				
MW13	MW13_WG_20060926	N	26 Sep 2006			10	U			2.1	U			0.36	U							2.7	U			4.2	U				
MW13	MW13_WG_20061218	N	18 Dec 2006			13	U			2.1	U			0.36	U							2.6	U								
MW13	MW13_WG_20070326	N	26 Mar 2007			30				2.1	U			0.36	U							2.6	U			4.2	U				
MW13	MW13_WG_20070508	N	08 May 2007			32				2.7	U			0.71	U							2.2	U			4.7	U				
MW13	MW13_WG_20070822	N	22 Aug 2007			6.5	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW13	MW13_WG_20071217	N	17 Dec 2007			7.9	U			6.7	U			0.71	U							2.2	U			4.7	U				
MW14	MW14_WG_20001115	N	15 Nov 2000			1.9	U			9.8				2	U							5	U			5	U				
MW14	MW14_WG_20010215	N	15 Feb 2001			20	U			10	U			2	U							5	U			5	U				
MW14	MW14_WG_20010614	N	14 Jun 2001			11.1	U			11.3				0.32	U							4.7	U			5.9					
MW14	MW14_WG_20010927	N	27 Sep 2001			11.1	U			8.4				0.32	U							4.7	U			4.9	U				
MW14	MW14_WG_20011128	N	28 Nov 2001			11.1	U			12.1				0.32	U							4.7	U			5.7					
MW14	MW14_WG_20020321	N	21 Mar 2002			11.1	U			10.6				0.32	U											8.2					
MW14	MW14_WG_20020605	N	05 Jun 2002			12	U			8.2				0.44	U							1.9	U			6.5					
MW14	MW14_WG_20020820	N	20 Aug 2002			12	U			12				0.44	U							2.9	U			6.5					
MW14	MW14_WG_20021119	N	19 Nov 2002			12	U			12				0.44	U							2.9	U			5	U				
MW14	MW14_WG_20030317	N	17 Mar 2003			12	U			11				0.44	U							2.9	U			6.6					
MW14	MW14_WG_20030515	N	15 May 2003			12	U			15				0.44	U							2.9	U			9					
MW14	MW14_WG_20030709	N	09 Jul 2003			12	U			9.9	U			0.44	U							0.62	U			5	U				
MW14	MW14_WG_20031016	N	16 Oct 2003			12	U			13				0.44	U							2.9	U			5	U				
MW14	MW14_WG_20040127	N	27 Jan 2004			12	U			12				0.44	U							2.9	U			5	U				
MW14	MW14_WG_20040519	N	19 May 2004			12	U			9.4	U			0.44	U							2.9	U			5.3	U				
MW14	MW14_WG_20040722	N	22 Jul 2004			12	U			9.1	U			0.44	U							2.9	U			5	U				
MW14	MW14_WG_20041021	N	21 Oct 2004			12	U			14				0.44	U							2.9	U			11					
MW14	MW14_WG_20050127	N	27 Jan 2005			4.5	U			7.2	U			0.41	U							2.5	U			3	U				
MW14	MW14_WG_20050512	N	12 May 2005			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW14	MW14_WG_20050824	N	24 Aug 2005			2.8	U			3.4	U			0.36	U							2.6	U			4.2	U				
MW14	MW14_WG_20051216	N	16 Dec 2005			3.9	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW14	MW14_WG_20060327	N	27 Mar 2006			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW14	MW14_WG_20060628	N	28 Jun 2006			2.8	U			3.6	U			0.36	U							2.6	U			4.2	U				
MW14	MW14_WG_20060926	N	26 Sep 2006			4.4	U			5.8	U			0.36	U							2.6	U			4.2	U				
MW14	MW14_WG_20061219	N	19 Dec 2006			2.8	U			5.3	U			0.36	U							2.6	U								
MW14	MW14_WG_20070326	N	26 Mar 2007			2.8	U			7	U			0.36	U							2.6	U			4.2	U				
MW14	MW14_WG_20070508	N	08 May 2007			4.5	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW14	MW14_WG_20070823	N	23 Aug 2007			4.5	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW14	MW14_WG_20071217	N	17 Dec 2007			4.5	U			6.8	U			0.71	U							2.2	U			4.7	U				
MW15	MW15_WG_20010212	N	12 Feb 2001							19				2	U							5	U								
MW15	MW15_WG_20010213	N	13 Feb 2001							70												100									
MW15	MW15_WG_20010615	N	15 Jun 2001			30.6				14.1				0.32	U							4.7	U			4.9	U				
MW15	MW15_WG_20010928	N	28 Sep 2001			44.7				29.9				0.32	U							4.7	U			4.9	U				
MW15	MW15_WG_20011127	N	27 Nov 2001			54.8				70.4				0.32	U							4.7	U			4.9	U				
MW15	MW15_WG_20020321	N	21 Mar 2002			43.1				53.5				1.2												6.2					
MW15	MW15_WG_20020606	N	06 Jun 2002			64				67				0.44	U							1.9	U			5	U				
MW15	MW15_WG_20020820	N	20 Aug 2002			41				150				0.44	U							2.9	U			8.6					
MW15	MW15_WG_20021120	N	20 Nov 2002			27				160				0.44	U							2.9	U			5	U				
MW15	MW15_WG_20030317	N	17 Mar 2003			21				65				0.44	U							2.9	U			7.1					
MW15	MW15_WG_20030514	N	14 May 2003			160				43				0.44	U							2.9	U			10					
MW15	MW15_WG_20030710	N	10 Jul 2003			170				610				0.44	U							0.93	U			5	U				
MW15	MW15_WG_20031016	N	16 Oct 2003			73				69				0.44	U							2.9	U			6.5	U				
MW15	MW15_WG_20040127	N	27 Jan 2004			52				20				0.44	U							2.9	U			5	U				
MW15	MW15_WG_20040519	N	19 May 2004			350				20				0.44	U							2.9	U			6.4	U				
MW15	MW15_WG_20040723	N	23 Jul 2004			78				32				0.68	U							2.9	U			5	U				
MW15	MW15_WG_20041022	N	22 Oct 2004			56				80				0.44	U							2.9	U			12					
MW15	MW15_WG_20050126	N	26 Jan 2005			100				11				0.54	U							2.5	U			3	U				
MW15	MW15_WG_20050511	N	11 May 2005			68				4.4	U			0.36	U							2.6	U			4.2	U				
MW15	MW15_WG_20050825	N	25 Aug 2005			56				38				0.36	U							2.6	U			4.2	U				
MW15	MW15_WG_20051215	N	15 Dec 2005			72				23				0.36	U							2.6	U			4.9	U				
MW15	MW15_WG_20060328	N	28 Mar 2006			120				8.5	U			0.36	U							2.6	U			4.4	U				
MW15	MW15_WG_20060628	N	28 Jun 2006			100				15				0.36	U							2.6	U			5.8	U				
MW15	MW15_WG_20060927	N	27 Sep 2006			87				17				0.36	U							3.2	U			4.2	U				
MW15	MW15_WG_20061218	N	18 Dec 2006			82				7.6	U			0.36	U							2.6	U								
MW15	MW15_WG_20070327	N	27 Mar 2007			110				7.5	U			0.36	U							2.8	U			4.2	U				
MW15	MW15_WG_20070509	N	09 May 2007			97				6.2	U			0.71	U							2.2	U			4.7	U				
MW15	MW15_WG_20070822	N	22 Aug 2007			77				9.8	U			0.71	U							2.2	U			6	U				
MW15	MW15_WG_20071218	N	18 Dec 2007			37				26				0.71	U							2.2	U			4.7	U				
MW15	MW15_WG_20080515	N	15 May 2008			84				5.2	U			0.46	U							2.5	U			4.6	U				
MW15	MW15_WG_20081106	N	06 Nov 2008			48				16				0.46	U							1.8	U			4.2	U				
MW15	MW15_WG_20090625	N	25 Jun 2009			68				11				0.6	U							3.2	U			3.1	U				

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			Chemical	Antimony		Antimony		Arsenic		Arsenic		Cadmium		Cadmium		Iron		Iron		Lead		Lead		Selenium		Selenium		Alkalinity, Total as CaCO3		Hardness as CaCO3	
			Unit	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
			Fraction	D		T		D		T		D		T		D		T		D		T		D		T		T		T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
MW15	MW15_WG_20091120	N	20 Nov 2009			80	U			9	U			0.34	U							2.1	U			3.1	U				
MW15	MW15_WG_20100602	N	02 Jun 2010			74				5.3	U			0.19	U							1.7	U			2.8	U				
MW15	MW15_WG_20101112	N	12 Nov 2010			54				31				0.57	U							2.4	U			2.4	U				
MW15	MW15_WG_20110721	N	21 Jul 2011			58				8.7	U			0.54	U							2	U			2.5	U				
MW15	MW15_WG_20111220	N	20 Dec 2011			84				4	U			0.68	U							2	U			4.6	U				
MW15	MW15_WG_20120612	N	12 Jun 2012			63				4.6	U			0.58	U							1.6	U			2.7	U				
MW15	MW15_WG_20130620	N	20 Jun 2013			72				3.6	U			1	U							2.3	U			4.6	U				
MW15	MW15_WG_20131115	N	15 Nov 2013			53				4.7	U			0.62	U							2.3	U			4.6	U				
MW15	MW15_WG_20140521	N	21 May 2014			96				3.8	U			1.1	U							2.3	U			4.6	U				
MW15	MW15_WG_20141105	N	05 Nov 2014			37				2.6	U			1.1	U							2.3	U			4.6	U				
MW15	MW15_WG_20150609	N	09 Jun 2015			75				3.8	U			1	U							2.5	U			4.6	U				
MW15	MW15_WG_20151117	N	17 Nov 2015			31				4.3	U			1	U							2.5	U			4.6	U				
MW15	MW15_WG_20160620	N	20 Jun 2016			62				4.4	U			1	U							2.5	U			4.6	U				
MW15	MW15_WG_20161221	N	21 Dec 2016			36				7.7	U			0.94	U							2.5	U			5.1	U				
MW15	MW15_WG_20170531	N	31 May 2017			82				3.7	U			1.1	U							2.7	U			5.3	U				
MW15	MW15-20181218	N	18 Dec 2018	67		120		3.8		74		1.2		3.4		82	U	5400		2.7	U	500		9.4		5.3	U	160000		140000	
MW15	MW-15	N	05 Jun 2019	88		110		3.7	U	38		0.94		2.4		88		4800		2.7	U	390		5.3	U	5.3	U	210000			
MW16	MW16_WG_20060927	N	27 Sep 2006			16	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW17	MW17_WG_20010213	N	13 Feb 2001											2	U							115									
MW17	MW17_WG_20160908	N	08 Sep 2016			20				1200				7.6								11				2.3	U				
MW18	MW18_WG_20010212	N	12 Feb 2001							2080				2	U							244									
MW18	MW18_WG_20010213	N	13 Feb 2001							1960				2	U							5	U								
MW18	MW18_WG_20010615	N	15 Jun 2001			11.1	U			1850				0.32	U							4.7	U			14.3					
MW18	MW18_WG_20010928	N	28 Sep 2001			11.1	U			1890				0.32	U							4.7	U			4.9	U				
MW18	MW18_WG_20011127	N	27 Nov 2001			11.1	U			2040				0.32	U							4.7	U			9.9					
MW18	MW18_WG_20020321	N	21 Mar 2002			11.1	U			1830				0.32	U											7.3					
MW18	MW18_WG_20020606	N	06 Jun 2002			12	U			2100				0.44	U							1.9	U			9.2					
MW18	MW18_WG_20020820	N	20 Aug 2002			12	U			1900				0.44	U							2.9	U			16					
MW18	MW18_WG_20021120	N	20 Nov 2002			12	U			2200				0.44	U							2.9	U			6.8					
MW18	MW18_WG_20030317	N	17 Mar 2003			12	U			1600				0.44	U							2.9	U			13					
MW18	MW18_WG_20030514	N	14 May 2003			12	U			1900				0.51								2.9	U			18					
MW18	MW18_WG_20030710	N	10 Jul 2003			12	U			2000				0.44	U							3.2				5	U				
MW18	MW18_WG_20031016	N	16 Oct 2003			12	U			2000				0.44	U							2.9	U			9.4	U				
MW18	MW18_WG_20040127	N	27 Jan 2004			12	U			1600				0.44	U							2.9	U			5	U				
MW18	MW18_WG_20040519	N	19 May 2004			12	U			1600				0.44	U							2.9	U			9.6	U				
MW18	MW18_WG_20040723	N	23 Jul 2004			12	U			1500				0.44	U							2.9	U			7.6	U				
MW18	MW18_WG_20041022	N	22 Oct 2004			12	U			1800				0.44	U							2.9	U			18					
MW18	MW18_WG_20050126	N	26 Jan 2005			4.5	U			1500				0.47	U							2.5	U			4	U				
MW18	MW18_WG_20050511	N	11 May 2005			2.8	U			1300				0.36	U							2.6	U			4.2	U				
MW18	MW18_WG_20050823	N	23 Aug 2005			3.1	U			950				0.36	U							2.6	U			4.2	U				
MW18	MW18_WG_20051215	N	15 Dec 2005			7.4	U			1200				0.36	U							2.6	U			4.2	U				
MW18	MW18_WG_20060328	N	28 Mar 2006			2.8	U			1300				0.36	U							2.6	U			4.2	U				
MW18	MW18_WG_20060629	N	29 Jun 2006			3.3	U			710				0.36	U							2.6	U			4.5	U				
MW18	MW18_WG_20060927	N	27 Sep 2006			2.8	U			720				0.36	U							2.6	U			4.2	U				
MW18	MW18_WG_20061218	N	18 Dec 2006			7.9	U			400				0.36	U							2.8	U								
MW18	MW18_WG_20070327	N	27 Mar 2007			8.2	U			580				0.36	U							2.6	U			4.2	U				
MW18	MW18_WG_20070509	N	09 May 2007			4.8	U			570				0.71	U							2.2	U			4.7	U				
MW18	MW18_WG_20070822	N	22 Aug 2007			12	U			270				0.71	U							2.2	U			4.7	U				
MW18	MW18_WG_20071218	N	18 Dec 2007			4.5	U			660				0.71	U							2.2	U			4.7	U				
MW18	MW18_WG_20080514	N	14 May 2008			5.1	U			220				0.46	U							2.4	U			4.2	U				
MW18	MW18_WG_20081106	N	06 Nov 2008			4.2	U			420				0.46	U							1.8	U			4.2	U				
MW18	MW18_WG_20090624	N	24 Jun 2009			5	U			220				0.34	U							2.1	U			3.1	U				
MW18	MW18_WG_20091119	N	19 Nov 2009			4.1	U			410				0.34	U							2.1	U			3.1	U				
MW18	MW18_WG_20100601	N	01 Jun 2010			3.4	U			220				0.19	U							2.4	U			2.8	U				
MW18	MW18_WG_20101112	N	12 Nov 2010			7	U			1000				0.25	U							1.7	U			2.4	U				
MW18	MW18_WG_20110721	N	21 Jul 2011			2.8	U			1000				0.36	U							2	U			2.5	U				
MW18	MW18_WG_20111220	N	20 Dec 2011			2.8	U			580				3.3								2	U			2.5	U				
MW18	MW18_WG_20120612	N	12 Jun 2012			2.6	U			760				1.6	U							1.6	U			2.7	U				
MW18	MW18_WG_20130620	N	20 Jun 2013			5.5	U			1300				0.85	U							4.8	U			4.6	U				
MW18	MW18_WG_20131115	N	15 Nov 2013			6.5	U			1300				0.44	U							2.3	U			4.6	U				
MW18	MW18_WG_20140521	N	21 May 2014			6.1	U			630				2.5	U							2.3	U			4.6	U				
MW18	MW18_WG_20141105	N	05 Nov 2014			5.4	U			1200				1.8	U							2.3	U			4.6	U				
MW18	MW18_WG_20150609	N	09 Jun 2015			6.4	U			1300				11								2.5	U			4.6	U				
MW18	MW18_WG_20151116	N	16 Nov 2015			6.4	U			1200				19								2.5	U			4.6	U				
MW18	MW18_WG_20160621	N	21 Jun 2016			6.4	U			710				0.94	U							2.5	U			4.6	U				
MW18	MW18_WG_20161220	N	20 Dec 2016			6.4	U			730				0.94	U							2.5	U			5.1	U				
MW18	MW18_WG_20170531	N	31 May 2017			6.2	U			260				4.6	U							2.7	U			5.3	U				
MW18	MW18-20181217	N	17 Dec 2018	10		21		250		510		0.74		2.3		280		5300		2.7	U	23		5.3		5.3	U	340000		310000	
MW18	MW-18	N	04 Jun 2019	15		20		230		420		1.6		2.4		1100		5200		7.0		26		5.3	U	5.3	U	290000			
MW19	MW19_WG_20010213	N	13 Feb 2001											2	U							50.3									
MW19	MW19_WG_20130621	N	21 Jun 2016			72				2400				0.94	U							2.5	U			6.4	U				
MW19	MW19_WG_20160908	N	08 Sep 2016			37				1100				0.73	U							1.3	U			3.4	U				
MW19	MW19_WG_20170621	N	21 Jun 2017			72				2400				0.94	U							2.5	U			6.4	U				
MW20	MW20_WG_20010214	N	14 Feb 2001											6.3								657									
MW20	MW20_WG_20060926	N	26 Sep 2006			220				480				6.9								2.6	U			4.8	U				
MW21	MW21_WG_20010212	N	12 Feb 2001							465				123								954									
MW21	MW21_WG_20010213	N	13 Feb 2001							85				13								7									
MW21	MW21_WG_20010614	N	14 Jun 2001			121				983				129								4.7	U			8.4					
MW21	MW21_WG_20010927	N	27 Sep 2001			216				1770				161								4.7	U			4.9	U				
MW21	MW21_WG_20011127	N	27 Nov 2001			247				3290				75.9								4.7	U			5.9					
MW21	MW21_WG_20020321	N	21 Mar 2002			167				1660				155												8.3					
MW21	MW21_WG_20020606	N	06 Jun 2002			200				1500				60								1.9	U			11					
MW21	MW21_WG_20020820	N	20 Aug 2002			300				2400				80								2.9	U			6.2					
MW21	MW21_WG_20021120	N	20 Nov 2002			140				3100				110								2.9	U			5	U				
MW21	MW21_WG_20030317	N	17 Mar 2003			110				2100				140								2.9	U			5	U				

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			Chemical Unit Fraction	Antimony ug/L D		Antimony ug/L T		Arsenic ug/L D		Arsenic ug/L T		Cadmium ug/L D		Cadmium ug/L T		Iron ug/L D		Iron ug/L T		Lead ug/L D		Lead ug/L T		Selenium ug/L D		Selenium ug/L T		Alkalinity, Total as CaCO3 ug/L T		Hardness as CaCO3 ug/L T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
MW21	MW21_WG_20030514	N	14 May 2003			170				2000				96								2.9	U			14					
MW21	MW21_WG_20030710	N	10 Jul 2003			270				2300				75								1.9				5.5	U				
MW21	MW21_WG_20031017	N	17 Oct 2003			270				1900				77								2.9	U			5	U				
MW21	MW21_WG_20040127	N	27 Jan 2004			190				1500				48								2.9	U			5.4	U				
MW21	MW21_WG_20040519	N	19 May 2004			230				1400				44								2.9	U			8	U				
MW21	MW21_WG_20040723	N	23 Jul 2004			250				1500				56								2.9	U			5	U				
MW21	MW21_WG_20041022	N	22 Oct 2004			230				1500				79								2.9	U			15					
MW21	MW21_WG_20050126	N	26 Jan 2005			170				900				34								2.5	U			3.4	U				
MW21	MW21_WG_20050511	N	11 May 2005			180				990				26								2.6	U			4.2	U				
MW21	MW21_WG_20050825	N	25 Aug 2005			260				1400				46								2.6	U			4.2	U				
MW21	MW21_WG_20051215	N	15 Dec 2005			200				1100				58								2.6	U			20					
MW21	MW21_WG_20060328	N	28 Mar 2006			170				890				37								2.6	U			5.9	U				
MW21	MW21_WG_20060628	N	28 Jun 2006			220				1000				46								2.6	U			5	U				
MW21	MW21_WG_20060926	N	26 Sep 2006			220				830				66								3.4	U			5.5	U				
MW21	MW21_WG_20061218	N	18 Dec 2006			170				720				53								8.3									
MW21	MW21_WG_20070327	N	27 Mar 2007			140				590				24								4.6	U			4.2	U				
MW21	MW21_WG_20070528	N	08 May 2007			150				640				30								2.2	U			4.7	U				
MW21	MW21_WG_20070822	N	22 Aug 2007			200				660				48								2.2	U			4.7	U				
MW21	MW21_WG_20071218	N	18 Dec 2007			160				660				58								2.2	U			4.7	U				
MW21	MW21_WG_20080515	N	15 May 2008			140				480				35								1.8	U			4.2	U				
MW21	MW21_WG_20081106	N	06 Nov 2008			180				610				40								1.8	U			4.2	U				
MW21	MW21_WG_20090624	N	24 Jun 2009			150				440				38								2.3	U			3.1	U				
MW21	MW21_WG_20091120	N	20 Nov 2009			140	U			460				63								2.1	U			4.2	U				
MW21	MW21_WG_20100602	N	02 Jun 2010			130				370				47								2.8	U			2.8	U				
MW21	MW21_WG_20101112	N	12 Nov 2010			160				550				69								1.8	U			3.1	U				
MW21	MW21_WG_20110721	N	21 Jul 2011			150				380				64								2	U			2.5	U				
MW21	MW21_WG_20111220	N	20 Dec 2011			120				320				47								2	U			2.5	U				
MW21	MW21_WG_20120612	N	12 Jun 2012			140				410				49								1.6	U			2.7	U				
MW21	MW21_WG_20130620	N	20 Jun 2013			130				300				72								2.3	U			4.6	U				
MW21	MW21_WG_20131114	N	14 Nov 2013			140				360				120								13				4.6	U				
MW21	MW21_WG_20140521	N	21 May 2014			100				240				39	U							2.3	U			4.6	U				
MW21	MW21_WG_20141105	N	05 Nov 2014			100				240				78	U							2.3	U			4.6	U				
MW21	MW21_WG_20150609	N	09 Jun 2015			110				190				57								2.5	U			4.6	U				
MW21	MW21_WG_20151117	N	17 Nov 2015			120				250				67								2.5	U			4.6	U				
MW21	MW21_WG_20160620	N	20 Jun 2016			100				200				62								2.5	U			4.6	U				
MW21	MW21_WG_20161220	N	20 Dec 2016			77				140				78								2.5	U			5.1	U				
MW21	MW21_WG_20170531	N	31 May 2017			91				110				59	U							2.7	U			5.3	U				
MW21	MW21-20181218	N	18 Dec 2018	75		90		130		310		60		130		82	U	5700		2.7	U	55		8.8		5.3	U	180000		150000	
MW21	DUP-1	FD	05 Jun 2019	81		97		130		250		33		82		82	U	4700		2.7	U	64		9.6		6.1		150000			
MW21	MW-21	N	05 Jun 2019	81		100		120		210		35		81		440		5100		5.9		72		5.3	U	5.3	U	170000			
MW22	MW22_WG_20010214	N	14 Feb 2001											2	U							13.3									
MW22	MW22_WG_20060927	N	27 Sep 2006			11	U			6.5	U			0.36	U							2.6	U			4.2	U				
MW22	MW22_WG_20140521	N	21 May 2014			99				4.4	U			5.4	U							2.3	U			4.6	U				
MW22	MW22_WG_20160908	N	08 Sep 2016			2.4	U			12				0.38	U							1.3	U			2.7	U				
MW23	MW23_WG_20010212	N	12 Feb 2001							95				109								120									
MW23	MW23_WG_20010213	N	13 Feb 2001							10	U			2	U							5	U								
MW23	MW23_WG_20010615	N	15 Jun 2001			11.1	U			5.3	U			1.4								4.7	U			9					
MW23	MW23_WG_20010928	N	28 Sep 2001			11.1	U			5.3	U			8.2								4.7	U			4.9	U				
MW23	MW23_WG_20011127	N	27 Nov 2001			26				5.3	U			22.8								4.7	U			5.4					
MW23	MW23_WG_20020321	N	21 Mar 2002			23.6				5.3	U			12												5.7					
MW23	MW23_WG_20020605	N	05 Jun 2002			19				5.4				9.3								1.9	U			5	U				
MW23	MW23_WG_20020820	N	20 Aug 2002			12	U			28				7.5								2.9	U			8.1					
MW23	MW23_WG_20021120	N	20 Nov 2002			230				5.2	U			3.1								2.9	U			6.5					
MW23	MW23_WG_20030317	N	17 Mar 2003			100				6.3				4.8								2.9	U			8.3					
MW23	MW23_WG_20030514	N	14 May 2003			220				7.6				4								2.9	U			11					
MW23	MW23_WG_20030710	N	10 Jul 2003			170				9.3	U			5.1								1.5				5	U				
MW23	MW23_WG_20031017	N	17 Oct 2003			97				10				7.2								2.9	U			9.3	U				
MW23	MW23_WG_20040127	N	27 Jan 2004			120				5.4	U			1.2	U							2.9	U			13					
MW23	MW23_WG_20040519	N	19 May 2004			150				8.1	U			6.6								5.6				23					
MW23	MW23_WG_20040723	N	23 Jul 2004			100				9	U			13								2.9	U			7.9	U				
MW23	MW23_WG_20041022	N	22 Oct 2004			68				9.7	U			2.1								2.9	U			22					
MW23	MW23_WG_20050126	N	26 Jan 2005			140				3.5	U			1.5	U							2.5	U			10					
MW23	MW23_WG_20050511	N	11 May 2005			140				2.1	U			2.4								2.6	U			12					
MW23	MW23_WG_20050825	N	25 Aug 2005			110				6.4	U			7.8								2.6	U			4.4	U				
MW23	MW23_WG_20051215	N	15 Dec 2005			81				2.1	U			5.3								2.6	U			11					
MW23	MW23_WG_20060328	N	28 Mar 2006			140				2.1	U			1.9	U							2.6	U			6.5	U				
MW23	MW23_WG_20060629	N	29 Jun 2006			140				6.4	U			5.8								2.6	U			10					
MW23	MW23_WG_20060927	N	27 Sep 2006			170				2.8	U			4								2.6	U			4.2	U				
MW23	MW23_WG_20061218	N	18 Dec 2006			100				2.1	U			2.5								2.6	U								
MW23	MW23_WG_20070327	N	27 Mar 2007			120				2.1	U			3.1								2.6	U			7.6	U				
MW23	MW23_WG_20070508	N	08 May 2007			160				2.7	U			3.7								2.2	U			4.7	U				
MW23	MW23_WG_20070822	N	22 Aug 2007			140				2.7	U			6.8								2.2	U			9.4	U				
MW23	MW23_WG_20071218	N	18 Dec 2007			110				2.7	U			2.4								2.2	U			17					
MW23	MW23_WG_20080514	N	14 May 2008			120				2.8	U			3.4								2.4	U			5.3	U				
MW23	MW23_WG_20081105	N	05 Nov 2008			110				2.8	U			3.6								1.8	U			4.2	U				
MW23	MW23_WG_20090624	N	24 Jun 2009			130				2.2	U			4.2								2.1	U			3.4	U				
MW23	MW23_WG_20091120	N	20 Nov 2009			130	U			2.2	U			3								2.1	U			6.6	U				
MW23	MW23_WG_20100602	N	02 Jun 2010			130				2.3	U			6								2.4	U			2.8	U				
MW23	MW23_WG_20101111	N	11 Nov 2010			95				1.7	U			7.5								1.7	U			7.1	U				
MW23	MW23_WG_20110721	N	21 Jul 2011			99				2.5	U			8.2								2	U			2.5	U				
MW23	MW23_WG_20111220	N	20 Dec 2011			100				2.5	U			3.1								2	U			5	U				
MW23	MW23_WG_20120612	N	12 Jun 2012			110				2.4	U			6.1								1.6	U			3.3	U				
MW23	MW23_WG_20130620	N	20 Jun 2013			110				2.6	U			6.6								2.5	U			4.6	U				
MW23	MW23_WG_20131115	N	15 Nov 2013			91				3.7	U			4.1								2.3	U			4.6	U				
MW23	MW23_WG_20141105	N	05 Nov 2014			88				2.6	U			6.3	U							2.3	U			4.6	U				

Table L-1
Historical and Recent Groundwater Analytical Data
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Unit Fraction	Antimony ug/L D		Antimony ug/L T		Arsenic ug/L D		Arsenic ug/L T		Cadmium ug/L D		Cadmium ug/L T		Iron ug/L D		Iron ug/L T		Lead ug/L D		Lead ug/L T		Selenium ug/L D		Selenium ug/L T		Alkalinity, Total as CaCO3 ug/L T		Hardness as CaCO3 ug/L T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
MW23	MW23_WG_20150609	N	09 Jun 2015			100				3.8	U			7.3								2.5	U			4.6	U				
MW23	MW23_WG_20151117	N	17 Nov 2015			71				3.8	U			8.4								2.5	U			4.6	U				
MW23	MW23_WG_20160620	N	20 Jun 2016			86				3.8	U			9.4								2.5	U			4.6	U				
MW23	MW23_WG_20161220	N	20 Dec 2016			100				3.8	U			5.6								2.5	U			7	U				
MW23	MW23_WG_20170531	N	31 May 2017			98				3.7	U			8.6	U							2.7	U			5.3	U				
MW23	MW23-20181218	N	18 Dec 2018	89		100		3.7	U	11		5.3		21		82	U	2600		2.7	U	110		8.8		5.6		130000		120000	
MW23	MW-23	N	05 Jun 2019	87		94		3.7	U	3.7	U	9.7		15		82	U	1900		2.7	U	55		5.3	U	5.3	U	170000			
MW24	MW24_WG_20010213	N	13 Feb 2001											4.4								3420									
MW24	MW24_WG_20160908	N	08 Sep 2016			16				510				0.47	U							1.3	U			2.1	U				
MW25	MW25_WG_20010212	N	12 Feb 2001							21				2	U							67									
MW25	MW25_WG_20010213	N	13 Feb 2001											2	U							5	U								
MW25	MW25_WG_20020213	N	13 Feb 2001							10	U																				
MW25	MW25_WG_20010615	N	15 Jun 2001			53.7				5.3	U			0.32	U							4.7	U			7.3					
MW25	MW25_WG_20010928	N	28 Sep 2001			59.7				5.3	U			1.3								4.7	U			4.9	U				
MW25	MW25_WG_20011127	N	27 Nov 2001			35.9				5.3	U			0.32	U							4.7	U			4.9	U				
MW25	MW25_WG_20020321	N	21 Mar 2002			24.6				5.3	U			0.33												4.9	U				
MW25	MW25_WG_20020605	N	05 Jun 2002			27				5.2	U			0.44	U							1.9	U			5.8					
MW25	MW25_WG_20020820	N	20 Aug 2002			61				6.3				0.44	U							2.9	U			8.3					
MW25	MW25_WG_20021120	N	20 Nov 2002			180				5.2	U			0.44	U							2.9	U			9.8					
MW25	MW25_WG_20030317	N	17 Mar 2003			80				6.4				0.44	U							2.9	U			9.7					
MW25	MW25_WG_20030514	N	14 May 2003			97				6.5				0.44	U							2.9	U			10					
MW25	MW25_WG_20030710	N	10 Jul 2003			89				5.5	U			0.44	U							0.55	U			5	U				
MW25	MW25_WG_20031017	N	17 Oct 2003			61				9.7	U			24								2.9	U			6.3	U				
MW25	MW25_WG_20040127	N	27 Jan 2004			31				6.1	U			0.86	U							2.9	U			5	U				
MW25	MW25_WG_20040519	N	19 May 2004			33				20				0.44	U							2.9	U			5	U				
MW25	MW25_WG_20040723	N	23 Jul 2004			27				120				0.44	U							2.9	U								
MW25	MW25_WG_20041023	N	23 Jul 2004																							5	U				
MW25	MW25_WG_20041022	N	22 Oct 2004			20				370				0.44	U							2.9	U			13					
MW25	MW25_WG_20050126	N	26 Jan 2005			20	U			170				0.66	U							2.5	U			3	U				
MW25	MW25_WG_20050511	N	11 May 2005			14	U			160				0.36	U							2.6	U			4.2	U				
MW25	MW25_WG_20050823	N	23 Aug 2005			20	U			200				0.36	U							2.6	U			4.2	U				
MW25	MW25_WG_20051215	N	15 Dec 2005			51				31				0.36	U							2.6	U			5.3	U				
MW25	MW25_WG_20060328	N	28 Mar 2006			57				12				0.36	U							2.6	U			4.2	U				
MW25	MW25_WG_20060629	N	29 Jun 2006			48				27				0.36	U							2.6	U			4.2	U				
MW25	MW25_WG_20060927	N	27 Sep 2006			34				25				0.36	U							2.7	U			4.2	U				
MW25	MW25_WG_20061218	N	18 Dec 2006			11	U			60				0.36	U							2.6	U								
MW25	MW25_WG_20070327	N	27 Mar 2007			11	U			32				0.36	U							2.6	U			4.2	U				
MW25	MW25_WG_20070509	N	09 May 2007			14	U			31				0.71	U							2.2	U			4.7	U				
MW25	MW25_WG_20070822	N	22 Aug 2007			26				67				0.71	U							2.2	U			4.7	U				
MW25	MW25_WG_20071218	N	18 Dec 2007			12	U			91				0.71	U							2.2	U			6.1	U				
MW25	MW25_WG_20080514	N	14 May 2008			31				55				0.46	U							2.2	U			4.2	U				
MW25	MW25_WG_20081105	N	05 Nov 2008			25				130				0.46	U							1.8	U			4.2	U				
MW25	MW25_WG_20090624	N	24 Jun 2009			32				54				0.34	U							2.1	U			3.1	U				
MW25	MW25_WG_20091119	N	19 Nov 2009			34	U			45				0.34	U							2.1	U			3.1	U				
MW25	MW25_WG_20100601	N	01 Jun 2010			25				49				0.19	U							1.7	U			2.8	U				
MW25	MW25_WG_20101111	N	11 Nov 2010			14	U			160				1.4	U							1.7	U			2.4	U				
MW25	MW25_WG_20110721	N	21 Jul 2011			14	U			50				0.36	U							2	U			2.5	U				
MW25	MW25_WG_20111220	N	20 Dec 2011			19	U			68				1	U							2	U			2.5	U				
MW25	MW25_WG_20120612	N	12 Jun 2012			11	U			56				0.82	U							1.6	U			2.7	U				
MW25	MW25_WG_20130620	N	20 Jun 2013			27				41				0.36	U							2.3	U			4.6	U				
MW25	MW25_WG_20131114	N	14 Nov 2013			24				38				0.58	U							2.3	U			5	U				
MW25	MW25_WG_20140521	N	21 May 2014			23				56				0.62	U							2.3	U			4.6	U				
MW25	MW25_WG_20141105	N	05 Nov 2014			9.4	U			36				0.99	U							2.3	U			4.6	U				
MW25	MW25_WG_20150608	N	08 Jun 2015			9.7	U			30				1.3	U							2.5	U			4.6	U				
MW25	MW25_WG_20151116	N	16 Nov 2015			6.4	U			95				2.2								2.5	U			4.6	U				
MW25	MW25_WG_20160620	N	20 Jun 2016			6.8	U			49				0.94	U							2.5	U			4.6	U				
MW25	MW25_WG_20161220	N	20 Dec 2016			6.4	U			390				0.94	U							2.5	U			5.1	U				
MW25	MW25_WG_20170531	N	31 May 2017			9.5	U			150				3.3	U							2.7	U			5.3	U				
MW25	MW25-20181218	N	18 Dec 2018	15		25		66		420		0.81		2.6		82	U	7600		2.7	U	11		8.4		5.3	U	180000		190000	
MW25	MW-25	N	05 Jun 2019	22		50		42		1300		1.0		31		82	U	41000		2.7	U	100		5.3	U	5.3	U	190000			
MW3	MW3_WG_20001115	N	15 Nov 2000			1.9	U			5	U			2	U							5	U			5	U				
MW3	MW3_WG_20010214	N	14 Feb 2001			20	U			10	U			2	U							5	U			5.6					
MW3	MW3_WG_20010615	N	15 Jun 2001			11.1	U			5.3	U			0.32	U							4.7	U			6.6					
MW3	MW3_WG_20010927	N	27 Sep 2001			11.1	U			5.3	U			0.32	U							4.7	U			4.9	U				
MW3	MW3_WG_20011129	N	29 Nov 2001			11.1	U			5.3	U			0.32	U							4.7	U			4.9	U				
MW3	MW3_WG_20020321	N	21 Mar 2002			11.1	U			5.3	U			0.44												6					
MW3	MW3_WG_20020605	N	05 Jun 2002			12	U			5.2	U			0.44	U							1.9	U			7.3					
MW3	MW3_WG_20020820	N	20 Aug 2002			12	U			5.8				0.44	U							2.9	U			5.8					
MW3	MW3_WG_20021118	N	18 Nov 2002			12	U			5.2	U			0.44	U							2.9	U			5	U				
MW3	MW3_WG_20030317	N	17 Mar 2003			12	U			6.1				0.44	U							2.9	U			6.6					
MW3	MW3_WG_20030515	N	15 May 2003			12	U			5.2	U			0.44	U							2.9	U			13					
MW3	MW3_WG_20030709	N	09 Jul 2003			12	U			5.2	U			0.44	U							0.4	U			5	U				
MW3	MW3_WG_20031016	N	16 Oct 2003			12	U			6.9	U			0.44	U							2.9	U			5.8	U				
MW3	MW3_WG_20040126	N	26 Jan 2004			12	U			7.9	U			0.44	U							2.9	U			5.4	U				
MW3	MW3_WG_20040519	N	19 May 2004			12	U			8.8	U			0.44	U							2.9	U			10					
MW3	MW3_WG_20040722	N	22 Jul 2004			12	U			12				0.44	U							2.9	U			5	U				
MW3	MW3_WG_20041021	N	21 Oct 2004			12	U			14				0.44	U							2.9	U			7.7	U				
MW3	MW3_WG_20050127	N	27 Jan 2005			4.5	U			6.2	U			0.47	U							2.5	U			3	U				
MW3	MW3_WG_20050512	N	12 May 2005			2.8	U			3.3	U			0.36	U							2.6	U			4.2	U				
MW3	MW3_WG_20050824	N	24 Aug 2005			2.8	U			15				0.36	U							2.6	U			4.2	U				
MW3	MW3_WG_20051215	N	15 Dec 2005			7.2	U			5	U			0.36	U							2.6	U			4.2	U				
MW3	MW3_WG_20060327	N	27 Mar 2006			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW3	MW3_WG_20060628	N	28 Jun 2006			2.8	U			5.6	U			0.36	U							2.6	U			4.2	U				
MW3	MW3_WG_20060926	N	26 Sep 2006			8.1	U			8.9	U			0.36	U							2.9	U			4.2	U				
MW3	MW3_WG_20061218	N	18 Dec 2006			2.8	U			7.9	U			0.36	U							2.6	U								

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			Chemical Unit Fraction	Antimony ug/L D		Antimony ug/L T		Arsenic ug/L D		Arsenic ug/L T		Cadmium ug/L D		Cadmium ug/L T		Iron ug/L D		Iron ug/L T		Lead ug/L D		Lead ug/L T		Selenium ug/L D		Selenium ug/L T		Alkalinity, Total as CaCO3 ug/L T		Hardness as CaCO3 ug/L T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
MW3	MW3_WG_20070326	N	26 Mar 2007			10	U			14				0.36	U							3	U			4.2	U				
MW3	MW3_WG_20070508	N	08 May 2007			5.6	U			5.4	U			0.71	U							2.2	U			4.7	U				
MW3	MW3_WG_20070822	N	22 Aug 2007			4.5	U			7.4	U			0.71	U							2.2	U			4.7	U				
MW3	MW3_WG_20071217	N	17 Dec 2007			4.5	U			15				0.71	U							2.2	U			4.7	U				
MW4	MW4_WG_20001116	N	16 Nov 2000			57				19				2	U							5	U			5	U				
MW4	MW4_WG_20010214	N	14 Feb 2001			23				10.6				2	U							5	U			5	U				
MW4	MW4_WG_20010614	N	14 Jun 2001			29.5				21				0.32	U							4.7	U			7.9					
MW4	MW4_WG_20010927	N	27 Sep 2001			14.4				34.8				0.32	U							4.7	U			4.9	U				
MW4	MW4_WG_20011127	N	27 Nov 2001			15.5				27.8				0.32	U							4.7	U			4.9	U				
MW4	MW4_WG_20020321	N	21 Mar 2002			47.8				21				0.32	U											5.3					
MW4	MW4_WG_20020605	N	05 Jun 2002			140				11				0.44	U							1.9	U			8.4					
MW4	MW4_WG_20020820	N	20 Aug 2002			97				28				0.44	U							2.9	U			6.7					
MW4	MW4_WG_20021119	N	19 Nov 2002			12	U			21				0.44	U							2.9	U			5	U				
MW4	MW4_WG_20030317	N	17 Mar 2003			12	U			20				0.44	U							2.9	U			8.2					
MW4	MW4_WG_20030514	N	14 May 2003			12	U			29				0.72								2.9	U			17					
MW4	MW4_WG_20030710	N	10 Jul 2003			12	U			23				0.44	U							0.48	U			5	U				
MW4	MW4_WG_20031016	N	16 Oct 2003			51				19				0.44	U							2.9	U			5.8	U				
MW4	MW4_WG_20040126	N	26 Jan 2004			110				11				0.44	U							2.9	U			7.7	U				
MW4	MW4_WG_20040519	N	19 May 2004			81				13				0.44	U							2.9	U			5.6	U				
MW4	MW4_WG_20040722	N	22 Jul 2004			120				19				0.44	U							2.9	U			5.1	U				
MW4	MW4_WG_20041021	N	21 Oct 2004			110				22				0.44	U							2.9	U			10					
MW4	MW4_WG_20050126	N	26 Jan 2005			130				6.6	U			0.27	U							2.5	U			6	U				
MW4	MW4_WG_20050512	N	12 May 2005			130				7.6	U			0.36	U							2.6	U			4.2	U				
MW4	MW4_WG_20050825	N	25 Aug 2005			26				21				0.36	U							2.6	U			4.2	U				
MW4	MW4_WG_20051216	N	16 Dec 2005			38				12				0.36	U							2.6	U			4.2	U				
MW4	MW4_WG_20060327	N	27 Mar 2006			34				7.8	U			0.36	U							2.6	U			6.9	U				
MW4	MW4_WG_20060629	N	29 Jun 2006			130				7	U			0.36	U							2.6	U			10					
MW4	MW4_WG_20060927	N	27 Sep 2006			140				11				0.36	U							2.6	U			4.2	U				
MW4	MW4_WG_20061219	N	19 Dec 2006			130				6.2	U			0.36	U							2.6	U								
MW4	MW4_WG_20070327	N	27 Mar 2007			160				5.6	U			0.46	U							2.6	U			7.4	U				
MW4	MW4_WG_20070509	N	09 May 2007			210				3.2	U			0.71	U							2.2	U			4.7	U				
MW4	MW4_WG_20070823	N	23 Aug 2007			27				12				0.71	U							2.2	U			4.7	U				
MW4	MW4_WG_20071218	N	18 Dec 2007			80				15				0.71	U							2.2	U			4.7	U				
MW5	MW5_WG_20001117	N	17 Nov 2000			32				153				2								5				5	U				
MW5	MW5_WG_20010216	N	16 Feb 2001			142				14.9				2.1								7.9				5	U				
MW5	MW5_WG_20010615	N	15 Jun 2001			11.8				98.2				1.4								4.7	U			10.8					
MW5	MW5_WG_20010927	N	27 Sep 2001			15.4				164				0.52								4.7	U			4.9	U				
MW5	MW5_WG_20011129	N	29 Nov 2001			46.7				131				0.32	U							4.7	U			4.9	U				
MW5	MW5_WG_20020321	N	21 Mar 2002			11.1	U			129				0.32	U											5.3					
MW5	MW5_WG_20020605	N	05 Jun 2002			19				260				0.51								1.9	U			7.9					
MW5	MW5_WG_20020820	N	20 Aug 2002			12	U			110				0.44	U							2.9	U			9.8					
MW5	MW5_WG_20021118	N	18 Nov 2002			12	U			200				0.44	U							2.9	U			5	U				
MW5	MW5_WG_20030317	N	17 Mar 2003			22				140				0.44	U							2.9	U			9.1					
MW5	MW5_WG_20030515	N	15 May 2003			21				130				0.44								2.9	U			16					
MW5	MW5_WG_20030709	N	09 Jul 2003							130				14								8.1				5	U				
MW5	MW5_WG_20031016	N	16 Oct 2003			12	U			260				0.44	U							2.9	U			6.3	U				
MW5	MW5_WG_20040126	N	26 Jan 2004			12	U			280				0.44	U							2.9	U			5	U				
MW5	MW5_WG_20040519	N	19 May 2004			12	U			140				0.44	U							2.9	U			14					
MW5	MW5_WG_20040722	N	22 Jul 2004			12	U			180				0.44	U							2.9	U			5	U				
MW5	MW5_WG_20041021	N	21 Oct 2004			12	U			430				0.44	U							2.9	U			9.4	U				
MW5	MW5_WG_20050127	N	27 Jan 2005			4.5	U			290				0.4	U							2.5	U			3	U				
MW5	MW5_WG_20050512	N	12 May 2005			4.9	U			160				0.36	U							2.6	U			4.2	U				
MW5	MW5_WG_20050824	N	24 Aug 2005			17	U			350				0.36	U							2.6	U			4.2	U				
MW5	MW5_WG_20051215	N	15 Dec 2005			20	U			330				0.36	U							2.6	U			4.9	U				
MW5	MW5_WG_20060327	N	27 Mar 2006			13	U			250				0.36	U							2.6	U			4.2	U				
MW5	MW5_WG_20060628	N	28 Jun 2006			12	U			190				0.36	U							2.6	U			4.2	U				
MW5	MW5_WG_20060926	N	26 Sep 2006			7.2	U			280				0.36	U							2.6	U			4.2	U				
MW5	MW5_WG_20061219	N	19 Dec 2006			13	U			290				0.36	U							2.6	U								
MW5	MW5_WG_20070326	N	26 Mar 2007			43				160				0.36	U							2.6	U			4.2	U				
MW5	MW5_WG_20070508	N	08 May 2007			55				110				0.71	U							2.2	U			4.7	U				
MW5	MW5_WG_20070822	N	22 Aug 2007			18	U			66				0.71	U							3.2	U			4.7	U				
MW5	MW5_WG_20071217	N	17 Dec 2007			6.5	U			370				0.71	U							2.2	U			4.7	U				
MW5	MW5_WG_20160620	N	20 Jun 2016			36				63				0.94	U							2.5	U			4.6	U				
MW5	MW5_WG_20170706	N	06 Jul 2017			14	U			110				0.43	U							2.7	U			5.3	U				
MW5	MW5-20181218	N	18 Dec 2018	9.6		170		150		250		0.84		210		21000		25000		2.7	U	1200		5.3	U	5.3	U	230000		220000	
MW5	MW-5	N	04 Jun 2019	14		100		44		280		0.87		120		4600		25000		2.7	U	1100		5.3	U	5.3	U	280000			
MW6	MW6_WG_20001116	N	16 Nov 2000			2				5	U			2	U							5	U			5	U				
MW6	MW6_WG_20010214	N	14 Feb 2001			20	U			10	U			2	U							5	U			12					
MW6	MW6_WG_20010615	N	15 Jun 2001			11.1	U			8.9				0.32	U							4.7	U			4.9	U				
MW6	MW6_WG_20010927	N	27 Sep 2001			11.1	U			5.3	U			0.32	U							4.7	U			4.9	U				
MW6	MW6_WG_20011128	N	28 Nov 2001			11.1	U			9.3				0.32	U							4.7	U			15.6					
MW6	MW6_WG_20020321	N	21 Mar 2002			11.1	U			7.4				0.32	U											12.6					
MW6	MW6_WG_20020605	N	05 Jun 2002			12	U			5.2	U			0.44	U							1.9	U			10					
MW6	MW6_WG_20020820	N	20 Aug 2002			12	U			5.4				0.44	U							2.9	U			7.4					
MW6	MW6_WG_20021118	N	18 Nov 2002			12	U			5.2	U			0.44	U							2.9	U			5	U				
MW6	MW6_WG_20030317	N	17 Mar 2003			12	U			5.2	U			0.44	U							2.9	U			9.8					
MW6	MW6_WG_20030515	N	15 May 2003			12	U			14				0.63								2.9	U			24					
MW6	MW6_WG_20030709	N	09 Jul 2003			12	U			5.2	U			0.44	U							2.4				5	U				
MW6	MW6_WG_20031015	N	15 Oct 2003			12	U			5.2	U			0.44	U							2.9	U			5	U				
MW6	MW6_WG_20040126	N	26 Jan 2004			12	U			5.5	U			0.44	U							2.9	U			5	U				
MW6	MW6_WG_20040518	N	18 May 2004			12	U			5.2	U			0.44	U							2.9	U			7.1	U				
MW6	MW6_WG_20040722	N	22 Jul 2004			12	U			5.2	U			0.44	U							2.9	U			5	U				
MW6	MW6_WG_20041021	N	21 Oct 2004			12	U			5.2	U			0.44	U							2.9	U			5	U				
MW6	MW6_WG_20050126	N	26 Jan 2005			4.5	U			3.5	U			0.35	U							2.5	U			3	U				
MW6	MW6_WG_20050511	N	11 May 2005			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				

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			Chemical Unit Fraction	Antimony ug/L D		Antimony ug/L T		Arsenic ug/L D		Arsenic ug/L T		Cadmium ug/L D		Cadmium ug/L T		Iron ug/L D		Iron ug/L T		Lead ug/L D		Lead ug/L T		Selenium ug/L D		Selenium ug/L T		Alkalinity, Total as CaCO3 ug/L T		Hardness as CaCO3 ug/L T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
MW6	MW6_WG_20050824	N	24 Aug 2005			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW6	MW6_WG_20051215	N	15 Dec 2005			3.7	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW6	MW6_WG_20060327	N	27 Mar 2006			3.2	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW6	MW6_WG_20060628	N	28 Jun 2006			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW6	MW6_WG_20060926	N	26 Sep 2006			4.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW6	MW6_WG_20061218	N	18 Dec 2006			2.8	U			2.1	U			0.36	U							2.6	U								
MW6	MW6_WG_20070326	N	26 Mar 2007			6.3	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW6	MW6_WG_20070508	N	08 May 2007			7.2	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW6	MW6_WG_20070823	N	23 Aug 2007			4.5	U			5.4	U			0.71	U							2.2	U			4.7	U				
MW6	MW6_WG_20071217	N	17 Dec 2007			4.5	U			6.9	U			0.71	U							2.2	U			4.7	U				
MW6	MW6_WG_20160621	N	21 Jun 2016			6.4	U			8.1	U			0.94	U							2.5	U			4.6	U				
MW6	MW6_WG_20161221	N	21 Dec 2016			6.4	U			18				0.94	U							2.5	U			5.7	U				
MW6	MW6_WG_20170601	N	01 Jun 2017			6	U			18				0.67	U							2.7	U			5.3	U				
MW6	MW6-20181217	N	17 Dec 2018	6	U	6	U	11		21		0.80		0.93		82	U	8400		2.7	U	3.9		7.2		5.3	U	190000		170000	
MW6	MW-6	N	04 Jun 2019	6	U	6	U	3.7	U	23		0.65		0.83		210		7400		2.7	U	3.1		5.3	U	5.3	U	220000			
MW7	MW7_WG_20001115	N	15 Nov 2000			12				742				4	U							5	U			5	U				
MW7	MW7_WG_20010215	N	15 Feb 2001			20	U			224				2	U							5	U			5.8					
MW7	MW7_WG_20010615	N	15 Jun 2001			11.1	U			928				0.32	U							4.7	U			4.9	U				
MW7	MW7_WG_20010927	N	27 Sep 2001			11.1	U			564				0.32	U							4.7	U			4.9	U				
MW7	MW7_WG_20011128	N	28 Nov 2001			11.1	U			791				0.32	U							4.7	U			4.9	U				
MW7	MW7_WG_20020321	N	21 Mar 2002			11.1	U			797				0.36												6					
MW7	MW7_WG_20020605	N	05 Jun 2002			12	U			500				0.44	U							1.9	U			10					
MW7	MW7_WG_20020820	N	20 Aug 2002			12	U			400				0.44	U							2.9	U			9.2					
MW7	MW7_WG_20021118	N	18 Nov 2002			12	U			750				0.44	U							2.9	U			5.2					
MW7	MW7_WG_20030317	N	17 Mar 2003			12	U			640				0.44	U							2.9	U			8.2					
MW7	MW7_WG_20030515	N	15 May 2003			12	U			670				0.5								2.9	U			17					
MW7	MW7_WG_20030709	N	09 Jul 2003			12	U			820				0.44	U							0.64	U			5	U				
MW7	MW7_WG_20031015	N	15 Oct 2003			14	U			300				0.44	U							2.9	U			5	U				
MW7	MW7_WG_20040126	N	26 Jan 2004			12	U			480				0.44	U							2.9	U			5	U				
MW7	MW7_WG_20040519	N	19 May 2004			12	U			560				0.44	U							2.9	U			11					
MW7	MW7_WG_20040722	N	22 Jul 2004			12	U			260				0.55	U							2.9	U			5	U				
MW7	MW7_WG_20041021	N	21 Oct 2004			12	U			360				0.44	U							2.9	U			14					
MW7	MW7_WG_20050126	N	26 Jan 2005			7.4	U			290				0.31	U							2.5	U			3.2	U				
MW7	MW7_WG_20050511	N	11 May 2005			9.2	U			970				0.36	U							2.6	U			4.2	U				
MW7	MW7_WG_20050824	N	24 Aug 2005			6.4	U			600				0.36	U							2.6	U			4.2	U				
MW7	MW7_WG_20051215	N	15 Dec 2005			14	U			520				0.36	U							2.6	U			4.2	U				
MW7	MW7_WG_20060327	N	27 Mar 2006			8.5	U			420				0.36	U							2.6	U			4.2	U				
MW7	MW7_WG_20060628	N	28 Jun 2006			13	U			360				0.36	U							2.6	U			4.2	U				
MW7	MW7_WG_20060926	N	26 Sep 2006			10	U			320				0.36	U							2.8	U			4.2	U				
MW7	MW7_WG_20061219	N	19 Dec 2006			5.7	U			680				0.36	U							2.6	U								
MW7	MW7_WG_20070326	N	26 Mar 2007			16	U			2000				0.36	U							2.6	U			4.2	U				
MW7	MW7_WG_20070508	N	08 May 2007			8.7	U			1400				0.71	U							2.2	U			4.7	U				
MW7	MW7_WG_20070822	N	22 Aug 2007			6.2	U			500				0.71	U							2.2	U			4.7	U				
MW7	MW7_WG_20071217	N	17 Dec 2007			7.2	U			770				0.71	U							2.2	U			4.7	U				
MW7	MW7_WG_20080514	N	14 May 2008			8.8	U			5200				0.46	U							2.8	U			4.2	U				
MW7	MW7_WG_20080618	N	18 Jun 2008							5600																					
MW7	MW7_WG_20080910	N	10 Sep 2008							9400																					
MW7	MW7_WG_20081105	N	05 Nov 2008			10	U			6500				0.46	U							2	U			4.2	U				
MW7	MW7_WG_20090624	N	24 Jun 2009			7.1	U			1000				0.34	U							2.5	U			3.1	U				
MW7	MW7_WG_20091119	N	19 Nov 2009			8.7	U			700				0.34	U							2.2	U			3.1	U				
MW7	MW7_WG_20100601	N	01 Jun 2010			7.6	U			6100				0.19	U							1.9	U			2.8	U				
MW7	MW7_WG_20101111	N	11 Nov 2010			10	U			6100				0.25	U							1.7	U			2.4	U				
MW7	MW7_WG_20110720	N	20 Jul 2011			8.3	U			11000				0.36	U							2	U			2.5	U				
MW7	MW7_WG_20111220	N	20 Dec 2011			12	U			17000				81								2	U			3.2	U				
MW7	MW7_WG_20120612	N	12 Jun 2012			11	U			14000				21								1.6	U			2.7	U				
MW7	MW7_WG_20130619	N	19 Jun 2013			9	U			3800				1.2	U							3.7	U			4.6	U				
MW7	MW7_WG_20131114	N	14 Nov 2013			12	U			11000				0.26	U							6				4.6	U				
MW7	MW7_WG_20140521	N	21 May 2014			10	U			11000				38	U							2.3	U			4.6	U				
MW7	MW7_WG_20141105	N	05 Nov 2014			16	U			17000				14	U							2.3	U			6.4	U				
MW7	MW7_WG_20150608	N	08 Jun 2015			12	U			14000				130								2.5	U			4.6	U				
MW7	MW7_WG_20151116	N	16 Nov 2015			15	U			15000				210								2.7	U			4.6	U				
MW7	MW7_WG_20160621	N	21 Jun 2016			15	U			16000				4.7								2.5	U			4.6	U				
MW7	MW7_WG_20161220	N	20 Dec 2016			16	U			24000				9.4	U							2.5	U			6.2	U				
MW7	MW7_WG_20170601	N	01 Jun 2017			18	U			18000				310	U							2.7	U			5.3	U				
MW7	MW7_WG_20170706	N	06 Jul 2017			21.5	U			16200				0.1	U							2.5	U			2.5	U				
MW7	DUP1-20181218	FD	18 Dec 2018	22		30		21000		22000		28		33		17000		21000		140	U	2.7	U	7.6		5.3	U	610000		520000	
MW7	MW7-20181218	N	18 Dec 2018	25		27		23000		23000		31		29		18000		21000		140	U	2.7	U	7.1		5.3	U	620000		520000	
MW7	MW-7	N	04 Jun 2019	21		30		12000		20000		180		120		1800		22000		2.7	U	4.3		5.3	U	5.3	U	610000			
MW8	MW8_WG_20001116	N	16 Nov 2000			13				5	U			2	U							5	U			5	U				
MW8	MW8_WG_20010215	N	15 Feb 2001			20	U			10	U			2	U							5	U			5.1					
MW8	MW8_WG_20010615	N	15 Jun 2001			11.1	U			6.4				0.32	U							4.7	U			7.2					
MW8	MW8_WG_20010927	N	27 Sep 2001			11.1	U			5.3	U			0.32	U							4.7	U			4.9	U				
MW8	MW8_WG_20011129	N	29 Nov 2001			11.1	U			6.4				0.32	U							4.7	U			5.3					
MW8	MW8_WG_20020321	N	21 Mar 2002			11.1	U			5.3	U			0.32	U											5.5					
MW8	MW8_WG_20020605	N	05 Jun 2002			12	U			5.2	U			0.44	U							1.9	U			6.5					
MW8	MW8_WG_20020820	N	20 Aug 2002			12	U			7.4				0.44	U							2.9	U			8.8					
MW8	MW8_WG_20021118	N	18 Nov 2002			12	U			5.2	U			0.44	U							2.9	U			5.5					
MW8	MW8_WG_20030317	N	17 Mar 2003			12	U			8.9				0.44	U							2.9	U			14					
MW8	MW8_WG_20030515	N	15 May 2003			12	U			13				0.89								2.9	U			23					
MW8	MW8_WG_20030709	N	09 Jul 2003			12	U			5.2	U			0.44	U							0.26	U			5	U				
MW8	MW8_WG_20031015	N	15 Oct 2003			12	U			11				0.44	U							2.9	U			12					
MW8	MW8_WG_20040126	N	26 Jan 2004			12	U			8.5	U			0.44	U							2.9	U			5	U				
MW8	MW8_WG_20040518	N	18 May 2004			12	U			8.5	U			0.44	U							2.9	U			16					
MW8	MW8_WG_20040722	N	22 Jul 2004			12	U			7.3	U			0.44	U							2.9	U			12					
MW8	MW8_WG_20041021	N	21 Oct 2004			12	U			11				0.44	U							2.9	U			23					

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			Chemical Unit Fraction	Antimony ug/L D		Antimony ug/L T		Arsenic ug/L D		Arsenic ug/L T		Cadmium ug/L D		Cadmium ug/L T		Iron ug/L D		Iron ug/L T		Lead ug/L D		Lead ug/L T		Selenium ug/L D		Selenium ug/L T		Alkalinity, Total as CaCO3 ug/L T		Hardness as CaCO3 ug/L T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
MW8	MW8_WG_20050126	N	26 Jan 2005			4.5	U			3.5	U			0.51	U							2.5	U			4.6	U				
MW8	MW8_WG_20050511	N	11 May 2005			7.4	U			2.1	U			0.42	U							2.6	U			4.2	U				
MW8	MW8_WG_20050824	N	24 Aug 2005			2.8	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW8	MW8_WG_20051215	N	15 Dec 2005			9.5	U			2.1	U			0.36	U							2.6	U			4.8	U				
MW8	MW8_WG_20060327	N	27 Mar 2006			13	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW8	MW8_WG_20060628	N	28 Jun 2006			5.2	U			5.2	U			0.36	U							2.6	U			4.2	U				
MW8	MW8_WG_20060926	N	26 Sep 2006			4.6	U			3.1	U			0.36	U							2.6	U			4.2	U				
MW8	MW8_WG_20061218	N	18 Dec 2006			4	U			2.1	U			0.36	U							2.6	U								
MW8	MW8_WG_20070326	N	26 Mar 2007			12	U			2.1	U			0.36	U							2.6	U			4.2	U				
MW8	MW8_WG_20070508	N	08 May 2007			9	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW8	MW8_WG_20070823	N	23 Aug 2007			4.8	U			2.7	U			0.71	U							2.2	U			4.7	U				
MW8	MW8_WG_20071217	N	17 Dec 2007			4.5	U			2.8	U			0.71	U							2.2	U			4.7	U				
MW8	MW8_WG_20080514	N	14 May 2008			7.2	U			2.8	U			0.46	U							1.8	U			4.2	U				
MW8	MW8_WG_20081105	N	05 Nov 2008			4.4	U			2.8	U			0.46	U							1.8	U			4.2	U				
MW8	MW8_WG_20090624	N	24 Jun 2009			5.1	U			2.2	U			0.34	U							4.8	U			3.1	U				
MW8	MW8_WG_20091119	N	19 Nov 2009			7.1	U			2.2	U			0.34	U							2.1	U			3.1	U				
MW8	MW8_WG_20100601	N	01 Jun 2010			3.4	U			2.3	U			0.19	U							1.7	U			2.8	U				
MW8	MW8_WG_20101111	N	11 Nov 2010			8.2	U			1.7	U			0.92	U							1.7	U			2.4	U				
MW8	MW8_WG_20110720	N	20 Jul 2011			3.3	U			4.7	U			0.36	U							2	U			2.5	U				
MW8	MW8_WG_20111220	N	20 Dec 2011			4.3	U			3.7	U			0.84	U							2	U			2.5	U				
MW8	MW8_WG_201206012	N	12 Jun 2012			3	U			5.6	U			0.81	U							1.6	U			2.7	U				
MW8	MW8_WG_20130619	N	19 Jun 2013			3.9	U			2.6	U			0.66	U							2.3	U			4.6	U				
MW8	MW8_WG_20131114	N	14 Nov 2013			7.5	U			6.5	U			0.68	U							2.3	U			4.6	U				
MW8	MW8_WG_20140521	N	21 May 2014			3.9	U			2.6	U			0.61	U							2.3	U			4.6	U				
MW8	MW8_WG_20141105	N	05 Nov 2014			5.2	U			11				1.2	U							2.3	U			4.6	U				
MW8	MW8_WG_20150608	N	08 Jun 2015			6.5	U			7.4	U			1.2	U							2.5	U			4.6	U				
MW8	MW8_WG_20151116	N	16 Nov 2015			7.2	U			4.8	U			1.5	U							2.5	U			4.6	U				
MW8	MW8_WG_20160621	N	21 Jun 2016			6.6	U			17				0.94	U							4.3	U			4.6	U				
MW8	MW8_WG_20161221	N	21 Dec 2016			6.6	U			25				0.94	U							2.5	U			5.1	U				
MW8	MW8_WG_20170601	N	01 Jun 2017			6	U			39				0.95	U							2.7	U			5.3	U				
MW8	MW8-20181217	N	17 Dec 2018	8.6		6	U	6.7		21		0.94		1.3		860		21000		2.7	U	2.7	U	7.4		5.3	U	730000		790000	
MW8	MW-8	N	04 Jun 2019	6	U	7.4		17		63		0.79		0.97		220		14000		2.7	U	6.3		5.3	U	5.3	U	530000			
MW9	MW9_WG_20001115	N	15 Nov 2000			1.9	U			353				4	U							5	U			5	U				
MW9	MW9_WG_20010215	N	15 Feb 2001			20	U			113				2	U							5	U			5	U				
MW9	MW9_WG_20010615	N	15 Jun 2001			11.1	U			198				0.32	U							4.7	U			9.4					
MW9	MW9_WG_20010928	N	28 Sep 2001			11.1	U			157				0.32	U							4.7	U			9.6					
MW9	MW9_WG_20011127	N	27 Nov 2001			11.1	U			192				0.32	U							4.7	U			12.6					
MW9	MW9_WG_20020321	N	21 Mar 2002			11.1	U			193				0.32	U											7.6					
MW9	MW9_WG_20020606	N	06 Jun 2002			59	U			160				2.2	U							1.9	U			25	U				
MW9	MW9_WG_20020820	N	20 Aug 2002			12	U			170				0.44	U							2.9	U			11					
MW9	MW9_WG_20021119	N	19 Nov 2002			12	U			210				0.44	U							2.9	U			7.3					
MW9	MW9_WG_20030317	N	17 Mar 2003			12	U			200				0.44	U							2.9	U			13					
MW9	MW9_WG_20030514	N	14 May 2003			12	U			250				0.67								2.9	U			21					
MW9	MW9_WG_20030710	N	10 Jul 2003			12	U			210				0.44	U							1.5				5	U				
MW9	MW9_WG_20031016	N	16 Oct 2003			12	U			150				0.44	U							2.9	U			7.1	U				
MW9	MW9_WG_20040127	N	27 Jan 2004			59	U			130				2.2	U							14	U			25	U				
MW9	MW9_WG_20040519	N	19 May 2004			12	U			130				0.44	U							2.9	U			5	U				
MW9	MW9_WG_20040723	N	23 Jul 2004			12	U			130				0.44	U							2.9	U			5	U				
MW9	MW9_WG_20041022	N	22 Oct 2004			12	U			95				0.44	U							2.9	U			8.2	U				
MW9	MW9_WG_20050126	N	26 Jan 2005			4.5	U			100				0.37	U							2.5	U			3	U				
MW9	MW9_WG_20050511	N	11 May 2005			2.8	U			50				0.36	U							2.6	U			4.2	U				
MW9	MW9_WG_20050823	N	23 Aug 2005			2.8	U			65				0.36	U							2.6	U			4.2	U				
MW9	MW9_WG_20051215	N	15 Dec 2005			4.8	U			68				0.36	U							2.6	U			4.2	U				
MW9	MW9_WG_20060328	N	28 Mar 2006			2.8	U			64				0.36	U							2.6	U			4.2	U				
MW9	MW9_WG_20060629	N	29 Jun 2006			2.8	U			54				0.36	U							2.6	U			4.2	U				
MW9	MW9_WG_20060927	N	27 Sep 2006			4.6	U			71				0.36	U							2.6	U			4.2	U				
MW9	MW9_WG_20061219	N	19 Dec 2006			2.8	U			80				0.36	U							2.6	U								
MW9	MW9_WG_20070327	N	27 Mar 2007			3.9	U			67				0.36	U							2.6	U			4.2	U				
MW9	MW9_WG_20070509	N	09 May 2007			4.5	U			46				0.71	U							2.2	U			4.7	U				
MW9	MW9_WG_20070822	N	22 Aug 2007			4.5	U			54				0.71	U							2.2	U			4.7	U				
MW9	MW9_WG_20071218	N	18 Dec 2007			4.5	U			49				0.71	U							2.2	U			4.7	U				
OU1MW1	OU1MW1-GW-121318	N	13 Dec 2018			8.5				1.4				0.13	U			550	J			0.094	U			0.81	U	530000		380000	
OU1MW1	OU1MW1-GW-FF-121318	N	13 Dec 2018	8.4				1.4				0.13	U			580				0.094	U			0.81	U						
OU1MW1	OU1MW1-GW-032119	N	21 Mar 2019			8.7				0.64	J			0.13	U			410				0.22	J			2.6	U	290000		340000	
OU1MW1	OU1MW1-GW-FF-032119	N	21 Mar 2019	8.6				0.55	J			0.13	U			210				0.13	U			2.6	U						
OU1MW1	OU1MW1-GW-060519	N	05 Jun 2019			13				0.45	J			0.13	U			53				0.13	U			2.6	U	280000		320000	
OU1MW1	OU1MW1-GW-FF-060519	N	05 Jun 2019	14				0.50	J			0.13	U			40	J			0.13	U			2.6	U						
OU1MW1	OU1MW1-GW-081219	N	12 Aug 2019			7.8				0.84	J			0.13	U			640				0.13	U			1.5	U	250000		300000	
OU1MW1	OU1MW1-GW-FF-081219	N	12 Aug 2019	7.9				1.0				0.13	U			600				0.13	U			1.5	U						
OU1MW2	OU1MW2-GW-121318	N	13 Dec 2018			10				0.59	J			0.13	U			45	J			0.094	U			0.81	U	210000		220000	
OU1MW2	OU1MW2-GW-FF-121318	N	13 Dec 2018	9.6				0.50	J			0.13	U			14	U			0.094	U			0.81	U						
OU1MW2	OU1MW2-GW-032119	N	21 Mar 2019			7.7				0.36	J			0.13	U			100				0.13	U			2.6	U	220000		260000	
OU1MW2	OU1MW2-GW-FF-032119	N	21 Mar 2019	8.3				0.32	U			0.13	U			19	J			0.13	U			2.6	U						
OU1MW2	OU1MW2-GW-060519	N	05 Jun 2019			12				0.32	J			0.13	U			14	U			0.13	U			3.2	J	230000		230000	
OU1MW2	OU1MW2-GW-FF-060519	N	05 Jun 2019	12				0.32	U			0.13	U			14	U			0.13	U			2.6	U						
OU1MW2	OU1MW2-GW-081219	N	12 Aug 2019			11				0.36	J			0.13	U			20	U			0.13	U			1.8	J	220000		220000	
OU1MW2	OU1MW2-GW-FF-081219	N	12 Aug 2019	11				0.32	U			0.13	U			20	U			0.13	U			3.5	J						
OU1MW3	OU1MW3-GW-121318	N	13 Dec 2018			3.2				4.3				0.13	U			7000	J			0.094	U			0.81	U	210000		670000	
OU1MW3	OU1MW3-GW-FF-121318	N	13 Dec 2018	3.0				4.2				0.13	U			7000				0.094	U			0.81	U						
OU1MW3	QC-GW-FD-1-032019	FD	20 Mar 2019			1.7	J			4.7				0.13	U			7700				0.13	U			2.6	U	270000		620000	
OU1MW3	QC-GW-FF-FD-1-032019	FD	20 Mar 2019	1.6	J			4.3				0.13	U			7200				0.13	U			2.6	U						
OU1MW3	OU1MW3-GW-032019	N	20 Mar 2019			2.1				4.4				0.13	U			6600				0.13	U			2.6	U	280000		600000	
OU1MW3	OU1MW3-GW-FF-032019	N	20 Mar 2019	2.2				4.4				0.13	U			6400				0.13	U			2.6	U						
OU1MW3	QC-GW-FD-1-060419	FD	04 Jun 2019			2.8				5.6				0.13	U			7500				0.13	U			2.6	U	280000		630000	
OU1MW3	QC-GW-FF-FD-1-060419	FD	04 Jun 2019	2.9				5.9				0.13	U			7600				0.13	U			2.6	U						

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			Chemical	Antimony		Antimony		Arsenic		Arsenic		Cadmium		Cadmium		Iron		Iron		Lead		Lead		Selenium		Selenium		Alkalinity, Total as CaCO3		Hardness as CaCO3	
			Unit	ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L		ug/L	
			Fraction	D		T		D		T		D		T		D		T		D		T		D		T		T		T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
OU1MW3	OU1MW3-GW-060419	N	04 Jun 2019			3.3				5.3				0.13	U			6900				0.13	U			2.6	U	280000		620000	
OU1MW3	OU1MW3-GW-FF-060419	N	04 Jun 2019	3.2				5.9				0.13	U			7600				0.13	U			2.6	U						
OU1MW3	QC-GW-FD-1-081319	FD	13 Aug 2019			1.6	J			6.4				0.13	U			6200				0.13	U			1.5	U	220000		710000	
OU1MW3	QC-GW-FF-FD-1-081319	FD	13 Aug 2019	2.1				6.0				0.13	U			6100				0.13	U			1.5	U						
OU1MW3	OU1MW3-GW-081319	N	13 Aug 2019			1.8	J			6.5				0.13	U			6500				0.13	U			1.5	U	220000		720000	
OU1MW3	OU1MW3-GW-FF-081319	N	13 Aug 2019	2.0				6.5				0.13	U			6500				0.25	J			1.5	U						
OU1MW3D	OU1MW3D-GW-121318	N	13 Dec 2018			1.1	U			41				0.13	U			34000	J			0.094	U			0.81	U	140000		1500000	
OU1MW3D	QC-GW-FD-1-122118	FD	21 Dec 2018	1.1	U	1.1	U	42		42		0.13	U	0.13	U	26000		25000		0.094	U	0.094	U	0.81	U	0.81	U			1500000	
OU1MW3D	OU1MW3D-GW-122118	N	21 Dec 2018			1.1	U			43				0.13	U			26000				0.094	U			0.81	U			1500000	
OU1MW3D	OU1MW3D-GW-FF-122118	N	21 Dec 2018	1.1	U			43				0.13	U			26000				0.094	U			0.81	U						
OU1MW3D	QC-GW-FD-2-032019	FD	20 Mar 2019			0.38	U			49				0.13	U			24000				0.13	U			2.6	U	180000		1600000	
OU1MW3D	QC-GW-FF-FD-2-032019	FD	20 Mar 2019	0.38	U			51				0.13	U			27000				0.13	U			2.6	U						
OU1MW3D	OU1MW3D-GW-032019	N	20 Mar 2019			0.38	U			50				0.13	U			23000				0.13	U			2.6	U	190000		1600000	
OU1MW3D	OU1MW3D-GW-FF-032019	N	20 Mar 2019	0.38	U			47				0.13	U			23000				0.13	U			2.6	U						
OU1MW3D	QC-GW-FD-2-060419	FD	04 Jun 2019			0.38	U			52				0.13	U			27000				0.13	U			2.6	U	170000		1500000	
OU1MW3D	QC-GW-FF-FD-2-060419	FD	04 Jun 2019	0.38	U			50				0.13	U			26000				0.13	U			2.6	U						
OU1MW3D	OU1MW3D-GW-060419	N	04 Jun 2019			0.38	U			49				0.13	U			24000				0.13	U			2.6	U	160000		1500000	
OU1MW3D	OU1MW3D-GW-FF-060419	N	04 Jun 2019	0.38	U			53				0.13	U			27000				0.13	U			2.6	U						
OU1MW3D	QC-GW-FD-2-081319	FD	13 Aug 2019			0.38	U			49				0.13	U			25000				0.13	U			1.5	U	140000		1500000	
OU1MW3D	QC-GW-FF-FD-2-081319	FD	13 Aug 2019	0.38	U			47				0.13	U			23000				0.13	U			1.5	U						
OU1MW3D	OU1MW3D-GW-081319	N	13 Aug 2019			0.38	U			48				0.13	U			24000				0.13	U			1.5	U	150000		1500000	
OU1MW3D	OU1MW3D-GW-FF-081319	N	13 Aug 2019	0.53	J			51				0.13	U			25000				0.13	U			1.5	U						
OU1MW4	OU1MW4-GW-121418	N	14 Dec 2018			19				1.4				0.13	U			1300	J			0.12	J			0.81	U	270000		520000	
OU1MW4	OU1MW4-GW-FF-121418	N	14 Dec 2018	20				1.4				0.13	U			1200				0.094	U			0.81	U						
OU1MW4	OU1MW4-GW-032119	N	20 Mar 2019			18				1.1				0.13	U			770				0.16	J			2.6	U	260000		370000	
OU1MW4	OU1MW4-GW-FF-032119	N	21 Mar 2019	19				0.87	J			0.13	U			500				0.13	U			2.6	U						
OU1MW4	OU1MW4-GW-060519	N	05 Jun 2019			28				0.85	J			0.13	U			730				0.13	U			2.6	U	250000		360000	
OU1MW4	OU1MW4-GW-FF-060519	N	05 Jun 2019	28				0.94	J			0.13	U			690				0.13	U			2.6	U						
OU1MW4	OU1MW4-GW-081319	N	13 Aug 2019			26				1.3				0.13	U			310				0.13	U			1.5	U	220000		310000	
OU1MW4	OU1MW4-GW-FF-081319	N	13 Aug 2019	27				1.1				0.13	U			280				0.13	U			1.8	J						
OU1MW5	OU1MW5-GW-121418	N	14 Dec 2018			1.5	J			0.82	J			0.13	U			14	UJ			96				0.81	U	1800000		1800000	
OU1MW5	OU1MW5-GW-FF-121418	N	14 Dec 2018	1.3	J			0.74	J			0.13	U			14	U			99				0.81	U						
OU1MW5	OU1MW5-GW-032119	N	21 Mar 2019			3.3				1.2				0.13	U			84				30				2.6	U	740000		890000	
OU1MW5	OU1MW5-GW-FF-032119	N	21 Mar 2019	3.2				0.78	J			0.13	U			14	U			20				2.6	U						
OU1MW5	OU1MW5-GW-060419	N	04 Jun 2019			4.1				0.39	J			0.13	U			14	U			220				2.6	U	1700000		1700000	
OU1MW5	OU1MW5-GW-FF-060419	N	04 Jun 2019	4.0				0.50	J			0.13	U			14	U			230				2.6	U						
OU1MW5	OU1MW5-GW-081319	N	13 Aug 2019			18				1.5				0.13	U			20	J			11				1.5	U	83000		480000	
OU1MW5	OU1MW5-GW-FF-081319	N	13 Aug 2019	18				0.96	J			0.13	U			20	U			2.3				1.5	U						
OU1MW5D	OU1MW5D-GW-121418	N	14 Dec 2018			1.1	U			13				0.13	U			8500				0.094	U			0.81	U	480000		710000	
OU1MW5D	OU1MW5D-GW-FF-121418	N	14 Dec 2018	1.1	U			14				0.13	U			8900				0.30	J			0.81	U						
OU1MW5D	OU1MW5D-GW-032119	N	21 Mar 2019			0.38	U			18				0.13	U			10000				0.13	U			2.6	U	530000		720000	
OU1MW5D	OU1MW5D-GW-FF-032119	N	21 Mar 2019	0.38	U			18				0.13	U			10000				0.13	U			2.6	U						
OU1MW5D	OU1MW5D-GW-060419	N	04 Jun 2019			0.48	J			19				0.13	U			12000				0.13	U			2.6	U	500000		700000	
OU1MW5D	OU1MW5D-GW-FF-060419	N	04 Jun 2019	0.45	J			20				0.13	U			12000				0.13	U			2.6	U						
OU1MW5D	OU1MW5D-GW-081319	N	13 Aug 2019			0.38	U			17				0.13	U			11000				0.13	U			1.5	U	490000		720000	
OU1MW5D	OU1MW5D-GW-FF-081319	N	13 Aug 2019	0.38	U			17				0.13	U			11000				0.13	U			1.5	U						
OU1MW6	OU1MW6-GW-121418	N	14 Dec 2018			6.5				1.8				0.13	U			310				0.14	J			4.5	J	310000		350000	
OU1MW6	OU1MW6-GW-FF-121418	N	14 Dec 2018	6.2				1.6				0.13	U			280				0.094	U			4.0	J						
OU1MW6	OU1MW6-GW-032119	N	21 Mar 2019			6.2				0.89	J			0.13	U			180				0.13	U			3.1	J	260000		300000	
OU1MW6	OU1MW6-GW-FF-032119	N	21 Mar 2019	6.7				1.2				0.13	U			160				0.13	U			3.0	J						
OU1MW6	OU1MW6-GW-060319	N	03 Jun 2019			11				0.69	J			0.13	U			18	J			0.13	U			6.7		270000		380000	
OU1MW6	OU1MW6-GW-FF-060319	N	03 Jun 2019	12				0.60	J			0.13	U			14	U			0.13	U			5.5							
OU1MW6	OU1MW6-GW-081319	N	13 Aug 2019			11				1.2				0.13	U			290				0.15	J			2.3	J	280000		370000	
OU1MW6	OU1MW6-GW-FF-081319	N	13 Aug 2019	10				1.1				0.13	U			230				0.13	U			2.6	J						
OU1MW6D	OU1MW6D-GW-121418	N	14 Dec 2018			1.1	U			37				0.13	U			5700				0.094	U			0.81	U	240000		430000	
OU1MW6D	OU1MW6D-GW-FF-121418	N	14 Dec 2018	1.1	U			36				0.13	U			5600				0.094	U			0.81	U						
OU1MW6D	OU1MW6D-GW-032119	N	21 Mar 2019			0.38	U			47				0.13	U			5900				0.13	U			2.6	U	230000		440000	
OU1MW6D	OU1MW6D-GW-FF-032119	N	21 Mar 2019	0.38	U			46				0.13	U			5600				0.13	U			2.6	U						
OU1MW6D	OU1MW6D-GW-060319	N	03 Jun 2019			0.42	J			56				0.13	U			12000				0.13	U			2.6	U	190000		650000	
OU1MW6D	OU1MW6D-GW-FF-060319	N	03 Jun 2019	0.38	U			55				0.13	U			12000				0.13	U			2.6	U						
OU1MW6D	OU1MW6D-GW-081319	N	13 Aug 2019			0.38	U			54				0.13	U			8800				0.13	U			1.5	U	190000		490000	
OU1MW6D	OU1MW6D-GW-FF-081319	N	13 Aug 2019	0.38	U			53				0.13	U			9000				0.13	U			1.5	U						
OU1MW7	OU1MW7-GW-121318	N	13 Dec 2018			5.2				0.78	J			0.13	U			68	J			0.10	J			1.3	J	290000		300000	
OU1MW7	OU1MW7-GW-FF-121318	N	13 Dec 2018	4.8				0.74	J			0.13	U			15	J			0.094	U			0.96	J						
OU1MW7	OU1MW7-GW-032119	N	21 Mar 2019			3.9				0.63	J			0.13	U			82				0.13	U			2.6	U	250000		260000	
OU1MW7	OU1MW7-GW-FF-032119	N	21 Mar 2019	4.3				0.48	J			0.13	U			20	J			0.13	U			2.6	U						
OU1MW7	OU1MW7-GW-060419	N	04 Jun 2019			17				0.45	J			0.13	U			28	J			0.13	U			2.6	U	240000		240000	
OU1MW7	OU1MW7-GW-FF-060419	N	04 Jun 2019	18				0.51	J			0.13	U			14	U			0.13	U			2.6	U						
OU1MW7	OU1MW7-GW-081319	N	13 Aug 2019			6.1				0.49	J			0.13	U			29	J			0.13	U			1.5	U	230000		230000	
OU1MW7	OU1MW7-GW-FF-081319	N	13 Aug 2019	7.0				0.72	J			0.13	U			20	U			0.13	U			2.3	J						
OU1MW8	OU1MW8-GW-121318	N	13 Dec 2018			6.7				1.4				0.13	U			430	J			0.094	U			0.81	U	540000		480000	
OU1MW8	OU1MW8-GW-FF-121318	N	13 Dec 2018	7.1				1.5				0.13	U			380				0.094	U			0.81	U						
OU1MW8	OU1MW8-GW-032119	N	21 Mar 2019			6.8				1.0				0.13	U			360				0.17	J			3.4	J	350000		420000	
OU1MW8	OU1MW8-GW-FF-032119	N	21 Mar 2019	5.8				1.0				0.13	U			190				0.13	U			2.6	U						
OU1MW8	OU1MW8-GW-060519	N	05 Jun 2019			15				1.2				0.13	U			340				0.13	U			3.2	J	390000		740000	
OU1MW8	OU1MW8-GW-FF-060519	N	05 Jun 2019	16				1.3				0.13	U			350				0.13	U			3.5	J						
OU1MW8	OU1MW8-GW-081319	N	13 Aug 2019			13				0.85	J			0.13	U			220				0.13	U			4.4	J	300000		710000	
OU1MW8	OU1MW8-GW-FF-081319	N	13 Aug 2019	12				0.88	J			0.13	U			200				0.13	U			4.6	J						
MW10	MW-10-20191227	N	27 Dec 2019	7.1	J			180				< 0.43	U							< 27	U			11							
MW18	MW-18-20191227	N	27 Dec 2019	14	J			330				< 0.43	U							< 2.7	U			< 5.3	U						
MW5	MW-5-20191227	N	27 Dec 2019	15	J			93				< 0.43	U							< 2.7	U			< 5.3	U						
MW6	MW-6-20191227	N	27 Dec 2019	< 6.0	U			< 3.7	U			< 0.43	U							< 2.7	U			< 5.3	U						
MW7	MW-7-20191227	N	27 Dec 2019	18	J			4500				< 0.43	U							< 2.7	U			6.6	J						
MW8	MW-8-20191227	N	27 Dec 2019	8.9	J			4.4	J			< 0.43	U							< 2.7	U			< 5.3	U						
	DUP-1-20191228	N	28 Dec 2019	21				5500				< 0.43	U							< 2.7	U			< 5.3	U						

Table L-1
Historical and Recent Groundwater Analytical Data
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

			Chemical Unit Fraction	Antimony ug/L D		Antimony ug/L T		Arsenic ug/L D		Arsenic ug/L T		Cadmium ug/L D		Cadmium ug/L T		Iron ug/L D		Iron ug/L T		Lead ug/L D		Lead ug/L T		Selenium ug/L D		Selenium ug/L T		Alkalinity, Total as CaCO3 ug/L T		Hardness as CaCO3 ug/L T	
Sample Location	Sample Name	Sample Type	Sample Date	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted (	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers	Result	Interpreted Qualifiers
MW15	MW-15-20191228	N	28 Dec 2019	77				5.1	J			5.4	J							< 2.7	U			8.5	J						
MW21	MW-21-20191228	N	28 Dec 2019	81				140				47								< 2.7	U			< 5.3	U						
MW23	MW-23-20191228	N	28 Dec 2019	77				< 3.7	U			5.5								< 2.7	U			7.6	J						
MW25	MW-25-20191228	N	28 Dec 2019	12	J			58				< 0.43	U							< 2.7	U			7.4	J						
MW12	MW-12-20200512	N	12 May 2020	15	J			4.1	J			< 0.43	U							3.1	J			< 5.3	U						
MW5	MW-5-20200512	N	12 May 2020	19	J			63				0.73	J							3.8	J			< 5.3	U						
MW6	MW-6-20200512	N	12 May 2020	9.9	J			5.2	J			0.45	J							< 2.7	U			< 5.3	U						
MW8	MW-8-20200512	N	12 May 2020	16	J			12				0.59	J							< 2.7	U			< 5.3	U						
	DUP-1-20200513	N	13 May 2020	16	J			6300				< 4.3	U							< 2.7	U			< 5.3	U						
MW10	MW-10-20200513	N	13 May 2020	15	J			210				< 0.43	U							4.2	J			< 5.3	U						
MW15	MW-15-20200513	N	13 May 2020	95				< 3.7	U			0.98	J							4.0	J			< 5.3	U						
MW18	MW-18-20200513	N	13 May 2020	11	J			150				0.49	J							< 2.7	U			< 5.3	U						
MW21	MW-21-20200513	N	13 May 2020	80				92				51								< 2.7	U			< 5.3	U						
MW23	MW-23-20200513	N	13 May 2020	82				< 3.7	U			6.8								< 2.7	U			< 5.3	U						

APPENDIX M HUMAN HEALTH RISK ASSESSMENT

Prepared for:

U.S. Smelter and Lead Refinery, Inc.
(USS Lead)

Revised Human Health Risk Assessment

USS Lead Superfund Site, Operable Unit 2,
5300 Kennedy Ave., East Chicago, IN

September 2021

Project No.: 0432213

The business of sustainability

ERM

Signature Page

September 2021

Revised Human Health Risk Assessment

USS Lead Superfund Site, Operable Unit 2, 5300 Kennedy Ave., East Chicago, IN

Daniel W. Petersen, Ph.D.
Partner-in-Charge

Timothy R. Barber, Ph.D.
Technical Director, Project Coordinator

Laura Judd, M.S.
Senior Risk Assessor

Environmental Resources Management
1701 Golf Road, Suite 1-700
Rolling Meadows, IL 60008

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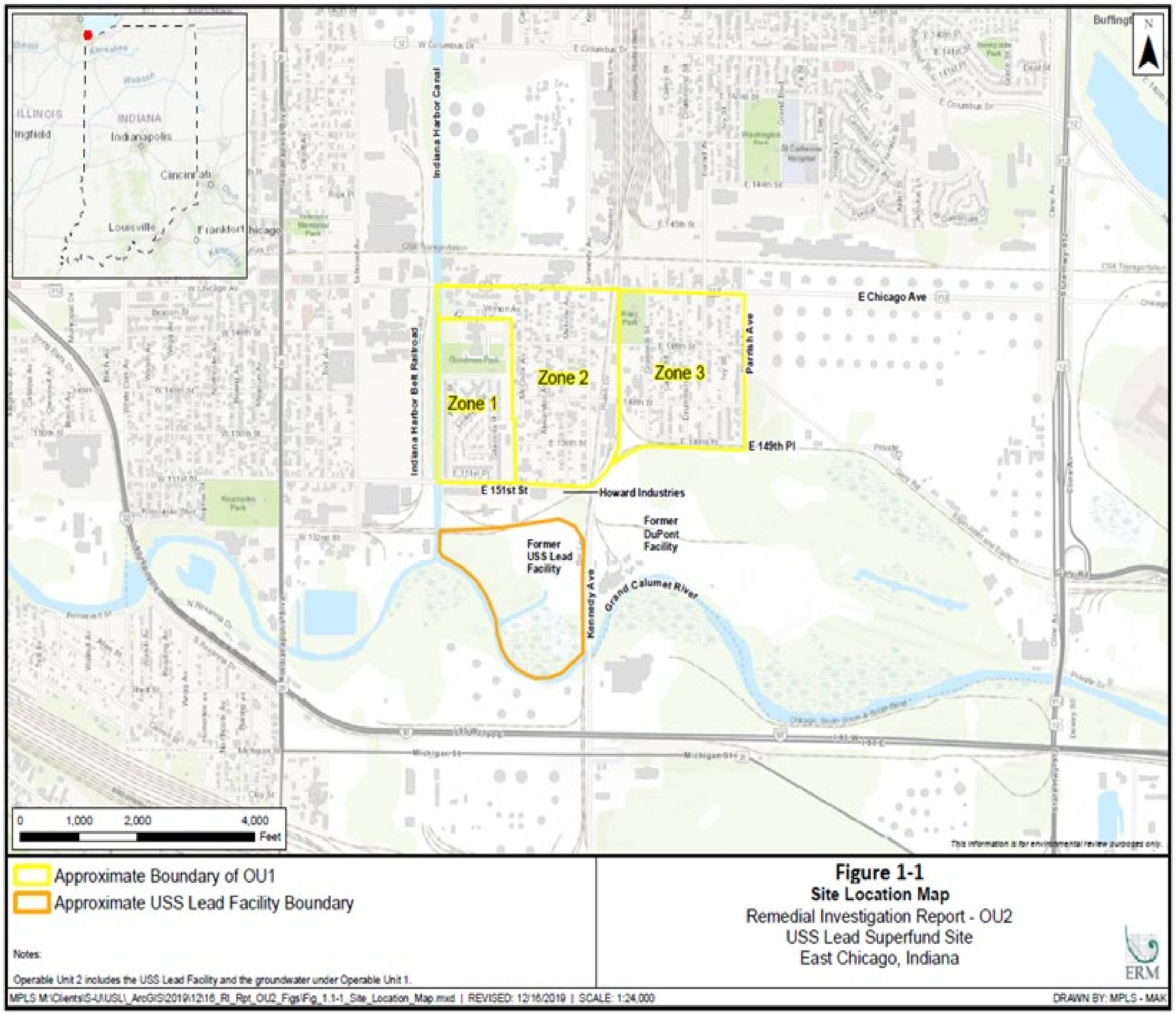
Acronyms and Abbreviations

Name	Description
AMSL	Above mean sea level
AOC	Administrative Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirements
ARCO	Atlantic Richfield Company
ASAOC	Administrative Settlement Agreement and Order on Consent
BGS	Below ground surface
CAMU	Corrective Action Management Unit
CDI	Chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COI	Chemicals of Interest
CSM	Conceptual site model
EPA	Regional Environmental Protection Agency
EPC	Exposure point concentration
ERC	Environmental Restrictive Covenant
ERM	Environmental Resources Management, Inc.
Facility	Former USS Lead Facility
FS	Feasibility Study
HQ	Hazard quotient
IDEM	Indiana Department of Environmental Management
LADI	Lifetime average daily intake
LOAEL	Lowest observed adverse effect level
MRFI	Modified RCRA Facility Investigation
NOAEL	No observed adverse effect level
O&M	Operation and maintenance
OU	Operable Unit
PEF	Particulate emission factor
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
Site	USS Lead Superfund Site, consisting of OU1 and OU2
SOW	Statement of Work
TR	Cancer target risk
UCL	Upper confidence level
USEPA	Federal Environmental Protection Agency
USS Lead	U.S. Smelter and Lead Refinery, Inc.

1. INTRODUCTION

Environmental Resources Management, Inc. (ERM) was retained by U.S. Smelter and Lead Refinery, Inc. (USS Lead) to perform the necessary work to complete a Remedial Investigation and Feasibility Study (RI/FS) for Operable Unit 2 (OU2) of the USS Lead Superfund Site (the "Site"; Figure 1). EPA divided the Site into two Operable Units (OU1 and OU2). OU1 (Zones 1, 2 and 3) includes the surface and subsurface soil of the Calumet Neighborhood, and OU2 includes the surface soil, subsurface soil, andw32 sediments at the former USS Lead Facility and the groundwater under both OU1 and OU2. This baseline human health risk assessment (HHRA) was completed in accordance with the Administrative Settlement Agreement and Order on Consent (ASAOC) between the U.S. Environmental Protection Agency - Region 5 (EPA) and USS Lead.

Figure 1: Site Location Map



Specific requirements for the HHRA are described in the Statement of Work ("RI/FS SOW") included in Appendix A of the ASAOC. The chemicals of interest (COIs) at the Site are antimony, arsenic, cadmium, lead, and selenium in soil, sediment, surface water, and groundwater.

1.1 Report Organization

This HHRA is organized as follows:

Section 1 – Introduction. This section provides a description of the Site and relevant site conditions.

Section 2 – Risk Assessment Overview. This section provides an overview of the risk assessment methodology utilized in this HHRA.

Section 3 – Human Health Conceptual Model. This section identifies the current and potential future uses of the Site, affected media, exposure pathways, and potentially exposed populations that are addressed in the HHRA.

Section 4 – Chemicals of Interest. This section identifies the COIs evaluated in this HHRA.

Section 5 – Exposure Assessment. This section describes the exposure settings, identifies the exposure points evaluated, exposure point concentrations for the COIs in the applicable media, the exposure factors for applicable receptors, and estimates of chemical intake for each receptor.

Section 6 – Toxicity Assessment. This section addresses the toxicity of COIs, and the cancer slope factors and non-carcinogenic toxicity reference that are used in the risk assessment.

Section 7 – Risk Characterization. This section assesses the non-carcinogenic health hazards and carcinogenic risks across various media and pathways.

Section 8 – Uncertainty Analysis. This section discusses sources of uncertainty in this HHRA, including the sampling data, identification of COIs, selection of exposure scenarios and pathways, estimation of exposure point concentrations (EPCs), selection of exposure variables used to estimate chemical intake, toxicity values for COIs, and risk characterization methodology.

Section 9 – Summary and Conclusions. This section summarizes the risk assessment results and conclusions.

Section 10 – References. Provides a list of the references that are cited in the body of the report

1.2 Site Description and Background

Between approximately 1906 and 1985, the USS Lead Facility processed and refined significant quantities of lead and other metals and chemicals, including arsenic. Between approximately 1912 and 1954, facilities in Zone 1 of the Site also processed and refined significant quantities of lead and other metals and chemicals, including arsenic and antimony. Between approximately 1893 and 2000, the DuPont Facility, located immediately south of Zone 3 of the Site, processed a significant quantity of metals and other chemicals primarily in the production of various inorganic acids and organic and inorganic chemicals, including lead arsenate, and zinc chloride.

The Site has undergone investigation, and interim remedial activities have been taken since the 1990s. Interim measures at the USS Lead Facility included removal of the baghouse dust and bags piles and off-site disposal, removal of the slag piles and disposal/storage at the on-Site Corrective Action Management Unit (CAMU), demolition and storage at the CAMU of the USS Lead Facility’s production plant structures, and removal and storage at the CAMU of soil and sediments with lead concentrations greater than 1,200 mg/kg, which was the Indiana regulatory limit for industrial property uses in the 1990s.

Other than the removal of potential sources via the soil and sediments excavation activities at the former USS Lead Facility and the targeted removal of the top 6 to 24 inches of soil in OU1 there have been no interim measures in OU1 and limited interim measures in OU2 related to groundwater

Site characterization, including physiography, geology, and hydrogeology, and soil, sediment, surface water, and groundwater are detailed in the RI Report.

1.3 Site Setting

As previously indicated, OU2 consists of (1) the former USS Lead Facility and (2) the Groundwater at the entire Site, which includes both the former USS Lead Facility and OU1. OU2 at the Site includes the following features:

- An approximately 10-acre CAMU;
- A 39-acre wetland area located south and southeast of the Canal;
- Several surface water ponds to the north, west, and south of the CAMU; and
- A forested uplands area that has remnants of the original dune and swale complex in the northwest corner of the Site covering approximately 20 acres.

OU1 consists of approximately 322 acres of mixed-use properties, with a total of 1,271 properties with the following uses: (1) residences, including single and multi-family units; (2) generally light commercial/industrial operations; (3) municipal and community offices and operations; (4) two schools (the Carrie Gosch Elementary School and the Carmelite School for Girls); (5) four municipal parks; and (6) numerous places of worship. The area where the former East Chicago Public Housing complex was built was previously occupied by the former Anaconda Lead Products and International Lead Refining Company facility (currently the Atlantic Richfield Company).

1.4 Current Conditions

USS Lead executed an environmental restrictive covenant (ERC) to implement institutional controls at the Facility on June 6, 2005 (Swidler Berlin LLP, 2005). The ERC was part of the RCRA closure plan approved by IDEM and among other provisions, and includes:

- Any activity that will impact, damage or threaten the integrity of the CAMU, the subsurface slurry wall, or the monitoring wells installed around the CAMU;
- Installation of drinking water wells;
- Use of the property for residences; and
- Off-site placement of surface or subsurface soil from the property unless it is properly sample and characterized for appropriate use or disposal.

Currently, OU2 is a controlled site, consisting of undeveloped land, a CAMU, wetlands, surface water bodies (three ponds and a canal), and a wooded area with remnants of the original dune and swale complex. The areas and deptsh of the surface water bodies is summarized in **Table 2.4-1** of the RI Report. The only activities taking place are related to the operation and maintenance (O&M) of the CAMU and monitoring of groundwater on a periodic basis, as described in the approved Post-Closure Permit (ETS, 2010-2016). O&M activities include periodic inspections of security, sand cover, vegetation, drainage, subsidence, extraction system monitoring and maintenance, site photographs, and CAMU groundwater elevations.

The RI/FS ASAOC indicates that Lake Michigan, instead of groundwater under the Site, is used currently as a source for drinking water for the Site residents at OU1. During the March 16, 2018 conference call to discuss USEPA comments on the January 2, 2018 RI/FS planning documents, USEPA noted that dermal contact to groundwater may potentially occur via basement flooding, sump pump operations, and seepage of groundwater into the basement.

2. RISK ASSESSMENT OVERVIEW

The methods used to conduct this HHRA are based on the risk assessment framework developed by the USEPA. The framework is documented in "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)" (also known as "RAGS") (EPA 1989).

The USEPA HHRA framework consists of the following six basic steps:

- **Conceptual Site Exposure Model:** This step involves evaluating potential exposure pathways to the COIs and human populations that might be exposed to them under current or future site conditions.
- **Data Evaluation and Selection of COIs:** This step consists of evaluating the analytical data for usability in the HHRA, grouping analytical data by site and by medium, and selecting COIs in site media.
- **Exposure Assessment:** This step quantifies exposure to the COIs identified for exposure pathways that are potentially complete. EPCs are estimated from measured or modeled concentrations, and pathway-specific intakes (doses) are estimated using current and potential future human receptors for evaluation in the subsequent risk calculations.
- **Toxicity Assessment:** This step consists of compiling toxicity values that characterize potential adverse health effects from exposure to COIs.
- **Risk Characterization:** This step combines the results of the previous steps to quantitatively characterize potential risks to human health associated with exposure to COIs at the area evaluated. Both potential cancer risks and non-cancer hazard indices (HI), a measure of the potential for adverse health effects other than cancer, are evaluated.
- **Uncertainty Analysis:** This step analyzes the major uncertainties associated with the risks calculated.

2.1 Risk Assessment Methodology

This HHRA was conducted according to USEPA guidance for the preparation of human health risk assessments. The key risk assessment documents that were used for this assessment include, but are not limited to:

- *USEPA Risk Assessment Guidance for Superfund (RAGS), Volume I - Human Health Evaluation Manual (Part A), Interim Final (EPA-540-1-89-002), OSWER 9285.7-01A; December 1, 1989;*
- *USEPA Risk Assessment Guidance for Superfund (RAGS),: Volume I - Human Health Evaluation Manual: (Part B, Development of Risk-based Preliminary Remediation Goals), Interim, OSWER 9285.7-01B; December, 1991;*
- *USEPA Risk Assessment Guidance for Superfund (RAGS), Volume I - Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments), Final, OSWER 9285.7-47, December 2001;*
- *USEPA Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final, (EPA/540/R/99/005), OSWER 9285.7-02EP; July 2004;*
- *USEPA Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment), Final, (EPA-540-R-070-002), OSWER 9285.7-82; January, 2009;*

- *USEPA Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors, OSWER 9285.6-03; March 25, 1991;*
- *USEPA Exposure Factors Handbook, Volumes I, II, and III; August 1997 (EPA/600/P- 95/002F a,b,c);*
- *USEPA Exposure Factors Handbook: 2011 Edition. (EPA/600/R-09/052F). September, 2011;*
- *USEPA Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER 9200.1-120; February, 2014;*
- *USEPA ProUCL Version 5.1.002 Technical Guide. Statistical Software for Environmental Applications for Data Sets With and Without Non-detect Observations, (EPA/600/R-07/041); October, 2015;*
- *USEPA Soil Screening Guidance: Technical Background Document (OSWER 9355.4-17A: May 1, 1996), Soil Screening Guidance: User's Guide (OSWER 9355.4-23; April, 1996); Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4; March 24, 2001 and OSWER Directive 9355.4-24; 2002;*
- *USEPA Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER 9355.4-12; July 14, 1994; and Clarification to the 1994 Revised Interim Soil Lead (Pb) Guidance for CERCLA Sites and RCRA Corrective Action Facilities, OSWER 9200.4-27P; August, 1998;*
- *USEPA Assessing Intermittent or Variable Exposures at Lead Sites, OSWER 9285.7-76; November, 2003; and*
- *USEPA Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil: The Adult Lead Methodology (ALM) (EPA-540-R-03-001), OSWER 9285.7-54; January, 2003.*

3. HUMAN HEALTH CONCEPTUAL SITE MODEL

The following human health conceptual site model (CSM) was developed based on site-specific observations and the current and prior investigations.

- **Current and Future Site Use:** The Site (OU2) is fenced (except for an area on the southwestern side, adjacent to the Indiana Harbor Canal and the Grand Calumet River), and has an ERC established as part of the RCRA closure process that prohibits the development of the property, the use of groundwater as a source of potable water, and the disturbance of the CAMU operation, maintenance, and monitoring activities. The Site is currently inactive, except for O&M and monitoring related to the CAMU. OU1 is currently and will likely continue to be a mixed-use area. The future use of the former Anaconda Lead site at Zone 1 in OU1 is currently unknown, because the West Calumet Housing Complex was demolished with no known plans for re-development.
- **Affected Media:** Soil, sediment, surface water, and groundwater have been potentially impacted with antimony, arsenic, cadmium, lead, and selenium as discussed in the RI Report.
- **Exposed Human Populations:** Exposed human populations within OU2 at the Site under current conditions include adult (>18 years old) CAMU O&M workers and potential trespassers. Trespassers may include both adolescents (7 to 18 years old) and adults engaging in recreational activities such as hiking in upland areas, or wading in open water or wetland areas of the Site. This population would include nearby residents or workers trespassing on the Site for recreational purposes. Otherwise, off-Site (nearby) populations are not expected to contact or be exposed to impacted media on-Site. Under future conditions, the same populations plus a utility worker, performing utility repairs or replacement (for a limited period of time), may be exposed to on-Site media.

Within OU1, human populations exposed to groundwater may include residents who may potentially contact the groundwater as a result of basement flooding, sump operations, and groundwater seepage in basements. The RI/FS ASAOC indicates that Lake Michigan is used currently as a source for drinking water for the Site residents at OU1. The results of a private water well search also confirm that groundwater in OU1 is not currently being used for drinking water. Hypothetical future use of OU1 groundwater would be potentially complete in the absence of an ordinance prohibiting the installation of groundwater wells. However, the City of East Chicago passed Ordinance No. 20-0013 on 24 August 2020 that explicitly prohibits the installation or drilling of wells or any attempted use of groundwater as a potable water supply[1]. Therefore, both current and hypothetical future use of OU1 groundwater as drinking water is incomplete.

- **Human Health Exposure Pathways:** The Site has undergone a modified RCRA Facility Investigation (MRFI) and remediation of lead-contaminated soils and sediments, consisting of construction of a CAMU to store excavated soils. The depth of excavation of soils and sediments in the remediated areas were up to 15 feet below ground surface (bgs). The O&M and monitoring activities are performed outdoors, once per quarter, depending on the activity. Also, there is a restriction on the development of the property and use of the groundwater as potable water, and the Site is completely fenced, except for an area on the southwestern side, adjacent to the Indiana Harbor Canal and Grand Calumet River. Given the Site's restricted access, and its illegal nature, hunting and/or fishing on-Site and subsequent game consumption is not considered a complete exposure pathway. Sediment that may originate from the Site and deposit in storm sewers following rain events would generally be inaccessible, or if so, not of a duration significant enough to warrant separate evaluation in the HHRA (the exposure to on-Site sediment is included in the HHRA).

  The potential human health exposure pathways include incidental ingestion of soil, dermal contact with soil, and inhalation of particulates by current O&M workers and trespassers, and by future utility workers. Trespassers may also be exposed through the incidental ingestion of and dermal contact with sediment and surface water. The utility worker may also be exposed through dermal contact with sediment, surface water or groundwater.

  For OU1, potential human health exposure pathways include the potential incidental ingestion of and dermal contact with groundwater because of basement flooding, sump operations, and groundwater seepage (intrusion) in basements.

The selection of potential exposure pathways is presented in RAGS Part D Table 1 (see **Attachment 2**).

4. CHEMICALS OF INTEREST

As described in the RI/FS FSP (ERM 2018b), historical data were reviewed to identify the COIs for the RI. Data collected at the former USS Lead Facility over the preceding 20 years were evaluated and compared to regulatory screening levels (SLs). As discussed in Section 4.1 of the RI, antimony, arsenic, cadmium, lead, and selenium have been determined to be the COIs for OU2. At the request of EPA, iron was added to the list of select metals to be analyzed in soil, sediment, and groundwater samples. While iron is not considered a COI, it was added to provide geochemical context for interpreting the results of the other metals.

The occurrence, distribution and HHRA screening of COIs is presented in RAGS Part D Table 2.1 (see **Attachment 2**) for OU2 surface soil (0 – 2 feet), OU2 surface plus subsurface soil (0 – 6 feet), OU2 sediment (0 – 2 feet based on historic discrete sample results), OU2 sediment (0 – 0.5 feet based on

[1] "Potable water" as defined by the Ordinance is defined as any water used for human or domestic consumption including but not limited to, water used for drinking, bathing, swimming, washing dishes, or preparing foods.

current Incremental Sampling Methodology [ISM] results), OU2 surface water, OU2 groundwater, OU1 Zone 1 (Z1) groundwater, and OU1 Zones 2 and 3 (Z2-3) groundwater. USEPA Regional Screening Levels (RSLs) based on a target hazard quotient = 0.1 or target cancer risk = 1E-06 (whichever lower) (USEPA 2021), are compared to maximum detected concentrations of COIs in Table 2.1. Generic RSLs available for residential soil, industrial soil (composite workers) and tap water are provided in Table 2.1. In addition, the USEPA's on-line calculator was used to generate soil RSLs for construction workers, soil/sediment RSLs for recreators, and surface water RSLs for recreators. The calculated RSLs are based on a target hazard quotient = 0.1 or target cancer risk = 1E-06 (whichever lower), and utilize calculator defaults in addition to Site-specific inputs noted in Table 2.1. The on-line RSL calculator outputs are provided in **Attachment 5**.

5. EXPOSURE ASSESSMENT

The exposure assessment evaluates the likelihood, magnitude, and frequency of exposure to the COIs, and identifies pathways and routes by which human receptors may be exposed to these constituents. The specific steps involved in the exposure assessment include the following:

- Characterization of exposure setting;
- Identification of exposure pathways;
- Development of exposure scenarios; and
- Estimation of exposure point concentrations.

5.1 Description of the Exposure Setting

As discussed previously, the former USS Lead Facility is a 79-acre parcel of land comprised of a CAMU on the eastern side, and surrounded by wetlands (and open water seasonally) to the north, west, and south, and a natural dune-and-swale complex that is located in the west/northwest portion of the former USS Lead Facility.

The USS Lead Canal runs southwest from the southwest corner of the CAMU for approximately 1,000 feet, where it used to join the Grand Calumet River. However, before removal of the canal sediments, a clay berm was installed to prevent surface water flow from reaching the river and to prevent the river from re-contaminating the canal, which influenced surface water discharging to the River. In addition, excavation and sand borrowing from areas north, west, and south of the CAMU reached deep enough to be in contact with the groundwater when the water table is high. The entire former USS Lead Facility is within the 100-year floodplain. The only upland area outside of the CAMU (approximately 10 acres) is the natural dune-and-swale complex.

Physical barriers were also constructed to protect surface water and limit chemical exposure to soil and sediment. The former USS Lead Facility established an ERC as part of the RCRA Closure with IDEM. The ERC prohibits the development of the property, the use of the groundwater as a source of drinking water, and the disturbance of the CAMU, plus other standard Indiana requirements (e.g., no off-site disposal of soil without soil characterization).

The former USS Lead Facility is predominantly covered with wetland emergent and shrub vegetation, and with trees and shrubs in the dune-and-swale complex, which minimizes direct contact exposures. There are no paved roads and no structures throughout the former USS Lead Facility, except for the CAMU. However, the area adjacent to the Indiana Harbor Canal and Grand Calumet River is not secured with fencing to restrict access; therefore, trespassing cannot be ruled out under current conditions.

With respect to OU1, groundwater is known to be shallow and may seep into or potentially flood basements. In some cases, sumps are used to control groundwater intrusion into basements.

5.2 Identification of Potentially-Exposed Populations

The identification of potential human receptors is based on several factors, including direct observations and current and potential future land use. This information was used to identify individuals working and/or engaging in activities within OU2, both currently and potentially in the future. Of particular importance is that the ERC prohibits disturbance of the CAMU, re-development of the former USS Lead Facility, and use of groundwater. Thus, considering all potential human receptor populations that may be present within OU2 and the anticipated pathways of exposure by which the receptors could contact soil, sediment, surface water, or groundwater include:

- Adult utility workers at the former USS Lead Facility;
- Adult O&M workers at the former USS Lead Facility (O&M workers may be on-Site intermittently to perform CAMU O&M and sample groundwater monitoring wells);
- Adult and adolescent trespassers at the former USS Lead Facility; and
- Adult, adolescent and child (0 – 6 years) residents who may potentially contact groundwater due to basement flooding, sump operations, and groundwater seepage into basements in OU1.

For each of these potentially exposed populations, potential exposure pathways are described in the following section.

5.3 Identification of Exposure Pathways

The purpose of this step is to identify the exposure pathways to be evaluated in the risk assessment. To qualify for evaluation, a complete pathway must include the following four elements:

- A source of COIs at the Site;
- A migration pathway for the COI to be present in media at the Site (e.g., soil, sediment, surface water, groundwater);
- A point of potential contact of the human receptor with the exposure medium (e.g., an individual accesses the Site and contacts the medium); and
- An exposure pathway (e.g., ingestion, dermal contact, inhalation).

Taking into account each of the above-listed elements, each sampled medium may be considered a potential transport medium for COI migration in the risk assessment. Potential receptors may contact constituents in soils and sediments through ingestion, dermal contact, and/or inhalation; in groundwater at OU2 via subsurface activities; and groundwater at OU1 through potential dermal contact with groundwater. These media may be contacted directly, or with a secondary exposure medium (e.g., air). Thus, considering all potential human receptor populations that may frequent the Site and the anticipated pathways of exposure by which the receptors could contact each medium, the plausible receptor and exposure pathways include:

- **Utility Worker Scenario.** Utility workers may contact impacted media in OU2 while repairing or replacing utilities, specifically those requiring subsurface disturbance. Utility workers may contact exposed surface and subsurface soils via incidental ingestion, dermal contact and inhalation of particulate emissions in outdoor air. Likewise, dermal contact with shallow groundwater while conducting subsurface activities (i.e., excavation/trenching activities) may occur. Utility workers also may have dermal contact with surface water and sediment contact (via incidental ingestion and dermal contact) present in the wetlands.

- **O&M Worker Scenario.** O&M workers may be at the former USS Lead Facility intermittently to perform CAMU O&M and sample groundwater-monitoring wells. Workers could be exposed to COIs in OU2 surface soil via incidental ingestion, dermal contact, and inhalation of particulates.
- **Trespasser Scenario.** Trespassers may include both adolescents and adults engaging in recreational activities in OU2 such as hiking in upland areas, or wading in open water or wetland areas of the Site. Trespassers may be exposed to COIs in surface soil via incidental ingestion, dermal contact, and inhalation of particulates. In addition, trespassers may be exposed to COIs in surface water and sediment via incidental ingestion and dermal contact.
- **Residential Scenario.** Residents may be exposed to COIs via incidental ingestion and dermal contact with OU1 groundwater due to basement flooding, sump operations, and groundwater seepage into basements. Although groundwater seeping into basements may result in the deposition of residuals onto basement floors after the groundwater seeps recede, this exposure medium is not quantifiable or distinguishable from other potential sources of residuals in residential basement settings. The uncertainty associated with excluding this potential exposure pathway is discussed qualitatively in the Uncertainty Analysis (Section 8).

  As noted previously, the selection of potential exposure pathways is presented in RAGS Part D Table 1 (see Attachment 2).

5.4 Exposure Point Concentrations

Estimates of COI concentrations at points of potential human exposure are necessary for evaluating chemical intakes by potentially exposed individuals. The concentrations of chemicals in an exposure medium at the exposure point are termed "exposure point concentrations" (EPCs).

Statistical and procedural methods were applied to the data in order to develop an estimate of the EPC for COIs in each medium. The general approach was to use the ProUCL statistical software package (version 5.1, USEPA 2015) to examine the data distribution and develop an upper confidence level (UCL) on the arithmetic mean (either 95%, 97.5% or 99% UCLs, as recommended by the ProUCL program). For the sediment samples collected using the incremental sampling methodology (ISM), the 95% UCL was calculated according to Interstate Technology & Regulatory Council (ITRC) guidance (ITRC 2020). The development of EPCs for each medium is described below, and collectively are presented in the RAGS Part D Table 3 Series (see **Attachment 2**).

5.4.1 Calculation of EPCs for Soil Exposure

Exposure point concentrations for soil exposure were developed separately for Site-wide surface soil (0 – 2 feet) and Site-wide surface plus subsurface soil (0 – 6 feet) because of the difference in potentially exposed receptors. The surface soil EPCs were used to evaluate potential risks to current and future O & M workers and trespassers. The surface plus subsurface soil EPCs were used to evaluate potential risks to future utility workers who might be engaged in subsurface intrusive activities.

See Section 4.3.1 of the RI Report for descriptions of the soil results and statistical summaries.

5.4.2 Calculation of EPCs for Sediment Exposure

Because of the disparity in sample collection and data processing methods, exposure point concentrations for sediment were developed separately for the ISM sediment samples (0 – 0.5 feet) collected and analyzed during this RI, and the discrete sediment samples (0 – 2 feet) compiled from the historical database. The ISM is designed to provide an unbiased, statistically valid estimate of mean concentrations and has been shown to provide more reliable and reproducible results than discrete sampling, thus reducing uncertainty in characterizing concentration means. The discrete sediment sampling dataset is subject to a high degree of skewness resulting from the presence of one or more outliers in the dataset, which inflates the estimate of the UCL on the mean resulting in a high degree of uncertainty. For this reason, both the ISM and discrete sediment EPCs were used to evaluate potential risks to current and future trespassers and future utility workers.

See Section 4.3.2 of the RI Report for descriptions of the sediment results and statistical summaries.

5.4.3 Calculation of EPCs for Groundwater Exposure

Exposure point concentrations were developed separately for OU1 and OU2 groundwater because of the difference in potentially exposed receptors. For OU1 groundwater, the potentially exposed receptors are adult, adolescent and child residents. This exposure may occur when OU1 groundwater intrudes into residential basements in OU1. EPCs for OU1 groundwater were established separately for Zone 1 and Zones 2-3 (combined) for the purposes of informing potential future risk management decision-making. For OU2 groundwater, the only potentially exposed receptor is the future utility worker who may be exposed to OU2 groundwater during a subsurface utility project. Groundwater EPCs were calculated using the most recent two rounds of sampling from each well within the specified areas. EPCs for total metals were selected preferentially over dissolved metals for all risk calculations.

See Section 4.3.5 of the RI Report for descriptions of the groundwater results and statistical summaries.

5.4.4 Calculation of EPCs for Surface Water Exposure

Exposure point concentrations for surface water were developed using samples collected and analyzed during this RI in addition to surface water samples compiled from historical datasets. Surface water EPCs were used to evaluate potential risks to current and future trespassers and future utility workers. EPCs for total metals were selected preferentially over dissolved metals for all risk calculations.

See Section 4.3.3 of the RI Report for descriptions of the surface water results and statistical summaries.

5.4.5 Calculation of EPCs for Fugitive Dust Exposure

EPCs for COIs released from soil to outdoor air as particulates were estimated using soil EPCs as the source term. To estimate air EPCs of COIs in wind-blown particulates from soil (fugitive dust), soil EPCs were divided by a particulate emission factor (PEF). For the exposure of trespassers and O&M workers to fugitive dust, the USEPA default PEF of 1.36×10^9 m^3/kg for commercial/industrial scenarios was used (USEPA 2002).

Because fugitive dust generated by utility workers during intrusive subsurface activities can be greater than typical commercial/industrial scenarios, a PEF for soils was calculated using USEPA's on-line calculator tool for the 'Mechanically Driven - Unpaved Road Traffic' scenario (https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search, accessed December 2019). This PEF value was generated assuming the following default inputs: number of cars = 5, tons/car = 2, number of trucks = 5, tons/truck = 20, and days of precipitation = 130, and was calculated as 3.61×10^6 m^3/kg.

5.5 Quantification of Exposure

The next step in the exposure assessment was to generate estimates of chemical intake based on the magnitude, frequency, and duration of exposure for each identified complete exposure pathway. In accordance with Risk Assessment Guidance for Superfund Vol. 1: Human Health Evaluation Manual

(USEPA 1989), exposure factors were applied to estimate the intake from incidental ingestion, dermal contact, and inhalation with Site media for the receptor populations.

The dose is calculated differently when evaluating carcinogenic effects than when evaluating non-cancer effects. Each is described as follows:

- **Carcinogenic effects**. The dose is based on the estimated exposure duration, extrapolated over an estimated 70-year lifetime, representing the lifetime average daily intake (LADI). This is consistent with the cancer slope factors (SFs), which are based on lifetime exposures, and on the assumptions that the risk of carcinogenic effects is cumulative and continues even after exposure has ceased.
- **Non-cancer effects**. The dose is averaged over the estimated exposure period and is expressed as a chronic daily intake (CDI). The CDI is used to represent the potential for adverse health effects over the period of exposure

Lifetime average daily intake and CDI values were calculated for a reasonable maximum exposure (RME) scenario. The RME scenario provides a conservative estimate of potential health risk related to exposure to COIs in Site media. The RME relies on estimated upper bound values for specific exposure parameters as a conservative and health protective measure. To provide a lower bound estimate of potential health risk related to exposure to COIs in Site media, LADI and CDI values were also calculated for a central tendency exposure (CTE) scenario. For the CTE evaluation, all exposure parameters from the RME scenario were retained; however, instead of using EPCs based on UCL concentrations, mean concentrations based on the underlying data distribution calculated by ProUCL were used as the EPCs.

5.5.1 Intake Equations

The intake equations for application in this HHRA are presented below.

5.5.1.1 Incidental Ingestion

The LADI/CDI resulting from the incidental ingestion of soil, sediment, surface water and/or groundwater was calculated using USEPA standard equations as follows:

LADI or CDI = EPC x IR x CF x FI x EF x ED x 1/BW x 1/AT

where:

LADI = Lifetime Average Daily Intake [for carcinogens] (mg/kg-day);

CDI = Chronic Daily Intake [for non-carcinogens] (mg/kg-day);

EPC = Exposure Point Concentration (mg/kg or mg/L);

IR = Ingestion Rate (kg/day or L/day);

CF = Conversion factor (10^{-6} kg/mg for soil, 1,000 ml/L for groundwater)

FI = Fraction Ingested from source (unitless);

EF = Exposure frequency (days/year);

ED = Exposure duration (years);

BW = Body weight (kg); and

AT = Averaging time (days).

Averaging time for non-carcinogens equals the exposure duration multiplied by 365 days/year, and for carcinogens remains constant at 70 years multiplied by 365 days/year (representing lifetime exposure).

5.5.1.2 Dermal Contact with Soil/Sediment

The CDI resulting from dermal contact with soil and/or sediment was calculated using USEPA standard equations as follows:

LADI or CDI = EPC x CF x SA x AF x ABS x EF x ED x EV x 1/BW x 1/AT

where:

LADI = Lifetime Average Daily Intake [for carcinogens] (mg/kg-day);

CDI = Chronic Daily Intake [for non-carcinogens] (mg/kg-day);

EPC = Exposure Point Concentration (mg/kg);

CF = Conversion factor (10^{-6} kg/mg);

SA = Skin surface area available for contact (cm^2);

AF = Soil-to-skin adherence factor (mg/cm^2-event);

ABS = Dermal absorption factor (unitless);

EF = Exposure frequency (days/year);

ED = Exposure duration (years);

EV = Event frequency (events/day);

BW = Body weight (kg); and

AT = Averaging time (days).

Averaging time for non-carcinogens equals the exposure duration multiplied by 365 days/year, and for carcinogens remains constant at 70 years multiplied by 365 days/year (representing lifetime exposure).

5.5.1.3 Dermal Contact with Groundwater

The CDI resulting from dermal contact with groundwater was calculated using USEPA standard equations as follows:

LADI or CDI = DA_{event} x EV x ED x EF x SA x 1/BW x 1/AT

where:

LADI = Lifetime Average Daily Intake [for carcinogens] (mg/kg-day);

CDI = Chronic Daily Intake [for non-carcinogens] (mg/kg-day);

DA_{event} = Absorbed Dose per Event (mg-cm^2/event);

EV = Event frequency (events/day);

ED = Exposure duration (years);

EF = Exposure frequency (days/year);

SA = Skin surface area available for contact (cm^2);

BW = Body weight (kg); and

AT = Averaging time (days).

Averaging time for non-carcinogens equals the exposure duration multiplied by 365 days/year, and for carcinogens remains constant at 70 years multiplied by 365 days/year (representing lifetime exposure).

Absorbed dose per event (DA_{event}) for inorganic constituents is calculated as follows:

$$DA_{event} = EPC \times CF \times ET \times K_p$$

where:

DA_{event} = Absorbed dose per event (mg/cm^2-event)

EPC = Exposure Point Concentration (mg/L);

CF = Conversion factor 0.001 (L/cm^3);

ET = Exposure time (hours); and

K_p = Dermal Permeability Constant (cm/hr; USEPA 2004).

5.5.1.4 Inhalation of Airborne Constituents

Exposure concentrations representing CDIs resulting from the inhalation of soil particulates were calculated using USEPA standard equations as follows:

$$EC = EPC_{air} \times ET \times EF \times ED \times 1/AT$$

where:

EC = Exposure Concentration (mg/m^3);

EPC_{air} = Air Exposure Point Concentration (mg/m^3);

ET = Exposure time (hours/day);

EF = Exposure frequency (days/year)

ED = Exposure duration (years); and

AT = Averaging time (hours).

Averaging time for non-carcinogens equals the exposure duration multiplied by 365 days/year and 24 hours/day, and for carcinogens remains constant at 70 years multiplied by 365 days/year and 24 hours/day (representing lifetime exposure).

5.5.2 Exposure Parameters

Exposure parameters used in the intake equations were identified for each of the exposure scenarios discussed in Section 5.2. Values for the exposure parameters selected generally reflect reasonable maximum exposure assumptions. Where USEPA guidance (USEPA 1989) has specified intake parameters for the abovementioned receptors, these values were adopted. If the USEPA did not have specific recommended inputs, USEPA guidance was consulted to develop reasonable exposure assumptions or best professional judgement was used. The guidance documents included: the *Exposure Factors Handbook* (USEPA 1997a and 2011); the *Standard Default Exposure Factors Guidance* (USEPA 1991a, b, c); the *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites* (USEPA, 2002a); *Supplemental Guidance for Dermal Risk Assessments* (USEPA 2004); *Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors* (USEPA 2014); and USEPA's on-line *Regional Screening Levels User's Guide* (USEPA 2021).

Exposure parameters account for a number of physiological factors, such as surface area of exposed skin. Exposure parameters common to all intake equations are the exposure time, exposure frequency, exposure duration, body weight, and averaging time. Each of these parameters is discussed below for each receptor population, and collectively are presented in the RAGS Part D Table 4 Series (see **Attachment 2**).

5.5.2.1 Body Weight

The body weight (BW [kg]) estimates are receptor-specific for adults, adolescents, and children. A default adult body weight of 80 kg (USEPA 2014) was applied for all adult receptors. For the adolescent trespasser (7 to 18 years) a body weight of 47.6 kg was used. This represents the average weight for males and females >6 to 18 years old (USEPA 2011; Table 8-24). For the child resident (0 – 6 years old), a default body weight of 15 kg was used (USEPA 2014).

5.5.2.2 Exposure Duration

The exposure duration (ED [years]) is an estimate of the time over which a receptor is exposed and is typically expressed in years. The ED values for each receptor population are discussed below.

Utility Workers – An RME exposure duration of 1 year was applied for the utility worker. This represents a conservative estimate of the duration for a utility project.

O&M Workers – An RME exposure duration of 25 years was selected for the O&M worker (USEPA 2014).

Adult Trespassers – For the adult trespasser, an ED value of 20 years was selected for the RME scenario based on the adult resident exposure duration recommended in OSWER Directive 9200.1-120 (USEPA 2014).

Adolescent Trespassers – An ED value of 12 years was applied for the adolescent trespasser (ages 7 to 18 years old).

Adult OU1 Residents – For the adult resident (> 18 years old), an ED value of 20 years was selected for the RME as the USEPA recommended default (USEPA 2014).

Adolescent OU1 Residents – An ED value of 12 years was applied for the adolescent resident (ages 7 to 18 years old).

Child OU1 Residents – An ED value of 6 years was applied for the child resident (ages 0 to 6 years old).

It should be noted that the potential health risks to OU1 residents related to exposure to COIs in OU1 groundwater includes the sum of the risks for children, adolescents and adults, in order to understand potential risks to lifetime residents. It is acknowledged that local residents may reside in their homes for a longer period than the lifetime residential duration of 38 years. However, regional-specific data on the frequency of this occurrence is unknown, thus a deviation from the standard USEPA default is not quantified in this HHRA. The consideration of an alternative residential exposure duration is discussed qualitatively in the Uncertainty Analysis (Section 8).

5.5.2.3 Exposure Frequency

Exposure frequency (EF [days/year]) is a receptor-specific estimate of how frequently exposure occurs. The EF values described below are based on best professional judgment for the majority of the receptor groups.

O&M Workers – A site-specific exposure frequency of 21 days/year years was selected for O&M workers. This represents the total number of days per year for: 1) bi-annual groundwater monitoring; 2) monthly CAMU inspections; 3) quarterly well repairs; 4) bi-annual maintenance activities; 5) quarterly effluent sampling; and 6) annual CAMU repairs. This value is considered conservative as it contemplates that the same individuals are undertaking all of the aforementioned activities.

Utility Workers – An RME exposure frequency of 25 days/year was applied for utility workers. This assumes that a utility project would take 5 weeks to complete (5 weeks x 5 days/week).

Adult and Adolescent Trespassers – For the adult trespasser, an RME exposure frequency value of 40 days/year was selected for the RME scenario. This represents two events per week for 20 weeks (May through September).

Adult, Adolescent and Child OU1 Residents – For the OU1 residents, an EF value of 16 days/year was selected for the RME. It was assumed that groundwater intrudes into a residential basement once a month at a level that would require cleanup by a resident, and on four occasions it is assumed that this cleanup requires two days to complete.

5.5.2.4 Exposure Time

The exposure time (ET [hr/day]) is a receptor-specific parameter that applies to inhalation exposure and dermal contact with water exposure, and describes the length of time over which exposure occurs. ET values used in this assessment correspond to the typical time spent by these receptors at the Site.

Utility Worker – An exposure time of 8 hours (representing a typical workday) was applied for the utility worker inhaling soil particulates in air. It was assumed that activities involving direct contact with surface water or groundwater would be limited to 4 hours (half the typical workday).

O&M Worker – An exposure time of 8 hours (representing a typical workday) was applied for the O&M worker inhaling soil particulates in air.

Adult and Adolescent Trespassers – An exposure time of 4 hours was applied for adult and adolescent trespassers inhaling soil particulates in air based on professional judgement. An exposure time of 4 hours was also assumed for adult and adolescent trespassers in direct contact with surface water while wading based on professional judgement.

Adult, Adolescent and Child Resident – An exposure time of 4 hours was applied for residents in direct contact with groundwater while engaged in basement cleanup following a groundwater intrusion event based on professional judgement.

5.5.2.5 Averaging Time

The averaging time (AT [days]) is the time which exposure is averaged. In accordance with RAGS Part A (USEPA 1989, Exhibits 6-11 through 6-16). The averaging time for exposure to potential carcinogenic compounds (AT-C) is 25,550 days, which accounts for exposure to a carcinogenic substance over a 70-year lifetime. For exposure to non-carcinogens, the averaging time (AT-NC) is calculated as the exposure duration (years) multiplied by 365 days per year (USEPA 1989, Exhibits 6-11 through 6-16). Therefore, the averaging time for exposure to non-carcinogenic substances and depends on exposure duration and are presented below for each receptor. Note that for the quantification of inhalation risks, the AT is reported in units of hours, so the AT in days is multiplied by 24 hours/day for the inhalation calculations.

O&M Workers – 9,125 days / 219,000 hours

Utility Workers – 365 days / 8,760 hours

Adult Trespassers – 7,300 days / 175,200 hours

Adolescent Trespassers – 4,380 days / 105,120 hours

Adult OU1 Residents – 7,300 days

Adolescent OU1 Residents – 4,380 days

Child OU1 Residents – 2,190 days

5.5.2.6 Incidental Ingestion Rate of Soil/Sediment

The soil/sediment ingestion rate (IR, in milligrams per day [mg/day]) refers to the rate at which bulk soil, sediment or soil dust is incidentally ingested. The IR values were obtained from USEPA's Exposure Factors Handbook (USEPA 2011), Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA 2002), OSWER Directive 9200.1-120 (USEPA 2014), and USEPA's on-line Regional Screening Level User's Guide (USEPA 2021). Soil ingestion rates to be used in the HHRA are described below.

Utility Workers – The RME soil and sediment ingestion rate for the utility worker is 330 mg/day. This value is consistent with USEPA guidance for construction workers (USEPA 2002, Exhibit 1-2; USEPA 2021).

O&M Workers – The RME IR value used for the O&M worker is 100 mg/day. This is consistent with the USEPA default value for outdoor workers (USEPA 2002, Exhibit 1-2) and OSWER Directive 9200.1-120 (USEPA 2014). The sediment ingestion pathway for the O&M worker is considered incomplete.

Adult and Adolescent Trespassers – The RME IR value soil and sediment for the adolescent and adult trespasser is 100 mg/day. This is consistent with the USEPA default value for outdoor workers (USEPA 2002, Exhibit 1-2) and OSWER Directive 9200.1-120 (USEPA 2014).

5.5.2.7 Incidental Ingestion Rate of Water

The incidental ingestion of surface water for adult and adolescent trespassers is assumed to result from splashing or other hand to mouth contact while wading (similar to a recreator). This is expected to be similar to the incidental ingestion rate of groundwater for OU1 residents engaged in basement cleanup following a groundwater intrusion event. Table 3-93 of the USEPA Exposure Factors Handbook (USEPA 2011) provides mean values for incidental ingestion of surface water by adults engaged in limited contact recreational activities. The mean incidental ingestion of surface water of the recreational activities listed in Table 3-93, excluding boat capsizing, is 3.7 milliliters/hour (mL/hour). This is consistent with the cited study abstract, which states indicates 3 – 4 mL/hour as the mean water ingestion rate during limited-contact recreation on surface waters. Because the reference does not distinguish between adult and child ingestion rates for this exposure scenario, this incidental ingestion rate was applied to all receptor age groups. The ingestion rate is converted into units of L/day by assuming an exposure time of 4 hours/event (0.0148 L/day).

5.5.2.8 Skin Surface Area

Skin surface area (SA [cm2]) for dermal absorption represents the exposed surface area of the skin that may contact water or soil and is highly dependent on the age of the receptor and the nature of activity or work they are conducting. The SA values used in the HHRA are provided below for each receptor group:

O&M Workers – The RME SA value used for the O&M worker is 3,527 cm^2, which is consistent with the surface area of an adult worker OSWER Directive 9200.1-120 (USEPA 2014). It represents the weighted average of mean values for the head, hands and forearms of adult males and females 21 years and older per USEPA guidance (USEPA 2014; 2011).

Utility Workers – The RME SA value used for the utility worker is 3,527 cm^2, which is consistent with the surface area of an adult worker OSWER Directive 9200.1-120 (USEPA 2014). It represents the weighted average of mean values for the head, hands and forearms of adult males and females 21 years and older per USEPA guidance (USEPA 2014; 2011).

Adult Trespassers – The RME SA value used for the adult trespasser is 6,032 cm^2. This represents the weighted average of mean values for head, hands, forearms, and lower legs of adult males and females 21 years and older per USEPA guidance (USEPA 2014; 2011, Tables 7-2 and 7-12).

Adolescent Trespassers – The RME SA value used for the adult trespasser is 5,314 cm^2. This represents the weighted mean of 50th percentile values for children <7 to <18 for head, hands, forearms, lower legs and feet (USEPA 2004b, Exhibit C-1).

Adult OU1 Residents – The RME SA value used for the adult OU1 resident is 6,032 cm^2. This represents the weighted average of mean values for head, hands, forearms, and lower legs of adult males and females 21 years and older per USEPA guidance (USEPA 2014; 2011, Tables 7-2 and 7-12).

Adolescent OU1 Residents – The RME SA value used for the adolescent OU1 resident is 5,314 cm^2. This represents the weighted mean of 50th percentile values for children <7 to <18 for head, hands, forearms, lower legs and feet (USEPA 2004b, Exhibit C-1).

Child OU1 Residents – The RME SA value used for the child OU1 resident is 2,373 cm^2. This represents the weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years) (USEPA 2014; 2004b, Exhibit C-1).

5.5.2.9 Dermal Absorption Factor

The dermal absorption factor (ABS [unitless]) represents the fraction of the soil constituent that may be absorbed through the skin during each exposure event. In general, metals are poorly absorbed through the skin; organic constituents may be absorbed more readily. Chemcial-specific values were obtained from the USEPA's Dermal Risk Assessment Guidance (RAGS Part E, USEPA 2004, Exhibit 3-4) and USEPA's website for assessing dermal exposure[2]. These values are as follows:

Constituent	Dermal Absorption Factor (%)
Antimony	0%
Arsenic	3%
Cadmium	0.1%
Lead	N/A
Selenium	0%

5.5.2.10 Relative Bioavailability Factors

Based on USEPA recommendations (USEPA 2012) and consistent with USEPA methodology for calculating RSLs (USEPA 2021), a relative bioavailability factor (RBA) of 0.6 (60%) is included in the calculation of the ingestion dose of arsenic in soil and sediment. The RBA accounts for the differences in the bioavailability of arsenic between the exposure medium (e.g., soil or sediment) and the medium associated with the derivation of the toxicity value (e.g., drinking water). An RBA of 1 (100%) was assumed for all other COIs.

5.5.2.11 Soil/Sediment-to-Skin Adherence Factor

Soil/sediment-to-skin or sediment-to-skin adherence factors (AF, milligrams per square centimeter [mg/cm2]) represent the average mass of soil or sediment that adheres to the skin over each exposure event. The AF depends on the specific activity being conducted and is higher for body parts with greater exposure to the media. AFs are derived as the weighted average for each receptor, considering the specific activities in which the receptor group is likely to participate. The specific AFs used in this HHRA a obtained from USEPA's Supplemental Soil Screening Guidance (USEPA 2002, Exhibit 1-2), Dermal Risk Assessment Guidance (RAGS Part E, USEPA 2004, Exhibit 3-3) and OSWER Directive 9200.1-120 (USEPA 2014) and are applied for each appropriate receptor group as summarized below.

2 https://www.epa.gov/risk/assessing-dermal-exposure-soil

O&M Workers – For the O&M worker, the recommended RME default soil-to-skin adherence factor value for workers of 0.12 mg/cm^2 was used. This values is based on the arithmetic mean of weighted average of body part-specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities (USEPA 2011, 2014).

Utility Workers – For a utility worker, the recommended RME soil-to-skin adherence factor value for construction workers of 0.3 mg/cm^2 was used. This values is based on the 95th percentile mean weighted soil AFs for construction workers (USEPA 2004). The RME value for the sediment-to-skin adherence factor is 0.9 mg/cm^2. This values is based on the 95th percentile mean weighted soil AFs for utility workers (USEPA 2004).

Adult Trespassers – For the adult trespasser, the recommended RME soil-to-skin adherence factor for adult residents of 0.07 mg/cm^2 was used (USEPA 2014). For the sediment-to-skin adherence factor for the adult trespasser, an RME value of 0.3 was used. This represents the geometric mean AF based on exposure to face, forearms, hands, and lower legs for adult gardeners (USEPA 2004).

Adolescent Trespassers – For an adolescent trespasser, the RME AF value is 0.2 mg/cm^2. This value is the 95th percentile weighted soil AFs for children playing in dry soils (USEPA 2004). For the sediment-to-skin adherence factor for the adolescent trespasser, an RME value of 0.3 was used. This represents the geometric mean AF based on exposure to face, forearms, hands, and lower legs for adult gardeners.

6. TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to evaluate available information regarding the potential for COIs to cause adverse effects in exposed individuals. The potential toxicological effects resulting from a given dose of a chemical are classified according to two criteria, consisting of non-cancer effects (hazards) and cancer effects (risks). The toxicity assessment presented herein was completed according to USEPA guidance (USEPA 1989).

Sources used to obtain toxicity criteria are listed below, and follow the hierarchy outlined in USEPA (2003):

1. EPA's Integrated Risk Information System (IRIS). IRIS is an on-line database that contains USEPA-approved reference doeses (RfD, reference concentrations (RfCs), cancer slope factors (CSFs), and inhalation unit risks (IURs). The toxicity criteria provided in IRIS have undergone review and are recognized as agency-wide consensus information.
2. California Environmental Protection Agency's (Cal/EPA) Office of Environmental Health Hazard Assessment (OEHHA) on-line database, which contains approved toxicity criteria. TheCal/EPA toxicity criteria have undergone review and are recognized by the USEPA as toxicity criteria for HHRAs.
3. Agency for Toxic Substances and Disease Registry (ATSDR).

6.1 Non-Cancer Effects

For non-cancer health effects, the USEPA assumes there is a dose threshold below which adverse effects are not expected to occur. For a given constituent, the dose that elicits no effect when evaluating the most sensitive response (the adverse effect that occurs at the lowest dose) in the most sensitive species is used to establish an acceptable dose (toxicity value) for non-carcinogenic effects. This dose is referred to as the reference dose (RfD) for oral and dermal exposures, and a reference concentration (RfC) for inhalation exposures. A chronic RfD (or RfC) of a constituent is an estimate of a lifetime daily dose to humans that is likely to be without appreciable deleterious non-carcinogenic health effects. Exposure greater than an RfD/RfC could possibly cause health effects. A lower RfD/RfC implies more potent toxicity. Non-cancer toxicity values are presented in the RAGS Part D Table 5 Series (see **Attachment 2**).

6.2 Cancer Effects

To evaluate cancer risks, the USEPA has developed cancer slope factors (CSFs), which are expressed as risks per (mg/kg-day)-1 for oral and dermal exposure. For inhalation exposures, inhalation unit risk factors (IURs), have been developed. Unit risk factors represent the upper-bound excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 μg/m^3 for air.

The CSFs are derived using a low-dose extrapolation procedure, which assumes that there is no threshold for the induction of cancer (in contrast to non-cancer toxicity, where it is assumed that certain doses will not produce adverse health effects).

The USEPA classifies substances according to their potential to induce cancer in humans. The USEPA reviews and evaluates available data regarding the potential carcinogenic effects of a constituent, and assigns a “carcinogenicity” classification according to a weight of evidence classification scheme. A constituent may be classified into one of five groups with respect to the weight of evidence for human carcinogenicity. The categories are:

Group A – Known Human Carcinogen. A constituent is classified in Group A if there is sufficient evidence from human observations (epidemiological studies) to support an association between exposure to a chemical agent and cancer in humans

Group B1 – Probable Human Carcinogen. A constituent is classified as a B1 carcinogen if there is sufficient evidence for carcinogenicity based on animal studies and limited (suggestive but not conclusive) evidence based on human observations.

Group B2 – Probable Human Carcinogen. A B2 carcinogen is a constituent for which there is sufficient evidence for carcinogenicity in animals and inadequate evidence for carcinogenicity in humans.

Group C – Possible Human Carcinogen. A constituent is classified as a Group C carcinogen if there is limited evidence for carcinogenicity in animals and inadequate evidence for carcinogenicity in humans.

Group D – A constituent is classified as a Group D agent if there is insufficient data available with which to evaluate the carcinogenicity of the constituent.

Group E - Evidence of Non-carcinogenicity for Humans: Agents that show no evidence for carcinogenicity in at least two adequate animal tests in different species or in both adequate epidemiologic and animal studies.

For Group A, B, or C chemicals, USEPA derives chemical-specific CSFs/IURs. A CSF/IUR, when multiplied by the estimated chemical-specific CDI, provides an estimate of the “excess cancer risk” associated with that exposure. Theoretically, the excess cancer risk represents the lifetime probability (greater than background) that a carcinogenic event would occur in an individual because of a given exposure or pattern of exposures. Cancer toxicity values are presented in the RAGS Part D Table 6 Series (see **Attachment 2**).

6.3 Lead Exposure

An assessment of risk from exposure to lead is unique because a reference dose (RfD) value for lead (Pb) is not available. Since the toxicokinetics (the absorption, distribution, metabolism and excretion of toxins in the body) of lead are well understood, lead is regulated based on blood lead concentration (PbB). The USEPA and the Centers for Disease Control and Prevention (CDC) have determined that childhood blood lead concentrations at or above 10 micrograms of lead per deciliter of blood (μg/dL) present risks to children's health (USEPA 2019). The USEPA provides two models for estimating blood lead levels: 1) the Integrated Exposure Uptake Biokinetic (IEUBK) Model for predicting blood lead levels in children 0-84 months (USEPA 2021); and the Adult Lead Model (ALM) for predicting blood-lead levels in fetuses of adult female receptors (USEPA 2017).

The ALM was used to characterize potential risks to adult and adolescent receptors exposed to lead in OU2 soil and sediment via incidental ingestion (i.e., utility workers, O&M workers, trespassers), with a risk management goal of less than a 5% probability that fetuses exposed to lead would exceed a blood lead level of 5 µg/dL (fetal PbB). The baseline blood lead concentration input parameter of the ALM represents the geometric mean blood lead concentration in women of child-bearing age and the geometric standard deviation (GSD) input parameter is a measure of the inter-individual variability in these concentrations. The Mother's Blood Lead Concentration at Childbirth (MatPb) allows for the assessment of the impact of lead transferred from the mother to the fetus in utero. Default values for these input parameters were are derived by USEPA from an analysis of blood lead data for U.S. women 17-45 years of age. The most recent update is from 2017, and includes parameters for the ALM based on the most recently available six years of baseline PbB data (using data from NHANES 2009-2014).

Workers and trespassers are assumed to be potentially exposed to the mean lead concentration in soil and sediment at the Site (the mean concentrations is the appropriate EPC for lead; USEPA 2003, USEPA 2019). The exposure frequencies and soil and sediment ingestion rates identified in Section 5.5.2.3 and Section 5.5.2.6 for each receptor group, respectively, were applied in the ALM.

For OU1 residents, exposure to lead via incidental ingestion in groundwater that intrudes into basements was assessed for the most sensitive receptor group, which is the child receptor (0 – 6 years), using the IEUBK Model (Version 2.0, Build 1.66, May 2021). The model output is a probability distribution function describing the percentage of children predicted to have blood-lead levels exceeding 5 ug/dL. To achieve a specific level of protectiveness, the USEPA has established a limit for exposure to lead levels such that a typical (or hypothetical) child would have an estimated risk of no more than 5% probability of exceeding the 5 ug/dL blood lead level (USEPA 1994). The IEUBK model addresses exposure from air, diet, soil/dust, and water consumption. To evaluate the incidental ingestion of lead in groundwater by OU1 childe residents, the incidental groundwater ingestion rate identified in Section 5.5.2.7 was applied to all age categories from 0 to 84 months, and the average lead concentration in groundwater was used as the EPC. All other model defaults were retained.

The USEPA does not provide any mechanism for evaluating dermal exposure to lead as a detailed multi-media examination of the mechanisms of absorption of lead (i.e., skin, lungs, and gastrointestinal tract) determined that dermal absorption of lead was not significant for inorganic lead. As such, the USEPA does not include this exposure pathway for quantitative evaluation in any of the models used for assessing exposure to lead at Superfund sites. (USEPA 1994).

RAGS Part D Lead Worksheets reporting the results of the ALM and IEUBK Modeling are provided in **Attachment 3**.

7. RISK CHARACTERIZATION

In the final step of the risk assessment, the results of the exposure assessment (i.e., the calculated intakes) are integrated with toxicity information to derive quantitative estimates of potential risk associated with the defined exposure scenarios. In this section, risk estimates were calculated following the standard procedures defined in RAGS Part A (USEPA 1989) and the results were compared to levels of acceptable risk defined by USEPA (USEPA 1990).

Carcinogenic risk (CR) represents the probability of developing cancer over a lifetime from exposure to the COIs associated with the Site. The CR associated with exposure to COIs at the Site was calculated according to the following equations:

$$CR_{ingestion} = CDI_{ingestion} \times CSF_{ingestion}$$

$$CR_{dermal} = CDI_{dermal} \times CSF_{dermal}$$

$$CR_{inhalation} = EC \times IUR$$

Where:

CR = chemical-specific individual excess lifetime cancer risk (unitless);
CDI = route- and chemical-specific lifetime chronic daily intake (mg/kg-day);
CSF = route- and chemical-specific cancer slope factor $(mg/kg\text{-}day)^{-1}$;
EC = exposure concentration $(\mu g/m^3)$; and
IUR = inhalation unit risk $(\mu g/m^3)^{-1}$

Cancer risk is unitless and is expressed in scientific notation. For example, a risk of 1E-06 indicates that an individual has one chance in one million of developing cancer as a result of exposure to site COIs during a lifetime. CR should not exceed an excess upper-bound lifetime risk of between one in 10,000 (i.e., 1E-04) and one in 1,000,000 (i.e., 1E-06). Cancer risks from exposure to multiple carcinogens are assumed to be additive (USEPA 1989); therefore, risk values for all COIs assessed were summed by exposure pathway, and conservatively assumed to be additive across all relevant pathways to provide total cumulative risk. The cumulative excess risk to exposed populations, are compared to USEPA's acceptable risk range of 1E-04 to 1E-06 established in the National Contingency Plan (USEPA 1990).

Potential non-carcinogenic effects were evaluated based on a comparison of COI-specific chronic exposure doses with corresponding protective doses derived from health criteria. The result of this comparison is expressed as the Hazard Quotient (HQ):

$$HQ_{ingestion} = CDI_{ingestion} / RfD_{oral}$$

$$HQ_{dermal} = CDI_{dermal} / RfD_{dermal}$$

$$HQ_{inhalation} = EC / RfC$$

Where:

HQ = chemical-specific hazard quotient (unitless);
CDI = route- and chemical-specific chronic daily intake (mg/kg-day);
RfD = route- and chemical-specific reference dose (mg/kg-day);
EC = exposure concentration $(\mu g/m^3)$; and
RfC = reference concentration $(\mu g/m^3)$

Total HQs are calculated for each COI by summing route-specific HQs (ingestion, dermal contact, and inhalation) to produce an estimate of the pathway-specific hazard (e.g., soil, groundwater). An individual HQ less than one indicates that the COI is present at a level to which the human population could be exposed on a daily basis without appreciable risk of deleterious effect to the exposed population. Consistent with USEPA guidance (USEPA 1989), HQs may also be summed across COIs to calculate a hazard index (HI) when they are associated with the same target organ or similar toxicological effects. HIs are reported separately for COIs that affect the same target organ or act by the same method of toxicity. The HI may not exceed 1.

Risk from lead exposure was described in terms of estimated blood-lead levels in the context of acceptable USEPA thresholds, as discussed in Section 6.3.

7.1 Reasonable Maximum Exposure

Reasonable maximum exposure risks and hazards for Site receptors are presented in RAGS Part D Table 7, 8, 9, and 10 Series (see **Attachment 2**). The RAGS Part D Table 7 Series presents the derivation of non-cancer hazards and cancer risks for each receptor population and exposure medium. The RAGS Part D Table 8 Series[3] provide the medium-specific summaries of non-cancer hazards and cancer risks for each receptor population. The RAGS Table 9 Series summarizes the cumulative non-cancer hazards by target organ group, and cancer risks for a given Site receptor across all relevant media. The RAGS Table 10 Series reduces the Table 9 Series to show only the COIs with hazard/risk above acceptable thresholds (risk drivers). The risk characterization discussion below focuses on overall risks and hazards to Site receptors across all relevant media, and identification of constituents that significantly contribute to those risks and hazards (RAGS Part D Table 9 and Table 10 Series).

As noted previously, exposure point concentrations for sediment were developed separately for the ISM sediment samples (0 – 0.5 feet) collected and analyzed during this RI, and the discrete sediment samples (0 – 2 feet) compiled from the historical database. The ISM dataset is considered an unbiased, statistically valid estimate of population mean concentrations. The historic discrete sediment sampling dataset is subject to a high degree of skewness resulting from the presence of one or more outliers, which inflates the estimate of the UCL on the mean resulting in a high degree of uncertainty. For this reason, both the ISM and discrete sediment EPCs were used to evaluate potential risks to current and future trespassers and future utility workers.

The results of the risk characterization are presented in the sections below.

7.1.1.1 Utility Worker

Utility workers were evaluated for exposure to surface and subsurface soil (0 – 6 feet), surface sediment (0 - 2 feet discrete; 0 - 0.5 feet ISM), surface water and groundwater in OU2. Non-cancer hazard and cancer risk calculations are provided in **Attachment 2**, Tables 7.1 through 7.5, and results are summarized in Tables 8.1 through 8.4. Total cumulative RME hazard and risk summaries are provided in Table 9.1A when assuming a sediment EPC based on the discrete data (0 – 2 feet), which shows the following:

- RME cancer risk of 1E-05
- RME non-cancer HI of 2 (target organ-specific HIs range from 0.0009 to 2)

Total cumulative RME hazard and risk summaries are provided in Table 9.1B when assuming a sediment EPC based on the ISM data (0 – 0.5 feet), which shows the following:

- RME cancer risk of 5E-06
- RME non-cancer HI of 1

In both cases, the estimated total cumulative RME cancer risk is within the acceptable range of 1E-04 to 1E-06. The maximum target organ-specific HI of 2 based on discrete sediment data is marginally above the acceptable threshold of 1, and driven by exposure to arsenic in sediment. The RME HI based on the ISM sediment data is at, but does not exceed, the acceptable threshold of 1.

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[3] It is noted that USEPA RAGS Part D Table 8 series is traditionally used to present risk calculations for radionuclides; however, in Attachment 2 the RAGS Part D Table 8 series provide medium-specific summaries of non-cancer hazards and cancer risks for each receptor population.

7.1.1.2 O&M Worker

O&M workers were evaluated for exposure to surface soil (0 – 2 feet). Non-cancer hazard and cancer risk calculations are provided in **Attachment 2**, Tables 7.6 through 7.7, and results are summarized in Table 8.5. Total cumulative RME hazard and risk summaries are provided in Table 9.2, which shows the following:

- RME cancer risk of 3E-06
- RME non-cancer HI of 0.03

The estimated total cumulative RME cancer risk is within the acceptable range of 1E-04 to 1E-06, and the RME HI does not exceed the acceptable threshold of 1.

7.1.1.3 Adult Trespasser

Adult trespassers were evaluated for exposure to surface soil (0 – 2 feet), surface sediment (0 - 2 feet discrete; 0 - 0.5 feet ISM) and surface water in OU2. Non-cancer hazard and cancer risk calculations are provided in **Attachment 2**, Tables 7.8 through 7.11, and results are summarized in Tables 8.6 through 8.8. Total cumulative RME hazard and risk summaries are provided in Table 9.3A when assuming a sediment EPC based on the discrete data (0 – 2 feet), which shows the following:

- RME cancer risk of 1E-04
- RME non-cancer HI of 0.9

Total cumulative RME hazard and risk summaries are provided in Table 9.3B when assuming a sediment EPC based on the ISM data (0 – 0.5 feet), which shows the following:

- RME cancer risk of 3E-05
- RME non-cancer HI of 0.3

The estimated total cumulative RME cancer risk when using the discrete sediment data is at the upper bound of the acceptable range of 1E-04 to 1E-06 and RME HI does not exceed the acceptable threshold of 1. When using the ISM sediment data, the estimated total cumulative RME cancer risk is within the acceptable range of 1E-04 to 1E-06, and the RME HI is further below the acceptable threshold of 1.

7.1.1.4 Adolescent Trespasser

Adolescent trespassers (7 to 18 years) were evaluated for exposure to surface soil (0 – 2 feet), surface sediment (0 - 2 feet discrete; 0 - 0.5 feet ISM) and surface water in OU2. Non-cancer hazard and cancer risk calculations are provided in **Attachment 2**, Tables 7.12 through 7.15, and results are summarized in Tables 8.9 through 8.11. Total cumulative RME hazard and risk summaries are provided in Table 9.4A when assuming a sediment EPC based on the discrete data (0 – 2 feet), which shows the following:

- RME cancer risk of 1E-04
- RME non-cancer HI of 1

Total cumulative RME hazard and risk summaries are provided in Table 9.4B when assuming a sediment EPC based on the ISM data (0 – 0.5 feet), which shows the following:

- RME cancer risk of 3E-05
- RME non-cancer HI of 0.5

The estimated total cumulative RME cancer risk when using the discrete sediment data is at the upper bound of the acceptable range of 1E-04 to 1E-06, and the RME HI is at, but does not exceed, the acceptable threshold of 1. When using the ISM sediment data, the estimated total cumulative RME cancer risk is within the acceptable range of 1E-04 to 1E-06, and the RME HI is further below the acceptable threshold of 1.

7.1.1.5 Adult OU1 Resident

Adult OU1 residents were evaluated for exposure to OU1 groundwater that may seep into residential basements. OU1 Zone 1 groundwater was evaluated as a separate exposure unit from OU1 Zones 2 and 3 groundwater. Non-cancer hazard and cancer risk calculations for OU1 Zone 1 groundwater are provided in **Attachment 2**, Table 7.16, and results are summarized in Table 8.12. Total cumulative RME hazard and risk summaries are provided in Table 9.5, which shows the following:

- RME cancer risk of 1E-06
- RME non-cancer HI of 0.2

For OU1 Zone 1 groundwater, the estimated total cumulative RME cancer risk is within the acceptable range of 1E-04 to 1E-06, and the RME HI does not exceed the acceptable threshold of 1.

Non-cancer hazard and cancer risk calculations for OU1 Zone 2-3 groundwater are provided in **Attachment 2**, Table 7.19, and results are summarized in Table 8.15. Total cumulative RME hazard and risk summaries are provided in Table 9.9, which shows the following:

- RME cancer risk of 2E-07
- RME non-cancer HI of 0.004

For OU1 Zone 2-3 groundwater, the estimated total cumulative RME cancer risk is below the acceptable range of 1E-04 to 1E-06, and the RME HI does not exceed the acceptable threshold of 1.

7.1.1.6 Adolescent OU1 Resident

Adolescent OU1 residents (7 to 18 years) were evaluated for exposure to OU1 groundwater that may seep into residential basements. OU1 Zone 1 groundwater was evaluated as a separate exposure unit from OU1 Zones 2 and 3 groundwater. Non-cancer hazard and cancer risk calculations for OU1 Zone 1 groundwater are provided in **Attachment 2**, Table 7.17, and results are summarized in Table 8.13. Total cumulative RME hazard and risk summaries are provided in Table 9.6, which shows the following:

- RME cancer risk of 1E-06
- RME non-cancer HI of 0.3

For OU1 Zone 1 groundwater, the estimated total cumulative RME cancer risk is within the acceptable range of 1E-04 to 1E-06, and the RME HI does not exceed the acceptable threshold of 1.

Non-cancer hazard and cancer risk calculations for OU1 Zone 2-3 groundwater are provided in **Attachment 2**, Table 7.20, and results are summarized in Table 8.16. Total cumulative RME hazard and risk summaries are provided in Table 9.10, which shows the following:

- RME cancer risk of 1E-07
- RME non-cancer HI of 0.005

For OU1 Zone 2-3 groundwater, the estimated total cumulative RME cancer risk is below the acceptable range of 1E-04 to 1E-06, and the RME HI does not exceed the acceptable threshold of 1.

7.1.1.7 Child OU1 Resident

Child OU1 residents (0 to 6 years) were evaluated for exposure to OU1 groundwater that may seep into residential basements. OU1 Zone 1 groundwater was evaluated as a separate exposure unit from OU1 Zones 2 and 3 groundwater. Non-cancer hazard and cancer risk calculations for OU1 Zone 1 groundwater are provided in **Attachment 2**, Table 7.18, and results are summarized in Table 8.14. Total cumulative RME hazard and risk summaries are provided in Table 9.7, which shows the following:

- RME cancer risk of 1E-06
- RME non-cancer HI of 0.5

For OU1 Zone 1 groundwater, the estimated total cumulative RME cancer risk is within the acceptable range of 1E-04 to 1E-06, and the RME HI does not exceed the acceptable threshold of 1.

Non-cancer hazard and cancer risk calculations for OU1 Zone 2-3 groundwater are provided in **Attachment 2**, Table 7.21, and results are summarized in Table 8.17. Total cumulative RME hazard and risk summaries are provided in Table 9.11, which shows the following:

- RME cancer risk of 1E-07
- RME non-cancer HI of 0.009

For OU1 Zone 2-3 groundwater, the estimated total cumulative RME cancer risk is below the acceptable range of 1E-04 to 1E-06, and the RME HI does not exceed the acceptable threshold of 1.

7.1.1.8 Lifetime OU1 Resident

Lifetime OU1 residents were evaluated for exposure to OU1 groundwater that may seep into residential basements. OU1 Zone 1 groundwater was evaluated as a separate exposure unit from OU1 Zones 2 and 3 groundwater. Lifetime OU1 residential risks were calculated as the sum of the non-cancer hazard and cancer risk calculations for the child, adolescent and child residential receptor populations. **Attachment 2**, Table 9.8 provides the total cumulative RME hazard and risks for lifetime residents exposed to OU1 Zone 1 groundwater seeps, which shows the following:

- RME cancer risk of 4E-06
- RME non-cancer HI of 1

For OU1 Zone 1 groundwater, the estimated total cumulative RME cancer risk is within the acceptable range of 1E-04 to 1E-06, and the RME HI is at, but does not exceed, the acceptable threshold of 1.

Attachment 2, Table 9.12 provides the total cumulative RME hazard and risks for lifetime residents exposed to OU1 Zone 2-3 groundwater seeps, which shows the following:

- RME cancer risk of 4E-07
- RME non-cancer HI of 0.02

For OU1 Zone 2-3 groundwater, the estimated total cumulative RME cancer risk is below the acceptable range of 1E-04 to 1E-06, and the RME HI does not exceed the acceptable threshold of 1.

7.2 Central Tendency Exposure

Central tendency exposure (CTE) non-cancer hazards and cancer risks for Site receptors are provided to provide perspective on the RME non-cancer hazards and cancer risks, particularly in cases where they were close to or exceeded acceptable thresholds. For simplicity, all exposure intake parameters were held consistent between the RME and CTE assessments, the only modification made was to set the EPCs to equal mean concentrations in all media (as opposed to UCL concentrations).

The RAGS Part D Table 9 Series for the CTE assessment are provided in **Attachment 4**. The estimated total cumulative CTE cancer risks are below or within the acceptable range of 1E-04 to 1E-06, and the CTE HIs do not exceed the acceptable threshold of 1 for all receptor populations.

7.3 Risks from Lead Exposure

Lead was identified as a COI in all media evaluated. As discussed in Section 6.3, the quantification of lead exposure differs from other COIs. Toxic effects from lead exposure have been correlated with blood concentrations of lead. As such, the preferred risk assessment approach for lead is the estimation of human blood lead concentrations associated with an exposure scenario. The USEPA provides the ALM to estimate blood-lead levels in adult receptors exposed to OU2 soil and sediment (USEPA 2017), and the IEUBK Model to estimate blood-lead levels in child receptors (0 to 84 months) exposed to OU1 groundwater seepage (USEPA May 2021).

ALM modeling of potential exposure to the average lead concentration (the appropriate EPC for lead; USEPA 2003, USEPA 2019) in both OU2 sediment and OU2 soil shows there is less than a 5% probability of exceeding the level of concern (5 ug/dL) in fetuses of adult female receptors. IEUBK modeling of potential exposure to the average lead concentration in OU1 groundwater seeping into residential basements shows there is less than a 5% probability of exceeding the level of concern (5 ug/dL) in child receptors. The results for all relevant receptors are summarized in Table 1 below. RAGS Part D lead worksheets and the ALM and IEUBK modeling outputs are provided in **Attachment 3**.

ALM Receptor	Exposure Medium	Lead EPC (mg/kg)	Geometric Mean Blood Level (µg/dL)	95th Percentile PbB Among Fetuses of Adults	Probability that Fetal PbB Exceeds 5 µg/dL
Utility Worker	Sediment-Discrete	640.5	1.3	3.1	0.66%
Utility Worker	Sediment-ISM	776.4	1.4	3.4	1.1%
Utility Worker	Soil (0-6 feet)	250.5	0.9	2.1	0.08%
O&M Worker	Soil (0-2 feet)	262.1	0.7	1.6	0.02%
Adult/Adolescent Trespasser	Sediment-Discrete	640.5	0.9	2.2	0.12%
Adult/Adolescent Trespasser	Sediment-ISM	776.4	1.0	2.4	0.18%
Adult/Adolescent Trespasser	Soil (0-2 feet)	262.1	0.7	1.7	0.03%
IEUBK Receptor	**Exposure Medium**	**Lead EPC (ug/L)**	**Geometric Mean PbB in Child (0 to 84 months)**	**Probability that Child PbB Exceeds 5 µg/dL**	
Child OU1 Resident	OU1 Z1 Groundwater	16.7	2.271	4.656%	
Child OU1 Resident	OU1 Z2-3 Groundwater	8.8	2.251	4.480%	

Notes:
EPC = Exposure point concentration (mean concentration)
mg/kg = Milligrams per kilogram; ug/L = micrograms per liter
O&M = Operation and Maintenance
µg/dL = micrograms per decilitre
PbB = Blood lead level

8. UNCERTAINTY ANALYSIS

This section provides a discussion of the both the inherent and Site-specific uncertainties associated with each step of the risk assessment (data collection and evaluation, exposure assessment, toxicity assessment, and risk characterization) and an evaluation of the significance of those uncertainties. While this HHRA was completed following USEPA guidance, which generally reduces uncertainty and increases consistency, the HHRA process involves making a number of assumptions in order to estimate potential risks. The objective of an uncertainty analysis is to present key information regarding assumptions and uncertainties in the risk assessment process to place the quantitative risk estimates in proper perspective and to inform subsequent risk management decisions (USEPA 1989).

8.1 Data Collection and Evaluation

With regard to analytical data, uncertainty can exist in data collection, data analysis and validation, statistical analysis of the data, and screening of the data. Historic discrete samples were collected from known and suspected areas of contamination (i.e., “biased sampling”), to delineate the nature and extent of contamination. Although this sampling methodology provided a reasonable estimation of the level of contamination at known or suspected contaminated areas, the possibility exists that the data sets formed by these samples do not accurately represent the level of contamination and instead overestimate the concentrations to which receptors are potentially exposed. This uncertainty is mitigated by the more recent sediment sampling in the southern wetlands, which was performed using ISM.

8.1.1 Selection of Chemicals of Interest

The Site has undergone numerous investigations and interim remedial activities since the 1990s. Consequently, there is high confidence that the COIs selected for inclusion in this HHRA represent constituents that that have the greatest potential to pose an unacceptable risk to human health and the environment.

8.2 Exposure Assessment

Uncertainties were identified in association with three areas of the exposure assessment process: (1) the selection of exposure scenarios and pathways, (2) the estimation of EPCs, and (3) the selection of exposure assumptions used to estimate chemical intake. Uncertainties in each of these areas are discussed below.

8.2.1 Exposure Media, Scenarios and Pathways

Exposure media, scenarios and pathways were identified based on observed and assumed land use and the types of activities that may occur by varying receptors. Uncertainties are introduced to the degree that land use, exposure media or activity patterns are not represented by those assumed. For example, groundwater seeping into residential basements in OU1 may result in the deposition of residuals onto basement floors after the groundwater seeps recede. However, this exposure medium is not quantifiable or distinguishable from other potential sources of residuals in residential basement settings. While there is the potential to underestimate potential risk by excluding this exposure pathway, the degree of this underestimate is considered *de minimis* considering the infrequent and short-term nature of groundwater intrusion events.

For the Site, there is high confidence that the assumed future use will remain the same and the potential receptors and exposure pathways are adequately identified.

8.2.2 Estimating Exposure Point Concentrations

As discussed previously, more recent sediment sampling was performed using ISM. The ISM is designed to provide an unbiased, statistically valid estimate of mean concentrations and has been shown to provide more reliable and reproducible results than discrete sampling, thus reducing uncertainty in characterizing concentration means. The discrete sediment sampling dataset is subject to a high degree of skewness resulting from the presence of one or more outliers in the dataset, which inflates EPCs resulting in a high degree of uncertainty. For this reason, both the ISM and discrete sediment EPCs were used to evaluate potential risks to current and future trespassers and future utility workers.

The exposure point concentrations used in the exposure assessment for the RME receptors are based generally on the 95% UCLs of the mean. These 95% UCL values provide a conservative estimate of the true average concentration, and, therefore, they tend to overestimate the potential exposure.

8.2.3 Selection of Exposure Assumptions

This risk assessment contains many layers of conservative exposure assumptions. The USEPA model for conducting human health risk assessments presently requires the use of point estimates for all parameters (e.g., chemical concentration, body weight, length of residence) to establish risk estimates for exposure scenarios. Single-point estimates, however, do not demonstrate the similarity or variability of the data. For example, it is acknowledged that local residents may reside in their homes for a longer period than the lifetime residential duration of 38 years used in this HHRA. However, regional-specific data on the frequency of this occurrence is unknown, thus a deviation from the USEPA RME default would introduce a high degree of uncertainty.

It should be noted that the exposure assumptions utilized in this HHRA to evaluate groundwater intrusion in OU1 basements are more conservative than those used by USEPA in their derivation of groundwater screening levels protective of this exposure pathway (Memorandum: *Update to the September 2019 Determination of risk from exposure to sump water and dust in the basements of the USS Lead Site Memo*, dated 9 January 2020). For example, only dermal exposure by residents aged 10 to 30 years old was assumed by USEPA; whereas, this HHRA includes dermal exposure in addition to incidental ingestion for adults, adolescents and children (and lifetime residents as a sum of the three groups). In addition, USEPA assumed 2 hours per cleanup event, for 12 events per year, for 20 years; whereas, this HHRA assumes 4 hours per event, for 16 events per year, for up to 38 years by lifetime residents. Therefore, it is highly likely that risks estimated for OU1 residents are overestimated.

Many of the default exposure parameters used in this risk assessment are USEPA RME default values such as those for ingestion rates of environmental media, exposure duration, and frequency of events. Exposure parameters based on professional judgement are also often based on upper-bound values. Using these RME assumptions tends to overestimate exposure in the current and future land-use scenarios. Consequently, the use of these default values will overestimate potential risks.

8.3 Toxicity Assessment

The primary uncertainties associated with the toxicity assessment are related to derivation of toxicity values for COIs. Standard RfDs, RfCs, SFs, and IURs developed by the USEPA were used to estimate potential cancer and non-cancer health effects from exposure to COIs. These values are derived by applying conservative (health-protective) assumptions and are intended to protect the most sensitive potentially exposed individuals.

Toxicity values are not available for all COIs. Therefore, health risks/hazards cannot be quantitatively assessed for all pathways for all COIs, and the total risk/hazard for the Site may be underestimated in such circumstances.

Cancer slope factors, are derived from cancer bioassay or epidemiologic dose-response data to estimate carcinogenic risk at constituent concentrations that may be several orders of magnitude lower that the given dose or estimated exposure observed in the studies that form the basis of the assessment. Thus, extrapolations are made in projecting potential effects at low doses from data on effects at high doses; all these extrapolations add to the uncertainty. A number of uncertainties are associated with this methodology. The extrapolation of observed carcinogenic effects at high doses used in animal cancer studies to possible cancer effects at substantially lower doses is based on the hypothesis that there is no threshold dose for carcinogens. The extrapolation of carcinogenic and non-carcinogenic effects in animals to effects in humans may not be appropriate for all constituents.

Toxicity values used to estimate chronic dosages that may induce non-cancer adverse effects also have a number of limitations. Unlike cancer risk assessment, by convention non-cancer adverse effects are assumed to occur in a dose-response manner only after a threshold dose has been exceeded. This assumption is the basis for the use of the RfD or RfC in estimating the HI. If this ratio is greater than one, such exposures may present a risk. The HI can only be used to rank the possibility of adverse non-cancer effects occurring. The HI used to describe non-cancer health hazards has an inherent uncertainty. For example, RfDs are derived from NOAEL or LOAEL dose rates determined from animal studies or human exposure investigations. Depending on the quality of the available data, the NOAEL or LOAEL is divided by an uncertainty factor ranging from 1 to 10,000. Large uncertainty factors used in extrapolating animal effects to human effects tend to over-estimate non-cancer hazards.

The HI approach assumes that all non-cancer adverse effects to the same organ or systems are additive. While this approach may be sound for assessing a series of constituents that have similar modes of action and act on the same target organ, it may not be appropriate when there are different modes of action. Summation of HIs to calculate a total HI for an exposure scenario can generate a very large number. The HI is a ratio of estimated exposure compared to a "safe" exposure dose. A health hazard is indicated if this ratio exceeds one. The magnitude of a calculated HI greater than one has little bearing on the potential severity of adverse effects.

8.4 Risk Characterization

In addition to the uncertainties related to the data evaluation, exposure, and toxicity, the risk characterization step may also be subject to uncertainty. The objective of the HHRA is to evaluate potential risks from exposure to COIs originating from the Site to support potential future risk management decision-making. The region within which the Site resides has been industrially developed for over a century, introducing an uncertainty associated with how Site-related risks are characterized and the potential contribution of COIs from sources outside of the Site.

9. SUMMARY AND CONCLUSIONS

This baseline HHRA presents an evaluation of potential risks to human health from COIs in surface soil, subsurface soil, and sediment in OU2 at the former USS Lead Facility and in groundwater under both OU1 and OU2, in accordance with the RI/FS SOW included in Appendix A of the ASAOC.

Based on the human health CSM, the following current and future potential human receptor populations and exposure pathways for soil, sediment, surface water, and/or groundwater were evaluated quantitatively in the HHRA:

- Adult utility workers at the former USS Lead Facility (OU2):
  - Surface and subsurface soil: incidental ingestion, dermal contact and inhalation of particulate emissions in outdoor air
  - Sediment: incidental ingestion and dermal contact
  - Surface water: dermal contact
  - Groundwater: dermal contact
- Adult O&M workers at the former USS Lead Facility (OU2):

  - Surface soil: incidental ingestion, dermal contact and inhalation of particulate emissions in outdoor air
- Adult and adolescent trespassers at the former USS Lead Facility (OU2):
  - Surface soil: incidental ingestion, dermal contact and inhalation of particulate emissions in outdoor air
  - Sediment: incidental ingestion and dermal contact
  - Surface water: incidental ingestion and dermal contact
- Adult, adolescent, child and lifetime residents (OU1):
  - Groundwater seepage in basements: incidental ingestion and dermal contact

The estimated RME total cancer risks and total noncancer HIs for the receptors evaluated are summarized below. Note that results are reported separately based on whether using the discrete sediment dataset or the ISM sediment dataset to evaluate potential receptor risks. Results are also reported separately for OU1 Zone 1 groundwater and OU1 Zones 2-3 groundwater for the purposes of informing potential future risk management decision-making.

Receptor	Risk/Hazard	Value	Risk Driver/Medium
Utility Worker	CR	1E-05 (Discrete) / 5E-06 (ISM)	N/A
Utility Worker	HI	2 (Discrete) / 1 (ISM)	Arsenic / Sediment
O&M Worker	CR	3E-06	N/A
O&M Worker	HI	0.03	N/A
Adult Trespasser	CR	1E-04 (Discrete) / 3E-05 (ISM)	Arsenic / Sediment
Adult Trespasser	HI	0.9 (Discrete) / 0.3 (ISM)	N/A
Adolescent Trespasser	CR	1E-04 (Discrete) / 3E-05 (ISM)	Arsenic / Sediment
Adolescent Trespasser	HI	1 (Discrete) / 0.5 (ISM)	N/A
Adult OU1 Resident	CR	1E-06 (Z1) / 2E-07 (Z2-3)	N/A
Adult OU1 Resident	HI	0.2 (Z1) / 0.004 (Z2-3)	N/A
Adolescent OU1 Resident	CR	1E-06 (Z1) / 1E-07 (Z2-3)	N/A
Adolescent OU1 Resident	HI	0.3 (Z1) / 0.005 (Z2-3)	N/A
Child OU1 Resident	CR	1E-06 (Z1) / 1E-07 (Z2-3)	N/A
Child OU1 Resident	HI	0.5 (Z1) / 0.009 (Z2-3)	N/A
Lifetime OU1 Resident	CR	4E-06 (Z1) / 4E-07 (Z2-3)	N/A
Lifetime OU1 Resident	HI	1 (Z1) / 0.02 (Z2-3)	N/A

Notes:
CR = Cancer risk
HI = Hazard index
N/A = not applicable
O&M = Operation and Maintenance

Of all the OU2 receptor populations evaluated in this HHRA, none have estimated RME cancer risks above USEPA's acceptable risk range, although the estimated RME cancer risk for adult and adolescent trespassers are at the upper bound limit of this acceptable range when using the discrete sediment dataset. The only receptor population with estimated RME non-cancer hazards above USEPA's acceptable HI threshold of 1 was the utility worker when using the discrete sediment dataset. The estimated RME non-cancer hazard for adolescent trespassers, was at, but does not exceed the acceptable threshold of 1 when using the discrete sediment dataset. The incidental ingestion of arsenic in

OU2 sediment was the primary COI/pathway responsible for the exceedance and near exceedances. When using the ISM sediment dataset or CTE exposures, all estimated cancer risks and non-cancer hazards are below thresholds of potential concern.

There were no risks identified for OU1 residents exposed to OU1 groundwater seeping into basements for any age group (adults, adolescents, children, lifetime residents). This HHRA employed conservative assumptions to evaluate OU1 residents through the groundwater intrusion pathway (significantly greater than the assumptions used by USEPA in defining screening levels for this exposure, see Section 8.2.3). Therefore, there is a high degree of confidence in the conclusions drawn in this HHRA.

ALM modeling of potential exposure to lead in OU2 sediment and OU2 soil shows that risks are below thresholds of concern for all receptors. IEUBK modeling of potential exposure to lead in OU1 groundwater seeping into residential basements also shows that risks are below thresholds of concern for child receptors (the most sensitive potentially exposed receptor population).

The HHRA evaluated the reasonable maximum exposure scenario and the underlying assumptions provided a conservative assessment that tend to overestimate risks. The main driver for the marginal risks estimated for the utility and trespasser scenarios is arsenic in sediment. Risks to a hypothetical utility worker could be managed with personal protective equipment (PPE) to mitigate exposure to COIs at the Site. In addition, access to the vast majority of affected sediment is precluded by either dense stands of *Phragmites* or by water depth, which limits the potential for exposure by adult and adolescent trespassers likely below what was assumed in the HHRA.

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ATTACHMENT 1 PRO UCL OUTPUT

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/19/2021 2:00:02 PM								
5	From File			USS Lead Soil Wide_Depths.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	Antimony											
11												
12	General Statistics											
13	Total Number of Observations					64	Number of Distinct Observations					52
14							Number of Missing Observations					13
15	Number of Detects					49	Number of Non-Detects					15
16	Number of Distinct Detects					42	Number of Distinct Non-Detects					12
17	Minimum Detect					1.9	Minimum Non-Detect					1.3
18	Maximum Detect					210	Maximum Non-Detect					31
19	Variance Detects					2775	Percent Non-Detects					23.44%
20	Mean Detects					38.48	SD Detects					52.68
21	Median Detects					16	CV Detects					1.369
22	Skewness Detects					2.24	Kurtosis Detects					4.538
23	Mean of Logged Detects					2.911	SD of Logged Detects					1.242
24												
25	Normal GOF Test on Detects Only											
26	Shapiro Wilk Test Statistic					0.663	Shapiro Wilk GOF Test					
27	5% Shapiro Wilk Critical Value					0.947	Detected Data Not Normal at 5% Significance Level					
28	Lilliefors Test Statistic					0.261	Lilliefors GOF Test					
29	5% Lilliefors Critical Value					0.126	Detected Data Not Normal at 5% Significance Level					
30	Detected Data Not Normal at 5% Significance Level											
31												
32	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
33	KM Mean					29.97	KM Standard Error of Mean					6.084
34	KM SD					48.16	95% KM (BCA) UCL					40.33
35	95% KM (t) UCL					40.13	95% KM (Percentile Bootstrap) UCL					40.33
36	95% KM (z) UCL					39.98	95% KM Bootstrap t UCL					42.89
37	90% KM Chebyshev UCL					48.22	95% KM Chebyshev UCL					56.49
38	97.5% KM Chebyshev UCL					67.97	99% KM Chebyshev UCL					90.51
39												
40	Gamma GOF Tests on Detected Observations Only											
41	A-D Test Statistic					1.499	Anderson-Darling GOF Test					
42	5% A-D Critical Value					0.79	Detected Data Not Gamma Distributed at 5% Significance Level					
43	K-S Test Statistic					0.176	Kolmogorov-Smirnov GOF					
44	5% K-S Critical Value					0.131	Detected Data Not Gamma Distributed at 5% Significance Level					
45	Detected Data Not Gamma Distributed at 5% Significance Level											
46												
47	Gamma Statistics on Detected Data Only											
48	k hat (MLE)					0.803	k star (bias corrected MLE)					0.767
49	Theta hat (MLE)					47.91	Theta star (bias corrected MLE)					50.13
50	nu hat (MLE)					78.7	nu star (bias corrected)					75.21
51	Mean (detects)					38.48						
52												
53	Gamma ROS Statistics using Imputed Non-Detects											

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
For such situations, GROS method may yield incorrect values of UCLs and BTVs			
This is especially true when the sample size is small.			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	29.46
Maximum	210	Median	11.2
SD	48.83	CV	1.657
k hat (MLE)	0.308	k star (bias corrected MLE)	0.304
Theta hat (MLE)	95.81	Theta star (bias corrected MLE)	97.07
nu hat (MLE)	39.36	nu star (bias corrected)	38.85
Adjusted Level of Significance (β)	0.0463		
Approximate Chi Square Value (38.85, α)	25.57	Adjusted Chi Square Value (38.85, β)	25.32
95% Gamma Approximate UCL (use when n>=50)	44.76	95% Gamma Adjusted UCL (use when n<50)	45.2
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	29.97	SD (KM)	48.16
Variance (KM)	2319	SE of Mean (KM)	6.084
k hat (KM)	0.387	k star (KM)	0.38
nu hat (KM)	49.58	nu star (KM)	48.59
theta hat (KM)	77.38	theta star (KM)	78.96
80% gamma percentile (KM)	48.06	90% gamma percentile (KM)	85.43
95% gamma percentile (KM)	126.8	99% gamma percentile (KM)	231.4
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (48.59, α)	33.59	Adjusted Chi Square Value (48.59, β)	33.3
95% Gamma Approximate KM-UCL (use when n>=50)	43.36	95% Gamma Adjusted KM-UCL (use when n<50)	43.73
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.947	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0986	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.126	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	29.9	Mean in Log Scale	2.336
SD in Original Scale	48.57	SD in Log Scale	1.532
95% t UCL (assumes normality of ROS data)	40.03	95% Percentile Bootstrap UCL	40.13
95% BCA Bootstrap UCL	42.53	95% Bootstrap t UCL	43.59
95% H-UCL (Log ROS)	54.1		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	2.355	KM Geo Mean	10.54
KM SD (logged)	1.497	95% Critical H Value (KM-Log)	2.458
KM Standard Error of Mean (logged)	0.191	95% H-UCL (KM -Log)	51.37
KM SD (logged)	1.497	95% Critical H Value (KM-Log)	2.458
KM Standard Error of Mean (logged)	0.191		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	30.09	Mean in Log Scale	2.355
SD in Original Scale	48.48	SD in Log Scale	1.542

	A	B	C	D	E	F	G	H	I	J	K	L
107	95% t UCL (Assumes normality)					40.21	95% H-Stat UCL					56.31
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114	KM H-UCL					51.37						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/19/2021 2:00:37 PM
From File	USS Lead Soil Wide_Depths.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	52	Number of Distinct Observations	49
		Number of Missing Observations	13
Number of Detects	51	Number of Non-Detects	1
Number of Distinct Detects	48	Number of Distinct Non-Detects	1
Minimum Detect	1.7	Minimum Non-Detect	17.6
Maximum Detect	630	Maximum Non-Detect	17.6
Variance Detects	12450	Percent Non-Detects	1.923%
Mean Detects	52.81	SD Detects	111.6
Median Detects	15	CV Detects	2.113
Skewness Detects	3.891	Kurtosis Detects	16.35
Mean of Logged Detects	2.763	SD of Logged Detects	1.55

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.482	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.323	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.123	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	51.91	KM Standard Error of Mean	15.35
KM SD	109.6	95% KM (BCA) UCL	81.89
95% KM (t) UCL	77.63	95% KM (Percentile Bootstrap) UCL	80.75
95% KM (z) UCL	77.16	95% KM Bootstrap t UCL	105.3
90% KM Chebyshev UCL	97.96	95% KM Chebyshev UCL	118.8
97.5% KM Chebyshev UCL	147.8	99% KM Chebyshev UCL	204.6

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.967	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.812	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.132	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.131	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.524	k star (bias corrected MLE)	0.506
Theta hat (MLE)	100.8	Theta star (bias corrected MLE)	104.4
nu hat (MLE)	53.43	nu star (bias corrected)	51.62
Mean (detects)	52.81		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
For such situations, GROS method may yield incorrect values of UCLs and BTVs			
This is especially true when the sample size is small.			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	51.8
Maximum	630	Median	14.25
SD	110.7	CV	2.138
k hat (MLE)	0.482	k star (bias corrected MLE)	0.467
Theta hat (MLE)	107.5	Theta star (bias corrected MLE)	111
nu hat (MLE)	50.1	nu star (bias corrected)	48.54
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (48.54, α)	33.55	Adjusted Chi Square Value (48.54, β)	33.2
95% Gamma Approximate UCL (use when n>=50)	74.95	95% Gamma Adjusted UCL (use when n<50)	75.75
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	51.91	SD (KM)	109.6
Variance (KM)	12013	SE of Mean (KM)	15.35
k hat (KM)	0.224	k star (KM)	0.224
nu hat (KM)	23.33	nu star (KM)	23.32
theta hat (KM)	231.4	theta star (KM)	231.5
80% gamma percentile (KM)	72.23	90% gamma percentile (KM)	156.7
95% gamma percentile (KM)	259.3	99% gamma percentile (KM)	536.8
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (23.32, α)	13.33	Adjusted Chi Square Value (23.32, β)	13.11
95% Gamma Approximate KM-UCL (use when n>=50)	90.8	95% Gamma Adjusted KM-UCL (use when n<50)	92.3
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Approximate Test Statistic	0.945	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0.0305	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0946	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.123	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Approximate Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	51.9	Mean in Log Scale	2.743
SD in Original Scale	110.7	SD in Log Scale	1.541
95% t UCL (assumes normality of ROS data)	77.62	95% Percentile Bootstrap UCL	78.52
95% BCA Bootstrap UCL	88.05	95% Bootstrap t UCL	104.8
95% H-UCL (Log ROS)	96.61		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	2.738	KM Geo Mean	15.46
KM SD (logged)	1.533	95% Critical H Value (KM-Log)	2.956
KM Standard Error of Mean (logged)	0.215	95% H-UCL (KM -Log)	94.4
KM SD (logged)	1.533	95% Critical H Value (KM-Log)	2.956
KM Standard Error of Mean (logged)	0.215		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	51.97	Mean in Log Scale	2.752
SD in Original Scale	110.6	SD in Log Scale	1.536

	A	B	C	D	E	F	G	H	I	J	K	L
107			95% t UCL (Assumes normality)			77.67					95% H-Stat UCL	96.45
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114					KM H-UCL	94.4						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/19/2021 2:01:05 PM
From File	USS Lead Soil Wide_Depths.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cadmium

General Statistics			
Total Number of Observations	52	Number of Distinct Observations	44
		Number of Missing Observations	13
Number of Detects	42	Number of Non-Detects	10
Number of Distinct Detects	39	Number of Distinct Non-Detects	8
Minimum Detect	0.1	Minimum Non-Detect	0.086
Maximum Detect	14	Maximum Non-Detect	0.64
Variance Detects	12.31	Percent Non-Detects	19.23%
Mean Detects	3.004	SD Detects	3.508
Median Detects	2.05	CV Detects	1.168
Skewness Detects	1.806	Kurtosis Detects	2.707
Mean of Logged Detects	0.353	SD of Logged Detects	1.399
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.735	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.942	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.22	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.135	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	2.445	KM Standard Error of Mean	0.466
KM SD	3.319	95% KM (BCA) UCL	3.214
95% KM (t) UCL	3.225	95% KM (Percentile Bootstrap) UCL	3.238
95% KM (z) UCL	3.211	95% KM Bootstrap t UCL	3.421
90% KM Chebyshev UCL	3.842	95% KM Chebyshev UCL	4.476
97.5% KM Chebyshev UCL	5.354	99% KM Chebyshev UCL	7.08
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.452	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.787	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0879	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.142	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.795	k star (bias corrected MLE)	0.754
Theta hat (MLE)	3.776	Theta star (bias corrected MLE)	3.981
nu hat (MLE)	66.82	nu star (bias corrected)	63.38
Mean (detects)	3.004		
Gamma ROS Statistics using Imputed Non-Detects			

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
For such situations, GROS method may yield incorrect values of UCLs and BTVs			
This is especially true when the sample size is small.			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	2.428
Maximum	14	Median	1.05
SD	3.363	CV	1.385
k hat (MLE)	0.436	k star (bias corrected MLE)	0.424
Theta hat (MLE)	5.565	Theta star (bias corrected MLE)	5.727
nu hat (MLE)	45.37	nu star (bias corrected)	44.09
Adjusted Level of Significance (β)	0.0454		
Approximate Chi Square Value (44.09, α)	29.86	Adjusted Chi Square Value (44.09, β)	29.53
95% Gamma Approximate UCL (use when n>=50)	3.585	95% Gamma Adjusted UCL (use when n<50)	3.626
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	2.445	SD (KM)	3.319
Variance (KM)	11.01	SE of Mean (KM)	0.466
k hat (KM)	0.543	k star (KM)	0.524
nu hat (KM)	56.44	nu star (KM)	54.52
theta hat (KM)	4.505	theta star (KM)	4.664
80% gamma percentile (KM)	4.023	90% gamma percentile (KM)	6.55
95% gamma percentile (KM)	9.235	99% gamma percentile (KM)	15.81
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (54.52, α)	38.55	Adjusted Chi Square Value (54.52, β)	38.17
95% Gamma Approximate KM-UCL (use when n>=50)	3.458	95% Gamma Adjusted KM-UCL (use when n<50)	3.492
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.893	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.942	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.122	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.135	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Approximate Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	2.443	Mean in Log Scale	-0.199
SD in Original Scale	3.353	SD in Log Scale	1.708
95% t UCL (assumes normality of ROS data)	3.222	95% Percentile Bootstrap UCL	3.231
95% BCA Bootstrap UCL	3.341	95% Bootstrap t UCL	3.385
95% H-UCL (Log ROS)	7.543		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-0.168	KM Geo Mean	0.846
KM SD (logged)	1.641	95% Critical H Value (KM-Log)	3.095
KM Standard Error of Mean (logged)	0.231	95% H-UCL (KM -Log)	6.618
KM SD (logged)	1.641	95% Critical H Value (KM-Log)	3.095
KM Standard Error of Mean (logged)	0.231		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.443	Mean in Log Scale	-0.228
SD in Original Scale	3.353	SD in Log Scale	1.754

	A	B	C	D	E	F	G	H	I	J	K	L
107	95% t UCL (Assumes normality)					3.222	95% H-Stat UCL					8.232
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Gamma Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114	95% KM Approximate Gamma UCL					3.458						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/19/2021 1:59:32 PM
From File	USS Lead Soil Wide_Depths.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Total Number of Observations	78	Number of Distinct Observations	67
Number of Detects	71	Number of Non-Detects	7
Number of Distinct Detects	62	Number of Distinct Non-Detects	6
Minimum Detect	1.7	Minimum Non-Detect	3.9
Maximum Detect	1800	Maximum Non-Detect	148
Variance Detects	136927	Percent Non-Detects	8.974%
Mean Detects	287.3	SD Detects	370
Median Detects	88	CV Detects	1.288
Skewness Detects	1.603	Kurtosis Detects	2.789
Mean of Logged Detects	4.421	SD of Logged Detects	1.9

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.77	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	3.442E-15	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.229	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.105	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	262.1	KM Standard Error of Mean	41.01
KM SD	359.6	95% KM (BCA) UCL	335.5
95% KM (t) UCL	330.4	95% KM (Percentile Bootstrap) UCL	335.3
95% KM (z) UCL	329.6	95% KM Bootstrap t UCL	341.9
90% KM Chebyshev UCL	385.2	95% KM Chebyshev UCL	440.9
97.5% KM Chebyshev UCL	518.2	99% KM Chebyshev UCL	670.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.369	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.816	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.135	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.112	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.511	k star (bias corrected MLE)	0.498
Theta hat (MLE)	562.6	Theta star (bias corrected MLE)	576.3
nu hat (MLE)	72.51	nu star (bias corrected)	70.78
Mean (detects)	287.3		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	262
Maximum	1800	Median	58.5
SD	362	CV	1.382
k hat (MLE)	0.376	k star (bias corrected MLE)	0.37
Theta hat (MLE)	696.2	Theta star (bias corrected MLE)	707.4
nu hat (MLE)	58.71	nu star (bias corrected)	57.78
Adjusted Level of Significance (β)	0.0469		
Approximate Chi Square Value (57.78, α)	41.31	Adjusted Chi Square Value (57.78, β)	41.04
95% Gamma Approximate UCL (use when n>=50)	366.5	95% Gamma Adjusted UCL (use when n<50)	368.8

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	262.1	SD (KM)	359.6
Variance (KM)	129311	SE of Mean (KM)	41.01
k hat (KM)	0.531	k star (KM)	0.52
nu hat (KM)	82.9	nu star (KM)	81.05
theta hat (KM)	493.3	theta star (KM)	504.6
80% gamma percentile (KM)	431.2	90% gamma percentile (KM)	703.6
95% gamma percentile (KM)	993.3	99% gamma percentile (KM)	1703

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (81.05, α)	61.3	Adjusted Chi Square Value (81.05, β)	60.98
95% Gamma Approximate KM-UCL (use when n>=50)	346.6	95% Gamma Adjusted KM-UCL (use when n<50)	348.4

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.929	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	5.9653E-4	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.113	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.105	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	262.1	Mean in Log Scale	4.16
SD in Original Scale	361.9	SD in Log Scale	2.01
95% t UCL (assumes normality of ROS data)	330.3	95% Percentile Bootstrap UCL	331.8
95% BCA Bootstrap UCL	340.2	95% Bootstrap t UCL	344.5
95% H-UCL (Log ROS)	1065		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	4.132	KM Geo Mean	62.32
KM SD (logged)	2.044	95% Critical H Value (KM-Log)	3.491
KM Standard Error of Mean (logged)	0.234	95% H-UCL (KM -Log)	1136
KM SD (logged)	2.044	95% Critical H Value (KM-Log)	3.491
KM Standard Error of Mean (logged)	0.234		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	262.9	Mean in Log Scale	4.184
SD in Original Scale	361.5	SD in Log Scale	1.999
95% t UCL (Assumes normality)	331	95% H-Stat UCL	1057

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Data do not follow a Discernible Distribution at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	95% KM (Chebyshev) UCL					440.9						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/19/2021 2:01:37 PM								
5	From File			USS Lead Soil Wide_Depths.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	Selenium											
11												
12	General Statistics											
13	Total Number of Observations					32	Number of Distinct Observations					26
14							Number of Missing Observations					33
15	Number of Detects					22	Number of Non-Detects					10
16	Number of Distinct Detects					20	Number of Distinct Non-Detects					8
17	Minimum Detect					0.11	Minimum Non-Detect					0.077
18	Maximum Detect					5.8	Maximum Non-Detect					1.9
19	Variance Detects					2.643	Percent Non-Detects					31.25%
20	Mean Detects					1.358	SD Detects					1.626
21	Median Detects					0.715	CV Detects					1.197
22	Skewness Detects					1.927	Kurtosis Detects					2.874
23	Mean of Logged Detects					-0.259	SD of Logged Detects					1.083
24												
25	Normal GOF Test on Detects Only											
26	Shapiro Wilk Test Statistic					0.708	Shapiro Wilk GOF Test					
27	5% Shapiro Wilk Critical Value					0.911	Detected Data Not Normal at 5% Significance Level					
28	Lilliefors Test Statistic					0.25	Lilliefors GOF Test					
29	5% Lilliefors Critical Value					0.184	Detected Data Not Normal at 5% Significance Level					
30	Detected Data Not Normal at 5% Significance Level											
31												
32	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
33	KM Mean					0.97	KM Standard Error of Mean					0.261
34	KM SD					1.44	95% KM (BCA) UCL					1.402
35	95% KM (t) UCL					1.413	95% KM (Percentile Bootstrap) UCL					1.417
36	95% KM (z) UCL					1.399	95% KM Bootstrap t UCL					1.702
37	90% KM Chebyshev UCL					1.753	95% KM Chebyshev UCL					2.108
38	97.5% KM Chebyshev UCL					2.6	99% KM Chebyshev UCL					3.567
39												
40	Gamma GOF Tests on Detected Observations Only											
41	A-D Test Statistic					0.708	Anderson-Darling GOF Test					
42	5% A-D Critical Value					0.77	Detected data appear Gamma Distributed at 5% Significance Level					
43	K-S Test Statistic					0.143	Kolmogorov-Smirnov GOF					
44	5% K-S Critical Value					0.191	Detected data appear Gamma Distributed at 5% Significance Level					
45	Detected data appear Gamma Distributed at 5% Significance Level											
46												
47	Gamma Statistics on Detected Data Only											
48	k hat (MLE)					1.02	k star (bias corrected MLE)					0.911
49	Theta hat (MLE)					1.331	Theta star (bias corrected MLE)					1.49
50	nu hat (MLE)					44.89	nu star (bias corrected)					40.1
51	Mean (detects)					1.358						
52												
53	Gamma ROS Statistics using Imputed Non-Detects											

	A–E	F	G–K	L
54	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
55	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
56	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
57	This is especially true when the sample size is small.			
58	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
59	Minimum	0.01	Mean	0.937
60	Maximum	5.8	Median	0.35
61	SD	1.481	CV	1.581
62	k hat (MLE)	0.421	k star (bias corrected MLE)	0.402
63	Theta hat (MLE)	2.226	Theta star (bias corrected MLE)	2.329
64	nu hat (MLE)	26.93	nu star (bias corrected)	25.73
65	Adjusted Level of Significance (β)	0.0416		
66	Approximate Chi Square Value (25.73, α)	15.18	Adjusted Chi Square Value (25.73, β)	14.74
67	95% Gamma Approximate UCL (use when n>=50)	1.588	95% Gamma Adjusted UCL (use when n<50)	1.635
68				
69	**Estimates of Gamma Parameters using KM Estimates**			
70	Mean (KM)	0.97	SD (KM)	1.44
71	Variance (KM)	2.074	SE of Mean (KM)	0.261
72	k hat (KM)	0.454	k star (KM)	0.432
73	nu hat (KM)	29.04	nu star (KM)	27.65
74	theta hat (KM)	2.138	theta star (KM)	2.245
75	80% gamma percentile (KM)	1.578	90% gamma percentile (KM)	2.702
76	95% gamma percentile (KM)	3.924	99% gamma percentile (KM)	6.974
77				
78	**Gamma Kaplan-Meier (KM) Statistics**			
79	Approximate Chi Square Value (27.65, α)	16.66	Adjusted Chi Square Value (27.65, β)	16.2
80	95% Gamma Approximate KM-UCL (use when n>=50)	1.611	95% Gamma Adjusted KM-UCL (use when n<50)	1.656
81				
82	**Lognormal GOF Test on Detected Observations Only**			
83	Shapiro Wilk Test Statistic	0.97	**Shapiro Wilk GOF Test**	
84	5% Shapiro Wilk Critical Value	0.911	Detected Data appear Lognormal at 5% Significance Level	
85	Lilliefors Test Statistic	0.107	**Lilliefors GOF Test**	
86	5% Lilliefors Critical Value	0.184	Detected Data appear Lognormal at 5% Significance Level	
87	**Detected Data appear Lognormal at 5% Significance Level**			
88				
89	**Lognormal ROS Statistics Using Imputed Non-Detects**			
90	Mean in Original Scale	0.962	Mean in Log Scale	-0.966
91	SD in Original Scale	1.465	SD in Log Scale	1.416
92	95% t UCL (assumes normality of ROS data)	1.402	95% Percentile Bootstrap UCL	1.415
93	95% BCA Bootstrap UCL	1.531	95% Bootstrap t UCL	1.683
94	95% H-UCL (Log ROS)	2.209		
95				
96	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
97	KM Mean (logged)	-0.927	KM Geo Mean	0.396
98	KM SD (logged)	1.353	95% Critical H Value (KM-Log)	2.886
99	KM Standard Error of Mean (logged)	0.248	95% H-UCL (KM -Log)	1.994
100	KM SD (logged)	1.353	95% Critical H Value (KM-Log)	2.886
101	KM Standard Error of Mean (logged)	0.248		
102				
103	**DL/2 Statistics**			
104	**DL/2 Normal**		**DL/2 Log-Transformed**	
105	Mean in Original Scale	0.98	Mean in Log Scale	-0.983
106	SD in Original Scale	1.462	SD in Log Scale	1.494

	A	B	C	D	E	F	G	H	I	J	K	L
107	95% t UCL (Assumes normality)					1.418	95% H-Stat UCL					2.612
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Gamma Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114	a Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)					1.656						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

UCL Statistics for Data Sets with Non-Detects			
User Selected Options			
Date/Time of Computation	ProUCL 5.18/13/2021 2:09:07 PM		
From File	USS Lead Soil Wide_trb_a.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Antimony			
General Statistics			
Total Number of Observations	85	Number of Distinct Observations	67
		Number of Missing Observations	13
Number of Detects	67	Number of Non-Detects	18
Number of Distinct Detects	55	Number of Distinct Non-Detects	14
Minimum Detect	0.97	Minimum Non-Detect	1.3
Maximum Detect	210	Maximum Non-Detect	31
Variance Detects	2306	Percent Non-Detects	21.18%
Mean Detects	31.6	SD Detects	48.02
Median Detects	12	CV Detects	1.52
Skewness Detects	2.546	Kurtosis Detects	6.288
Mean of Logged Detects	2.64	SD of Logged Detects	1.26
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.617	**Normal GOF Test on Detected Observations Only**	
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.299	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.108	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	25.39	KM Standard Error of Mean	4.809
KM SD	43.99	95% KM (BCA) UCL	33.34
95% KM (t) UCL	33.39	95% KM (Percentile Bootstrap) UCL	34.26
95% KM (z) UCL	33.3	95% KM Bootstrap t UCL	36.21
90% KM Chebyshev UCL	39.81	95% KM Chebyshev UCL	46.35
97.5% KM Chebyshev UCL	55.42	99% KM Chebyshev UCL	73.23
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	2.756	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.794	Detected Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.189	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.113	Detected Data Not Gamma Distributed at 5% Significance Level	
Detected Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.738	k star (bias corrected MLE)	0.715
Theta hat (MLE)	42.8	Theta star (bias corrected MLE)	44.18
nu hat (MLE)	98.92	nu star (bias corrected)	95.82
Mean (detects)	31.6		
Gamma ROS Statistics using Imputed Non-Detects			

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
For such situations, GROS method may yield incorrect values of UCLs and BTVs			
This is especially true when the sample size is small.			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	24.91
Maximum	210	Median	9.7
SD	44.5	CV	1.787
k hat (MLE)	0.323	k star (bias corrected MLE)	0.319
Theta hat (MLE)	77.11	Theta star (bias corrected MLE)	77.97
nu hat (MLE)	54.91	nu star (bias corrected)	54.31
Adjusted Level of Significance (β)	0.0472		
Approximate Chi Square Value (54.31, α)	38.38	Adjusted Chi Square Value (54.31, β)	38.14
95% Gamma Approximate UCL (use when n>=50)	35.25	95% Gamma Adjusted UCL (use when n<50)	35.46
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	25.39	SD (KM)	43.99
Variance (KM)	1935	SE of Mean (KM)	4.809
k hat (KM)	0.333	k star (KM)	0.329
nu hat (KM)	56.63	nu star (KM)	55.96
theta hat (KM)	76.22	theta star (KM)	77.12
80% gamma percentile (KM)	39.75	90% gamma percentile (KM)	73.98
95% gamma percentile (KM)	112.7	99% gamma percentile (KM)	212.1
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (55.96, α)	39.77	Adjusted Chi Square Value (55.96, β)	39.53
95% Gamma Approximate KM-UCL (use when n>=50)	35.73	95% Gamma Adjusted KM-UCL (use when n<50)	35.94
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Approximate Test Statistic	0.96	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0.0838	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.106	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.108	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	25.33	Mean in Log Scale	2.185
SD in Original Scale	44.27	SD in Log Scale	1.453
95% t UCL (assumes normality of ROS data)	33.31	95% Percentile Bootstrap UCL	33.6
95% BCA Bootstrap UCL	34.77	95% Bootstrap t UCL	36.33
95% H-UCL (Log ROS)	39.28		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	2.189	KM Geo Mean	8.925
KM SD (logged)	1.449	95% Critical H Value (KM-Log)	2.709
KM Standard Error of Mean (logged)	0.161	95% H-UCL (KM -Log)	39.13
KM SD (logged)	1.449	95% Critical H Value (KM-Log)	2.709
KM Standard Error of Mean (logged)	0.161		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	25.5	Mean in Log Scale	2.218
SD in Original Scale	44.2	SD in Log Scale	1.436

	A	B	C	D	E	F	G	H	I	J	K	L
107	95% t UCL (Assumes normality)					33.47	95% H-Stat UCL					39.29
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114	KM H-UCL					39.13						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

UCL Statistics for Uncensored Full Data Sets

User Selected Options	
Date/Time of Computation	ProUCL 5.18/13/2021 2:11:07 PM
From File	USS Lead Soil Wide_trb_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics			
Total Number of Observations	70	Number of Distinct Observations	62
		Number of Missing Observations	13
Minimum	0.87	Mean	41.98
Maximum	630	Median	12
SD	97.77	Std. Error of Mean	11.69
Coefficient of Variation	2.329	Skewness	4.466
Normal GOF Test			
Shapiro Wilk Test Statistic	0.447	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.337	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.106	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	61.46	95% Adjusted-CLT UCL (Chen-1995)	67.87
		95% Modified-t UCL (Johnson-1978)	62.5
Gamma GOF Test			
A-D Test Statistic	3.144	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.819	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.154	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.113	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	0.49	k star (bias corrected MLE)	0.479
Theta hat (MLE)	85.67	Theta star (bias corrected MLE)	87.72
nu hat (MLE)	68.6	nu star (bias corrected)	67
MLE Mean (bias corrected)	41.98	MLE Sd (bias corrected)	60.69
		Approximate Chi Square Value (0.05)	49.16
Adjusted Level of Significance	0.0466	Adjusted Chi Square Value	48.84
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	57.21	95% Adjusted Gamma UCL (use when n<50)	57.59
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.95	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	0.0175	Data Not Lognormal at 5% Significance Level	

	A	B	C	D	E	F	G	H	I	J	K	L
54					Lilliefors Test Statistic	0.0943	**Lilliefors Lognormal GOF Test**					
55					5% Lilliefors Critical Value	0.106	Data appear Lognormal at 5% Significance Level					
56	**Data appear Approximate Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59					Minimum of Logged Data	-0.139					Mean of logged Data	2.437
60					Maximum of Logged Data	6.446					SD of logged Data	1.571
61												
62	**Assuming Lognormal Distribution**											
63					95% H-UCL	61.76					90% Chebyshev (MVUE) UCL	67.39
64					95% Chebyshev (MVUE) UCL	80.76					97.5% Chebyshev (MVUE) UCL	99.32
65					99% Chebyshev (MVUE) UCL	135.8						
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
69												
70	**Nonparametric Distribution Free UCLs**											
71					95% CLT UCL	61.2					95% Jackknife UCL	61.46
72					95% Standard Bootstrap UCL	60.98					95% Bootstrap-t UCL	85.28
73					95% Hall's Bootstrap UCL	143					95% Percentile Bootstrap UCL	61.88
74					95% BCA Bootstrap UCL	69.62						
75					90% Chebyshev(Mean, Sd) UCL	77.04					95% Chebyshev(Mean, Sd) UCL	92.92
76					97.5% Chebyshev(Mean, Sd) UCL	115					99% Chebyshev(Mean, Sd) UCL	158.3
77												
78	**Suggested UCL to Use**											
79					95% H-UCL	61.76						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												
86	**ProUCL computes and outputs H-statistic based UCLs for historical reasons only.**											
87	**H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.**											
88	**It is therefore recommended to avoid the use of H-statistic based 95% UCLs.**											
89	**Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.**											
90												

1	**UCL Statistics for Data Sets with Non-Detects**	
2		
3	User Selected Options	
4	Date/Time of Computation	ProUCL 5.18/13/2021 2:09:55 PM
5	From File	USS Lead Soil Wide_trb_a.xls
6	Full Precision	OFF
7	Confidence Coefficient	95%
8	Number of Bootstrap Operations	2000
9		
10	Cadmium	
11		

12	**General Statistics**			
13	Total Number of Observations	70	Number of Distinct Observations	58
14			Number of Missing Observations	13
15	Number of Detects	60	Number of Non-Detects	10
16	Number of Distinct Detects	53	Number of Distinct Non-Detects	8
17	Minimum Detect	0.032	Minimum Non-Detect	0.086
18	Maximum Detect	530	Maximum Non-Detect	0.64
19	Variance Detects	4778	Percent Non-Detects	14.29%
20	Mean Detects	14.84	SD Detects	69.12
21	Median Detects	2.2	CV Detects	4.657
22	Skewness Detects	7.278	Kurtosis Detects	54.76
23	Mean of Logged Detects	0.416	SD of Logged Detects	2.02
24				
25	**Normal GOF Test on Detects Only**			
26	Shapiro Wilk Test Statistic	0.219	**Normal GOF Test on Detected Observations Only**	
27	5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
28	Lilliefors Test Statistic	0.427	**Lilliefors GOF Test**	
29	5% Lilliefors Critical Value	0.114	Detected Data Not Normal at 5% Significance Level	
30	**Detected Data Not Normal at 5% Significance Level**			
31				
32	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
33	KM Mean	12.73	KM Standard Error of Mean	7.674
34	KM SD	63.67	95% KM (BCA) UCL	27.87
35	95% KM (t) UCL	25.53	95% KM (Percentile Bootstrap) UCL	27.69
36	95% KM (z) UCL	25.36	95% KM Bootstrap t UCL	76.89
37	90% KM Chebyshev UCL	35.75	95% KM Chebyshev UCL	46.18
38	97.5% KM Chebyshev UCL	60.66	99% KM Chebyshev UCL	89.09
39				
40	**Gamma GOF Tests on Detected Observations Only**			
41	A-D Test Statistic	4.688	**Anderson-Darling GOF Test**	
42	5% A-D Critical Value	0.863	Detected Data Not Gamma Distributed at 5% Significance Level	
43	K-S Test Statistic	0.234	**Kolmogorov-Smirnov GOF**	
44	5% K-S Critical Value	0.124	Detected Data Not Gamma Distributed at 5% Significance Level	
45	**Detected Data Not Gamma Distributed at 5% Significance Level**			
46				
47	**Gamma Statistics on Detected Data Only**			
48	k hat (MLE)	0.302	k star (bias corrected MLE)	0.298
49	Theta hat (MLE)	49.16	Theta star (bias corrected MLE)	49.82
50	nu hat (MLE)	36.23	nu star (bias corrected)	35.75
51	Mean (detects)	14.84		
52				
53	**Gamma ROS Statistics using Imputed Non-Detects**			

	A–E	F	G–K	L
54	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
55	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
56	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
57	This is especially true when the sample size is small.			
58	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
59	Minimum	0.01	Mean	12.72
60	Maximum	530	Median	1.285
61	SD	64.13	CV	5.04
62	k hat (MLE)	0.25	k star (bias corrected MLE)	0.249
63	Theta hat (MLE)	50.95	Theta star (bias corrected MLE)	51.19
64	nu hat (MLE)	34.96	nu star (bias corrected)	34.8
65	Adjusted Level of Significance (β)	0.0466		
66	Approximate Chi Square Value (34.80, α)	22.3	Adjusted Chi Square Value (34.80, β)	22.09
67	95% Gamma Approximate UCL (use when n>=50)	19.85	95% Gamma Adjusted UCL (use when n<50)	20.04
68				
69	**Estimates of Gamma Parameters using KM Estimates**			
70	Mean (KM)	12.73	SD (KM)	63.67
71	Variance (KM)	4054	SE of Mean (KM)	7.674
72	k hat (KM)	0.04	k star (KM)	0.0478
73	nu hat (KM)	5.598	nu star (KM)	6.692
74	theta hat (KM)	318.4	theta star (KM)	266.4
75	80% gamma percentile (KM)	1.467	90% gamma percentile (KM)	18.29
76	95% gamma percentile (KM)	66.57	99% gamma percentile (KM)	281.9
77				
78	**Gamma Kaplan-Meier (KM) Statistics**			
79	Approximate Chi Square Value (6.69, α)	2.003	Adjusted Chi Square Value (6.69, β)	1.95
80	95% Gamma Approximate KM-UCL (use when n>=50)	42.54	95% Gamma Adjusted KM-UCL (use when n<50)	43.7
81				
82	**Lognormal GOF Test on Detected Observations Only**			
83	Shapiro Wilk Approximate Test Statistic	0.97	**Shapiro Wilk GOF Test**	
84	5% Shapiro Wilk P Value	0.312	Detected Data appear Lognormal at 5% Significance Level	
85	Lilliefors Test Statistic	0.0898	**Lilliefors GOF Test**	
86	5% Lilliefors Critical Value	0.114	Detected Data appear Lognormal at 5% Significance Level	
87	**Detected Data appear Lognormal at 5% Significance Level**			
88				
89	**Lognormal ROS Statistics Using Imputed Non-Detects**			
90	Mean in Original Scale	12.73	Mean in Log Scale	-0.0561
91	SD in Original Scale	64.13	SD in Log Scale	2.209
92	95% t UCL (assumes normality of ROS data)	25.51	95% Percentile Bootstrap UCL	27.43
93	95% BCA Bootstrap UCL	37.73	95% Bootstrap t UCL	88.93
94	95% H-UCL (Log ROS)	24.11		
95				
96	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
97	KM Mean (logged)	-0.0505	KM Geo Mean	0.951
98	KM SD (logged)	2.188	95% Critical H Value (KM-Log)	2.995
99	KM Standard Error of Mean (logged)	0.266	95% H-UCL (KM -Log)	22.95
100	KM SD (logged)	2.188	95% Critical H Value (KM-Log)	2.995
101	KM Standard Error of Mean (logged)	0.266		
102				
103	**DL/2 Statistics**			
104	**DL/2 Normal**		**DL/2 Log-Transformed**	
105	Mean in Original Scale	12.73	Mean in Log Scale	-0.0246
106	SD in Original Scale	64.13	SD in Log Scale	2.171

	A	B	C	D	E	F	G	H	I	J	K	L
107	95% t UCL (Assumes normality)					25.51	95% H-Stat UCL					22.53
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114	KM H-UCL					22.95						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/13/2021 2:08:41 PM
From File	USS Lead Soil Wide_trb_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Total Number of Observations	99	Number of Distinct Observations	84
Number of Detects	90	Number of Non-Detects	9
Number of Distinct Detects	80	Number of Distinct Non-Detects	8
Minimum Detect	1.4	Minimum Non-Detect	3.9
Maximum Detect	1800	Maximum Non-Detect	148
Variance Detects	157818	Percent Non-Detects	9.091%
Mean Detects	274.9	SD Detects	397.3
Median Detects	58.5	CV Detects	1.445
Skewness Detects	1.902	Kurtosis Detects	3.582
Mean of Logged Detects	4.205	SD of Logged Detects	1.978

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.716	**Normal GOF Test on Detected Observations Only**
5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.246	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0936	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	250.5	KM Standard Error of Mean	38.86
KM SD	384.5	95% KM (BCA) UCL	318.5
95% KM (t) UCL	315	95% KM (Percentile Bootstrap) UCL	313.3
95% KM (z) UCL	314.4	95% KM Bootstrap t UCL	322.7
90% KM Chebyshev UCL	367.1	95% KM Chebyshev UCL	419.9
97.5% KM Chebyshev UCL	493.2	99% KM Chebyshev UCL	637.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.982	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.829	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.141	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.1	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.456	k star (bias corrected MLE)	0.449
Theta hat (MLE)	602.4	Theta star (bias corrected MLE)	612.9
nu hat (MLE)	82.15	nu star (bias corrected)	80.75
Mean (detects)	274.9		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	250
59	Maximum	1800	Median	42
60	SD	386.8	CV	1.547
61	k hat (MLE)	0.331	k star (bias corrected MLE)	0.328
62	Theta hat (MLE)	755.3	Theta star (bias corrected MLE)	762.9
63	nu hat (MLE)	65.54	nu star (bias corrected)	64.88
64	Adjusted Level of Significance (β)	0.0476		
65	Approximate Chi Square Value (64.88, α)	47.35	Adjusted Chi Square Value (64.88, β)	47.13
66	95% Gamma Approximate UCL (use when n>=50)	342.6	95% Gamma Adjusted UCL (use when n<50)	344.2
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	250.5	SD (KM)	384.5
70	Variance (KM)	147860	SE of Mean (KM)	38.86
71	k hat (KM)	0.424	k star (KM)	0.418
72	nu hat (KM)	84.02	nu star (KM)	82.81
73	theta hat (KM)	590.3	theta star (KM)	598.9
74	80% gamma percentile (KM)	406.2	90% gamma percentile (KM)	701.9
75	95% gamma percentile (KM)	1025	99% gamma percentile (KM)	1833
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (82.81, α)	62.84	Adjusted Chi Square Value (82.81, β)	62.58
79	95% Gamma Approximate KM-UCL (use when n>=50)	330.1	95% Gamma Adjusted KM-UCL (use when n<50)	331.5
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Approximate Test Statistic	0.934	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk P Value	1.5871E-4	Detected Data Not Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.104	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.0936	Detected Data Not Lognormal at 5% Significance Level	
86	**Detected Data Not Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	250.4	Mean in Log Scale	3.944
90	SD in Original Scale	386.5	SD in Log Scale	2.072
91	95% t UCL (assumes normality of ROS data)	314.9	95% Percentile Bootstrap UCL	318.2
92	95% BCA Bootstrap UCL	328.1	95% Bootstrap t UCL	324.4
93	95% H-UCL (Log ROS)	921.1		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	3.933	KM Geo Mean	51.05
97	KM SD (logged)	2.081	95% Critical H Value (KM-Log)	3.521
98	KM Standard Error of Mean (logged)	0.212	95% H-UCL (KM -Log)	932.6
99	KM SD (logged)	2.081	95% Critical H Value (KM-Log)	3.521
100	KM Standard Error of Mean (logged)	0.212		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	251.1	Mean in Log Scale	3.968
105	SD in Original Scale	386.2	SD in Log Scale	2.058
106	95% t UCL (Assumes normality)	315.5	95% H-Stat UCL	909.4

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Data do not follow a Discernible Distribution at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113					95% KM (Chebyshev) UCL	419.9						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/13/2021 2:10:17 PM								
5	From File			USS Lead Soil Wide_trb_a.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	Selenium											
11												
12	General Statistics											
13	Total Number of Observations					50	Number of Distinct Observations					30
14							Number of Missing Observations					33
15	Number of Detects					25	Number of Non-Detects					25
16	Number of Distinct Detects					22	Number of Distinct Non-Detects					11
17	Minimum Detect					0.11	Minimum Non-Detect					0.077
18	Maximum Detect					5.8	Maximum Non-Detect					3.8
19	Variance Detects					2.457	Percent Non-Detects					50%
20	Mean Detects					1.221	SD Detects					1.568
21	Median Detects					0.62	CV Detects					1.284
22	Skewness Detects					2.093	Kurtosis Detects					3.648
23	Mean of Logged Detects					-0.413	SD of Logged Detects					1.099
24												
25	Normal GOF Test on Detects Only											
26	Shapiro Wilk Test Statistic					0.679	Shapiro Wilk GOF Test					
27	5% Shapiro Wilk Critical Value					0.918	Detected Data Not Normal at 5% Significance Level					
28	Lilliefors Test Statistic					0.254	Lilliefors GOF Test					
29	5% Lilliefors Critical Value					0.173	Detected Data Not Normal at 5% Significance Level					
30	Detected Data Not Normal at 5% Significance Level											
31												
32	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
33	KM Mean					0.662	KM Standard Error of Mean					0.177
34	KM SD					1.226	95% KM (BCA) UCL					0.97
35	95% KM (t) UCL					0.959	95% KM (Percentile Bootstrap) UCL					0.969
36	95% KM (z) UCL					0.954	95% KM Bootstrap t UCL					1.146
37	90% KM Chebyshev UCL					1.194	95% KM Chebyshev UCL					1.435
38	97.5% KM Chebyshev UCL					1.769	99% KM Chebyshev UCL					2.427
39												
40	Gamma GOF Tests on Detected Observations Only											
41	A-D Test Statistic					0.946	Anderson-Darling GOF Test					
42	5% A-D Critical Value					0.775	Detected Data Not Gamma Distributed at 5% Significance Level					
43	K-S Test Statistic					0.161	Kolmogorov-Smirnov GOF					
44	5% K-S Critical Value					0.18	Detected data appear Gamma Distributed at 5% Significance Level					
45	Detected data follow Appr. Gamma Distribution at 5% Significance Level											
46												
47	Gamma Statistics on Detected Data Only											
48	k hat (MLE)					0.949	k star (bias corrected MLE)					0.861
49	Theta hat (MLE)					1.287	Theta star (bias corrected MLE)					1.417
50	nu hat (MLE)					47.43	nu star (bias corrected)					43.07
51	Mean (detects)					1.221						
52												
53	Gamma ROS Statistics using Imputed Non-Detects											

	A–E	F	G–K	L
54	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
55	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
56	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
57	This is especially true when the sample size is small.			
58	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
59	Minimum	0.01	Mean	0.615
60	Maximum	5.8	Median	0.06
61	SD	1.256	CV	2.041
62	k hat (MLE)	0.335	k star (bias corrected MLE)	0.328
63	Theta hat (MLE)	1.838	Theta star (bias corrected MLE)	1.876
64	nu hat (MLE)	33.48	nu star (bias corrected)	32.8
65	Adjusted Level of Significance (β)	0.0452		
66	Approximate Chi Square Value (32.80, α)	20.71	Adjusted Chi Square Value (32.80, β)	20.42
67	95% Gamma Approximate UCL (use when n>=50)	0.975	95% Gamma Adjusted UCL (use when n<50)	0.988
68				
69	**Estimates of Gamma Parameters using KM Estimates**			
70	Mean (KM)	0.662	SD (KM)	1.226
71	Variance (KM)	1.502	SE of Mean (KM)	0.177
72	k hat (KM)	0.292	k star (KM)	0.287
73	nu hat (KM)	29.16	nu star (KM)	28.75
74	theta hat (KM)	2.269	theta star (KM)	2.302
75	80% gamma percentile (KM)	1.004	90% gamma percentile (KM)	1.962
76	95% gamma percentile (KM)	3.069	99% gamma percentile (KM)	5.962
77				
78	**Gamma Kaplan-Meier (KM) Statistics**			
79	Approximate Chi Square Value (28.75, α)	17.51	Adjusted Chi Square Value (28.75, β)	17.25
80	95% Gamma Approximate KM-UCL (use when n>=50)	1.086	95% Gamma Adjusted KM-UCL (use when n<50)	1.103
81				
82	**Lognormal GOF Test on Detected Observations Only**			
83	Shapiro Wilk Test Statistic	0.959	**Shapiro Wilk GOF Test**	
84	5% Shapiro Wilk Critical Value	0.918	Detected Data appear Lognormal at 5% Significance Level	
85	Lilliefors Test Statistic	0.133	**Lilliefors GOF Test**	
86	5% Lilliefors Critical Value	0.173	Detected Data appear Lognormal at 5% Significance Level	
87	**Detected Data appear Lognormal at 5% Significance Level**			
88				
89	**Lognormal ROS Statistics Using Imputed Non-Detects**			
90	Mean in Original Scale	0.64	Mean in Log Scale	-1.731
91	SD in Original Scale	1.244	SD in Log Scale	1.614
92	95% t UCL (assumes normality of ROS data)	0.935	95% Percentile Bootstrap UCL	0.942
93	95% BCA Bootstrap UCL	1.003	95% Bootstrap t UCL	1.133
94	95% H-UCL (Log ROS)	1.329		
95				
96	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
97	KM Mean (logged)	-1.428	KM Geo Mean	0.24
98	KM SD (logged)	1.299	95% Critical H Value (KM-Log)	2.688
99	KM Standard Error of Mean (logged)	0.191	95% H-UCL (KM -Log)	0.919
100	KM SD (logged)	1.299	95% Critical H Value (KM-Log)	2.688
101	KM Standard Error of Mean (logged)	0.191		
102				
103	**DL/2 Statistics**			
104	**DL/2 Normal**		**DL/2 Log-Transformed**	
105	Mean in Original Scale	0.698	Mean in Log Scale	-1.45
106	SD in Original Scale	1.249	SD in Log Scale	1.433

	A	B	C	D	E	F	G	H	I	J	K	L
107	95% t UCL (Assumes normality)					0.994	95% H-Stat UCL					1.177
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Approximate Gamma Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114	95% KM Approximate Gamma UCL					1.086						
115												
116	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
117	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
118												
119	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
120	Recommendations are based upon data size, data distribution, and skewness.											
121	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
122	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
123												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/19/2021 2:17:28 PM
From File	USS Lead Sediment Wide_Depths.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Total Number of Observations	105	Number of Distinct Observations	64
		Number of Missing Observations	254
Number of Detects	37	Number of Non-Detects	68
Number of Distinct Detects	36	Number of Distinct Non-Detects	29
Minimum Detect	0.82	Minimum Non-Detect	0.026
Maximum Detect	3710	Maximum Non-Detect	380
Variance Detects	484552	Percent Non-Detects	64.76%
Mean Detects	348.1	SD Detects	696.1
Median Detects	119	CV Detects	2
Skewness Detects	3.622	Kurtosis Detects	15.28
Mean of Logged Detects	4.166	SD of Logged Detects	2.274

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.531	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.936	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.351	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.144	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	124	KM Standard Error of Mean	43.53
KM SD	439.9	95% KM (BCA) UCL	211.9
95% KM (t) UCL	196.2	95% KM (Percentile Bootstrap) UCL	198.6
95% KM (z) UCL	195.6	95% KM Bootstrap t UCL	273.8
90% KM Chebyshev UCL	254.6	95% KM Chebyshev UCL	313.7
97.5% KM Chebyshev UCL	395.8	99% KM Chebyshev UCL	557.1

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.779	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.837	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.154	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.156	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.392	k star (bias corrected MLE)	0.378
Theta hat (MLE)	889	Theta star (bias corrected MLE)	921.3
nu hat (MLE)	28.98	nu star (bias corrected)	27.96
Mean (detects)	348.1		

Gamma ROS Statistics using Imputed Non-Detects

	A–E	F	G–K	L
54	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
55	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
56	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
57	This is especially true when the sample size is small.			
58	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
59	Minimum	0.01	Mean	122.7
60	Maximum	3710	Median	0.01
61	SD	442.3	CV	3.606
62	k hat (MLE)	0.125	k star (bias corrected MLE)	0.128
63	Theta hat (MLE)	983.5	Theta star (bias corrected MLE)	962
64	nu hat (MLE)	26.2	nu star (bias corrected)	26.78
65	Adjusted Level of Significance (β)	0.0477		
66	Approximate Chi Square Value (26.78, α)	15.98	Adjusted Chi Square Value (26.78, β)	15.87
67	95% Gamma Approximate UCL (use when n>=50)	205.6	95% Gamma Adjusted UCL (use when n<50)	207.1
68				
69	**Estimates of Gamma Parameters using KM Estimates**			
70	Mean (KM)	124	SD (KM)	439.9
71	Variance (KM)	193545	SE of Mean (KM)	43.53
72	k hat (KM)	0.0794	k star (KM)	0.0835
73	nu hat (KM)	16.67	nu star (KM)	17.53
74	theta hat (KM)	1561	theta star (KM)	1485
75	80% gamma percentile (KM)	63.95	90% gamma percentile (KM)	301.6
76	95% gamma percentile (KM)	721.9	99% gamma percentile (KM)	2151
77				
78	**Gamma Kaplan-Meier (KM) Statistics**			
79	Approximate Chi Square Value (17.53, α)	9.051	Adjusted Chi Square Value (17.53, β)	8.966
80	95% Gamma Approximate KM-UCL (use when n>=50)	240.1	95% Gamma Adjusted KM-UCL (use when n<50)	242.3
81				
82	**Lognormal GOF Test on Detected Observations Only**			
83	Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk GOF Test**	
84	5% Shapiro Wilk Critical Value	0.936	Detected Data Not Lognormal at 5% Significance Level	
85	Lilliefors Test Statistic	0.157	**Lilliefors GOF Test**	
86	5% Lilliefors Critical Value	0.144	Detected Data Not Lognormal at 5% Significance Level	
87	**Detected Data Not Lognormal at 5% Significance Level**			
88				
89	**Lognormal ROS Statistics Using Imputed Non-Detects**			
90	Mean in Original Scale	123.8	Mean in Log Scale	1.044
91	SD in Original Scale	442	SD in Log Scale	2.998
92	95% t UCL (assumes normality of ROS data)	195.3	95% Percentile Bootstrap UCL	201.8
93	95% BCA Bootstrap UCL	232.4	95% Bootstrap t UCL	263.3
94	95% H-UCL (Log ROS)	976.7		
95				
96	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
97	KM Mean (logged)	0.441	KM Geo Mean	1.554
98	KM SD (logged)	3.579	95% Critical H Value (KM-Log)	5.357
99	KM Standard Error of Mean (logged)	0.498	95% H-UCL (KM -Log)	6164
100	KM SD (logged)	3.579	95% Critical H Value (KM-Log)	5.357
101	KM Standard Error of Mean (logged)	0.498		
102				
103	**DL/2 Statistics**			
104	**DL/2 Normal**		**DL/2 Log-Transformed**	
105	Mean in Original Scale	129.5	Mean in Log Scale	2.375
106	SD in Original Scale	440.8	SD in Log Scale	2.449

	A	B	C	D	E	F	G	H	I	J	K	L
107			95% t UCL (Assumes normality)			200.9				95% H-Stat UCL		546.8
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Gamma Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114			95% KM Approximate Gamma UCL			240.1						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/19/2021 2:18:00 PM								
5	From File			USS Lead Sediment Wide_Depths.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	Arsenic											
12												
13	General Statistics											
14	Total Number of Observations					47	Number of Distinct Observations					46
15							Number of Missing Observations					312
16	Minimum					1.51	Mean					488.6
17	Maximum					5700	Median					36
18	SD					1020	Std. Error of Mean					148.7
19	Coefficient of Variation					2.087	Skewness					3.689
20												
21	Normal GOF Test											
22	Shapiro Wilk Test Statistic					0.532	Shapiro Wilk GOF Test					
23	5% Shapiro Wilk Critical Value					0.946	Data Not Normal at 5% Significance Level					
24	Lilliefors Test Statistic					0.316	Lilliefors GOF Test					
25	5% Lilliefors Critical Value					0.128	Data Not Normal at 5% Significance Level					
26	Data Not Normal at 5% Significance Level											
27												
28	Assuming Normal Distribution											
29	95% Normal UCL						95% UCLs (Adjusted for Skewness)					
30	95% Student's-t UCL					738.3	95% Adjusted-CLT UCL (Chen-1995)					818.8
31							95% Modified-t UCL (Johnson-1978)					751.6
32												
33	Gamma GOF Test											
34	A-D Test Statistic					2.193	Anderson-Darling Gamma GOF Test					
35	5% A-D Critical Value					0.856	Data Not Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic					0.198	Kolmogorov-Smirnov Gamma GOF Test					
37	5% K-S Critical Value					0.14	Data Not Gamma Distributed at 5% Significance Level					
38	Data Not Gamma Distributed at 5% Significance Level											
39												
40	Gamma Statistics											
41	k hat (MLE)					0.325	k star (bias corrected MLE)					0.318
42	Theta hat (MLE)					1504	Theta star (bias corrected MLE)					1535
43	nu hat (MLE)					30.54	nu star (bias corrected)					29.92
44	MLE Mean (bias corrected)					488.6	MLE Sd (bias corrected)					866
45							Approximate Chi Square Value (0.05)					18.43
46	Adjusted Level of Significance					0.0449	Adjusted Chi Square Value					18.14
47												
48	Assuming Gamma Distribution											
49	95% Approximate Gamma UCL (use when n>=50))					793.2	95% Adjusted Gamma UCL (use when n<50)					805.7
50												
51	Lognormal GOF Test											
52	Shapiro Wilk Test Statistic					0.906	Shapiro Wilk Lognormal GOF Test					
53	5% Shapiro Wilk Critical Value					0.946	Data Not Lognormal at 5% Significance Level					

	A–E	F	G–K	L
54	Lilliefors Test Statistic	0.156	**Lilliefors Lognormal GOF Test**	
55	5% Lilliefors Critical Value	0.128	Data Not Lognormal at 5% Significance Level	
56	**Data Not Lognormal at 5% Significance Level**			
57				
58	**Lognormal Statistics**			
59	Minimum of Logged Data	0.412	Mean of logged Data	4.096
60	Maximum of Logged Data	8.648	SD of logged Data	2.365
61				
62	**Assuming Lognormal Distribution**			
63	95% H-UCL	4128	90% Chebyshev (MVUE) UCL	2078
64	95% Chebyshev (MVUE) UCL	2652	97.5% Chebyshev (MVUE) UCL	3449
65	99% Chebyshev (MVUE) UCL	5015		
66				
67	**Nonparametric Distribution Free UCL Statistics**			
68	**Data do not follow a Discernible Distribution (0.05)**			
69				
70	**Nonparametric Distribution Free UCLs**			
71	95% CLT UCL	733.2	95% Jackknife UCL	738.3
72	95% Standard Bootstrap UCL	727.2	95% Bootstrap-t UCL	944.4
73	95% Hall's Bootstrap UCL	1691	95% Percentile Bootstrap UCL	765.4
74	95% BCA Bootstrap UCL	851		
75	90% Chebyshev(Mean, Sd) UCL	934.8	95% Chebyshev(Mean, Sd) UCL	1137
76	97.5% Chebyshev(Mean, Sd) UCL	1417	99% Chebyshev(Mean, Sd) UCL	1969
77				
78	**Suggested UCL to Use**			
79	97.5% Chebyshev (Mean, Sd) UCL	1417		
80				
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
82	Recommendations are based upon data size, data distribution, and skewness.			
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
85				

UCL Statistics for Data Sets with Non-Detects			
User Selected Options			
Date/Time of Computation	ProUCL 5.18/19/2021 2:18:26 PM		
From File	USS Lead Sediment Wide_Depths.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

Cadmium

General Statistics			
Total Number of Observations	47	Number of Distinct Observations	39
		Number of Missing Observations	312
Number of Detects	33	Number of Non-Detects	14
Number of Distinct Detects	29	Number of Distinct Non-Detects	11
Minimum Detect	0.16	Minimum Non-Detect	0.023
Maximum Detect	160	Maximum Non-Detect	0.73
Variance Detects	1194	Percent Non-Detects	29.79%
Mean Detects	23.73	SD Detects	34.56
Median Detects	13	CV Detects	1.457
Skewness Detects	2.507	Kurtosis Detects	7.147
Mean of Logged Detects	1.926	SD of Logged Detects	1.954
Normal GOF Test on Detects Only			
Shapiro Wilk Test Statistic	0.689	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.931	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.264	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.152	Detected Data Not Normal at 5% Significance Level	
Detected Data Not Normal at 5% Significance Level			
Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
KM Mean	16.69	KM Standard Error of Mean	4.517
KM SD	30.5	95% KM (BCA) UCL	24.2
95% KM (t) UCL	24.28	95% KM (Percentile Bootstrap) UCL	24.25
95% KM (z) UCL	24.12	95% KM Bootstrap t UCL	28.59
90% KM Chebyshev UCL	30.24	95% KM Chebyshev UCL	36.38
97.5% KM Chebyshev UCL	44.9	99% KM Chebyshev UCL	61.64
Gamma GOF Tests on Detected Observations Only			
A-D Test Statistic	0.443	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.81	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.11	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.162	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data appear Gamma Distributed at 5% Significance Level			
Gamma Statistics on Detected Data Only			
k hat (MLE)	0.51	k star (bias corrected MLE)	0.484
Theta hat (MLE)	46.49	Theta star (bias corrected MLE)	49.01
nu hat (MLE)	33.68	nu star (bias corrected)	31.96
Mean (detects)	23.73		
Gamma ROS Statistics using Imputed Non-Detects			

	A–E	F	G–K	L
54	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
55	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
56	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
57	This is especially true when the sample size is small.			
58	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
59	Minimum	0.01	Mean	16.66
60	Maximum	160	Median	1.5
61	SD	30.84	CV	1.851
62	k hat (MLE)	0.251	k star (bias corrected MLE)	0.249
63	Theta hat (MLE)	66.48	Theta star (bias corrected MLE)	66.97
64	nu hat (MLE)	23.56	nu star (bias corrected)	23.39
65	Adjusted Level of Significance (β)	0.0449		
66	Approximate Chi Square Value (23.39, α)	13.39	Adjusted Chi Square Value (23.39, β)	13.15
67	95% Gamma Approximate UCL (use when n>=50)	29.12	95% Gamma Adjusted UCL (use when n<50)	29.65
68				
69	**Estimates of Gamma Parameters using KM Estimates**			
70	Mean (KM)	16.69	SD (KM)	30.5
71	Variance (KM)	930	SE of Mean (KM)	4.517
72	k hat (KM)	0.3	k star (KM)	0.295
73	nu hat (KM)	28.16	nu star (KM)	27.7
74	theta hat (KM)	55.71	theta star (KM)	56.65
75	80% gamma percentile (KM)	25.48	90% gamma percentile (KM)	49.34
76	95% gamma percentile (KM)	76.8	99% gamma percentile (KM)	148.3
77				
78	**Gamma Kaplan-Meier (KM) Statistics**			
79	Approximate Chi Square Value (27.70, α)	16.69	Adjusted Chi Square Value (27.70, β)	16.42
80	95% Gamma Approximate KM-UCL (use when n>=50)	27.7	95% Gamma Adjusted KM-UCL (use when n<50)	28.15
81				
82	**Lognormal GOF Test on Detected Observations Only**			
83	Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk GOF Test**	
84	5% Shapiro Wilk Critical Value	0.931	Detected Data Not Lognormal at 5% Significance Level	
85	Lilliefors Test Statistic	0.152	**Lilliefors GOF Test**	
86	5% Lilliefors Critical Value	0.152	Detected Data Not Lognormal at 5% Significance Level	
87	**Detected Data Not Lognormal at 5% Significance Level**			
88				
89	**Lognormal ROS Statistics Using Imputed Non-Detects**			
90	Mean in Original Scale	16.71	Mean in Log Scale	0.75
91	SD in Original Scale	30.82	SD in Log Scale	2.475
92	95% t UCL (assumes normality of ROS data)	24.25	95% Percentile Bootstrap UCL	24.15
93	95% BCA Bootstrap UCL	27.89	95% Bootstrap t UCL	28.49
94	95% H-UCL (Log ROS)	214.7		
95				
96	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
97	KM Mean (logged)	0.479	KM Geo Mean	1.614
98	KM SD (logged)	2.816	95% Critical H Value (KM-Log)	4.764
99	KM Standard Error of Mean (logged)	0.434	95% H-UCL (KM -Log)	614.8
100	KM SD (logged)	2.816	95% Critical H Value (KM-Log)	4.764
101	KM Standard Error of Mean (logged)	0.434		
102				
103	**DL/2 Statistics**			
104	**DL/2 Normal**		**DL/2 Log-Transformed**	
105	Mean in Original Scale	16.72	Mean in Log Scale	0.78
106	SD in Original Scale	30.81	SD in Log Scale	2.475

	A	B	C	D	E	F	G	H	I	J	K	L
107	95% t UCL (Assumes normality)					24.27	95% H-Stat UCL					221
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Gamma Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114	a Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)					28.15						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

	A–E	F	G–K	L
1	UCL Statistics for Data Sets with Non-Detects			
2				
3	User Selected Options			
4	Date/Time of Computation	ProUCL 5.18/19/2021 2:16:52 PM		
5	From File	USS Lead Sediment Wide_Depths.xls		
6	Full Precision	OFF		
7	Confidence Coefficient	95%		
8	Number of Bootstrap Operations	2000		
9				
10	Lead			
11				
12	General Statistics			
13	Total Number of Observations	358	Number of Distinct Observations	265
14			Number of Missing Observations	3
15	Number of Detects	326	Number of Non-Detects	32
16	Number of Distinct Detects	254	Number of Distinct Non-Detects	18
17	Minimum Detect	1.9	Minimum Non-Detect	4
18	Maximum Detect	20000	Maximum Non-Detect	3200
19	Variance Detects	3047892	Percent Non-Detects	8.939%
20	Mean Detects	702.1	SD Detects	1746
21	Median Detects	202	CV Detects	2.487
22	Skewness Detects	6.543	Kurtosis Detects	57.58
23	Mean of Logged Detects	5.153	SD of Logged Detects	1.763
24				
25	Normal GOF Test on Detects Only			
26	Shapiro Wilk Test Statistic	0.419	Normal GOF Test on Detected Observations Only	
27	5% Shapiro Wilk P Value	0	Detected Data Not Normal at 5% Significance Level	
28	Lilliefors Test Statistic	0.344	Lilliefors GOF Test	
29	5% Lilliefors Critical Value	0.0495	Detected Data Not Normal at 5% Significance Level	
30	Detected Data Not Normal at 5% Significance Level			
31				
32	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
33	KM Mean	641.4	KM Standard Error of Mean	88.68
34	KM SD	1675	95% KM (BCA) UCL	801.4
35	95% KM (t) UCL	787.7	95% KM (Percentile Bootstrap) UCL	794.6
36	95% KM (z) UCL	787.3	95% KM Bootstrap t UCL	837.2
37	90% KM Chebyshev UCL	907.4	95% KM Chebyshev UCL	1028
38	97.5% KM Chebyshev UCL	1195	99% KM Chebyshev UCL	1524
39				
40	Gamma GOF Tests on Detected Observations Only			
41	A-D Test Statistic	8.724	Anderson-Darling GOF Test	
42	5% A-D Critical Value	0.832	Detected Data Not Gamma Distributed at 5% Significance Level	
43	K-S Test Statistic	0.136	Kolmogorov-Smirnov GOF	
44	5% K-S Critical Value	0.0535	Detected Data Not Gamma Distributed at 5% Significance Level	
45	Detected Data Not Gamma Distributed at 5% Significance Level			
46				
47	Gamma Statistics on Detected Data Only			
48	k hat (MLE)	0.46	k star (bias corrected MLE)	0.457
49	Theta hat (MLE)	1528	Theta star (bias corrected MLE)	1535
50	nu hat (MLE)	299.6	nu star (bias corrected)	298.2
51	Mean (detects)	702.1		
52				
53	Gamma ROS Statistics using Imputed Non-Detects			

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	639.3
Maximum	20000	Median	171.5
SD	1678	CV	2.624
k hat (MLE)	0.314	k star (bias corrected MLE)	0.313
Theta hat (MLE)	2036	Theta star (bias corrected MLE)	2041
nu hat (MLE)	224.9	nu star (bias corrected)	224.3
Adjusted Level of Significance (β)	0.0493		
Approximate Chi Square Value (224.32, α)	190.7	Adjusted Chi Square Value (224.32, β)	190.5
95% Gamma Approximate UCL (use when n>=50)	752.2	95% Gamma Adjusted UCL (use when n<50)	752.7

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	641.4	SD (KM)	1675
Variance (KM)	2805703	SE of Mean (KM)	88.68
k hat (KM)	0.147	k star (KM)	0.147
nu hat (KM)	105	nu star (KM)	105.4
theta hat (KM)	4374	theta star (KM)	4355
80% gamma percentile (KM)	687.6	90% gamma percentile (KM)	1897
95% gamma percentile (KM)	3543	99% gamma percentile (KM)	8337

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (105.44, α)	82.75	Adjusted Chi Square Value (105.44, β)	82.67
95% Gamma Approximate KM-UCL (use when n>=50)	817.3	95% Gamma Adjusted KM-UCL (use when n<50)	818.1

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.977	**Shapiro Wilk GOF Test**
5% Shapiro Wilk P Value	0.053	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.0604	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.0495	Detected Data Not Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	640.5	Mean in Log Scale	4.858
SD in Original Scale	1677	SD in Log Scale	1.954
95% t UCL (assumes normality of ROS data)	786.7	95% Percentile Bootstrap UCL	797.8
95% BCA Bootstrap UCL	825.9	95% Bootstrap t UCL	842.4
95% H-UCL (Log ROS)	1193		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	4.83	KM Geo Mean	125.3
KM SD (logged)	2.005	95% Critical H Value (KM-Log)	3.114
KM Standard Error of Mean (logged)	0.107	95% H-UCL (KM -Log)	1302
KM SD (logged)	2.005	95% Critical H Value (KM-Log)	3.114
KM Standard Error of Mean (logged)	0.107		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	645.5	Mean in Log Scale	4.859
SD in Original Scale	1678	SD in Log Scale	1.988

	A	B	C	D	E	F	G	H	I	J	K	L
107	95% t UCL (Assumes normality)					791.7	95% H-Stat UCL					1288
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114	KM H-UCL					1302						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

	A–E	F	G–K	L
1	**UCL Statistics for Data Sets with Non-Detects**			
2				
3	User Selected Options			
4	Date/Time of Computation	ProUCL 5.18/19/2021 2:18:53 PM		
5	From File	USS Lead Sediment Wide_Depths.xls		
6	Full Precision	OFF		
7	Confidence Coefficient	95%		
8	Number of Bootstrap Operations	2000		
9				
10	**Selenium**			
11				
12	**General Statistics**			
13	Total Number of Observations	28	Number of Distinct Observations	25
14			Number of Missing Observations	331
15	Number of Detects	15	Number of Non-Detects	13
16	Number of Distinct Detects	15	Number of Distinct Non-Detects	10
17	Minimum Detect	1.1	Minimum Non-Detect	0.085
18	Maximum Detect	43.9	Maximum Non-Detect	1.9
19	Variance Detects	155.1	Percent Non-Detects	46.43%
20	Mean Detects	18.49	SD Detects	12.45
21	Median Detects	16	CV Detects	0.674
22	Skewness Detects	0.615	Kurtosis Detects	-0.626
23	Mean of Logged Detects	2.623	SD of Logged Detects	0.926
24				
25	**Normal GOF Test on Detects Only**			
26	Shapiro Wilk Test Statistic	0.93	**Shapiro Wilk GOF Test**	
27	5% Shapiro Wilk Critical Value	0.881	Detected Data appear Normal at 5% Significance Level	
28	Lilliefors Test Statistic	0.193	**Lilliefors GOF Test**	
29	5% Lilliefors Critical Value	0.22	Detected Data appear Normal at 5% Significance Level	
30	**Detected Data appear Normal at 5% Significance Level**			
31				
32	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
33	KM Mean	9.979	KM Standard Error of Mean	2.483
34	KM SD	12.69	95% KM (BCA) UCL	14.12
35	95% KM (t) UCL	14.21	95% KM (Percentile Bootstrap) UCL	14.27
36	95% KM (z) UCL	14.06	95% KM Bootstrap t UCL	14.73
37	90% KM Chebyshev UCL	17.43	95% KM Chebyshev UCL	20.8
38	97.5% KM Chebyshev UCL	25.49	99% KM Chebyshev UCL	34.69
39				
40	**Gamma GOF Tests on Detected Observations Only**			
41	A-D Test Statistic	0.309	**Anderson-Darling GOF Test**	
42	5% A-D Critical Value	0.749	Detected data appear Gamma Distributed at 5% Significance Level	
43	K-S Test Statistic	0.12	**Kolmogorov-Smirnov GOF**	
44	5% K-S Critical Value	0.225	Detected data appear Gamma Distributed at 5% Significance Level	
45	**Detected data appear Gamma Distributed at 5% Significance Level**			
46				
47	**Gamma Statistics on Detected Data Only**			
48	k hat (MLE)	1.85	k star (bias corrected MLE)	1.525
49	Theta hat (MLE)	9.991	Theta star (bias corrected MLE)	12.12
50	nu hat (MLE)	55.51	nu star (bias corrected)	45.74
51	Mean (detects)	18.49		
52				
53	**Gamma ROS Statistics using Imputed Non-Detects**			

Row				
54	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
55	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
56	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
57	This is especially true when the sample size is small.			
58	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
59	Minimum	0.01	Mean	9.922
60	Maximum	43.9	Median	3.65
61	SD	12.97	CV	1.307
62	k hat (MLE)	0.246	k star (bias corrected MLE)	0.243
63	Theta hat (MLE)	40.34	Theta star (bias corrected MLE)	40.76
64	nu hat (MLE)	13.77	nu star (bias corrected)	13.63
65	Adjusted Level of Significance (β)	0.0404		
66	Approximate Chi Square Value (13.63, α)	6.319	Adjusted Chi Square Value (13.63, β)	6.012
67	95% Gamma Approximate UCL (use when n>=50)	21.4	95% Gamma Adjusted UCL (use when n<50)	22.49
68				
69	**Estimates of Gamma Parameters using KM Estimates**			
70	Mean (KM)	9.979	SD (KM)	12.69
71	Variance (KM)	161.1	SE of Mean (KM)	2.483
72	k hat (KM)	0.618	k star (KM)	0.576
73	nu hat (KM)	34.62	nu star (KM)	32.24
74	theta hat (KM)	16.14	theta star (KM)	17.33
75	80% gamma percentile (KM)	16.45	90% gamma percentile (KM)	26.19
76	95% gamma percentile (KM)	36.45	99% gamma percentile (KM)	61.33
77				
78	**Gamma Kaplan-Meier (KM) Statistics**			
79	Approximate Chi Square Value (32.24, α)	20.26	Adjusted Chi Square Value (32.24, β)	19.68
80	95% Gamma Approximate KM-UCL (use when n>=50)	15.88	95% Gamma Adjusted KM-UCL (use when n<50)	16.35
81				
82	**Lognormal GOF Test on Detected Observations Only**			
83	Shapiro Wilk Test Statistic	0.886	**Shapiro Wilk GOF Test**	
84	5% Shapiro Wilk Critical Value	0.881	Detected Data appear Lognormal at 5% Significance Level	
85	Lilliefors Test Statistic	0.15	**Lilliefors GOF Test**	
86	5% Lilliefors Critical Value	0.22	Detected Data appear Lognormal at 5% Significance Level	
87	**Detected Data appear Lognormal at 5% Significance Level**			
88				
89	**Lognormal ROS Statistics Using Imputed Non-Detects**			
90	Mean in Original Scale	10.68	Mean in Log Scale	1.624
91	SD in Original Scale	12.39	SD in Log Scale	1.297
92	95% t UCL (assumes normality of ROS data)	14.67	95% Percentile Bootstrap UCL	14.59
93	95% BCA Bootstrap UCL	15.32	95% Bootstrap t UCL	15.43
94	95% H-UCL (Log ROS)	23.91		
95				
96	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
97	KM Mean (logged)	0.352	KM Geo Mean	1.422
98	KM SD (logged)	2.568	95% Critical H Value (KM-Log)	4.794
99	KM Standard Error of Mean (logged)	0.517	95% H-UCL (KM -Log)	411.3
100	KM SD (logged)	2.568	95% Critical H Value (KM-Log)	4.794
101	KM Standard Error of Mean (logged)	0.517		
102				
103	**DL/2 Statistics**			
104	**DL/2 Normal**		**DL/2 Log-Transformed**	
105	Mean in Original Scale	10.16	Mean in Log Scale	0.925
106	SD in Original Scale	12.79	SD in Log Scale	2.112

	A	B	C	D	E	F	G	H	I	J	K	L
107			95% t UCL (Assumes normality)			14.27					95% H-Stat UCL	122.3
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Detected Data appear Normal Distributed at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114				95% KM (t) UCL		14.21						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

Calculation of Weighted 95% UCLs for a Combined Decision Unit (DU) from Several Smaller DUs Having Replicate Incremental Samples

Enter information in green highlighted cells. See the "Instructions" tab for detailed instructions.

Project ID:	0432213
Property/Sample ID:	USS Lead Superfund Site
Date of calculations:	6/2/2021
Calculator completed by:	John Blackman
Analyte:	Antimony
Analyte units:	mg/kg
DU metric units:	Acres
Notes:	

Click in green cell below to select from drop-down menu

DU size metric: area, volume, or depth interval: Area

Note: Assumes all replicates have the same number of increments

Number of increments per replicate: 30

Row #	IDs/Names of the Smaller DUs	DU Area (Acres)	Replicate field sample concentrations						Number of Replicates	Weight	Arithmetic Mean	SD of Replicates	calc'd SD of Increments	calc'd CV for the DU	Adj Factor	adj'd SD of Increments	adj'd CV for DU	SE of DU	95% UCL			
			Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6											Student's-t	Chebychev	CV of Increments	95% UCL
1	DU1	0.92	47	49	51				3	0.11	49.0	2.00	10.95	0.22	1.13	12.34	0.25	1.15	52.4	54.0	Low	52.4
2	DU2	1.38	39	20	27				3	0.17	28.7	9.61	52.63	1.84	1.29	67.79	2.36	5.55	44.9	52.8	Med	52.8
3	DU3	1.25	11	15	12				3	0.15	12.7	2.08	11.40	0.90	1.15	13.15	1.04	1.20	16.2	17.9	Low	16.2
4	DU4	0.81	15	11	16				3	0.10	14.0	2.65	14.49	1.04	1.17	16.89	1.21	1.53	18.5	20.7	Low	18.5
5	DU5	0.93	34	36	33				3	0.11	34.3	1.53	8.37	0.24	1.13	9.42	0.27	0.88	36.9	38.2	Low	36.9
6	DU6	0.77	26	28	30				3	0.09	28.0	2.00	10.95	0.39	1.13	12.35	0.44	1.15	31.4	33.0	Low	31.4
7	DU7	0.77	16	12	15				3	0.09	14.3	2.08	11.40	0.80	1.15	13.06	0.91	1.20	17.8	19.6	Low	17.8
8	DU8	1.42	46	44	48				3	0.17	46.0	2.00	10.95	0.24	1.13	12.34	0.27	1.15	49.4	51.0	Low	49.4
9																						
10																						
	Sum:	8.25	--	--	--	--	--	--	24	1.00	29.1	1.76	9.64	0.33	NA	12.23	0.42	1.02	32.1	33.5	Low	32.1

df by Welch-Satterthwaite approximation: **2.7**

Recommended UCL: **32.1** **mg/kg** >> Student's t 95% UCL

Note: Student's-t or Chebychev 95% UCL may be appropriate.

*Student's t UCL is acceptable if adj'd CV for DU is "Low" (e.g., CV ≤ 1.5). The User should consult the instructions for additional guidance on which 95% UCL is recommended for specific data sets.

Notes

adj'd	= adjusted	df	= degrees of freedom	SD	= arithmetic standard deviation
calc'd	= calculated	DU	= decision unit	SE	= standard error
CV	= coefficient of variation	RSD	= relative standard deviation	95% UCL	= 95% upper confidence limit for arithmetic mean

Calculation of Weighted 95% UCLs for a Combined Decision Unit (DU) from Several Smaller DUs Having Replicate Incremental Samples

Enter information in green highlighted cells. See the "Instructions" tab for detailed instructions.

Project ID:	0432213
Property/Sample ID:	USS Lead Superfund Site
Date of calculations:	6/2/2021
Calculator completed by:	John Blackman
Analyte:	Arsenic
Analyte units:	mg/kg
DU metric units:	Acres
Notes:	

Click in green cell below to select from drop-down menu

DU size metric: area, volume, or depth interval: Area

Note: Assumes all replicates have the same number of increments

Number of increments per replicate: 30

			Replicate field sample concentrations																	95% UCL			
Row #	IDs/Names of the Smaller DUs	DU Area (Acres)	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Number of Replicates	Weight	Arithmetic Mean	SD of Replicates	calc'd SD of Increments	calc'd CV for the DU	Adj Factor	adj'd SD of Increments	adj'd CV for DU	SE of DU	Student's-t	Chebychev	CV of Increments	95% UCL
1	DU1	0.92	320	390	390				3	0.11	366.7	40.41	221.36	0.60	1.13	251.10	0.68	23.33	434.8	468.4	Low	434.8
2	DU2	1.38	410	270	290				3	0.17	323.3	75.72	414.73	1.28	1.19	495.51	1.53	43.72	451.0	513.9	Med	513.9
3	DU3	1.25	240	290	260				3	0.15	263.3	25.17	137.84	0.52	1.13	155.92	0.59	14.53	305.8	326.7	Low	305.8
4	DU4	0.81	230	200	270				3	0.10	233.3	35.12	192.35	0.82	1.15	220.72	0.95	20.28	292.5	321.7	Low	292.5
5	DU5	0.93	550	590	570				3	0.11	570.0	20.00	109.54	0.19	1.13	123.42	0.22	11.55	603.7	620.3	Low	603.7
6	DU6	0.77	320	320	380				3	0.09	340.0	34.64	189.74	0.56	1.13	214.87	0.63	20.00	398.4	427.2	Low	398.4
7	DU7	0.77	200	180	180				3	0.09	186.7	11.55	63.25	0.34	1.13	71.27	0.38	6.67	206.1	215.7	Low	206.1
8	DU8	1.42	310	300	280				3	0.17	296.7	15.28	83.67	0.28	1.13	94.25	0.32	8.82	322.4	335.1	Low	322.4
9																						
10																						
	Sum:	8.25	--	--	--	--	--	--	24	1.00	320.2	15.33	83.99	0.26	NA	98.88	0.31	8.85	341.1	358.8	Low	341.1

df by Welch-Satterthwaite approximation: **3.9**

Recommended UCL: **341.1** **mg/kg** >> Student's t 95% UCL

Note: Student's-t or Chebychev 95% UCL may be appropriate.

*Student's t UCL is acceptable if adj'd CV for DU is "Low" (e.g., CV ≤ 1.5). The User should consult the instructions for additional guidance on which 95% UCL is recommended for specific data sets.

Notes

adj'd	= adjusted	df	= degrees of freedom	SD	= arithmetic standard deviation
calc'd	= calculated	DU	= decision unit	SE	= standard error
CV	= coefficient of variation	RSD	= relative standard deviation	95% UCL	= 95% upper confidence limit for arithmetic mean

Calculation of Weighted 95% UCLs for a Combined Decision Unit (DU) from Several Smaller DUs Having Replicate Incremental Samples

Enter information in green highlighted cells. See the "Instructions" tab for detailed instructions.

Project ID:	0432213
Property/Sample ID:	USS Lead Superfund Site
Date of calculations:	6/2/2021
Calculator completed by:	John Blackman
Analyte:	Cadmium
Analyte units:	mg/kg
DU metric units:	Acres
Notes:	

Click in green cell below to select from drop-down menu

DU size metric: area, volume, or depth interval: Area

Note: Assumes all replicates have the same number of increments

Number of increments per replicate: 30

			Replicate field sample concentrations																95% UCL			
Row #	IDs/Names of the Smaller DUs	DU Area (Acres)	Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Number of Replicates	Weight	Arithmetic Mean	SD of Replicates	calc'd SD of Increments	calc'd CV for the DU	Adj Factor	adj'd SD of Increments	adj'd CV for DU	SE of DU	Student's-t	Chebychev	CV of Increments	95% UCL
1	DU1	0.92	12	14	13				3	0.11	13.0	1.00	5.48	0.42	1.13	6.18	0.48	0.58	14.7	15.5	Low	14.7
2	DU2	1.38	6	4	4.6				3	0.17	4.9	1.03	5.62	1.16	1.18	6.63	1.36	0.59	6.6	7.4	Low	6.6
3	DU3	1.25	5.4	7.4	7				3	0.15	6.6	1.06	5.80	0.88	1.15	6.68	1.01	0.61	8.4	9.3	Low	8.4
4	DU4	0.81	7.3	7.3	7.9				3	0.10	7.5	0.35	1.90	0.25	1.13	2.14	0.28	0.20	8.1	8.4	Low	8.1
5	DU5	0.93	21	19	15				3	0.11	18.3	3.06	16.73	0.91	1.15	19.32	1.05	1.76	23.5	26.0	Low	23.5
6	DU6	0.77	56	57	65				3	0.09	59.3	4.93	27.02	0.46	1.13	30.51	0.51	2.85	67.6	71.7	Low	67.6
7	DU7	0.77	33	29	33				3	0.09	31.7	2.31	12.65	0.40	1.13	14.27	0.45	1.33	35.6	37.5	Low	35.6
8	DU8	1.42	64	56	58				3	0.17	59.3	4.16	22.80	0.38	1.13	25.71	0.43	2.40	66.4	69.8	Low	66.4
9																						
10																						
	Sum:	8.25	--	--	--	--	--	--	24	1.00	24.6	0.97	5.31	0.22	NA	6.02	0.24	0.56	25.7	27.0	Low	25.7

df by Welch-Satterthwaite approximation: **5.7**

Recommended UCL: **25.7** **mg/kg** >> Student's t 95% UCL

Note: Student's-t or Chebychev 95% UCL may be appropriate.

*Student's t UCL is acceptable if adj'd CV for DU is "Low" (e.g., CV ≤ 1.5). The User should consult the instructions for additional guidance on which 95% UCL is recommended for specific data sets.

Notes

adj'd	= adjusted	df	= degrees of freedom	SD	= arithmetic standard deviation
calc'd	= calculated	DU	= decision unit	SE	= standard error
CV	= coefficient of variation	RSD	= relative standard deviation	95% UCL	= 95% upper confidence limit for arithmetic mean

Calculation of Weighted 95% UCLs for a Combined Decision Unit (DU) from Several Smaller DUs Having Replicate Incremental Samples

Enter information in green highlighted cells. See the "Instructions" tab for detailed instructions.

Project ID:	0432213
Property/Sample ID:	USS Lead Superfund Site
Date of calculations:	6/2/2021
Calculator completed by:	John Blackman
Analyte:	Lead
Analyte units:	mg/kg
DU metric units:	Acres
Notes:	

Click in green cell below to select from drop-down menu

DU size metric: area, volume, or depth interval:	Area

Note: Assumes all replicates have the same number of increments

Number of increments per replicate:	30

Row #	IDs/Names of the Smaller DUs	DU Area (Acres)	Replicate field sample concentrations						Number of Replicates	Weight	Arithmetic Mean	SD of Replicates	calc'd SD of Increments	calc'd CV for the DU	Adj Factor	adj'd SD of Increments	adj'd CV for DU	SE of DU	95% UCL			
			Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6											Student's-t	Chebychev	CV of Increments	95% UCL
1	DU1	0.92	980	1100	1100				3	0.11	1060.0	69.28	379.47	0.36	1.13	427.73	0.40	40.00	1176.8	1234.4	Low	1176.8
2	DU2	1.38	710	390	450				3	0.17	516.7	170.10	931.67	1.80	1.28	1193.80	2.31	98.21	803.4	944.7	Med	944.7
3	DU3	1.25	260	340	400				3	0.15	333.3	70.24	384.71	1.15	1.18	453.48	1.36	40.55	451.7	510.1	Low	451.7
4	DU4	0.81	350	290	420				3	0.10	353.3	65.06	356.37	1.01	1.16	414.54	1.17	37.56	463.0	517.1	Low	463.0
5	DU5	0.93	660	800	640				3	0.11	700.0	87.18	477.49	0.68	1.14	543.53	0.78	50.33	847.0	919.4	Low	847.0
6	DU6	0.77	680	890	950				3	0.09	840.0	141.77	776.53	0.92	1.16	897.28	1.07	81.85	1079.0	1196.8	Low	1079.0
7	DU7	0.77	640	590	690				3	0.09	640.0	50.00	273.86	0.43	1.13	309.03	0.48	28.87	724.3	765.8	Low	724.3
8	DU8	1.42	1800	1500	1500				3	0.17	1600.0	173.21	948.68	0.59	1.13	1075.70	0.67	100.00	1892.0	2035.9	Low	1892.0
9																						
10																						
	Sum:	8.25	--	--	--	--	--	--	24	1.00	776.4	46.93	257.02	0.33	NA	307.49	0.40	27.09	829.1	894.5	Low	829.1

df by Welch-Satterthwaite approximation:	**6.4**

Recommended UCL: **829.1** **mg/kg** >> Student's t 95% UCL

Note: Student's-t or Chebychev 95% UCL may be appropriate.

*Student's t UCL is acceptable if adj'd CV for DU is "Low" (e.g., CV ≤ 1.5). The User should consult the instructions for additional guidance on which 95% UCL is recommended for specific data sets.

Notes

adj'd	= adjusted	df	= degrees of freedom	SD	= arithmetic standard deviation
calc'd	= calculated	DU	= decision unit	SE	= standard error
CV	= coefficient of variation	RSD	= relative standard deviation	95% UCL	= 95% upper confidence limit for arithmetic mean

Calculation of Weighted 95% UCLs for a Combined Decision Unit (DU) from Several Smaller DUs Having Replicate Incremental Samples

Enter information in green highlighted cells. See the "Instructions" tab for detailed instructions.

Project ID:	0432213
Property/Sample ID:	USS Lead Superfund Site
Date of calculations:	6/2/2021
Calculator completed by:	John Blackman
Analyte:	Selenium
Analyte units:	mg/kg
DU metric units:	Acres
Notes:	

Click in green cell below to select from drop-down menu

DU size metric: area, volume, or depth interval: Area

Note: Assumes all replicates have the same number of increments

Number of increments per replicate: 30

Row #	IDs/Names of the Smaller DUs	DU Area (Acres)	Replicate field sample concentrations Rep 1	Rep 2	Rep 3	Rep 4	Rep 5	Rep 6	Number of Replicates	Weight	Arithmetic Mean	SD of Replicates	calc'd SD of Increments	calc'd CV for the DU	Adj Factor	adj'd SD of Increments	adj'd CV for DU	SE of DU	95% UCL Student's-t	Chebychev	CV of Increments	95% UCL
1	DU1	0.92	2.8	3.3	3.2				3	0.11	3.1	0.26	1.45	0.47	1.13	1.64	0.53	0.15	3.5	3.8	Low	3.5
2	DU2	1.38	7.4	4.3	5				3	0.17	5.6	1.63	8.91	1.60	1.24	11.07	1.99	0.94	8.3	9.7	Med	9.7
3	DU3	1.25	5.3	7.4	6.2				3	0.15	6.3	1.05	5.77	0.92	1.15	6.66	1.06	0.61	8.1	9.0	Low	8.1
4	DU4	0.81	5.3	4.1	5.6				3	0.10	5.0	0.79	4.35	0.87	1.15	5.00	1.00	0.46	6.3	7.0	Low	6.3
5	DU5	0.93	10	11	10				3	0.11	10.3	0.58	3.16	0.31	1.13	3.56	0.34	0.33	11.3	11.8	Low	11.3
6	DU6	0.77	6.1	5.8	6.6				3	0.09	6.2	0.40	2.21	0.36	1.13	2.50	0.40	0.23	6.8	7.2	Low	6.8
7	DU7	0.77	3.7	3.1	3.4				3	0.09	3.4	0.30	1.64	0.48	1.13	1.86	0.55	0.17	3.9	4.2	Low	3.9
8	DU8	1.42	6	6.1	5.4				3	0.17	5.8	0.38	2.07	0.36	1.13	2.34	0.40	0.22	6.5	6.8	Low	6.5
9																						
10																						
Sum:		8.25	--	--	--	--	--	--	24	1.00	5.8	0.34	1.89	0.33	NA	2.28	0.40	0.20	6.2	6.6	Low	6.2

df by Welch-Satterthwaite approximation: **4.3**

Recommended UCL: **6.2** **mg/kg** >> Student's t 95% UCL

Note: Student's-t or Chebychev 95% UCL may be appropriate.

*Student's t UCL is acceptable if adj'd CV for DU is "Low" (e.g., CV ≤ 1.5). The User should consult the instructions for additional guidance on which 95% UCL is recommended for specific data sets.

Notes

adj'd	= adjusted	df	= degrees of freedom	SD	= arithmetic standard deviation
calc'd	= calculated	DU	= decision unit	SE	= standard error
CV	= coefficient of variation	RSD	= relative standard deviation	95% UCL	= 95% upper confidence limit for arithmetic mean

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/13/2021 1:40:18 PM
From File	USS Lead SW Wide_ug_L-TOTAL_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Antimony

General Statistics

Total Number of Observations	13	Number of Distinct Observations	12
Number of Detects	10	Number of Non-Detects	3
Number of Distinct Detects	9	Number of Distinct Non-Detects	3
Minimum Detect	7	Minimum Non-Detect	2.7
Maximum Detect	46	Maximum Non-Detect	6.4
Variance Detects	196.1	Percent Non-Detects	23.08%
Mean Detects	20.95	SD Detects	14
Median Detects	18	CV Detects	0.668
Skewness Detects	0.891	Kurtosis Detects	-0.426
Mean of Logged Detects	2.838	SD of Logged Detects	0.68

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.873	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	16.74	KM Standard Error of Mean	4.082
KM SD	13.96	95% KM (BCA) UCL	23.84
95% KM (t) UCL	24.01	95% KM (Percentile Bootstrap) UCL	23.61
95% KM (z) UCL	23.45	95% KM Bootstrap t UCL	26.2
90% KM Chebyshev UCL	28.98	95% KM Chebyshev UCL	34.53
97.5% KM Chebyshev UCL	42.23	99% KM Chebyshev UCL	57.35

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.344	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.165	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.269	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.605	k star (bias corrected MLE)	1.89
Theta hat (MLE)	8.042	Theta star (bias corrected MLE)	11.08
nu hat (MLE)	52.1	nu star (bias corrected)	37.8
Mean (detects)	20.95		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

	A	B	C	D	E	F	G	H	I	J	K	L
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
56	This is especially true when the sample size is small.											
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
58					Minimum	0.01					Mean	16.12
59					Maximum	46					Median	11
60					SD	15.21					CV	0.944
61					k hat (MLE)	0.397					k star (bias corrected MLE)	0.357
62					Theta hat (MLE)	40.6					Theta star (bias corrected MLE)	45.19
63					nu hat (MLE)	10.32					nu star (bias corrected)	9.273
64					Adjusted Level of Significance (β)	0.0301						
65					Approximate Chi Square Value (9.27, α)	3.493					Adjusted Chi Square Value (9.27, β)	3.006
66					95% Gamma Approximate UCL (use when n>=50)	42.79					95% Gamma Adjusted UCL (use when n<50)	49.73
67												
68	**Estimates of Gamma Parameters using KM Estimates**											
69					Mean (KM)	16.74					SD (KM)	13.96
70					Variance (KM)	194.9					SE of Mean (KM)	4.082
71					k hat (KM)	1.437					k star (KM)	1.157
72					nu hat (KM)	37.37					nu star (KM)	30.08
73					theta hat (KM)	11.64					theta star (KM)	14.47
74					80% gamma percentile (KM)	26.6					90% gamma percentile (KM)	37.18
75					95% gamma percentile (KM)	47.64					99% gamma percentile (KM)	71.69
76												
77	**Gamma Kaplan-Meier (KM) Statistics**											
78					Approximate Chi Square Value (30.08, α)	18.56					Adjusted Chi Square Value (30.08, β)	17.28
79					95% Gamma Approximate KM-UCL (use when n>=50)	27.13					95% Gamma Adjusted KM-UCL (use when n<50)	29.14
80												
81	**Lognormal GOF Test on Detected Observations Only**											
82					Shapiro Wilk Test Statistic	0.934	**Shapiro Wilk GOF Test**					
83					5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level					
84					Lilliefors Test Statistic	0.145	**Lilliefors GOF Test**					
85					5% Lilliefors Critical Value	0.262	Detected Data appear Lognormal at 5% Significance Level					
86	**Detected Data appear Lognormal at 5% Significance Level**											
87												
88	**Lognormal ROS Statistics Using Imputed Non-Detects**											
89					Mean in Original Scale	16.89					Mean in Log Scale	2.462
90					SD in Original Scale	14.38					SD in Log Scale	0.926
91					95% t UCL (assumes normality of ROS data)	23.99					95% Percentile Bootstrap UCL	23.73
92					95% BCA Bootstrap UCL	24.64					95% Bootstrap t UCL	26.75
93					95% H-UCL (Log ROS)	37.27						
94												
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
96					KM Mean (logged)	2.412					KM Geo Mean	11.16
97					KM SD (logged)	0.961					95% Critical H Value (KM-Log)	2.781
98					KM Standard Error of Mean (logged)	0.281					95% H-UCL (KM -Log)	38.32
99					KM SD (logged)	0.961					95% Critical H Value (KM-Log)	2.781
100					KM Standard Error of Mean (logged)	0.281						
101												
102	**DL/2 Statistics**											
103	**DL/2 Normal**						**DL/2 Log-Transformed**					
104					Mean in Original Scale	16.7					Mean in Log Scale	2.38
105					SD in Original Scale	14.58					SD in Log Scale	1.069
106					95% t UCL (Assumes normality)	23.9					95% H-Stat UCL	47.79

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Normal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113					95% KM (t) UCL	24.01						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Uncensored Full Data Sets											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/13/2021 1:42:06 PM								
5	From File			USS Lead SW Wide_ug_L-TOTAL_a.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10												
11	**Arsenic**											
12												
13	**General Statistics**											
14	Total Number of Observations					13	Number of Distinct Observations					12
15							Number of Missing Observations					0
16	Minimum					9.9	Mean					69.53
17	Maximum					300	Median					47
18	SD					83.52	Std. Error of Mean					23.16
19	Coefficient of Variation					1.201	Skewness					2.059
20												
21	**Normal GOF Test**											
22	Shapiro Wilk Test Statistic					0.739	**Shapiro Wilk GOF Test**					
23	5% Shapiro Wilk Critical Value					0.866	Data Not Normal at 5% Significance Level					
24	Lilliefors Test Statistic					0.24	**Lilliefors GOF Test**					
25	5% Lilliefors Critical Value					0.234	Data Not Normal at 5% Significance Level					
26	**Data Not Normal at 5% Significance Level**											
27												
28	**Assuming Normal Distribution**											
29	**95% Normal UCL**						**95% UCLs (Adjusted for Skewness)**					
30	95% Student's-t UCL					110.8	95% Adjusted-CLT UCL (Chen-1995)					121.8
31							95% Modified-t UCL (Johnson-1978)					113
32												
33	**Gamma GOF Test**											
34	A-D Test Statistic					0.559	**Anderson-Darling Gamma GOF Test**					
35	5% A-D Critical Value					0.759	Detected data appear Gamma Distributed at 5% Significance Level					
36	K-S Test Statistic					0.206	**Kolmogorov-Smirnov Gamma GOF Test**					
37	5% K-S Critical Value					0.243	Detected data appear Gamma Distributed at 5% Significance Level					
38	**Detected data appear Gamma Distributed at 5% Significance Level**											
39												
40	**Gamma Statistics**											
41	k hat (MLE)					0.961	k star (bias corrected MLE)					0.79
42	Theta hat (MLE)					72.39	Theta star (bias corrected MLE)					88
43	nu hat (MLE)					24.97	nu star (bias corrected)					20.54
44	MLE Mean (bias corrected)					69.53	MLE Sd (bias corrected)					78.22
45							Approximate Chi Square Value (0.05)					11.25
46	Adjusted Level of Significance					0.0301	Adjusted Chi Square Value					10.28
47												
48	**Assuming Gamma Distribution**											
49	95% Approximate Gamma UCL (use when n>=50)					126.9	95% Adjusted Gamma UCL (use when n<50)					138.9
50												
51	**Lognormal GOF Test**											
52	Shapiro Wilk Test Statistic					0.905	**Shapiro Wilk Lognormal GOF Test**					
53	5% Shapiro Wilk Critical Value					0.866	Data appear Lognormal at 5% Significance Level					

	A	B	C	D	E	F	G	H	I	J	K	L
54					Lilliefors Test Statistic	0.207	**Lilliefors Lognormal GOF Test**					
55					5% Lilliefors Critical Value	0.234	Data appear Lognormal at 5% Significance Level					
56	**Data appear Lognormal at 5% Significance Level**											
57												
58	**Lognormal Statistics**											
59					Minimum of Logged Data	2.293					Mean of logged Data	3.638
60					Maximum of Logged Data	5.704					SD of logged Data	1.158
61												
62	**Assuming Lognormal Distribution**											
63					95% H-UCL	211.8					90% Chebyshev (MVUE) UCL	141.4
64					95% Chebyshev (MVUE) UCL	174.3					97.5% Chebyshev (MVUE) UCL	219.9
65					99% Chebyshev (MVUE) UCL	309.4						
66												
67	**Nonparametric Distribution Free UCL Statistics**											
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**											
69												
70	**Nonparametric Distribution Free UCLs**											
71					95% CLT UCL	107.6					95% Jackknife UCL	110.8
72					95% Standard Bootstrap UCL	106.4					95% Bootstrap-t UCL	152.5
73					95% Hall's Bootstrap UCL	291.8					95% Percentile Bootstrap UCL	110.6
74					95% BCA Bootstrap UCL	121.8						
75					90% Chebyshev(Mean, Sd) UCL	139					95% Chebyshev(Mean, Sd) UCL	170.5
76					97.5% Chebyshev(Mean, Sd) UCL	214.2					99% Chebyshev(Mean, Sd) UCL	300
77												
78	**Suggested UCL to Use**											
79					95% Adjusted Gamma UCL	138.9						
80												
81	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
82	Recommendations are based upon data size, data distribution, and skewness.											
83	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
84	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
85												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/13/2021 1:42:48 PM
From File	USS Lead SW Wide_ug_L-TOTAL_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cadmium

General Statistics

Total Number of Observations	13	Number of Distinct Observations	4
Number of Detects	4	Number of Non-Detects	9
Number of Distinct Detects	2	Number of Distinct Non-Detects	2
Minimum Detect	0.95	Minimum Non-Detect	0.71
Maximum Detect	1.2	Maximum Non-Detect	0.94
Variance Detects	0.0156	Percent Non-Detects	69.23%
Mean Detects	1.138	SD Detects	0.125
Median Detects	1.2	CV Detects	0.11
Skewness Detects	-2	Kurtosis Detects	4
Mean of Logged Detects	0.124	SD of Logged Detects	0.117

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.63	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.441	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.842	KM Standard Error of Mean	0.0661
KM SD	0.206	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.959	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.95	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	1.04	95% KM Chebyshev UCL	1.129
97.5% KM Chebyshev UCL	1.254	99% KM Chebyshev UCL	1.499

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.96	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.657	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.468	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.394	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	101.9	k star (bias corrected MLE)	25.64
Theta hat (MLE)	0.0112	Theta star (bias corrected MLE)	0.0444
nu hat (MLE)	815.2	nu star (bias corrected)	205.1
Mean (detects)	1.138		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
For such situations, GROS method may yield incorrect values of UCLs and BTVs			
This is especially true when the sample size is small.			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.644	Mean	0.905
Maximum	1.2	Median	0.874
SD	0.194	CV	0.214
k hat (MLE)	24.34	k star (bias corrected MLE)	18.77
Theta hat (MLE)	0.0372	Theta star (bias corrected MLE)	0.0482
nu hat (MLE)	632.7	nu star (bias corrected)	488.1
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (488.06, α)	437.8	Adjusted Chi Square Value (488.06, β)	431.1
95% Gamma Approximate UCL (use when n>=50)	1.008	95% Gamma Adjusted UCL (use when n<50)	N/A
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	0.842	SD (KM)	0.206
Variance (KM)	0.0425	SE of Mean (KM)	0.0661
k hat (KM)	16.65	k star (KM)	12.86
nu hat (KM)	432.9	nu star (KM)	334.3
theta hat (KM)	0.0505	theta star (KM)	0.0654
80% gamma percentile (KM)	1.03	90% gamma percentile (KM)	1.153
95% gamma percentile (KM)	1.261	99% gamma percentile (KM)	1.481
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (334.31, α)	292.9	Adjusted Chi Square Value (334.31, β)	287.4
95% Gamma Approximate KM-UCL (use when n>=50)	0.96	95% Gamma Adjusted KM-UCL (use when n<50)	0.979
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.63	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.441	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.375	Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	0.914	Mean in Log Scale	-0.108
SD in Original Scale	0.182	SD in Log Scale	0.193
95% t UCL (assumes normality of ROS data)	1.004	95% Percentile Bootstrap UCL	1
95% BCA Bootstrap UCL	0.997	95% Bootstrap t UCL	1.023
95% H-UCL (Log ROS)	1.013		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	-0.199	KM Geo Mean	0.82
KM SD (logged)	0.222	95% Critical H Value (KM-Log)	1.847
KM Standard Error of Mean (logged)	0.0712	95% H-UCL (KM -Log)	0.946
KM SD (logged)	0.222	95% Critical H Value (KM-Log)	1.847
KM Standard Error of Mean (logged)	0.0712		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	0.64	Mean in Log Scale	-0.571
SD in Original Scale	0.354	SD in Log Scale	0.5
95% t UCL (Assumes normality)	0.815	95% H-Stat UCL	0.869

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Data do not follow a Discernible Distribution at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	95% KM (t) UCL					0.959	KM H-UCL					0.946
114	95% KM (BCA) UCL					N/A						
115	**Warning: One or more Recommended UCL(s) not available!**											
116												
117	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
118	Recommendations are based upon data size, data distribution, and skewness.											
119	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
120	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
121												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/13/2021 1:39:45 PM
From File	USS Lead SW Wide_ug_L-TOTAL_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Lead

General Statistics

Total Number of Observations	13	Number of Distinct Observations	7
Number of Detects	4	Number of Non-Detects	9
Number of Distinct Detects	4	Number of Distinct Non-Detects	3
Minimum Detect	2.9	Minimum Non-Detect	2.5
Maximum Detect	19	Maximum Non-Detect	82
Variance Detects	54.11	Percent Non-Detects	69.23%
Mean Detects	8.1	SD Detects	7.356
Median Detects	5.25	CV Detects	0.908
Skewness Detects	1.852	Kurtosis Detects	3.565
Mean of Logged Detects	1.83	SD of Logged Detects	0.795

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.77	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.383	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data Not Normal at 5% Significance Level

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	4.367	KM Standard Error of Mean	1.509
KM SD	4.527	95% KM (BCA) UCL	N/A
95% KM (t) UCL	7.056	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	6.849	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	8.894	95% KM Chebyshev UCL	10.94
97.5% KM Chebyshev UCL	13.79	99% KM Chebyshev UCL	19.38

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.462	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.66	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.352	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.398	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.063	k star (bias corrected MLE)	0.682
Theta hat (MLE)	3.927	Theta star (bias corrected MLE)	11.87
nu hat (MLE)	16.5	nu star (bias corrected)	5.459
Mean (detects)	8.1		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	2.499
59	Maximum	19	Median	0.01
60	SD	5.351	CV	2.141
61	k hat (MLE)	0.207	k star (bias corrected MLE)	0.21
62	Theta hat (MLE)	12.09	Theta star (bias corrected MLE)	11.88
63	nu hat (MLE)	5.376	nu star (bias corrected)	5.468
64	Adjusted Level of Significance (β)	0.0301		
65	Approximate Chi Square Value (5.47, α)	1.374	Adjusted Chi Square Value (5.47, β)	1.106
66	95% Gamma Approximate UCL (use when n>=50)	9.943	95% Gamma Adjusted UCL (use when n<50)	N/A
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	4.367	SD (KM)	4.527
70	Variance (KM)	20.5	SE of Mean (KM)	1.509
71	k hat (KM)	0.93	k star (KM)	0.767
72	nu hat (KM)	24.19	nu star (KM)	19.94
73	theta hat (KM)	4.694	theta star (KM)	5.694
74	80% gamma percentile (KM)	7.151	90% gamma percentile (KM)	10.73
75	95% gamma percentile (KM)	14.38	99% gamma percentile (KM)	23.04
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (19.94, α)	10.81	Adjusted Chi Square Value (19.94, β)	9.86
79	95% Gamma Approximate KM-UCL (use when n>=50)	8.057	95% Gamma Adjusted KM-UCL (use when n<50)	8.83
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.304	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level	
86	**Detected Data appear Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	2.815	Mean in Log Scale	-0.202
90	SD in Original Scale	5.202	SD in Log Scale	1.664
91	95% t UCL (assumes normality of ROS data)	5.386	95% Percentile Bootstrap UCL	5.517
92	95% BCA Bootstrap UCL	6.87	95% Bootstrap t UCL	9.712
93	95% H-UCL (Log ROS)	23.17		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	1.221	KM Geo Mean	3.39
97	KM SD (logged)	0.586	95% Critical H Value (KM-Log)	2.217
98	KM Standard Error of Mean (logged)	0.195	95% H-UCL (KM -Log)	5.86
99	KM SD (logged)	0.586	95% Critical H Value (KM-Log)	2.217
100	KM Standard Error of Mean (logged)	0.195		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	6.438	Mean in Log Scale	1.004
105	SD in Original Scale	11.48	SD in Log Scale	1.173
106	95% t UCL (Assumes normality)	12.11	95% H-Stat UCL	15.8

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Approximate Normal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113					95% KM (t) UCL	7.056						
114												
115	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
116	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
117												
118	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
119	Recommendations are based upon data size, data distribution, and skewness.											
120	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
121	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
122												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/13/2021 1:43:25 PM								
5	From File			USS Lead SW Wide_ug_L-TOTAL_a.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	**Selenium**											
11												
12	**General Statistics**											
13	Total Number of Observations					13	Number of Distinct Observations					3
14	Number of Detects					1	Number of Non-Detects					12
15	Number of Distinct Detects					1	Number of Distinct Non-Detects					3
16												
17	**Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!**											
18	**It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).**											
19												
20	**The data set for variable Selenium was not processed!**											
21												
22												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/14/2021 8:08:36 PM
From File	USS Lead Wide GW 6.0_trb - OU2.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Sb-T

General Statistics

Total Number of Observations	27	Number of Distinct Observations	20
Number of Detects	21	Number of Non-Detects	6
Number of Distinct Detects	18	Number of Distinct Non-Detects	2
Minimum Detect	0.45	Minimum Non-Detect	0.38
Maximum Detect	170	Maximum Non-Detect	6
Variance Detects	2176	Percent Non-Detects	22.22%
Mean Detects	58.36	SD Detects	46.64
Median Detects	32	CV Detects	0.799
Skewness Detects	0.719	Kurtosis Detects	-0.332
Mean of Logged Detects	3.564	SD of Logged Detects	1.335

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.895	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.238	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	45.48	KM Standard Error of Mean	9.233
KM SD	46.82	95% KM (BCA) UCL	61.35
95% KM (t) UCL	61.23	95% KM (Percentile Bootstrap) UCL	61.63
95% KM (z) UCL	60.67	95% KM Bootstrap t UCL	62.77
90% KM Chebyshev UCL	73.18	95% KM Chebyshev UCL	85.73
97.5% KM Chebyshev UCL	103.1	99% KM Chebyshev UCL	137.3

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.57	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.767	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.17	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.194	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.132	k star (bias corrected MLE)	1.002
Theta hat (MLE)	51.54	Theta star (bias corrected MLE)	58.22
nu hat (MLE)	47.56	nu star (bias corrected)	42.1
Mean (detects)	58.36		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	45.69
Maximum	170	Median	27
SD	47.52	CV	1.04
k hat (MLE)	0.402	k star (bias corrected MLE)	0.382
Theta hat (MLE)	113.7	Theta star (bias corrected MLE)	119.6
nu hat (MLE)	21.7	nu star (bias corrected)	20.63
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (20.63, α)	11.31	Adjusted Chi Square Value (20.63, β)	10.87
95% Gamma Approximate UCL (use when n>=50)	83.3	95% Gamma Adjusted UCL (use when n<50)	86.67

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	45.48	SD (KM)	46.82
Variance (KM)	2192	SE of Mean (KM)	9.233
k hat (KM)	0.944	k star (KM)	0.864
nu hat (KM)	50.96	nu star (KM)	46.63
theta hat (KM)	48.19	theta star (KM)	52.67
80% gamma percentile (KM)	73.99	90% gamma percentile (KM)	108.6
95% gamma percentile (KM)	143.6	99% gamma percentile (KM)	225.7

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (46.63, α)	31.96	Adjusted Chi Square Value (46.63, β)	31.18
95% Gamma Approximate KM-UCL (use when n>=50)	66.36	95% Gamma Adjusted KM-UCL (use when n<50)	68.01

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.829	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.908	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.192	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.188	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	46.04	Mean in Log Scale	2.978
SD in Original Scale	47.18	SD in Log Scale	1.638
95% t UCL (assumes normality of ROS data)	61.52	95% Percentile Bootstrap UCL	61.4
95% BCA Bootstrap UCL	63.55	95% Bootstrap t UCL	63.79
95% H-UCL (Log ROS)	228.2		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.573	KM Geo Mean	13.1
KM SD (logged)	2.182	95% Critical H Value (KM-Log)	4.341
KM Standard Error of Mean (logged)	0.431	95% H-UCL (KM -Log)	908.2
KM SD (logged)	2.182	95% Critical H Value (KM-Log)	4.341
KM Standard Error of Mean (logged)	0.431		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	45.95	Mean in Log Scale	2.914
SD in Original Scale	47.26	SD in Log Scale	1.775
95% t UCL (Assumes normality)	61.47	95% H-Stat UCL	319.9

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Gamma Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	95% KM Adjusted Gamma UCL					68.01	95% GROS Adjusted Gamma UCL					86.67
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/14/2021 8:10:25 PM
From File	USS Lead Wide GW 6.0_trb - OU2.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

As-T

General Statistics

Total Number of Observations	27	Number of Distinct Observations	24
Number of Detects	25	Number of Non-Detects	2
Number of Distinct Detects	23	Number of Distinct Non-Detects	1
Minimum Detect	0.62	Minimum Non-Detect	3.7
Maximum Detect	23000	Maximum Non-Detect	3.7
Variance Detects	34923447	Percent Non-Detects	7.407%
Mean Detects	1947	SD Detects	5910
Median Detects	74	CV Detects	3.034
Skewness Detects	3.311	Kurtosis Detects	9.876
Mean of Logged Detects	4.581	SD of Logged Detects	2.616

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.355	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.918	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.464	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.173	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1803	KM Standard Error of Mean	1099
KM SD	5595	95% KM (BCA) UCL	4085
95% KM (t) UCL	3678	95% KM (Percentile Bootstrap) UCL	3612
95% KM (z) UCL	3611	95% KM Bootstrap t UCL	31639
90% KM Chebyshev UCL	5100	95% KM Chebyshev UCL	6593
97.5% KM Chebyshev UCL	8666	99% KM Chebyshev UCL	12738

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.138	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.881	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.24	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.192	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.239	k star (bias corrected MLE)	0.237
Theta hat (MLE)	8149	Theta star (bias corrected MLE)	8218
nu hat (MLE)	11.95	nu star (bias corrected)	11.85
Mean (detects)	1947		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
For such situations, GROS method may yield incorrect values of UCLs and BTVs			
This is especially true when the sample size is small.			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	1803
Maximum	23000	Median	63
SD	5702	CV	3.162
k hat (MLE)	0.204	k star (bias corrected MLE)	0.206
Theta hat (MLE)	8841	Theta star (bias corrected MLE)	8754
nu hat (MLE)	11.01	nu star (bias corrected)	11.12
Adjusted Level of Significance (β)	0.0401		
Approximate Chi Square Value (11.12, α)	4.656	Adjusted Chi Square Value (11.12, β)	4.39
95% Gamma Approximate UCL (use when n>=50)	4308	95% Gamma Adjusted UCL (use when n<50)	4569
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	1803	SD (KM)	5595
Variance (KM)	31302962	SE of Mean (KM)	1099
k hat (KM)	0.104	k star (KM)	0.117
nu hat (KM)	5.61	nu star (KM)	6.32
theta hat (KM)	17359	theta star (KM)	15409
80% gamma percentile (KM)	1537	90% gamma percentile (KM)	5073
95% gamma percentile (KM)	10322	99% gamma percentile (KM)	26444
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (6.32, α)	1.805	Adjusted Chi Square Value (6.32, β)	1.656
95% Gamma Approximate KM-UCL (use when n>=50)	6312	95% Gamma Adjusted KM-UCL (use when n<50)	6882
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.972	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.918	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0952	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.173	Detected Data appear Lognormal at 5% Significance Level	
Detected Data appear Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1803	Mean in Log Scale	4.226
SD in Original Scale	5701	SD in Log Scale	2.823
95% t UCL (assumes normality of ROS data)	3675	95% Percentile Bootstrap UCL	3529
95% BCA Bootstrap UCL	4446	95% Bootstrap t UCL	31135
95% H-UCL (Log ROS)	74797		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	4.227	KM Geo Mean	68.53
KM SD (logged)	2.766	95% Critical H Value (KM-Log)	5.339
KM Standard Error of Mean (logged)	0.544	95% H-UCL (KM -Log)	56956
KM SD (logged)	2.766	95% Critical H Value (KM-Log)	5.339
KM Standard Error of Mean (logged)	0.544		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1803	Mean in Log Scale	4.287
SD in Original Scale	5701	SD in Log Scale	2.727
95% t UCL (Assumes normality)	3675	95% H-Stat UCL	50314

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113					99% KM (Chebyshev) UCL	12738						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/14/2021 8:12:51 PM								
5	From File			USS Lead Wide GW 6.0_trb - OU2.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	Cd-T											
11												
12	General Statistics											
13	Total Number of Observations					27	Number of Distinct Observations					21
14	Number of Detects					23	Number of Non-Detects					4
15	Number of Distinct Detects					20	Number of Distinct Non-Detects					1
16	Minimum Detect					0.83	Minimum Non-Detect					0.22
17	Maximum Detect					210	Maximum Non-Detect					0.22
18	Variance Detects					3261	Percent Non-Detects					14.81%
19	Mean Detects					34.38	SD Detects					57.11
20	Median Detects					3.4	CV Detects					1.661
21	Skewness Detects					1.919	Kurtosis Detects					3.07
22	Mean of Logged Detects					2.054	SD of Logged Detects					1.81
23												
24	Normal GOF Test on Detects Only											
25	Shapiro Wilk Test Statistic					0.648	Shapiro Wilk GOF Test					
26	5% Shapiro Wilk Critical Value					0.914	Detected Data Not Normal at 5% Significance Level					
27	Lilliefors Test Statistic					0.31	Lilliefors GOF Test					
28	5% Lilliefors Critical Value					0.18	Detected Data Not Normal at 5% Significance Level					
29	Detected Data Not Normal at 5% Significance Level											
30												
31	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
32	KM Mean					29.32	KM Standard Error of Mean					10.42
33	KM SD					52.96	95% KM (BCA) UCL					45.71
34	95% KM (t) UCL					47.09	95% KM (Percentile Bootstrap) UCL					46.67
35	95% KM (z) UCL					46.46	95% KM Bootstrap t UCL					57.38
36	90% KM Chebyshev UCL					60.58	95% KM Chebyshev UCL					74.74
37	97.5% KM Chebyshev UCL					94.4	99% KM Chebyshev UCL					133
38												
39	Gamma GOF Tests on Detected Observations Only											
40	A-D Test Statistic					1.766	Anderson-Darling GOF Test					
41	5% A-D Critical Value					0.819	Detected Data Not Gamma Distributed at 5% Significance Level					
42	K-S Test Statistic					0.297	Kolmogorov-Smirnov GOF					
43	5% K-S Critical Value					0.193	Detected Data Not Gamma Distributed at 5% Significance Level					
44	Detected Data Not Gamma Distributed at 5% Significance Level											
45												
46	Gamma Statistics on Detected Data Only											
47	k hat (MLE)					0.437	k star (bias corrected MLE)					0.409
48	Theta hat (MLE)					78.63	Theta star (bias corrected MLE)					84.02
49	nu hat (MLE)					20.11	nu star (bias corrected)					18.82
50	Mean (detects)					34.38						
51												
52	Gamma ROS Statistics using Imputed Non-Detects											
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											

	A–E	F	G–K	L
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	29.29
59	Maximum	210	Median	3.2
60	SD	53.98	CV	1.843
61	k hat (MLE)	0.299	k star (bias corrected MLE)	0.29
62	Theta hat (MLE)	98.04	Theta star (bias corrected MLE)	100.9
63	nu hat (MLE)	16.13	nu star (bias corrected)	15.67
64	Adjusted Level of Significance (β)	0.0401		
65	Approximate Chi Square Value (15.67, α)	7.732	Adjusted Chi Square Value (15.67, β)	7.376
66	95% Gamma Approximate UCL (use when n>=50)	59.37	95% Gamma Adjusted UCL (use when n<50)	62.23
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	29.32	SD (KM)	52.96
70	Variance (KM)	2804	SE of Mean (KM)	10.42
71	k hat (KM)	0.307	k star (KM)	0.297
72	nu hat (KM)	16.55	nu star (KM)	16.05
73	theta hat (KM)	95.65	theta star (KM)	98.67
74	80% gamma percentile (KM)	44.86	90% gamma percentile (KM)	86.57
75	95% gamma percentile (KM)	134.5	99% gamma percentile (KM)	259.3
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (16.05, α)	7.995	Adjusted Chi Square Value (16.05, β)	7.632
79	95% Gamma Approximate KM-UCL (use when n>=50)	58.85	95% Gamma Adjusted KM-UCL (use when n<50)	61.64
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Test Statistic	0.883	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk Critical Value	0.914	Detected Data Not Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.238	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.18	Detected Data Not Lognormal at 5% Significance Level	
86	**Detected Data Not Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	29.31	Mean in Log Scale	1.44
90	SD in Original Scale	53.97	SD in Log Scale	2.255
91	95% t UCL (assumes normality of ROS data)	47.02	95% Percentile Bootstrap UCL	47.08
92	95% BCA Bootstrap UCL	50.91	95% Bootstrap t UCL	55.88
93	95% H-UCL (Log ROS)	385.5		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	1.525	KM Geo Mean	4.596
97	KM SD (logged)	2.068	95% Critical H Value (KM-Log)	4.15
98	KM Standard Error of Mean (logged)	0.407	95% H-UCL (KM -Log)	209.8
99	KM SD (logged)	2.068	95% Critical H Value (KM-Log)	4.15
100	KM Standard Error of Mean (logged)	0.407		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	29.3	Mean in Log Scale	1.422
105	SD in Original Scale	53.97	SD in Log Scale	2.27
106	95% t UCL (Assumes normality)	47.02	95% H-Stat UCL	401.9

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Data do not follow a Discernible Distribution at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	95% KM (Chebyshev) UCL					74.74						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

	A	B	C	D	E	F	G	H	I	J	K	L
1	**UCL Statistics for Data Sets with Non-Detects**											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/14/2021 8:13:49 PM								
5	From File			USS Lead Wide GW 6.0_trb - OU2.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	**Pb-T**											
11												
12	**General Statistics**											
13	Total Number of Observations					27	Number of Distinct Observations					24
14	Number of Detects					23	Number of Non-Detects					4
15	Number of Distinct Detects					22	Number of Distinct Non-Detects					2
16	Minimum Detect					0.17	Minimum Non-Detect					0.13
17	Maximum Detect					1200	Maximum Non-Detect					2.7
18	Variance Detects					112643	Percent Non-Detects					14.81%
19	Mean Detects					163.2	SD Detects					335.6
20	Median Detects					26	CV Detects					2.057
21	Skewness Detects					2.546	Kurtosis Detects					5.72
22	Mean of Logged Detects					2.94	SD of Logged Detects					2.532
23												
24	**Normal GOF Test on Detects Only**											
25	Shapiro Wilk Test Statistic					0.535	**Shapiro Wilk GOF Test**					
26	5% Shapiro Wilk Critical Value					0.914	Detected Data Not Normal at 5% Significance Level					
27	Lilliefors Test Statistic					0.389	**Lilliefors GOF Test**					
28	5% Lilliefors Critical Value					0.18	Detected Data Not Normal at 5% Significance Level					
29	**Detected Data Not Normal at 5% Significance Level**											
30												
31	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**											
32	KM Mean					139.1	KM Standard Error of Mean					60.69
33	KM SD					308.4	95% KM (BCA) UCL					250.2
34	95% KM (t) UCL					242.6	95% KM (Percentile Bootstrap) UCL					242.3
35	95% KM (z) UCL					238.9	95% KM Bootstrap t UCL					392.4
36	90% KM Chebyshev UCL					321.2	95% KM Chebyshev UCL					403.6
37	97.5% KM Chebyshev UCL					518.1	99% KM Chebyshev UCL					743
38												
39	**Gamma GOF Tests on Detected Observations Only**											
40	A-D Test Statistic					0.758	**Anderson-Darling GOF Test**					
41	5% A-D Critical Value					0.845	Detected data appear Gamma Distributed at 5% Significance Level					
42	K-S Test Statistic					0.174	**Kolmogorov-Smirnov GOF**					
43	5% K-S Critical Value					0.196	Detected data appear Gamma Distributed at 5% Significance Level					
44	**Detected data appear Gamma Distributed at 5% Significance Level**											
45												
46	**Gamma Statistics on Detected Data Only**											
47	k hat (MLE)					0.317	k star (bias corrected MLE)					0.305
48	Theta hat (MLE)					514.6	Theta star (bias corrected MLE)					535.5
49	nu hat (MLE)					14.59	nu star (bias corrected)					14.02
50	Mean (detects)					163.2						
51												
52	**Gamma ROS Statistics using Imputed Non-Detects**											
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											

	A B C D E	F	G H I J K	L
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	139
59	Maximum	1200	Median	11
60	SD	314.3	CV	2.261
61	k hat (MLE)	0.231	k star (bias corrected MLE)	0.23
62	Theta hat (MLE)	601.5	Theta star (bias corrected MLE)	604.1
63	nu hat (MLE)	12.48	nu star (bias corrected)	12.43
64	Adjusted Level of Significance (β)	0.0401		
65	Approximate Chi Square Value (12.43, α)	5.51	Adjusted Chi Square Value (12.43, β)	5.217
66	95% Gamma Approximate UCL (use when n>=50)	313.6	95% Gamma Adjusted UCL (use when n<50)	331.2
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	139.1	SD (KM)	308.4
70	Variance (KM)	95130	SE of Mean (KM)	60.69
71	k hat (KM)	0.203	k star (KM)	0.205
72	nu hat (KM)	10.98	nu star (KM)	11.09
73	theta hat (KM)	684	theta star (KM)	677
74	80% gamma percentile (KM)	185.8	90% gamma percentile (KM)	420.6
75	95% gamma percentile (KM)	711.6	99% gamma percentile (KM)	1509
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (11.09, α)	4.636	Adjusted Chi Square Value (11.09, β)	4.371
79	95% Gamma Approximate KM-UCL (use when n>=50)	332.8	95% Gamma Adjusted KM-UCL (use when n<50)	353
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Test Statistic	0.964	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk Critical Value	0.914	Detected Data appear Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.0959	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.18	Detected Data appear Lognormal at 5% Significance Level	
86	**Detected Data appear Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	139.1	Mean in Log Scale	2.242
90	SD in Original Scale	314.3	SD in Log Scale	2.934
91	95% t UCL (assumes normality of ROS data)	242.2	95% Percentile Bootstrap UCL	245.1
92	95% BCA Bootstrap UCL	273.5	95% Bootstrap t UCL	441.5
93	95% H-UCL (Log ROS)	17809		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	2.293	KM Geo Mean	9.905
97	KM SD (logged)	2.779	95% Critical H Value (KM-Log)	5.361
98	KM Standard Error of Mean (logged)	0.551	95% H-UCL (KM -Log)	8742
99	KM SD (logged)	2.779	95% Critical H Value (KM-Log)	5.361
100	KM Standard Error of Mean (logged)	0.551		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	139.2	Mean in Log Scale	2.437
105	SD in Original Scale	314.3	SD in Log Scale	2.684
106	95% t UCL (Assumes normality)	242.3	95% H-Stat UCL	6462

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Gamma Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	a Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)					353						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/14/2021 8:11:20 PM								
5	From File			USS Lead Wide GW 6.0_trb - OU2.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	Se-T											
11												
12	General Statistics											
13	Total Number of Observations					27	Number of Distinct Observations					4
14	Number of Detects					2	Number of Non-Detects					25
15	Number of Distinct Detects					2	Number of Distinct Non-Detects					2
16	Minimum Detect					2.2	Minimum Non-Detect					1.5
17	Maximum Detect					5.6	Maximum Non-Detect					5.3
18	Variance Detects					5.78	Percent Non-Detects					92.59%
19	Mean Detects					3.9	SD Detects					2.404
20	Median Detects					3.9	CV Detects					0.616
21	Skewness Detects					N/A	Kurtosis Detects					N/A
22	Mean of Logged Detects					1.256	SD of Logged Detects					0.661
23												
24	Warning: Data set has only 2 Detected Values.											
25	This is not enough to compute meaningful or reliable statistics and estimates.											
26												
27												
28	Normal GOF Test on Detects Only											
29	Not Enough Data to Perform GOF Test											
30												
31	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
32	KM Mean					1.764	KM Standard Error of Mean					0.251
33	KM SD					0.795	95% KM (BCA) UCL					N/A
34	95% KM (t) UCL					2.192	95% KM (Percentile Bootstrap) UCL					N/A
35	95% KM (z) UCL					2.177	95% KM Bootstrap t UCL					N/A
36	90% KM Chebyshev UCL					2.517	95% KM Chebyshev UCL					2.858
37	97.5% KM Chebyshev UCL					3.331	99% KM Chebyshev UCL					4.261
38												
39	Gamma GOF Tests on Detected Observations Only											
40	Not Enough Data to Perform GOF Test											
41												
42	Gamma Statistics on Detected Data Only											
43	k hat (MLE)					4.906	k star (bias corrected MLE)					N/A
44	Theta hat (MLE)					0.795	Theta star (bias corrected MLE)					N/A
45	nu hat (MLE)					19.62	nu star (bias corrected)					N/A
46	Mean (detects)					3.9						
47												
48	Estimates of Gamma Parameters using KM Estimates											
49	Mean (KM)					1.764	SD (KM)					0.795
50	Variance (KM)					0.631	SE of Mean (KM)					0.251
51	k hat (KM)					4.929	k star (KM)					4.406
52	nu hat (KM)					266.2	nu star (KM)					237.9
53	theta hat (KM)					0.358	theta star (KM)					0.4

80% gamma percentile (KM)	2.406	90% gamma percentile (KM)	2.89
95% gamma percentile (KM)	3.334	99% gamma percentile (KM)	4.279
Gamma Kaplan-Meier (KM) Statistics			
		Adjusted Level of Significance (β)	0.0401
Approximate Chi Square Value (237.93, α)	203.2	Adjusted Chi Square Value (237.93, β)	201.2
95% Gamma Approximate KM-UCL (use when n>=50)	2.066	95% Gamma Adjusted KM-UCL (use when n<50)	2.087
Lognormal GOF Test on Detected Observations Only			
Not Enough Data to Perform GOF Test			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1.004	Mean in Log Scale	-0.434
SD in Original Scale	1.139	SD in Log Scale	0.938
95% t UCL (assumes normality of ROS data)	1.378	95% Percentile Bootstrap UCL	1.4
95% BCA Bootstrap UCL	1.54	95% Bootstrap t UCL	1.663
95% H-UCL (Log ROS)	1.576		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	0.516	KM Geo Mean	1.675
KM SD (logged)	0.275	95% Critical H Value (KM-Log)	1.804
KM Standard Error of Mean (logged)	0.102	95% H-UCL (KM -Log)	1.917
KM SD (logged)	0.275	95% Critical H Value (KM-Log)	1.804
KM Standard Error of Mean (logged)	0.102		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	2.391	Mean in Log Scale	0.762
SD in Original Scale	0.983	SD in Log Scale	0.531
95% t UCL (Assumes normality)	2.714	95% H-Stat UCL	3.037
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution at 5% Significance Level			
Suggested UCL to Use			
95% KM (Chebyshev) UCL	2.858		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			

1	**UCL Statistics for Data Sets with Non-Detects**			
2				
3	User Selected Options			
4	Date/Time of Computation	ProUCL 5.18/14/2021 8:25:40 PM		
5	From File	USS Lead Wide GW 6.0_trb - Zone 1.xls		
6	Full Precision	OFF		
7	Confidence Coefficient	95%		
8	Number of Bootstrap Operations	2000		
9				
10	**Sb-T**			
11				
12	**General Statistics**			
13	Total Number of Observations	20	Number of Distinct Observations	17
14	Number of Detects	17	Number of Non-Detects	3
15	Number of Distinct Detects	15	Number of Distinct Non-Detects	2
16	Minimum Detect	0.42	Minimum Non-Detect	0.38
17	Maximum Detect	1200	Maximum Non-Detect	1.1
18	Variance Detects	184854	Percent Non-Detects	15%
19	Mean Detects	215.8	SD Detects	429.9
20	Median Detects	20	CV Detects	1.992
21	Skewness Detects	1.917	Kurtosis Detects	2.056
22	Mean of Logged Detects	3.194	SD of Logged Detects	2.271
23				
24	**Normal GOF Test on Detects Only**			
25	Shapiro Wilk Test Statistic	0.536	**Shapiro Wilk GOF Test**	
26	5% Shapiro Wilk Critical Value	0.892	Detected Data Not Normal at 5% Significance Level	
27	Lilliefors Test Statistic	0.412	**Lilliefors GOF Test**	
28	5% Lilliefors Critical Value	0.207	Detected Data Not Normal at 5% Significance Level	
29	**Detected Data Not Normal at 5% Significance Level**			
30				
31	**Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs**			
32	KM Mean	183.5	KM Standard Error of Mean	90.39
33	KM SD	392.2	95% KM (BCA) UCL	353.2
34	95% KM (t) UCL	339.8	95% KM (Percentile Bootstrap) UCL	342.9
35	95% KM (z) UCL	332.2	95% KM Bootstrap t UCL	424.7
36	90% KM Chebyshev UCL	454.7	95% KM Chebyshev UCL	577.5
37	97.5% KM Chebyshev UCL	748	99% KM Chebyshev UCL	1083
38				
39	**Gamma GOF Tests on Detected Observations Only**			
40	A-D Test Statistic	1.429	**Anderson-Darling GOF Test**	
41	5% A-D Critical Value	0.839	Detected Data Not Gamma Distributed at 5% Significance Level	
42	K-S Test Statistic	0.269	**Kolmogorov-Smirnov GOF**	
43	5% K-S Critical Value	0.226	Detected Data Not Gamma Distributed at 5% Significance Level	
44	**Detected Data Not Gamma Distributed at 5% Significance Level**			
45				
46	**Gamma Statistics on Detected Data Only**			
47	k hat (MLE)	0.314	k star (bias corrected MLE)	0.298
48	Theta hat (MLE)	687.4	Theta star (bias corrected MLE)	724.8
49	nu hat (MLE)	10.67	nu star (bias corrected)	10.12
50	Mean (detects)	215.8		
51				
52	**Gamma ROS Statistics using Imputed Non-Detects**			
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			

	A–E	F	G–K	L
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	183.4
59	Maximum	1200	Median	11
60	SD	402.4	CV	2.194
61	k hat (MLE)	0.226	k star (bias corrected MLE)	0.226
62	Theta hat (MLE)	810.2	Theta star (bias corrected MLE)	812.5
63	nu hat (MLE)	9.055	nu star (bias corrected)	9.03
64	Adjusted Level of Significance (β)	0.038		
65	Approximate Chi Square Value (9.03, α)	3.345	Adjusted Chi Square Value (9.03, β)	3.077
66	95% Gamma Approximate UCL (use when n>=50)	495.1	95% Gamma Adjusted UCL (use when n<50)	538.4
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	183.5	SD (KM)	392.2
70	Variance (KM)	153799	SE of Mean (KM)	90.39
71	k hat (KM)	0.219	k star (KM)	0.219
72	nu hat (KM)	8.755	nu star (KM)	8.775
73	theta hat (KM)	838.2	theta star (KM)	836.3
74	80% gamma percentile (KM)	252.9	90% gamma percentile (KM)	554.3
75	95% gamma percentile (KM)	922.2	99% gamma percentile (KM)	1920
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (8.78, α)	3.192	Adjusted Chi Square Value (8.78, β)	2.931
79	95% Gamma Approximate KM-UCL (use when n>=50)	504.4	95% Gamma Adjusted KM-UCL (use when n<50)	549.4
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk Critical Value	0.892	Detected Data appear Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.138	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.207	Detected Data appear Lognormal at 5% Significance Level	
86	**Detected Data appear Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	183.4	Mean in Log Scale	2.425
90	SD in Original Scale	402.4	SD in Log Scale	2.814
91	95% t UCL (assumes normality of ROS data)	339	95% Percentile Bootstrap UCL	342.8
92	95% BCA Bootstrap UCL	365.7	95% Bootstrap t UCL	424.6
93	95% H-UCL (Log ROS)	25196		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	2.571	KM Geo Mean	13.08
97	KM SD (logged)	2.515	95% Critical H Value (KM-Log)	5.25
98	KM Standard Error of Mean (logged)	0.58	95% H-UCL (KM -Log)	6382
99	KM SD (logged)	2.515	95% Critical H Value (KM-Log)	5.25
100	KM Standard Error of Mean (logged)	0.58		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	183.5	Mean in Log Scale	2.519
105	SD in Original Scale	402.4	SD in Log Scale	2.665
106	95% t UCL (Assumes normality)	339	95% H-Stat UCL	12716

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Lognormal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	97.5% KM (Chebyshev) UCL					748						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/14/2021 8:27:58 PM
From File	USS Lead Wide GW 6.0_trb - Zone 1.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

As-T

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	0.69	Mean	77.57
Maximum	440	Median	13.5
SD	149.2	Std. Error of Mean	33.36
Coefficient of Variation	1.923	Skewness	2.079

Normal GOF Test

Shapiro Wilk Test Statistic	0.542	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.407	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.192	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	135.3	95% Adjusted-CLT UCL (Chen-1995)	149
		95% Modified-t UCL (Johnson-1978)	137.8

Gamma GOF Test

A-D Test Statistic	1.269	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.833	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.201	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.209	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.355	k star (bias corrected MLE)	0.335
Theta hat (MLE)	218.8	Theta star (bias corrected MLE)	231.8
nu hat (MLE)	14.18	nu star (bias corrected)	13.39
MLE Mean (bias corrected)	77.57	MLE Sd (bias corrected)	134.1
		Approximate Chi Square Value (0.05)	6.155
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	5.77

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	168.7	95% Adjusted Gamma UCL (use when n<50)	180

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level

	A–E	F	G–K	L
54	Lilliefors Test Statistic	0.177	**Lilliefors Lognormal GOF Test**	
55	5% Lilliefors Critical Value	0.192	Data appear Lognormal at 5% Significance Level	
56	**Data appear Lognormal at 5% Significance Level**			
57				
58	**Lognormal Statistics**			
59	Minimum of Logged Data	-0.371	Mean of logged Data	2.459
60	Maximum of Logged Data	6.087	SD of logged Data	2.146
61				
62	**Assuming Lognormal Distribution**			
63	95% H-UCL	1109	90% Chebyshev (MVUE) UCL	240.9
64	95% Chebyshev (MVUE) UCL	310.8	97.5% Chebyshev (MVUE) UCL	407.8
65	99% Chebyshev (MVUE) UCL	598.2		
66				
67	**Nonparametric Distribution Free UCL Statistics**			
68	**Data appear to follow a Discernible Distribution at 5% Significance Level**			
69				
70	**Nonparametric Distribution Free UCLs**			
71	95% CLT UCL	132.4	95% Jackknife UCL	135.3
72	95% Standard Bootstrap UCL	131.3	95% Bootstrap-t UCL	157.6
73	95% Hall's Bootstrap UCL	117.8	95% Percentile Bootstrap UCL	134.8
74	95% BCA Bootstrap UCL	149.1		
75	90% Chebyshev(Mean, Sd) UCL	177.6	95% Chebyshev(Mean, Sd) UCL	223
76	97.5% Chebyshev(Mean, Sd) UCL	285.9	99% Chebyshev(Mean, Sd) UCL	409.5
77				
78	**Suggested UCL to Use**			
79	95% Adjusted Gamma UCL	180		
80				
81	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test			
82	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL			
83				
84	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
85	Recommendations are based upon data size, data distribution, and skewness.			
86	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
87	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			
88				

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/14/2021 8:31:58 PM
From File	USS Lead Wide GW 6.0_trb - Zone 1.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Cd-T

General Statistics

Total Number of Observations	20	Number of Distinct Observations	8
Number of Detects	6	Number of Non-Detects	14
Number of Distinct Detects	6	Number of Distinct Non-Detects	2
Minimum Detect	0.5	Minimum Non-Detect	0.13
Maximum Detect	59	Maximum Non-Detect	0.22
Variance Detects	734	Percent Non-Detects	70%
Mean Detects	26.37	SD Detects	27.09
Median Detects	24.35	CV Detects	1.028
Skewness Detects	0.121	Kurtosis Detects	-2.904
Mean of Logged Detects	2.101	SD of Logged Detects	2.12

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.81	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.288	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	8.001	KM Standard Error of Mean	4.437
KM SD	18.11	95% KM (BCA) UCL	14.58
95% KM (t) UCL	15.67	95% KM (Percentile Bootstrap) UCL	15.36
95% KM (z) UCL	15.3	95% KM Bootstrap t UCL	16.94
90% KM Chebyshev UCL	21.31	95% KM Chebyshev UCL	27.34
97.5% KM Chebyshev UCL	35.71	99% KM Chebyshev UCL	52.15

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.569	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.734	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.303	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.348	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.537	k star (bias corrected MLE)	0.379
Theta hat (MLE)	49.13	Theta star (bias corrected MLE)	69.49
nu hat (MLE)	6.44	nu star (bias corrected)	4.553
Mean (detects)	26.37		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

	A–E	F	G–K	L
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	7.917
59	Maximum	59	Median	0.01
60	SD	18.62	CV	2.352
61	k hat (MLE)	0.163	k star (bias corrected MLE)	0.172
62	Theta hat (MLE)	48.61	Theta star (bias corrected MLE)	46.09
63	nu hat (MLE)	6.515	nu star (bias corrected)	6.871
64	Adjusted Level of Significance (β)	0.038		
65	Approximate Chi Square Value (6.87, α)	2.1	Adjusted Chi Square Value (6.87, β)	1.898
66	95% Gamma Approximate UCL (use when n>=50)	25.9	95% Gamma Adjusted UCL (use when n<50)	28.66
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	8.001	SD (KM)	18.11
70	Variance (KM)	328.1	SE of Mean (KM)	4.437
71	k hat (KM)	0.195	k star (KM)	0.199
72	nu hat (KM)	7.805	nu star (KM)	7.968
73	theta hat (KM)	41	theta star (KM)	40.17
74	80% gamma percentile (KM)	10.52	90% gamma percentile (KM)	24.2
75	95% gamma percentile (KM)	41.27	99% gamma percentile (KM)	88.3
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (7.97, α)	2.716	Adjusted Chi Square Value (7.97, β)	2.48
79	95% Gamma Approximate KM-UCL (use when n>=50)	23.47	95% Gamma Adjusted KM-UCL (use when n<50)	25.71
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Test Statistic	0.844	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.286	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level	
86	**Detected Data appear Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	7.935	Mean in Log Scale	-3.149
90	SD in Original Scale	18.61	SD in Log Scale	4.33
91	95% t UCL (assumes normality of ROS data)	15.13	95% Percentile Bootstrap UCL	15.26
92	95% BCA Bootstrap UCL	17.05	95% Bootstrap t UCL	18.63
93	95% H-UCL (Log ROS)	2322866		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	-0.798	KM Geo Mean	0.45
97	KM SD (logged)	2.174	95% Critical H Value (KM-Log)	4.622
98	KM Standard Error of Mean (logged)	0.532	95% H-UCL (KM -Log)	47.94
99	KM SD (logged)	2.174	95% Critical H Value (KM-Log)	4.622
100	KM Standard Error of Mean (logged)	0.532		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	7.962	Mean in Log Scale	-1.204
105	SD in Original Scale	18.6	SD in Log Scale	2.479
106	95% t UCL (Assumes normality)	15.15	95% H-Stat UCL	123.6

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Normal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113					95% KM (t) UCL	15.67						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/14/2021 8:32:58 PM
From File	USS Lead Wide GW 6.0_trb - Zone 1.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Pb-T

General Statistics

Total Number of Observations	20	Number of Distinct Observations	14
Number of Detects	13	Number of Non-Detects	7
Number of Distinct Detects	12	Number of Distinct Non-Detects	2
Minimum Detect	0.14	Minimum Non-Detect	0.094
Maximum Detect	89	Maximum Non-Detect	0.13
Variance Detects	1252	Percent Non-Detects	35%
Mean Detects	25.64	SD Detects	35.38
Median Detects	15	CV Detects	1.38
Skewness Detects	1.272	Kurtosis Detects	-0.111
Mean of Logged Detects	1.484	SD of Logged Detects	2.477

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.703	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.321	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.234	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	16.7	KM Standard Error of Mean	6.98
KM SD	29.99	95% KM (BCA) UCL	28.55
95% KM (t) UCL	28.77	95% KM (Percentile Bootstrap) UCL	28.4
95% KM (z) UCL	28.18	95% KM Bootstrap t UCL	33.09
90% KM Chebyshev UCL	37.64	95% KM Chebyshev UCL	47.12
97.5% KM Chebyshev UCL	60.29	99% KM Chebyshev UCL	86.15

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.641	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.814	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.203	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.254	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.377	k star (bias corrected MLE)	0.342
Theta hat (MLE)	67.94	Theta star (bias corrected MLE)	75.06
nu hat (MLE)	9.812	nu star (bias corrected)	8.881
Mean (detects)	25.64		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	16.67
59	Maximum	89	Median	0.46
60	SD	30.79	CV	1.847
61	k hat (MLE)	0.211	k star (bias corrected MLE)	0.213
62	Theta hat (MLE)	79.05	Theta star (bias corrected MLE)	78.41
63	nu hat (MLE)	8.435	nu star (bias corrected)	8.503
64	Adjusted Level of Significance (β)	0.038		
65	Approximate Chi Square Value (8.50, α)	3.03	Adjusted Chi Square Value (8.50, β)	2.777
66	95% Gamma Approximate UCL (use when n>=50)	46.78	95% Gamma Adjusted UCL (use when n<50)	51.05
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	16.7	SD (KM)	29.99
70	Variance (KM)	899.5	SE of Mean (KM)	6.98
71	k hat (KM)	0.31	k star (KM)	0.297
72	nu hat (KM)	12.4	nu star (KM)	11.87
73	theta hat (KM)	53.87	theta star (KM)	56.26
74	80% gamma percentile (KM)	25.54	90% gamma percentile (KM)	49.31
75	95% gamma percentile (KM)	76.65	99% gamma percentile (KM)	147.8
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (11.87, α)	5.144	Adjusted Chi Square Value (11.87, β)	4.797
79	95% Gamma Approximate KM-UCL (use when n>=50)	38.55	95% Gamma Adjusted KM-UCL (use when n<50)	41.33
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Test Statistic	0.878	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk Critical Value	0.866	Detected Data appear Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.228	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.234	Detected Data appear Lognormal at 5% Significance Level	
86	**Detected Data appear Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	16.67	Mean in Log Scale	-0.629
90	SD in Original Scale	30.79	SD in Log Scale	3.649
91	95% t UCL (assumes normality of ROS data)	28.58	95% Percentile Bootstrap UCL	28.67
92	95% BCA Bootstrap UCL	31.12	95% Bootstrap t UCL	33.88
93	95% H-UCL (Log ROS)	190868		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	0.137	KM Geo Mean	1.147
97	KM SD (logged)	2.656	95% Critical H Value (KM-Log)	5.513
98	KM Standard Error of Mean (logged)	0.618	95% H-UCL (KM -Log)	1121
99	KM SD (logged)	2.656	95% Critical H Value (KM-Log)	5.513
100	KM Standard Error of Mean (logged)	0.618		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	16.69	Mean in Log Scale	-0.00831
105	SD in Original Scale	30.78	SD in Log Scale	2.87
106	95% t UCL (Assumes normality)	28.59	95% H-Stat UCL	2991

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Gamma Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	a Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)					41.33						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/14/2021 8:29:03 PM								
5	From File			USS Lead Wide GW 6.0_trb - Zone 1.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	Se-T											
11												
12	General Statistics											
13	Total Number of Observations					20	Number of Distinct Observations					12
14	Number of Detects					9	Number of Non-Detects					11
15	Number of Distinct Detects					9	Number of Distinct Non-Detects					3
16	Minimum Detect					2.3	Minimum Non-Detect					0.81
17	Maximum Detect					82	Maximum Non-Detect					2.6
18	Variance Detects					1082	Percent Non-Detects					55%
19	Mean Detects					25.08	SD Detects					32.9
20	Median Detects					4.5	CV Detects					1.312
21	Skewness Detects					1.095	Kurtosis Detects					-0.718
22	Mean of Logged Detects					2.273	SD of Logged Detects					1.469
23												
24	Normal GOF Test on Detects Only											
25	Shapiro Wilk Test Statistic					0.71	Shapiro Wilk GOF Test					
26	5% Shapiro Wilk Critical Value					0.829	Detected Data Not Normal at 5% Significance Level					
27	Lilliefors Test Statistic					0.378	Lilliefors GOF Test					
28	5% Lilliefors Critical Value					0.274	Detected Data Not Normal at 5% Significance Level					
29	Detected Data Not Normal at 5% Significance Level											
30												
31	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
32	KM Mean					11.77	KM Standard Error of Mean					5.702
33	KM SD					24.04	95% KM (BCA) UCL					21.95
34	95% KM (t) UCL					21.63	95% KM (Percentile Bootstrap) UCL					21.43
35	95% KM (z) UCL					21.15	95% KM Bootstrap t UCL					29.12
36	90% KM Chebyshev UCL					28.87	95% KM Chebyshev UCL					36.62
37	97.5% KM Chebyshev UCL					47.37	99% KM Chebyshev UCL					68.5
38												
39	Gamma GOF Tests on Detected Observations Only											
40	A-D Test Statistic					1.086	Anderson-Darling GOF Test					
41	5% A-D Critical Value					0.76	Detected Data Not Gamma Distributed at 5% Significance Level					
42	K-S Test Statistic					0.332	Kolmogorov-Smirnov GOF					
43	5% K-S Critical Value					0.291	Detected Data Not Gamma Distributed at 5% Significance Level					
44	Detected Data Not Gamma Distributed at 5% Significance Level											
45												
46	Gamma Statistics on Detected Data Only											
47	k hat (MLE)					0.644	k star (bias corrected MLE)					0.504
48	Theta hat (MLE)					38.93	Theta star (bias corrected MLE)					49.81
49	nu hat (MLE)					11.59	nu star (bias corrected)					9.063
50	Mean (detects)					25.08						
51												
52	Gamma ROS Statistics using Imputed Non-Detects											
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											

	A	B	C	D	E	F	G	H	I	J	K	L
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)											
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs											
56	This is especially true when the sample size is small.											
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
58					Minimum	0.01					Mean	11.29
59					Maximum	82					Median	0.01
60					SD	24.89					CV	2.204
61					k hat (MLE)	0.189					k star (bias corrected MLE)	0.194
62					Theta hat (MLE)	59.82					Theta star (bias corrected MLE)	58.27
63					nu hat (MLE)	7.55					nu star (bias corrected)	7.751
64					Adjusted Level of Significance (β)	0.038						
65					Approximate Chi Square Value (7.75, α)	2.592					Adjusted Chi Square Value (7.75, β)	2.362
66					95% Gamma Approximate UCL (use when n>=50)	33.77					95% Gamma Adjusted UCL (use when n<50)	37.06
67												
68	**Estimates of Gamma Parameters using KM Estimates**											
69					Mean (KM)	11.77					SD (KM)	24.04
70					Variance (KM)	577.9					SE of Mean (KM)	5.702
71					k hat (KM)	0.24					k star (KM)	0.237
72					nu hat (KM)	9.586					nu star (KM)	9.481
73					theta hat (KM)	49.11					theta star (KM)	49.65
74					80% gamma percentile (KM)	16.75					90% gamma percentile (KM)	35.44
75					95% gamma percentile (KM)	57.86					99% gamma percentile (KM)	118
76												
77	**Gamma Kaplan-Meier (KM) Statistics**											
78					Approximate Chi Square Value (9.48, α)	3.62					Adjusted Chi Square Value (9.48, β)	3.338
79					95% Gamma Approximate KM-UCL (use when n>=50)	30.82					95% Gamma Adjusted KM-UCL (use when n<50)	33.42
80												
81	**Lognormal GOF Test on Detected Observations Only**											
82					Shapiro Wilk Test Statistic	0.796	**Shapiro Wilk GOF Test**					
83					5% Shapiro Wilk Critical Value	0.829	Detected Data Not Lognormal at 5% Significance Level					
84					Lilliefors Test Statistic	0.266	**Lilliefors GOF Test**					
85					5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level					
86	**Detected Data appear Approximate Lognormal at 5% Significance Level**											
87												
88	**Lognormal ROS Statistics Using Imputed Non-Detects**											
89					Mean in Original Scale	11.43					Mean in Log Scale	8.2349E-4
90					SD in Original Scale	24.82					SD in Log Scale	2.477
91					95% t UCL (assumes normality of ROS data)	21.03					95% Percentile Bootstrap UCL	20.83
92					95% BCA Bootstrap UCL	22.84					95% Bootstrap t UCL	30
93					95% H-UCL (Log ROS)	408.7						
94												
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
96					KM Mean (logged)	0.933					KM Geo Mean	2.542
97					KM SD (logged)	1.536					95% Critical H Value (KM-Log)	3.487
98					KM Standard Error of Mean (logged)	0.367					95% H-UCL (KM -Log)	28.23
99					KM SD (logged)	1.536					95% Critical H Value (KM-Log)	3.487
100					KM Standard Error of Mean (logged)	0.367						
101												
102	**DL/2 Statistics**											
103	**DL/2 Normal**						**DL/2 Log-Transformed**					
104					Mean in Original Scale	11.79					Mean in Log Scale	0.944
105					SD in Original Scale	24.65					SD in Log Scale	1.582
106					95% t UCL (Assumes normality)	21.32					95% H-Stat UCL	32.73

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Approximate Lognormal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	95% KM (Chebyshev) UCL					36.62						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/14/2021 8:43:10 PM								
5	From File			USS Lead Wide GW 6.0_trb - Zones 2 & 3.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	Sb-T											
11												
12	General Statistics											
13	Total Number of Observations					41	Number of Distinct Observations					32
14	Number of Detects					33	Number of Non-Detects					8
15	Number of Distinct Detects					30	Number of Distinct Non-Detects					2
16	Minimum Detect					0.48	Minimum Non-Detect					0.38
17	Maximum Detect					28	Maximum Non-Detect					1.1
18	Variance Detects					56.56	Percent Non-Detects					19.51%
19	Mean Detects					9.512	SD Detects					7.52
20	Median Detects					7.7	CV Detects					0.791
21	Skewness Detects					0.953	Kurtosis Detects					0.118
22	Mean of Logged Detects					1.877	SD of Logged Detects					0.98
23												
24	Normal GOF Test on Detects Only											
25	Shapiro Wilk Test Statistic					0.898	Shapiro Wilk GOF Test					
26	5% Shapiro Wilk Critical Value					0.931	Detected Data Not Normal at 5% Significance Level					
27	Lilliefors Test Statistic					0.149	Lilliefors GOF Test					
28	5% Lilliefors Critical Value					0.152	Detected Data appear Normal at 5% Significance Level					
29	Detected Data appear Approximate Normal at 5% Significance Level											
30												
31	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
32	KM Mean					7.731	KM Standard Error of Mean					1.2
33	KM SD					7.564	95% KM (BCA) UCL					9.763
34	95% KM (t) UCL					9.751	95% KM (Percentile Bootstrap) UCL					9.793
35	95% KM (z) UCL					9.704	95% KM Bootstrap t UCL					10.08
36	90% KM Chebyshev UCL					11.33	95% KM Chebyshev UCL					12.96
37	97.5% KM Chebyshev UCL					15.22	99% KM Chebyshev UCL					19.67
38												
39	Gamma GOF Tests on Detected Observations Only											
40	A-D Test Statistic					0.159	Anderson-Darling GOF Test					
41	5% A-D Critical Value					0.766	Detected data appear Gamma Distributed at 5% Significance Level					
42	K-S Test Statistic					0.064	Kolmogorov-Smirnov GOF					
43	5% K-S Critical Value					0.156	Detected data appear Gamma Distributed at 5% Significance Level					
44	Detected data appear Gamma Distributed at 5% Significance Level											
45												
46	Gamma Statistics on Detected Data Only											
47	k hat (MLE)					1.475	k star (bias corrected MLE)					1.361
48	Theta hat (MLE)					6.449	Theta star (bias corrected MLE)					6.989
49	nu hat (MLE)					97.34	nu star (bias corrected)					89.82
50	Mean (detects)					9.512						
51												
52	Gamma ROS Statistics using Imputed Non-Detects											
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											

	A–E	F	G–K	L
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	7.66
59	Maximum	28	Median	5.5
60	SD	7.729	CV	1.009
61	k hat (MLE)	0.47	k star (bias corrected MLE)	0.452
62	Theta hat (MLE)	16.29	Theta star (bias corrected MLE)	16.95
63	nu hat (MLE)	38.55	nu star (bias corrected)	37.06
64	Adjusted Level of Significance (β)	0.0441		
65	Approximate Chi Square Value (37.06, α)	24.13	Adjusted Chi Square Value (37.06, β)	23.74
66	95% Gamma Approximate UCL (use when n>=50)	11.77	95% Gamma Adjusted UCL (use when n<50)	11.96
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	7.731	SD (KM)	7.564
70	Variance (KM)	57.22	SE of Mean (KM)	1.2
71	k hat (KM)	1.045	k star (KM)	0.984
72	nu hat (KM)	85.65	nu star (KM)	80.72
73	theta hat (KM)	7.401	theta star (KM)	7.854
74	80% gamma percentile (KM)	12.46	90% gamma percentile (KM)	17.87
75	95% gamma percentile (KM)	23.29	99% gamma percentile (KM)	35.89
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (80.72, α)	61.02	Adjusted Chi Square Value (80.72, β)	60.39
79	95% Gamma Approximate KM-UCL (use when n>=50)	10.23	95% Gamma Adjusted KM-UCL (use when n<50)	10.33
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Test Statistic	0.958	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk Critical Value	0.931	Detected Data appear Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.0861	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.152	Detected Data appear Lognormal at 5% Significance Level	
86	**Detected Data appear Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	7.814	Mean in Log Scale	1.457
90	SD in Original Scale	7.58	SD in Log Scale	1.242
91	95% t UCL (assumes normality of ROS data)	9.807	95% Percentile Bootstrap UCL	9.731
92	95% BCA Bootstrap UCL	9.927	95% Bootstrap t UCL	10.18
93	95% H-UCL (Log ROS)	15.55		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	1.325	KM Geo Mean	3.76
97	KM SD (logged)	1.417	95% Critical H Value (KM-Log)	2.848
98	KM Standard Error of Mean (logged)	0.225	95% H-UCL (KM -Log)	19.42
99	KM SD (logged)	1.417	95% Critical H Value (KM-Log)	2.848
100	KM Standard Error of Mean (logged)	0.225		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	7.719	Mean in Log Scale	1.264
105	SD in Original Scale	7.671	SD in Log Scale	1.551
106	95% t UCL (Assumes normality)	9.736	95% H-Stat UCL	24.76

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Approximate Normal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113					95% KM (t) UCL	9.751						
114												
115	When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test											
116	When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL											
117												
118	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
119	Recommendations are based upon data size, data distribution, and skewness.											
120	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
121	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
122												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/14/2021 8:44:38 PM
From File	USS Lead Wide GW 6.0_trb - Zones 2 & 3.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

As-T

General Statistics

Total Number of Observations	41	Number of Distinct Observations	33
Number of Detects	40	Number of Non-Detects	1
Number of Distinct Detects	32	Number of Distinct Non-Detects	1
Minimum Detect	0.32	Minimum Non-Detect	0.31
Maximum Detect	50	Maximum Non-Detect	0.31
Variance Detects	232.4	Percent Non-Detects	2.439%
Mean Detects	8.615	SD Detects	15.24
Median Detects	1.2	CV Detects	1.769
Skewness Detects	1.999	Kurtosis Detects	2.637
Mean of Logged Detects	0.753	SD of Logged Detects	1.636

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.581	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.94	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.336	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.139	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	8.412	KM Standard Error of Mean	2.36
KM SD	14.92	95% KM (BCA) UCL	12.46
95% KM (t) UCL	12.39	95% KM (Percentile Bootstrap) UCL	12.47
95% KM (z) UCL	12.29	95% KM Bootstrap t UCL	13.99
90% KM Chebyshev UCL	15.49	95% KM Chebyshev UCL	18.7
97.5% KM Chebyshev UCL	23.15	99% KM Chebyshev UCL	31.9

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.662	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.822	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.305	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.148	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.46	k star (bias corrected MLE)	0.442
Theta hat (MLE)	18.75	Theta star (bias corrected MLE)	19.5
nu hat (MLE)	36.76	nu star (bias corrected)	35.34
Mean (detects)	8.615		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
For such situations, GROS method may yield incorrect values of UCLs and BTVs			
This is especially true when the sample size is small.			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	0.01	Mean	8.405
Maximum	50	Median	1.2
SD	15.11	CV	1.798
k hat (MLE)	0.431	k star (bias corrected MLE)	0.416
Theta hat (MLE)	19.48	Theta star (bias corrected MLE)	20.2
nu hat (MLE)	35.38	nu star (bias corrected)	34.13
Adjusted Level of Significance (β)	0.0441		
Approximate Chi Square Value (34.13, α)	21.77	Adjusted Chi Square Value (34.13, β)	21.4
95% Gamma Approximate UCL (use when n>=50)	13.18	95% Gamma Adjusted UCL (use when n<50)	13.4
Estimates of Gamma Parameters using KM Estimates			
Mean (KM)	8.412	SD (KM)	14.92
Variance (KM)	222.7	SE of Mean (KM)	2.36
k hat (KM)	0.318	k star (KM)	0.311
nu hat (KM)	26.06	nu star (KM)	25.49
theta hat (KM)	26.47	theta star (KM)	27.07
80% gamma percentile (KM)	13.01	90% gamma percentile (KM)	24.7
95% gamma percentile (KM)	38.05	99% gamma percentile (KM)	72.57
Gamma Kaplan-Meier (KM) Statistics			
Approximate Chi Square Value (25.49, α)	14.98	Adjusted Chi Square Value (25.49, β)	14.69
95% Gamma Approximate KM-UCL (use when n>=50)	14.31	95% Gamma Adjusted KM-UCL (use when n<50)	14.6
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.851	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.94	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.234	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.139	Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	8.406	Mean in Log Scale	0.655
SD in Original Scale	15.11	SD in Log Scale	1.733
95% t UCL (assumes normality of ROS data)	12.38	95% Percentile Bootstrap UCL	12.36
95% BCA Bootstrap UCL	13.03	95% Bootstrap t UCL	13.3
95% H-UCL (Log ROS)	21.19		
Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution			
KM Mean (logged)	0.706	KM Geo Mean	2.026
KM SD (logged)	1.623	95% Critical H Value (KM-Log)	3.119
KM Standard Error of Mean (logged)	0.257	95% H-UCL (KM -Log)	16.85
KM SD (logged)	1.623	95% Critical H Value (KM-Log)	3.119
KM Standard Error of Mean (logged)	0.257		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	8.409	Mean in Log Scale	0.689
SD in Original Scale	15.11	SD in Log Scale	1.667
95% t UCL (Assumes normality)	12.38	95% H-Stat UCL	18.46

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Data do not follow a Discernible Distribution at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113	95% KM (Chebyshev) UCL					18.7						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/14/2021 8:45:40 PM								
5	From File			USS Lead Wide GW 6.0_trb - Zones 2 & 3.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	Cd-T											
11												
12	General Statistics											
13	Total Number of Observations					41	Number of Distinct Observations					2
14	Number of Detects					0	Number of Non-Detects					41
15	Number of Distinct Detects					0	Number of Distinct Non-Detects					2
16												
17	**Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!**											
18	**Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!**											
19	**The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).**											
20												
21	**The data set for variable Cd-T was not processed!**											
22												
23												

	A	B	C	D	E	F	G	H	I	J	K	L
1	UCL Statistics for Data Sets with Non-Detects											
2												
3	User Selected Options											
4	Date/Time of Computation			ProUCL 5.18/14/2021 8:42:32 PM								
5	From File			USS Lead Wide GW 6.0_trb - Zones 2 & 3.xls								
6	Full Precision			OFF								
7	Confidence Coefficient			95%								
8	Number of Bootstrap Operations			2000								
9												
10	Pb-T											
11												
12	General Statistics											
13	Total Number of Observations					41	Number of Distinct Observations					14
14	Number of Detects					12	Number of Non-Detects					29
15	Number of Distinct Detects					12	Number of Distinct Non-Detects					2
16	Minimum Detect					0.1	Minimum Non-Detect					0.094
17	Maximum Detect					220	Maximum Non-Detect					0.13
18	Variance Detects					4354	Percent Non-Detects					70.73%
19	Mean Detects					29.92	SD Detects					65.98
20	Median Detects					0.265	CV Detects					2.205
21	Skewness Detects					2.635	Kurtosis Detects					7.028
22	Mean of Logged Detects					0.273	SD of Logged Detects					2.838
23												
24	Normal GOF Test on Detects Only											
25	Shapiro Wilk Test Statistic					0.542	Shapiro Wilk GOF Test					
26	5% Shapiro Wilk Critical Value					0.859	Detected Data Not Normal at 5% Significance Level					
27	Lilliefors Test Statistic					0.363	Lilliefors GOF Test					
28	5% Lilliefors Critical Value					0.243	Detected Data Not Normal at 5% Significance Level					
29	Detected Data Not Normal at 5% Significance Level											
30												
31	Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs											
32	KM Mean					8.826	KM Standard Error of Mean					5.998
33	KM SD					36.77	95% KM (BCA) UCL					20.08
34	95% KM (t) UCL					18.93	95% KM (Percentile Bootstrap) UCL					19.3
35	95% KM (z) UCL					18.69	95% KM Bootstrap t UCL					71.87
36	90% KM Chebyshev UCL					26.82	95% KM Chebyshev UCL					34.97
37	97.5% KM Chebyshev UCL					46.29	99% KM Chebyshev UCL					68.51
38												
39	Gamma GOF Tests on Detected Observations Only											
40	A-D Test Statistic					1.389	Anderson-Darling GOF Test					
41	5% A-D Critical Value					0.857	Detected Data Not Gamma Distributed at 5% Significance Level					
42	K-S Test Statistic					0.33	Kolmogorov-Smirnov GOF					
43	5% K-S Critical Value					0.27	Detected Data Not Gamma Distributed at 5% Significance Level					
44	Detected Data Not Gamma Distributed at 5% Significance Level											
45												
46	Gamma Statistics on Detected Data Only											
47	k hat (MLE)					0.23	k star (bias corrected MLE)					0.228
48	Theta hat (MLE)					129.9	Theta star (bias corrected MLE)					131.1
49	nu hat (MLE)					5.527	nu star (bias corrected)					5.479
50	Mean (detects)					29.92						
51												
52	Gamma ROS Statistics using Imputed Non-Detects											
53	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											

	A–E	F	G–K	L
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	8.765
59	Maximum	220	Median	0.01
60	SD	37.25	CV	4.249
61	k hat (MLE)	0.144	k star (bias corrected MLE)	0.15
62	Theta hat (MLE)	60.66	Theta star (bias corrected MLE)	58.36
63	nu hat (MLE)	11.85	nu star (bias corrected)	12.31
64	Adjusted Level of Significance (β)	0.0441		
65	Approximate Chi Square Value (12.31, α)	5.435	Adjusted Chi Square Value (12.31, β)	5.268
66	95% Gamma Approximate UCL (use when n>=50)	19.86	95% Gamma Adjusted UCL (use when n<50)	20.49
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	8.826	SD (KM)	36.77
70	Variance (KM)	1352	SE of Mean (KM)	5.998
71	k hat (KM)	0.0576	k star (KM)	0.0697
72	nu hat (KM)	4.724	nu star (KM)	5.711
73	theta hat (KM)	153.2	theta star (KM)	126.7
74	80% gamma percentile (KM)	3.125	90% gamma percentile (KM)	18.97
75	95% gamma percentile (KM)	50.74	99% gamma percentile (KM)	166.7
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (5.71, α)	1.494	Adjusted Chi Square Value (5.71, β)	1.418
79	95% Gamma Approximate KM-UCL (use when n>=50)	33.74	95% Gamma Adjusted KM-UCL (use when n<50)	35.56
80	95% Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50)			
81				
82	**Lognormal GOF Test on Detected Observations Only**			
83	Shapiro Wilk Test Statistic	0.806	**Shapiro Wilk GOF Test**	
84	5% Shapiro Wilk Critical Value	0.859	Detected Data Not Lognormal at 5% Significance Level	
85	Lilliefors Test Statistic	0.282	**Lilliefors GOF Test**	
86	5% Lilliefors Critical Value	0.243	Detected Data Not Lognormal at 5% Significance Level	
87	**Detected Data Not Lognormal at 5% Significance Level**			
88				
89	**Lognormal ROS Statistics Using Imputed Non-Detects**			
90	Mean in Original Scale	8.762	Mean in Log Scale	-5.821
91	SD in Original Scale	37.25	SD in Log Scale	5.168
92	95% t UCL (assumes normality of ROS data)	18.56	95% Percentile Bootstrap UCL	19.51
93	95% BCA Bootstrap UCL	28.59	95% Bootstrap t UCL	72.26
94	95% H-UCL (Log ROS)	1920104		
95				
96	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
97	KM Mean (logged)	-1.574	KM Geo Mean	0.207
98	KM SD (logged)	1.891	95% Critical H Value (KM-Log)	3.487
99	KM Standard Error of Mean (logged)	0.309	95% H-UCL (KM -Log)	3.515
100	KM SD (logged)	1.891	95% Critical H Value (KM-Log)	3.487
101	KM Standard Error of Mean (logged)	0.309		
102				
103	**DL/2 Statistics**			
104	**DL/2 Normal**		**DL/2 Log-Transformed**	
105	Mean in Original Scale	8.801	Mean in Log Scale	-1.909
106	SD in Original Scale	37.24	SD in Log Scale	2.061

	A	B	C	D	E	F	G	H	I	J	K	L
107			95% t UCL (Assumes normality)			18.59					95% H-Stat UCL	4.18
108	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
109												
110	**Nonparametric Distribution Free UCL Statistics**											
111	**Data do not follow a Discernible Distribution at 5% Significance Level**											
112												
113	**Suggested UCL to Use**											
114			97.5% KM (Chebyshev) UCL			46.29						
115												
116	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
117	Recommendations are based upon data size, data distribution, and skewness.											
118	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
119	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
120												

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.18/14/2021 8:47:17 PM
From File	USS Lead Wide GW 6.0_trb - Zones 2 & 3.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Se-T

General Statistics

Total Number of Observations	41	Number of Distinct Observations	8
Number of Detects	7	Number of Non-Detects	34
Number of Distinct Detects	6	Number of Distinct Non-Detects	3
Minimum Detect	1.3	Minimum Non-Detect	0.81
Maximum Detect	4.4	Maximum Non-Detect	2.6
Variance Detects	1.086	Percent Non-Detects	82.93%
Mean Detects	2.843	SD Detects	1.042
Median Detects	3.2	CV Detects	0.367
Skewness Detects	-0.161	Kurtosis Detects	-0.313
Mean of Logged Detects	0.977	SD of Logged Detects	0.418

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.96	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	1.203	KM Standard Error of Mean	0.152
KM SD	0.861	95% KM (BCA) UCL	1.46
95% KM (t) UCL	1.459	95% KM (Percentile Bootstrap) UCL	1.442
95% KM (z) UCL	1.453	95% KM Bootstrap t UCL	1.423
90% KM Chebyshev UCL	1.659	95% KM Chebyshev UCL	1.865
97.5% KM Chebyshev UCL	2.152	99% KM Chebyshev UCL	2.714

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.341	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.709	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.246	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.312	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	7.511	k star (bias corrected MLE)	4.387
Theta hat (MLE)	0.379	Theta star (bias corrected MLE)	0.648
nu hat (MLE)	105.2	nu star (bias corrected)	61.42
Mean (detects)	2.843		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

	A–E	F	G–K	L
54	GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)			
55	For such situations, GROS method may yield incorrect values of UCLs and BTVs			
56	This is especially true when the sample size is small.			
57	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
58	Minimum	0.01	Mean	0.686
59	Maximum	4.4	Median	0.01
60	SD	1.141	CV	1.663
61	k hat (MLE)	0.31	k star (bias corrected MLE)	0.304
62	Theta hat (MLE)	2.213	Theta star (bias corrected MLE)	2.26
63	nu hat (MLE)	25.42	nu star (bias corrected)	24.89
64	Adjusted Level of Significance (β)	0.0441		
65	Approximate Chi Square Value (24.89, α)	14.53	Adjusted Chi Square Value (24.89, β)	14.24
66	95% Gamma Approximate UCL (use when n>=50)	1.175	95% Gamma Adjusted UCL (use when n<50)	1.199
67				
68	**Estimates of Gamma Parameters using KM Estimates**			
69	Mean (KM)	1.203	SD (KM)	0.861
70	Variance (KM)	0.741	SE of Mean (KM)	0.152
71	k hat (KM)	1.954	k star (KM)	1.827
72	nu hat (KM)	160.2	nu star (KM)	149.8
73	theta hat (KM)	0.616	theta star (KM)	0.659
74	80% gamma percentile (KM)	1.821	90% gamma percentile (KM)	2.391
75	95% gamma percentile (KM)	2.938	99% gamma percentile (KM)	4.157
76				
77	**Gamma Kaplan-Meier (KM) Statistics**			
78	Approximate Chi Square Value (149.83, α)	122.5	Adjusted Chi Square Value (149.83, β)	121.6
79	95% Gamma Approximate KM-UCL (use when n>=50)	1.471	95% Gamma Adjusted KM-UCL (use when n<50)	1.482
80				
81	**Lognormal GOF Test on Detected Observations Only**			
82	Shapiro Wilk Test Statistic	0.92	**Shapiro Wilk GOF Test**	
83	5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level	
84	Lilliefors Test Statistic	0.244	**Lilliefors GOF Test**	
85	5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level	
86	**Detected Data appear Lognormal at 5% Significance Level**			
87				
88	**Lognormal ROS Statistics Using Imputed Non-Detects**			
89	Mean in Original Scale	1.012	Mean in Log Scale	-0.369
90	SD in Original Scale	0.997	SD in Log Scale	0.871
91	95% t UCL (assumes normality of ROS data)	1.274	95% Percentile Bootstrap UCL	1.26
92	95% BCA Bootstrap UCL	1.319	95% Bootstrap t UCL	1.358
93	95% H-UCL (Log ROS)	1.372		
94				
95	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**			
96	KM Mean (logged)	0.034	KM Geo Mean	1.035
97	KM SD (logged)	0.48	95% Critical H Value (KM-Log)	1.882
98	KM Standard Error of Mean (logged)	0.0905	95% H-UCL (KM -Log)	1.34
99	KM SD (logged)	0.48	95% Critical H Value (KM-Log)	1.882
100	KM Standard Error of Mean (logged)	0.0905		
101				
102	**DL/2 Statistics**			
103	**DL/2 Normal**		**DL/2 Log-Transformed**	
104	Mean in Original Scale	1.233	Mean in Log Scale	-0.00583
105	SD in Original Scale	0.911	SD in Log Scale	0.651
106	95% t UCL (Assumes normality)	1.472	95% H-Stat UCL	1.511

	A	B	C	D	E	F	G	H	I	J	K	L
107	**DL/2 is not a recommended method, provided for comparisons and historical reasons**											
108												
109	**Nonparametric Distribution Free UCL Statistics**											
110	**Detected Data appear Normal Distributed at 5% Significance Level**											
111												
112	**Suggested UCL to Use**											
113					95% KM (t) UCL	1.459						
114												
115	Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
116	Recommendations are based upon data size, data distribution, and skewness.											
117	These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).											
118	However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.											
119												

ATTACHMENT 2 RAGS PART D TABLES, REASONABLE MAXIMUM EXPOSURE

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Chemical-Specific Toxicity Data - Non-Cancer

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Chemical-Specific Toxicity Data - Cancer

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Calculation of Non-Cancer Hazards and Cancer Risks

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Table 7.10 B	Adult Trespasser	OU2 Sediment (0 - 0.5 feet) ISM
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Medium-Specific Summary of Non-Cancer and Cancer Risks

Cumulative Risk Summary of Receptor Risks and Hazards

Table 9.3 A	Adult Trespasser	OU2 Soil (0 - 2 feet), OU2 Sediment (0 - 2 feet) Discrete, OU2 Surface Water
Table 9.3 B	Adult Trespasser	OU2 Soil (0 - 2 feet), OU2 Sediment (0 - 0.5 feet) ISM, OU2 Surface Water
Table 9.4 A	Adolescent Trespasser	OU2 Soil (0 - 2 feet), OU2 Sediment (0 - 2 feet) Discrete, OU2 Surface Water
Table 9.4 B	Adolescent Trespasser	OU2 Soil (0 - 2 feet), OU2 Sediment (0 - 0.5 feet) ISM, OU2 Surface Water
Table 9.5	OU1 Adult Resident (>18 years)	OU1 Zone 1 Groundwater
Table 9.6	OU1 Adolescent Resident (7 to 18 years)	OU1 Zone 1 Groundwater
Table 9.7	OU1 Child Resident (0 to 6 years)	OU1 Zone 1 Groundwater
Table 9.8	OU1 Lifetime Resident	OU1 Zone 1 Groundwater
Table 9.9	OU1 Adult Resident (>18 years)	OU1 Zone 2-3 Groundwater
Table 9.10	OU1 Adolescent Resident (7 to 18 years)	OU1 Zone 2-3 Groundwater
Table 9.11	OU1 Child Resident (0 to 6 years)	OU1 Zone 2-3 Groundwater
Table 9.12	OU1 Lifetime Resident	OU1 Zone 2-3 Groundwater

Risk Driver Summary of Receptor Risks and Hazards

Table 10.1 A	Utility Worker	OU2 Soil (0 - 6 feet), OU2 Sediment (0 - 2 feet) Discrete, OU2 Surface Water, OU2 Groundwater
Table 10.1 B	Utility Worker	OU2 Soil (0 - 6 feet), OU2 Sediment (0 - 0.5 feet) ISM, OU2 Surface Water, OU2 Groundwater
Table 10.2 A	Adult Trespasser	OU2 Soil (0 - 2 feet), OU2 Sediment (0 - 2 feet) Discrete, OU2 Surface Water
Table 10.2 B	Adult Trespasser	OU2 Soil (0 - 2 feet), OU2 Sediment (0 - 0.5 feet) ISM, OU2 Surface Water
Table 10.3 A	Adolescent Trespasser	OU2 Soil (0 - 2 feet), OU2 Sediment (0 - 2 feet) Discrete, OU2 Surface Water
Table 10.3 B	Adolescent Trespasser	OU2 Soil (0 - 2 feet), OU2 Sediment (0 - 0.5 feet) ISM, OU2 Surface Water

Table 1
Human Health Risk Assessment
SELECTION OF POTENTIAL EXPOSURE PATHWAYS
USS Lead Superfund Site - Operable Units 1 & 2

Scenario Timeframe	Environmental Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age Group	Exposure Route	Type of Analysis	Rationale for Type of Analysis of Exposure Pathway
Current/Future	Groundwater	Groundwater Seeps	OU1 Groundwater Seeps in Basements	Resident	Adult (>18 years old)	Incidential Ingestion	Quantitative	Residents in OU1 may have direct contact with and incidentally ingest groundwater seeping into basements.
						Dermal Contact	Quantitative	
					Adolescent (7 to 18 years)	Incidential Ingestion	Quantitative	
						Dermal Contact	Quantitative	
					Child (0 to 6 years)	Incidential Ingestion	Quantitative	
						Dermal Contact	Quantitative	
	Groundwater	Groundwater Residuals	OU1 Groundwater Residuals in Basements	Resident	Adult (>18 years old)	Incidential Ingestion	Qualitative	Groundwater seeping into basements may result in the deposition of residuals onto basement floors after the groundwater seeps recede. This exposure medium is not quantifiable, nor distinguishable from other potential sources of residuals in residential basement settings, thus is discussed qualitatively.
						Dermal Contact	Qualitative	
					Adolescent (7 to 18 years)	Incidential Ingestion	Qualitative	
						Dermal Contact	Qualitative	
					Child (0 to 6 years)	Incidential Ingestion	Qualitative	
						Dermal Contact	Qualitative	
	Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 ft bgs discrete samples; 0 - 0.5 feet ISM samples)	Trespasser	Adult (>18 years old)	Incidental Ingestion	Quantitative	Adult and adolescent trespassers may have direct contact with and incidentally ingest sediment while trespassing in OU2. Sediment exposure does not include inhalation of airborne particulates due to inundated conditions.
						Dermal Contact	Quantitative	
						Particulate Inhalation	Excluded	
					Adolescent (7 to 18 years)	Incidental Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Particulate Inhalation	Excluded	
	Surface Water	Surface Water	OU2 Surface Water	Trespasser	Adult (>18 years old)	Incidential Ingestion	Quantitative	Adult and adolescent trespassers may have direct contact with and incidentally ingest surface water while trespassing in OU2.
						Dermal Contact	Quantitative	
					Adolescent (7 to 18 years)	Incidential Ingestion	Quantitative	
						Dermal Contact	Quantitative	
	Soil	Surface Soil	OU2 Surface Soil (0 - 2 ft bgs)	Trespasser	Adult (>18 years old)	Incidental Ingestion	Quantitative	Adult and adolescent trespassers may have direct contact with and incidentally ingest soil while trespassing in OU2, as well as be exposed to airborne particulates during activities in OU2
						Dermal Contact	Quantitative	
						Particulate Inhalation	Quantitative	
					Adolescent (7 to 18 years)	Incidential Ingestion	Quantitative	
						Dermal Contact	Quantitative	
						Particulate Inhalation	Quantitative	
				O & M Worker	Adult (>18 years old)	Incidental Ingestion	Quantitative	Adult O & M workers may have direct contact with and incidentally ingest soil while working in OU2, as well as be exposed to airborne particulates during activities in OU2
						Dermal Contact	Quantitative	
						Particulate Inhalation	Quantitative	
Future	Soil	Surface and Subsurface Soil	OU2 Surface and Subsurface Soil (0 - 6 ft bgs)	Utility Worker	Adult (>18 years old)	Incidental Ingestion	Quantitative	Adult utility workers may have direct contact with and incidentally ingest soil while working in OU2, as well as be exposed to airborne particulates during activities in OU2
						Dermal Contact	Quantitative	
						Particulate Inhalation	Quantitative	
	Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 ft bgs discrete samples; 0 - 0.5 feet ISM samples)	Utility Worker	Adult (>18 years old)	Incidental Ingestion	Quantitative	Adult utility workers may have direct contact with and incidentally ingest sediment while working in OU2. Sediment exposure does not include inhalation of airborne particulates due to inundated conditions.
						Dermal Contact	Quantitative	
						Particulate Inhalation	Excluded	
	Surface Water	Surface Water	OU2 Surface Water	Utility Worker	Adult (>18 years old)	Incidental Ingestion	Qualitative	Adult utility workers may have direct contact with surface water while working in OU2. Incidental ingestion of surface water by a utility worker is *de minimis* and discussed qualitatively.
						Dermal Contact	Quantitative	
	Groundwater	Groundwater	OU2 Groundwater	Utility Worker	Adult (>18 years old)	Incidental Ingestion	Qualitative	Adult utility workers may have direct contact with groundwater during during project-related activities in OU2. Incidental ingestion of groundwater by a utility worker is *de minimis* and discussed qualitatively.
						Dermal Contact	Quantitative	

TABLE 2.1
OCCURRENCE, DISTRIBUTION AND SCREENING OF CHEMICALS OF INTEREST
USS Lead Superfund Site - Operable Units 1 & 2

Scenario Timeframe:	Current/Future
Medium:	Multiple
Exposure Medium:	Multiple
Exposure Point:	Multiple

CAS Number	Chemical	Minimum (1) Concentration	Maximum (1) Concentration	Units	Detection Frequency	Minimum Detection Limit	Maximum Detection Limit	Concentration Used for Screening	Regional Screening Levels (RSLs) (2)						Potential ARAR/TBC Value	Potential ARAR/TBC Source	COI Flag	Rationale for (3) Contaminant Deletion or Selection
OU2 Surface Soil (0 - 2 feet)																		
7440-36-0	Antimony	1.9	210	mg/kg	49 / 64	1.3	31	210	3.1	a	47	b	292	c			YES	ASL
7440-38-2	Arsenic	1.7	630	mg/kg	51 / 52	17.6	17.6	630	0.68	a	3	b	23.4	c			YES	ASL
7440-43-9	Cadmium	0.1	14	mg/kg	42 / 52	0.086	0.64	14	7.1	a	98	b	619	c			YES	ASL
7439-92-1	Lead	1.7	1800	mg/kg	71 / 78	3.9	148	1800	400	a	800	b	-				YES	ASL
7782-49-2	Selenium	0.11	5.8	mg/kg	22 / 32	0.077	1.9	5.8	39	a	580	b	3,650	c			YES	INC
OU2 Surface+Subsurface Soil (0 - 6 feet)																		
7440-36-0	Antimony	0.97	210	mg/kg	67 / 85	1.3	31	210	3.1	a	47	b	13.5	d			YES	ASL
7440-38-2	Arsenic	0.87	630	mg/kg	70 / 70	-	-	630	0.68	a	3	b	8.9	d			YES	ASL
7440-43-9	Cadmium	0.032	530	mg/kg	60 / 70	0.086	0.64	530	7.1	a	98	b	7.55	d			YES	ASL
7439-92-1	Lead	1.4	1800	mg/kg	90 / 99	3.9	148	1800	400	a	800	b	-				YES	ASL
7782-49-2	Selenium	0.11	5.8	mg/kg	25 / 50	0.077	3.8	5.8	39	a	580	b	169	d			YES	INC
OU2 Sediment (0 - 2 feet) DISCRETE																		
7440-36-0	Antimony	0.82	3710	mg/kg	37 / 105	0.026	380	3710	3.1	a	47	b	292	c			YES	ASL
7440-38-2	Arsenic	1.51	5700	mg/kg	47 / 47	-	-	5700	0.68	a	3	b	23.4	c			YES	ASL
7440-43-9	Cadmium	0.16	160	mg/kg	33 / 47	0.023	0.73	160	7.1	a	98	b	619	c			YES	ASL
7439-92-1	Lead	1.9	20000	mg/kg	326 / 358	4	3200	20000	400	a	800	b	-				YES	ASL
7782-49-2	Selenium	1.1	43.9	mg/kg	15 / 28	0.085	1.9	43.9	39	a	580	b	3,650	c			YES	ASL
OU2 Sediment (0 - 0.5 feet) ISM																		
7440-36-0	Antimony	11	51	mg/kg	24 / 24	-	-	51	3.1	a	47	b	292	c			YES	ASL
7440-38-2	Arsenic	180	590	mg/kg	24 / 24	-	-	590	0.68	a	3	b	23.4	c			YES	ASL
7440-43-9	Cadmium	4	65	mg/kg	24 / 24	-	-	65	7.1	a	98	b	619	c			YES	ASL
7439-92-1	Lead	260	1800	mg/kg	24 / 24	-	-	1800	400	a	800	b	-				YES	ASL
7782-49-2	Selenium	2.8	11	mg/kg	24 / 24	-	-	11	39	a	580	b	3,650	c			YES	INC
OU2 Surface Water																		
7440-36-0	Antimony, Total	7	46	ug/L	10 / 13	2.7	6.4	46	0.8	e	132	f			5.6 / 640	NRWQC W+O / W	YES	ASL
7440-38-2	Arsenic, Total	9.9	300	ug/L	13 / 13	-	-	300	0.1	e	21.7	f			0.018 / 0.14	NRWQC W+O / W	YES	ASL
7440-43-9	Cadmium, Total	0.95	1.2	ug/L	4 / 13	0.71	0.94	1.2	0.9	e	67.3	f					YES	ASL
7439-92-1	Lead, Total	2.9	19	ug/L	4 / 13	2.5	82	19	15.0	e	-						YES	ASL
7782-49-2	Selenium, Total	4.6	4.6	ug/L	1 / 13	4.6	5.3	4.6	10.0	e	4,340	f			170 / 4,200	NRWQC W+O / W	YES	INC
OU2 Groundwater																		
7440-36-0	Antimony, Total	0.45	170	ug/L	21 / 27	0.38	6	170	0.8	e					6	MCL	YES	ASL
7440-38-2	Arsenic, Total	0.62	23000	ug/L	25 / 27	3.7	3.7	23000	0.1	e					10	MCL	YES	ASL
7440-43-9	Cadmium, Total	0.83	210	ug/L	23 / 27	0.22	0.22	210	0.9	e					5	MCL	YES	ASL
7439-92-1	Lead, Total	0.17	1200	ug/L	23 / 27	0.13	2.7	1200	15.0	e					15	MCL	YES	ASL
7782-49-2	Selenium, Total	2.2	5.6	ug/L	2 / 27	1.5	5.3	5.6	10.0	e					50	MCL	YES	INC
OU1 Z1 Groundwater																		
7440-36-0	Antimony, Total	0.42	1200	ug/L	17 / 20	0.38	1.1	1200	0.8	e					6	MCL	YES	ASL
7440-38-2	Arsenic, Total	0.69	440	ug/L	20 / 20	-	-	440	0.1	e					10	MCL	YES	ASL
7440-43-9	Cadmium, Total	0.5	59	ug/L	6 / 20	0.13	0.22	59	0.9	e					5	MCL	YES	ASL
7439-92-1	Lead, Total	0.14	89	ug/L	13 / 20	0.094	0.13	89	15.0	e					15	MCL	YES	ASL
7782-49-2	Selenium, Total	2.3	82	ug/L	9 / 20	0.81	2.6	82	10.0	e					50	MCL	YES	ASL
OU1 Z2-3 Groundwater																		
7440-36-0	Antimony, Total	0.48	28	ug/L	33 / 41	0.38	1.1	28	0.8	e					6	MCL	YES	ASL
7440-38-2	Arsenic, Total	0.32	50	ug/L	40 / 41	0.31	0.31	50	0.1	e					10	MCL	YES	ASL
7440-43-9	Cadmium, Total	ND	ND	ug/L	0 / 41	0.22	0.22	-	0.9	e					5	MCL	YES	ASL
7439-92-1	Lead, Total	0.1	220	ug/L	12 / 41	0.094	0.13	220	15.0	e					15	MCL	YES	ASL
7782-49-2	Selenium, Total	1.3	4.4	ug/L	7 / 41	0.81	2.6	4.4	10.0	e					50	MCL	YES	INC

(1) Minimum/maximum detected concentration.

(2) USEPA Regional Screening Levels (RSLs) based on HQ = 0.1 or Cancer Risk = 10-6. Tables dated May 2021.

a Residential Soil RSL

b Industrial Soil RSL

c Recreator Soil/Sediment RSL (calculated using USEPA's on-line calculator tool, assuming 4 hrs/day, 40 days/year [all other calculator defaults accepted])

d Construction Worker Soil RSL (calculated using USEPA's on-line calculator tool for the 'Mechanically Driven - Unpaved Road Traffic' scenario. The RSLs were generated assuming the following inputs: number of cars = 5, tons/car = 2, number of trucks = 5, tons/truck = 20, and days of precipitation = 130 [all other calculator defaults accepted]

e Tapwater RSL

f Recreator Surface Water RSL (calculated using USEPA's on-line calculator tool, assuming 4 hrs/day, 40 days/year, incidental water ingestion rate 0.015 L/hour, skin surface area 6,032 cm^2 [all other calculator defaults accepted])

(3) Above Screening Level(s) (ASL)
Included based on identification as COI in another exposure medium (INC)

Definitions:
COI = Chemical of Interest
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered
MCL = Federal Maximum Contaminant Level
NRWQC = National Recommended Water Quality Criteria - Human Health Criteria
W+O / W = Consumption of Water + Organism / Water Only

Table 3.1
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Soil
Exposure Point:	OU2 Soil

Chemical of Interest	Units	Mean [1]	ProUCL - Recommended [2] UCL on the Mean	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			
							Medium EPC Value	Medium EPC Statistic[7]	Medium EPC Rationale	Particulates in Air Concentration (mg/m^3)
Surface Soil (0 - 2 feet)										(3)
Antimony	mg/kg	29.9	51.4	210		mg/kg	51.4	95% UCL - KM H (LN)	(5)	3.8E-08
Arsenic	mg/kg	51.9	94	630		mg/kg	94	95% UCL - KM H (LN)	(5)	6.9E-08
Cadmium	mg/kg	2.4	3.5	14.0		mg/kg	3.5	95% UCL - KM Approximate Gamma (G)	(5)	2.5E-09
Lead	mg/kg	262	441	1800		mg/kg	262	Mean	(6)	1.9E-07
Selenium	mg/kg	1.0	1.7	5.8		mg/kg	1.7	95% UCL - Gamma Adjusted KM (G)	(5)	1.2E-09
Surface+Subsurface Soil (0 - 6 feet)										(4)
Antimony	mg/kg	25.3	39.1	210		mg/kg	39.1	95% UCL - KM H (LN)	(5)	1.1E-05
Arsenic	mg/kg	42.0	62	630		mg/kg	62	95% UCL - H (NDD)	(5)	1.7E-05
Cadmium	mg/kg	12.7	23	530		mg/kg	23.0	95% UCL - KM H (LN)	(5)	6.4E-06
Lead	mg/kg	251	420	1800		mg/kg	251	Mean	(6)	6.9E-05
Selenium	mg/kg	0.7	1.1	5.8		mg/kg	1.1	95% UCL - KM Approximate Gamma (G)	(5)	3.0E-07

Statistics: Maximum Detected Value (Maximum) or ProUCL-recommended Upper Confidence Limit (UCL) on the Mean
(1) Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution
(2) Calculated by ProUCL (Version 5.1.002)
(3) Particulate Air Concentration = Soil Conc / Particulate Emission Factor (PEF) where PEF = 1.36×10^9 m^3/kg (USEPA default based on ambient wind erosion).
(4) Particulate Air Concentration = Soil Conc / Particulate Emission Factor (PEF) where PEF = 3.61×10^9 m^3/kg (derived from USEPA Unpaved Road Traffic model for construction/utility workers).

Table 3.2
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Surface Sediment
Exposure Point:	OU2 Sediment

Chemical of Interest	Units	Mean [1]	ProUCL - Recommended [2] UCL on the Mean	Maximum Detected Concentration	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure			
							Medium EPC Value	Medium EPC Statistic[5]	Medium EPC Rationale	Particulates in Air Concentration (mg/m^3)
Sediment (0 - 2 feet) DISCRETE										
Antimony	mg/kg	124	240	3710		mg/kg	240	95% UCL - KM Approximate Gamma (G)	(3)	N/A
Arsenic	mg/kg	489	1417	5700		mg/kg	1417	97.5% UCL - Chebyshev (NDD)	(3)	N/A
Cadmium	mg/kg	16.7	28.2	160		mg/kg	28.2	95% UCL - Gamma Adjusted KM (G)	(3)	N/A
Lead	mg/kg	641	1302	20000		mg/kg	641	Mean	(4)	N/A
Selenium	mg/kg	10.0	14.2	43.9		mg/kg	14.2	95% UCL - KM (t) (N)	(3)	N/A
Sediment (0 - 0.5 feet) ISM										
Antimony	mg/kg	29	32	51		mg/kg	32	95% UCL - Student's-t UCL (N)	(3)	N/A
Arsenic	mg/kg	320	341	590		mg/kg	341	95% UCL - Student's-t UCL (N)	(3)	N/A
Cadmium	mg/kg	24.6	25.7	65		mg/kg	25.7	95% UCL - Student's-t UCL (N)	(3)	N/A
Lead	mg/kg	776	829	1800		mg/kg	776	Mean	(4)	N/A
Selenium	mg/kg	5.8	6.2	11.0		mg/kg	6.2	95% UCL - Student's-t UCL (N)	(3)	N/A

Statistics: Maximum Detected Value (Maximum) or ProUCL-recommended Upper Confidence Limit (UCL) on the Mean
(1) Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution
(2) Calculated by ProUCL (Version 5.1.002)
(3) UCL < Maximum (USEPA, OSWER 9285.6-10, December 2002)
(4) USEPA guidance specifies use of the mean for evaluating lead exposure (USEPA, EPA/540/R-03/001, 2003)
Particulate Air Concentration = N/A (assumes wet sediment not a significant source of airborne particulates)

Table 3.3
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Surface water
Exposure Medium:	Surface water
Exposure Point:	OU2 Surface water

Chemical of Interest	Units	Mean [1]	ProUCL - Recommended [2] UCL on the Mean	Maximum Detected Concentration mg/L	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic[6]	Medium EPC Rationale
Total Metals									
Antimony	mg/L	1.67E-02	2.40E-02	4.60E-02		mg/L	2.40E-02	95% UCL - KM (t) (N)	(3)
Arsenic	mg/L	6.95E-02	1.39E-01	3.00E-01		mg/L	1.39E-01	95% UCL - Adjusted Gamma (NDD)	(3)
Cadmium	mg/L	8.42E-04	9.59E-04	1.20E-03		mg/L	9.59E-04	95% UCL - KM (t) (NDD)	(3)
Lead	mg/L	4.37E-03	7.06E-03	1.90E-02		mg/L	4.37E-03	Mean	(4)
Selenium	mg/L	4.60E-03	NC	4.60E-03		mg/L	4.60E-03	Maximum	(5)

Statistics: Maximum Detected Value (Maximum) or ProUCL-recommended Upper Confidence Limit (UCL) on the Mean
(1) Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution
(2) Calculated by ProUCL (Version 5.1.002)
(3) UCL < Maximum (USEPA, OSWER 9285.6-10, December 2002)
(4) USEPA guidance specifies use of the mean for evaluating lead exposure (USEPA, EPA/540/R-03/001, 2003)
(5) Maximum used due to only one detection
NC = Not calculated due to insufficiently sized data set

Table 3.4
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater
Exposure Point:	OU2 Groundwater

Chemical of Interest	Units	Mean [1]	ProUCL - Recommended [2] UCL on the Mean	Maximum Detected Concentration mg/L	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic[3]	Medium EPC Rationale
Total Metals									
Antimony	mg/L	4.55E-02	6.80E-02	1.70E-01		mg/L	6.80E-02	95% UCL - KM Adjusted Gamma (G)	(3)
Arsenic	mg/L	1.80E+00	1.27E+01	2.30E+01		mg/L	1.27E+01	99% UCL - Kaplan-Meier (KM) Chebyshev (LN)	(3)
Cadmium	mg/L	2.93E-02	7.47E-02	2.10E-01		mg/L	7.47E-02	95% UCL - Kaplan-Meier (KM) Chebyshev (NDD)	(3)
Lead	mg/L	1.39E-01	3.53E-01	1.20E+00		mg/L	1.39E-01	Mean	(4)
Selenium	mg/L	1.76E-03	2.86E-03	5.60E-03		mg/L	2.86E-03	95% UCL - Kaplan-Meier (KM) Chebyshev (NDD)	(3)

Statistics: Maximum Detected Value (Maximum) or ProUCL-recommended Upper Confidence Limit (UCL) on the Mean
(1) Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution
(2) Calculated by ProUCL (Version 5.1.002)

Table 3.5
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Z1 Groundwater Seeps in Basements

Chemical of Interest	Units	Mean [1]	ProUCL - Recommended [2] UCL on the Mean	Maximum Detected Concentration mg/L	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic[2]	Medium EPC Rationale
Total Metals									
Antimony	mg/L	1.84E-01	7.48E-01	1.20E+00		mg/L	7.48E-01	97.5% UCL - Kaplan-Meier (KM) Chebyshev (LN)	(3)
Arsenic	mg/L	7.76E-02	1.80E-01	4.40E-01		mg/L	1.80E-01	95% UCL - Adjusted Gamma (G)	(3)
Cadmium	mg/L	8.00E-03	1.57E-02	5.90E-02		mg/L	1.57E-02	95% UCL - KM (t) (N)	(3)
Lead	mg/L	1.67E-02	4.13E-02	8.90E-02		mg/L	1.67E-02	Mean	(4)
Selenium	mg/L	1.18E-02	3.66E-02	8.20E-02		mg/L	3.66E-02	95% UCL - Kaplan-Meier (KM) Chebyshev (LN)	(3)

Statistics: Maximum Detected Value (Maximum) or ProUCL-recommended Upper Confidence Limit (UCL) on the Mean
[1] Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution
[2] Calculated by ProUCL (Version 5.1.002)

Table 3.5
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Z2-3 Groundwater Seeps in Basements

Chemical of Interest	Units	Mean [1]	ProUCL - Recommended [2] UCL on the Mean	Maximum Detected Concentration mg/L	Maximum Qualifier	EPC Units	Reasonable Maximum Exposure		
							Medium EPC Value	Medium EPC Statistic[5]	Medium EPC Rationale
Total Metals									
Antimony	mg/L	7.73E-03	9.75E-03	2.80E-02		mg/L	9.75E-03	95% UCL - KM (t) (N)	(3)
Arsenic	mg/L	8.41E-03	1.87E-02	5.00E-02		mg/L	1.87E-02	95% UCL - Kaplan-Meier (KM) Chebyshev (NDD)	(3)
Cadmium	mg/L	0.00E+00	0.00E+00	0.00E+00		mg/L	0.00E+00	Not detected	(5)
Lead	mg/L	8.83E-03	4.63E-02	2.20E-01		mg/L	8.83E-03	Mean	(4)
Selenium	mg/L	1.20E-03	1.46E-03	4.40E-03		mg/L	1.46E-03	95% UCL - KM (t) (N)	(3)

Statistics: Maximum Detected Value (Maximum) or ProUCL-recommended Upper Confidence Limit (UCL) on the Mean
(1) Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution
(2) Calculated by ProUCL (Version 5.1.002)
(3) UCL < Maximum (USEPA, OSWER 9285.6-10, December 2002)

Table 4.1
Human Health Risk Assessment
VALUES USED FOR DAILY INTAKE CALCULATIONS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Soil
Exposure Medium:	Surface and Subsurface Soil
Exposure Point:	OU2 Surface and Subsurface Soil (0 - 6 feet)
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSoil	Chemical Concentration in Soil	mg/kg soil	See Table 3.1	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR_{soil}	Ingestion Rate of Soil	mg soil/day	330	USEPA 2002; 2004 -- Recommended value for soil ingestion by a construction worker.	CSoil x IR_{soil} x CF x FI x RBA x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	0.000001	--	
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	RBA	Relative Bioavailability Factor	unitless	Chemical-Specific	USEPA 2012, 2021 -- RBA of 0.6 applied to Arsenic, RBA of 1 for all other COIs	
	EF	Exposure Frequency	days/yr	25	Professional Judgment -- assumes 5 weeks/year (5 d/wk)	
	ED	Exposure Duration	yr	1	Professional Judgment -- assumes 5 weeks of utility activity in 1 year	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Life Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	365	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSoil	Chemical Concentration in Soil	mg/kg soil	See Table 3.1	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
	CF	Conversion Factor	kg/mg	0.000001	--	CSoil x CF x SA x SSAF x DABS x EF x
	SA	Skin Surface Area Available for Contact	cm^2/event	3,527	USEPA 2014 -- Recommended value for adult worker, which is the weighted average of mean values for head, hands, and forearms (male and female, 21+years) (Table 7-2; EPA 2011)	ED x 1/BW x 1/AT
	SSAF	Soil-to-Skin Adherence Factor	mg/cm^2/event	0.3	USEPA 2002; 2004 -- Recommended value for construction worker.	
	DABS	Dermal Absorption Factor	--	Chemical-Specific	USEPA 1995 -- Refer to Supporting Documentation	
	EF	Exposure Frequency	days/yr	25	Professional Judgment -- assumes 5 weeks/year (5 d/wk)	
	ED	Exposure Duration	yr	1	Professional Judgment -- assumes 5 weeks of utility activity in 1 year	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	365	ED (year) x 365 days/year (USEPA 1989)	

Table 4.2
Human Health Risk Assessment
VALUES USED FOR DAILY INTAKE CALCULATIONS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Surface Sediment
Exposure Point:	OU2 Surface Sediment (0 - 2 feet discrete; 0 - 0.5 feet ISM)
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSed	Chemical Concentration in Sediment	mg/kg sediment	See Table 3.2	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) =
	IRsed	Ingestion Rate of Sediment	mg sediment/day	330	USEPA 2002; 2004 -- Recommended value for soil ingestion by a construction worker.	CSed x IR_{sed} x CF x FI x RBA x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	0.000001	--	
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	RBA	Relative Bioavailability Factor	unitless	Chemical-Specific	USEPA 2012, 2021 -- RBA of 0.6 applied to Arsenic, RBA of 1 for all other COIs	
	EF	Exposure Frequency	days/yr	25	Professional Judgment -- assumes that a utility project would take 5 weeks to complete (5 weeks x 5 days/week).	
	ED	Exposure Duration	yr	1	Professional Judgment -- assumes 6 mos of active construction in 1 year	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	365	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSed	Chemical Concentration in Sediment	mg/kg sediment	See Table 3.2	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) =
	CF	Conversion Factor	kg/mg	0.000001	--	CSed x CF x SA x SSAF x DABS x EF x
	SA	Skin Surface Area Available for Contact	cm^2/event	3,527	USEPA 2014 -- Recommended value for adult worker, which is the weighted average of mean values for head, hands, and forearms (male and female, 21+years) (Table 7-2; EPA 2011)	ED x 1/BW x 1/AT
	SSAF	Sediment-to-Skin Adherence Factor	mg/cm^2/event	0.9	USEPA 2004 -- Based on the 95th percentile weighted soil AFs for utility workers.	
	DABS	Dermal Absorption Factor	--	Chemical-Specific	USEPA 1995 -- Refer to Supporting Documentation	
	EF	Exposure Frequency	days/yr	25	Professional Judgment -- assumes 24 weeks/year (5 d/wk, 6 months)	
	ED	Exposure Duration	yr	1	Professional Judgment -- assumes 6 mos of active construction in 1 year	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	365	ED (year) x 365 days/year (USEPA 1989)	

Table 4.3
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Surface water
Exposure Medium:	Surface water
Exposure Point:	OU2 Surface water
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Dermal	CSW	Chemical Concentration in Surface Water	mg/L	See Table 3.3	See Table 3.4	Chronic Daily Intake (CDI) (mg/kd-day) =
	SA	Skin Surface Area Available for Contact	cm^2	3,527	USEPA 2014 -- Recommended value for adult worker, which is the weighted average of mean values for head, hands, and forearms (male and female, 21+years) (Table 7-2; EPA 2011)	DAevent x SA x EV x EF x ED x
	K_p	Permeability Constant	cm/hr	Chemical-Specific	USEPA 2004 -- Refer to Supporting Documentation	1/BW x 1/AT
	ET	Exposure Time	hr/event	4	Professional Judgement -- Half the typical work day	
	EV	Event Frequency	events/day	1	One event per day	Where Dermal Absorbed Dose (Inorganics)
	EF	Exposure Frequency	days/yr	25	Professional Judgment -- assumes that a utility project would take 5 weeks to complete (5 weeks x 5 days/week).	(DA_{event}) (mg/cm2-event) =
	ED	Exposure Duration	yr	1	Professional Judgment -- assumes 6 mos of active construction in 1 year	= CW x CF x ET x Kp
	CF	Conversion Factor	L/cm^3	0.001	--	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	365	ED (year) x 365 days/year (USEPA 1989)	

Table 4.4
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater
Exposure Point:	OU2 Groundwater
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Dermal	CSW	Chemical Concentration in Ground Water	mg/L	See Table 3.4	See Table 3.4	Chronic Daily Intake (CDI) (mg/kd-day) =
	SA	Skin Surface Area Available for Contact	cm^2	3,527	USEPA 2014 -- Recommended value for adult worker, which is the weighted average of mean values for head, hands, and forearms (male and female, 21+years) (Table 7-2; EPA 2011)	DAevent x SA x EV x EF x ED x
	K_p	Permeability Constant	cm/hr	Chemical-Specific	USEPA 2004 -- Refer to Supporting Documentation	1/BW x 1/AT
	ET	Exposure Time	hr/event	4	Professional Judgement -- Half the typical work day	
	EV	Event Frequency	events/day	1	One event per day	<u>Where Dermal Absorbed Dose (Inorganics)</u>
	EF	Exposure Frequency	days/yr	25	Professional Judgment -- assumes that a utility project would take 5 weeks to complete (5 weeks x 5 days/week).	(DA_{event}) (mg/cm2-event) =
	ED	Exposure Duration	yr	1	Professional Judgment -- assumes 6 mos of active construction in 1 year	= CW x CF x ET x Kp
	CF	Conversion Factor	L/cm^3	0.001	--	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	365	ED (year) x 365 days/year (USEPA 1989)	

Table 4.5
Human Health Risk Assessment
VALUES USED FOR DAILY INTAKE CALCULATIONS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Surface Soil
Exposure Point:	OU2 Surface Soil (0 - 2 feet)
Receptor Population:	O&M Worker
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSoil	Chemical Concentration in Soil	mg/kg soil	See Table 3.1	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR_{soil}	Ingestion Rate of Soil	mg soil/day	100	USEPA 2014 -- Recommended value for soil ingestion by an adult worker.	CSoil x IR_{soil} x CF x FI x RBA x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	0.000001	--	
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	RBA	Relative Bioavailability Factor	unitless	Chemical-Specific	USEPA 2012, 2021 -- RBA of 0.6 applied to Arsenic, RBA of 1 for all other COIs	
	EF	Exposure Frequency	days/yr	21	Professional Judgment -- This represents the total number of days per year for: 1) bi-annual groundwater monitoring; 2) monthly CAMU inspections; 3) quarterly well repairs; 4) bi-annual maintenance activities; 5) quarterly effluent sampling; and 6) annual CAMU repairs.	
	ED	Exposure Duration	yr	25	USEPA 2014 -- Default worker exposure duration	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	9,125	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSoil	Chemical Concentration in Soil	mg/kg soil	See Table 3.1	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
	CF	Conversion Factor	kg/mg	0.000001	--	CSoil x CF x SA x SSAF x DABS x EF x
	SA	Skin Surface Area Available for Contact	cm^2/event	3,527	USEPA 2014 -- Recommended value for adult worker, which is the weighted average of mean values for head, hands, and forearms (male and female, 21+years) (Table 7-2; EPA 2011)	ED x 1/BW x 1/AT
	SSAF	Soil-to-Skin Adherence Factor	mg/cm^2/event	0.12	USEPA 2014 -- Default worker soil adherence factor	
	DABS	Dermal Absorption Factor	--	Chemical-Specific	USEPA 1995 -- Refer to Supporting Documentation	
	EF	Exposure Frequency	days/yr	21	Professional Judgment -- This represents the total number of days per year for: 1) bi-annual groundwater monitoring; 2) monthly CAMU inspections; 3) quarterly well repairs; 4) bi-annual maintenance activities; 5) quarterly effluent sampling; and 6) annual CAMU repairs.	
	ED	Exposure Duration	yr	25	USEPA 2014 -- Default worker exposure duration	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	9125	ED (year) x 365 days/year (USEPA 1989)	
Inhalation	CA	Chemical Concentration in Particulate Air	mg/m^3	See Table 3.1	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =

Table 4.6
Human Health Risk Assessment
VALUES USED FOR DAILY INTAKE CALCULATIONS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Surface Soil
Exposure Point:	OU2 Surface Soil (0 - 2 feet)
Receptor Population:	Trespasser
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSoil	Chemical Concentration in Soil	mg/kg soil	See Table 3.1	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR_{soil}	Ingestion Rate of Soil	mg soil/day	100	Consistent USEPA recommended value for outdoor workers and residents (USEPA 2002, Exhibit 1-2) and OSWER Directive 9200.1-120 (USEPA 2014).	CSoil x IR_{soil} x CF x FI x RBA x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	0.000001	--	
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	RBA	Relative Bioavailability Factor	unitless	Chemical-Specific	USEPA 2012, 2021 -- RBA of 0.6 applied to Arsenic, RBA of 1 for all other COIs	
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	20	Professional Judgement - same duration as adult resident	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	7300	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSoil	Chemical Concentration in Soil	mg/kg soil	See Table 3.1	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
	CF	Conversion Factor	kg/mg	0.000001	--	CSoil x CF x SA x SSAF x DABS x EF x
	SA	Skin Surface Area Available for Contact	cm^2/event	6,032	USEPA 2014 -- Default adult resident skin surface area: weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, 21+ years)	ED x 1/BW x 1/AT
	SSAF	Soil-to-Skin Adherence Factor	mg/cm^2/event	0.07	USEPA 2014 -- Recommended value for adult resident	
	DABS	Dermal Absorption Factor	--	Chemical-Specific	USEPA 1995 -- Refer to Supporting Documentation	
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	20	Professional Judgement - same duration as adult resident	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	7300	ED (year) x 365 days/year (USEPA 1989)	
Inhalation	CA	Chemical Concentration in Particulate Air	mg/m^3	See Table 3.1	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
	ET	Exposure Time - Outdoor	hr/day	4	Professional Judgment.	(CA x ET x EF x ED)/AT
	EF	Exposure Frequency - Outdoor	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	20	Professional Judgement - same duration as adult resident	
	AT_c	Averaging Time for Carcinogens	hours	613,200	70-year lifetime x 365 days/year x 24 hours/day (USEPA 1989, 2009)	
	AT_{nc}	Averaging Time for Noncarcinogens	hours	175,200	ED (year) x 365 days/year x 24 hours/day (USEPA 2009)	

Table 4.7
Human Health Risk Assessment
VALUES USED FOR DAILY INTAKE CALCULATIONS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Surface Sediment
Exposure Point:	OU2 Surface Sediment (0 - 2 feet discrete; 0 - 0.5 feet ISM)
Receptor Population:	Trespasser
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSed	Chemical Concentration in Sediment	mg/kg sediment	See Table 3.2	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) = CSed x IR_{sed} x CF x FI x RBA x EF x ED x 1/BW x 1/AT
	IRsed	Ingestion Rate of Sediment	mg sediment/day	100	Consistent USEPA recommended value for outdoor workers and residents (USEPA 2002, Exhibit 1-2) and OSWER Directive 9200.1-120 (USEPA 2014).	
	CF	Conversion Factor	kg/mg	0.000001	--	
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	RBA	Relative Bioavailability Factor	unitless	Chemical-Specific	USEPA 2012, 2021 -- RBA of 0.6 applied to Arsenic, RBA of 1 for all other COIs	
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	20	Professional Judgement - same duration as adult resident	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	7300	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSed	Chemical Concentration in Sediment	mg/kg sediment	See Table 3.2	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) = CSed x CF x SA x SSAF x DABS x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	0.000001	--	
	SA	Skin Surface Area Available for Contact	cm^2/event	6,032	USEPA 2014 -- Default adult resident skin surface area: weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, 21+ years)	
	SSAF	Sediment-to-Skin Adherence Factor	mg/cm^2/event	0.3	USEPA 2004 -- Based on the geometric mean AF based on exposure to face, forearms, hands, and lower legs for adult gardeners	
	DABS	Dermal Absorption Factor	--	Chemical-Specific	USEPA 1995 -- Refer to Supporting Documentation	
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	20	Professional Judgement - same duration as adult resident	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	7300	ED (year) x 365 days/year (USEPA 1989)	

Table 4.8
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Surface water
Exposure Medium:	Surface water
Exposure Point:	OU2 Surface water
Receptor Population:	Trespasser
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical Concentration in Surface Water	mg/L	See Table 3.3	See Table 3.3	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR_{sw}	Ingestion Rate of Surface Water	L/day	0.0148	Incidental ingestion while wading: 0.0037 L/hour (3.7 mL/hour) used for all receptors, which is the mean value from Table 3-93 of the Exposure Factors Handbook (2011)	CSW x IR_{sw} x FI x EF x ED x
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	1/BW x 1/AT
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	20	Professional Judgement - same duration as adult resident	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	7,300	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSW	Chemical Concentration in Surface Water	mg/L	See Table 3.3	See Table 3.3	Chronic Daily Intake (CDI) (mg/kd-day) =
	SA	Skin Surface Area Available for Contact	cm^2	6,032	USEPA 2014 -- Default adult resident skin surface area: weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, 21+ years)	DAevent x SA x EV x EF x ED x
	K_p	Permeability Constant	cm/hr	Chemical-Specific	USEPA 2004 -- Refer to Supporting Documentation	1/BW x 1/AT
	ET	Exposure Time	hr/event	4	Professional Judgement	
	EV	Event Frequency	events/day	1	One event per day	Where Dermal Absorbed Dose (Inorganics)
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	(DA_{event}) (mg/cm2-event) =
	ED	Exposure Duration	yr	20	Professional Judgement - same duration as adult resident	= CW x CF x ET x Kp
	CF	Conversion Factor	L/cm^3	0.001	--	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	7,300	ED (year) x 365 days/year (USEPA 1989)	

Table 4.9
Human Health Risk Assessment
VALUES USED FOR DAILY INTAKE CALCULATIONS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Surface Soil
Exposure Point:	OU2 Surface Soil (0 - 2 feet)
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 - 18 years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSoil	Chemical Concentration in Soil	mg/kg soil	See Table 3.1	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR_{soil}	Ingestion Rate of Soil	mg soil/day	100	Assumed the same rate as adult outdoor workers and residents; (USEPA 2002, Exhibit 1-2) and OSWER Directive 9200.1-120 (USEPA 2014).	CSoil x IR_{soil} x CF x FI x RBA x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	0.000001	--	
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	RBA	Relative Bioavailability Factor	unitless	Chemical-Specific	USEPA 2012, 2021 -- RBA of 0.6 applied to Arsenic, RBA of 1 for all other COIs	
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	12	Based on age group of receptor	
	BW	Body Weight	kg	47.6	Mean of body weight values for males and females >6 to 18 years old (USEPA 2011)	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	4,380	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSoil	Chemical Concentration in Soil	mg/kg soil	See Table 3.1	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
	CF	Conversion Factor	kg/mg	0.000001	--	CSoil x CF x SA x SSAF x DABS x EF x
	SA	Skin Surface Area Available for Contact	cm^2/event	5,314	USEPA 2004 -- Mean of 50th percentile for children <7 to <18 -- Head, hands, forearms, lower legs and feet (Exhibit C-1)	ED x 1/BW x 1/AT
	SSAF	Soil-to-Skin Adherence Factor	mg/cm^2/event	0.2	USEPA 2004 -- 95th percentile and geometric mean weighted soil AFs for children playing in dry soils	
	DABS	Dermal Absorption Factor	--	Chemical-Specific	USEPA 1995 -- Refer to Supporting Documentation	
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	12	Based on age group of receptor	
	BW	Body Weight	kg	47.6	Mean of body weight values for males and females >6 to 18 years old (USEPA 2011)	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	4380	ED (year) x 365 days/year (USEPA 1989)	
Inhalation	CA	Chemical Concentration in Particulate Air	mg/m^3	See Table 3.1	See Table 3.1	Exposure Concentration (EC) (mg/m^3) =
	ET	Exposure Time - Outdoor	hr/day	4	Professional Judgment.	(CA x ET x EF x ED)/AT
	EF	Exposure Frequency - Outdoor	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	12	Based on age group of receptor	
	AT_c	Averaging Time for Carcinogens	hours	613,200	70-year lifetime x 365 days/year x 24 hours/day (USEPA 1989, 2009)	
	AT_{nc}	Averaging Time for Noncarcinogens	hours	105,120	ED (year) x 365 days/year x 24 hours/day (USEPA 2009)	

Table 4.10
Human Health Risk Assessment
VALUES USED FOR DAILY INTAKE CALCULATIONS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	OU2 Sediment
Exposure Point:	OU2 Surface Sediment (0 - 2 feet discrete; 0 - 0.5 feet ISM)
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 - 18 years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSed	Chemical Concentration in Sediment	mg/kg sediment	See Table 3.2	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) = CSed x IR_{sed} x CF x FI x RBA x EF x ED x 1/BW x 1/AT
	IRsed	Ingestion Rate of Sediment	mg sediment/day	100	Assumed the same rate as adult outdoor workers and residents; (USEPA 2002, Exhibit 1-2) and OSWER Directive 9200.1-120 (USEPA 2014).	
	CF	Conversion Factor	kg/mg	0.000001	--	
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	RBA	Relative Bioavailability Factor	unitless	Chemical-Specific	USEPA 2012, 2021 -- RBA of 0.6 applied to Arsenic, RBA of 1 for all other COIs	
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	12	Based on age group of receptor	
	BW	Body Weight	kg	47.6	Mean of body weight values for males and females >6 to 18 years old (USEPA 2011)	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	4380	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSed	Chemical Concentration in Sediment	mg/kg sediment	See Table 3.2	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) = CSed x CF x SA x SSAF x DABS x EF x ED x 1/BW x 1/AT
	CF	Conversion Factor	kg/mg	0.000001	--	
	SA	Skin Surface Area Available for Contact	cm^2/event	5,314	USEPA 2004 -- Mean of 50th percentile for children <7 to <18 -- Head, hands, forearms, lower legs and feet (Exhibit C-1)	
	SSAF	Sediment-to-Skin Adherence Factor	mg/cm^2/event	0.3	USEPA 2004 -- Based on the geometric mean AF based on exposure to face, forearms, hands, and lower legs for adult gardeners	
	DABS	Dermal Absorption Factor	--	Chemical-Specific	USEPA 1995 -- Refer to Supporting Documentation	
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	12	Based on age group of receptor	
	BW	Body Weight	kg	47.6	Mean of body weight values for males and females >6 to 18 years old (USEPA 2011)	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	4380	ED (year) x 365 days/year (USEPA 1989)	

Table 4.11
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Surface water
Exposure Medium:	Surface water
Exposure Point:	OU2 Surface water
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 - 18 years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical Concentration in Surface Water	mg/L	See Table 3.3	See Table 3.3	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR_{sw}	Ingestion Rate of Surface Water	L/day	0.0148	Incidental ingestion while wading: 0.0037 L/hour (3.7 mL/hour) used for all receptors, which is the mean value from Table 3-93 of the Exposure Factors Handbook (2011)	CSW x IR_{sw} x FI x EF x ED x 1/BW x 1/AT
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	
	ED	Exposure Duration	yr	12	Based on age group of receptor	
	BW	Body Weight	kg	47.6	Mean of body weight values for males and females >6 to 18 years old (USEPA 2011)	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	4,380	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSW	Chemical Concentration in Surface Water	mg/L	See Table 3.3	See Table 3.3	Chronic Daily Intake (CDI) (mg/kd-day) =
	SA	Skin Surface Area Available for Contact	cm^2	5,314	USEPA 2004 -- Mean of 50th percentile for children <7 to <18 -- Head, hands, forearms, lower legs and feet (Exhibit C-1)	DAevent x SA x EV x EF x ED x
	K_p	Permeability Constant	cm/hr	Chemical-Specific	USEPA 2004 -- Refer to Supporting Documentation	1/BW x 1/AT
	ET	Exposure Time	hr/event	4	Professional Judgement	
	EV	Event Frequency	events/day	1	One event per day	Where Dermal Absorbed Dose (Inorganics)
	EF	Exposure Frequency	days/yr	40	Professional Judgment - 2 events/week for 20 weeks (May through September)	(DA_{event}) (mg/cm2-event) =
	ED	Exposure Duration	yr	12	Based on age group of receptor	= CW x CF x ET x Kp
	CF	Conversion Factor	L/cm^3	0.001	--	
	BW	Body Weight	kg	47.6	Mean of body weight values for males and females >6 to 18 years old (USEPA 2011)	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	4,380	ED (year) x 365 days/year (USEPA 1989)	

Table 4.12
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Groundwater Seeps in Basements
Receptor Population:	OU1 Resident
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical Concentration in Ground Water	mg/L	See Table 3.5-3.6	See Table 3.5-3.6	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR_{sw}	Ingestion Rate of Ground Water	L/day	0.0148	Incidental ingestion while wading: 0.0037 L/hour (3.7 mL/hour) used for all receptors, which is the mean value from Table 3-93 of the Exposure Factors Handbook (2011)	CSW x IR_{sw} x FI x EF x ED x 1/BW x 1/AT
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	EF	Exposure Frequency	days/yr	12	Professional Judgment -- assumes groundwater seeps into a residential basement requiring cleanup once a month.	
	ED	Exposure Duration	yr	20	USEPA 2014 -- Assumes standard residential exposure duration	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	7,300	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSW	Chemical Concentration in Ground Water	mg/L	See Table 3.5-3.6	See Table 3.5-3.6	Chronic Daily Intake (CDI) (mg/kd-day) =
	SA	Skin Surface Area Available for Contact	cm^2	6,032	USEPA 2014 -- Default adult resident skin surface area: weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, 21+ years)	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
	K_p	Permeability Constant	cm/hr	Chemical-Specific	USEPA 2004 -- Refer to Supporting Documentation	
	ET	Exposure Time	hr/event	4	Professional Judgement	
	EV	Event Frequency	events/day	1	One event per day	Where Dermal Absorbed Dose (Inorganics)
	EF	Exposure Frequency	days/yr	16	Professional Judgment -- assumes groundwater seeps into a residential basement requiring cleanup once a month, and on 4 occasions cleanup requires 2 days to complete.	(DA_{event}) (mg/cm2-event) =
	ED	Exposure Duration	yr	20	USEPA 2014 -- Assumes standard residential exposure duration	= CW x CF x ET x Kp
	CF	Conversion Factor	L/cm^3	0.001	--	
	BW	Body Weight	kg	80	USEPA 2014 -- Default adult body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	7,300	ED (year) x 365 days/year (USEPA 1989)	

Table 4.13
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Groundwater Seeps in Basements
Receptor Population:	OU1 Resident
Receptor Age:	Adolescent (7 - 18 years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical Concentration in Ground Water	mg/L	See Table 3.5-3.6	See Table 3.5-3.6	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR_{sw}	Ingestion Rate of Ground Water	L/day	0.0148	Incidental ingestion while wading: 0.0037 L/hour (3.7 mL/hour) used for all receptors, which is the mean value from Table 3-93 of the Exposure Factors Handbook (2011)	CSW x IR_{sw} x FI x EF x ED x 1/BW x 1/AT
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	EF	Exposure Frequency	days/yr	12	Professional Judgment -- assumes groundwater seeps into a residential basement requiring cleanup once a month.	
	ED	Exposure Duration	yr	12	Based on age group of receptor	
	BW	Body Weight	kg	47.6	Mean of body weight values for males and females >6 to 18 years old (USEPA 2011)	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	4,380	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSW	Chemical Concentration in Ground Water	mg/L	See Table 3.5-3.6	See Table 3.5-3.6	Chronic Daily Intake (CDI) (mg/kd-day) =
	SA	Skin Surface Area Available for Contact	cm^2	5,314	USEPA 2004 -- Mean of 50th percentile for children <7 to <18 -- Head, hands, forearms, lower legs and feet (Exhibit C-1)	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
	K_p	Permeability Constant	cm/hr	Chemical-Specific	USEPA 2004 -- Refer to Supporting Documentation	
	ET	Exposure Time	hr/event	4	Professional Judgement	
	EV	Event Frequency	events/day	1	One event per day	Where Dermal Absorbed Dose (Inorganics)
	EF	Exposure Frequency	days/yr	16	Professional Judgment -- assumes groundwater seeps into a residential basement requiring cleanup once a month, and on 4 occasions cleanup requires 2 days to complete.	(DA_{event}) (mg/cm2-event) =
	ED	Exposure Duration	yr	12	Based on age group of receptor	= CW x CF x ET x Kp
	CF	Conversion Factor	L/cm^3	0.001	--	
	BW	Body Weight	kg	47.6	Mean of body weight values for males and females >6 to 18 years old (USEPA 2011)	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	4,380	ED (year) x 365 days/year (USEPA 1989)	

Table 4.14
Human Health Risk Assessment
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Groundwater Seeps in Basements
Receptor Population:	OU1 Resident
Receptor Age:	Child (0 - 6 years)

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	Intake Equation/ Model Name
Ingestion	CSW	Chemical Concentration in Ground Water	mg/L	See Table 3.5-3.6	See Table 3.5-3.6	Chronic Daily Intake (CDI) (mg/kg-day) =
	IR_{sw}	Ingestion Rate of Ground Water	L/day	0.0148	Incidental ingestion while wading: 0.0037 L/hour (3.7 mL/hour) used for all receptors, which is the mean value from Table 3-93 of the Exposure Factors Handbook (2011)	CSW x IR_{sw} x FI x EF x ED x 1/BW x 1/AT
	FI	Fraction Ingested from Contaminated Source	--	1	Professional Judgment -- assumes 100%	
	EF	Exposure Frequency	days/yr	12	Professional Judgment -- assumes groundwater seeps into a residential basement requiring cleanup once a month.	
	ED	Exposure Duration	yr	6	Based on age group of receptor	
	BW	Body Weight	kg	15	USEPA 2014 -- Default child body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	2,190	ED (year) x 365 days/year (USEPA 1989)	
Dermal	CSW	Chemical Concentration in Ground Water	mg/L	See Table 3.5-3.6	See Table 3.5-3.6	Chronic Daily Intake (CDI) (mg/kd-day) =
	SA	Skin Surface Area Available for Contact	cm^2	2,373	USEPA 2014 -- Default child resident skin surface area: weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years)	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
	K_p	Permeability Constant	cm/hr	Chemical-Specific	USEPA 2004 -- Refer to Supporting Documentation	
	ET	Exposure Time	hr/event	4	Professional Judgement	
	EV	Event Frequency	events/day	1	One event per day	Where Dermal Absorbed Dose (Inorganics)
	EF	Exposure Frequency	days/yr	16	Professional Judgment -- assumes groundwater seeps into a residential basement requiring cleanup once a month, and on 4 occasions cleanup requires 2 days to complete.	(DA_{event}) (mg/cm2-event) =
	ED	Exposure Duration	yr	6	Based on age group of receptor	= CW x CF x ET x Kp
	CF	Conversion Factor	L/cm^3	0.001	--	
	BW	Body Weight	kg	15	USEPA 2014 -- Default child body weight	
	AT_c	Averaging Time for Carcinogens	days	25,550	70-year lifetime x 365 days/year (USEPA 1989)	
	AT_{nc}	Averaging Time for Noncarcinogens	days	2,190	ED (year) x 365 days/year (USEPA 1989)	

Table 5.1
Human Health Risk Assessment
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
USS Lead Superfund Site - Operable Unit 1 & 2

Chemical of Interest	Chronic/ Subchronic	Oral Reference Dose (RfD) (mg/kg-day)	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2) (mg/kg-day)	Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	Dates (3) (MM/DD/YYYY)
Antimony	Chronic	4.0E-04	15%	6.0E-05	Longevity, Blood	1000	IRIS, 1/31/1987
Arsenic	Chronic	3.0E-04	100%	3.0E-04	Skin	3	IRIS, 09/01/1991
Cadmium (diet)	Chronic	1.0E-03	2.5%	2.5E-05	Kidney	10	IRIS, 10/1/1989
Cadmium (water)	Chronic	5.0E-04	5.0%	2.5E-05	Kidney	10	IRIS, 10/1/1989
Lead	N/A	N/A	N/A	N/A	Developmental	N/A	IRIS, 7/8/2004
Selenium	Chronic	5.0E-03	100%	5.0E-03	Selenosis	3	IRIS, 6/1/1991

N/A = Not Applicable

(1) https://www.epa.gov/risk/assessing-dermal-exposure-soil

(2) Adjusted Dermal RfD = Oral RfD * Oral to Dermal Adjustment Factor

(3) For IRIS values, provides the date that the IRIS value was last updated

Table 5.2
Human Health Risk Assessment
NON-CANCER TOXICITY DATA -- INHALATION
USS Lead Superfund Site - Operable Unit 1 & 2

Chemical of Interest	Chronic/ Subchronic	Inhalation RfC (mg/m3)	Primary Target Organ(s)	Combined Uncertainty/ Modifying Factors	Dates [(2)] (MM/DD/YYYY)
Antimony	Chronic	3.0E-04	Respiratory	Unknown	ATSDR, RSL Table May 2021
Arsenic	Chronic	1.5E-05	Nervous System	30	Cal EPA, RSL Table May 2021
Cadmium	Chronic	1.0E-05	Kidney	Unknown	ATSDR, RSL Table May 2021
Lead	N/A	N/A	Developmental	N/A	N/A
Selenium	Chronic	2.0E-02	Liver, Cardiovascular, Nervous System	3	Cal EPA, RSL Table May 2021

N/A = Not Applicable
(1) For IRIS values, provides the date IRIS value was last updated
Cal EPA and ATSDR values from USEPA Regional Screening Level (RSL) tables - May 2021

Table 6.1
Human Health Risk Assessment
CANCER TOXICITY DATA -- ORAL/DERMAL
USS Lead Superfund Site - Operable Unit 1 & 2

Chemical of Interest	Oral Cancer Slope Factor (CSF) $(mg/kg\text{-}day)^{-1}$	Oral to Dermal Adjustment Factor	Adjusted Dermal CSF (1) $(mg/kg\text{-}day)^{-1}$	Weight of Evidence/Cancer Guideline Description	Date (2) (MM/DD/YYYY)
Antimony	N/A	N/A	N/A	Not assessed under IRIS program	N/A
Arsenic	1.50E+00	100%	1.5E+00	A, Human Carcinogen	IRIS, 6/1/1995
Cadmium	N/A	N/A	N/A	B1, Probable human carcinogen – based on limited evidence of carcinogenicity in humans	IRIS, 3/31/1987
Lead	N/A	N/A	N/A	B2, Probable human carcinogen – based on sufficient evidence of carcinogenicity in animals	IRIS, 9/26/1988
Selenium	N/A	N/A	N/A	D, Not classifiable as to human carcinogenicity	IRIS, 3/1/1991

N/A = Not Applicable
(1) Adjusted Dermal CSF = Oral CSF / Oral to Dermal Adjustment Factor
(2) For IRIS values, provide the date IRIS was searched.

Table 6.2
Human Health Risk Assessment
CANCER TOXICITY DATA -- INHALATION
USS Lead Superfund Site - Operable Unit 1 & 2

Chemical of Interest	Inhalation Unit Risk (m^3/mg)	Weight of Evidence/Cancer Guideline Description	Date [(1)] (MM/DD/YYYY)
Antimony	N/A	Not assessed under IRIS program	N/A
Arsenic	4.30E-03	A, Human Carcinogen	IRIS, 6/1/1995
Cadmium	1.80E-03	B1, Probable human carcinogen – based on limited evidence of carcinogenicity in humans	IRIS, 3/31/1987
Lead	N/A	B2, Probable human carcinogen – based on sufficient evidence of carcinogenicity in animals	IRIS, 9/26/1988
Selenium	N/A	D, Not classifiable as to human carcinogenicity	IRIS, 3/1/1991

N/A = Not Applicable
(1) For IRIS values, provide the date IRIS was searched.

Table 7.1
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Soil
Exposure Medium:	Surface and Subsurface Soil
Exposure Point:	OU2 Surface and Subsurface Soil (0 - 6 feet)
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	39.1	mg/kg	39.1	mg/kg	M	1.1E-05	mg/kg-day	4.0E-04	mg/kg-day	2.8E-02	1.6E-07	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	61.8	mg/kg	62	mg/kg	M	1.0E-05	mg/kg-day	3.0E-04	mg/kg-day	3.5E-02	1.5E-07	mg/kg-day	1.50E+00	kg-day/mg	2.2E-07
	Cadmium	23.0	mg/kg	23.0	mg/kg	M	6.5E-06	mg/kg-day	1.0E-03	mg/kg-day	6.5E-03	9.3E-08	mg/kg-day	N/A	kg-day/mg	- -
	Lead	250.5	mg/kg	251	mg/kg	M	7.1E-05	mg/kg-day	N/A	mg/kg-day	- -	1.0E-06	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.1	mg/kg	1.1	mg/kg	M	3.1E-07	mg/kg-day	5.0E-03	mg/kg-day	6.1E-05	4.4E-09	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**6.9E-02**					**2.2E-07**
Dermal	Antimony	39.1	mg/kg	39.1	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	62	mg/kg	62	mg/kg	M	1.7E-06	mg/kg-day	3.0E-04	mg/kg-day	5.6E-03	2.4E-08	mg/kg-day	1.50E+00	kg-day/mg	3.6E-08
	Cadmium	23.0	mg/kg	23.0	mg/kg	M	2.1E-08	mg/kg-day	2.5E-05	mg/kg-day	8.3E-04	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	251	mg/kg	251	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.1	mg/kg	1.1	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**6.4E-03**					**3.6E-08**
								Total Hazard Index for Ingestion and Dermal			**7.6E-02**		Total Risk for Ingestion and Dermal			**2.6E-07**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Arsenic 0.6

Dermal Absorption Reference: *USEPA RAGS Part E, July 2004 and USEPA RSL User's Guide, May 2021*

Antimony	0.0%
Arsenic	3.0%
Cadmium	0.1%
Lead	N/A
Selenium	0.0%

Table 7.2
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INHALATION
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Soil
Exposure Medium:	Particulats in Air
Exposure Point:	OU2 Surface and Subsurface Soil (0 - 6 feet)
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	IUR	IUR units	Cancer Risk
Inhalation	Antimony	39.1	mg/kg	1.08E-05	mg/m^3	R	2.5E-07	mg/m^3	3.00E-04	mg/m^3	8.2E-04	3.5E-09	mg/m^3	N/A	m^3/ug	- -
	Arsenic	61.8	mg/kg	1.71E-05	mg/m^3	R	3.9E-07	mg/m^3	1.50E-05	mg/m^3	2.6E-02	5.6E-09	mg/m^3	4.30E-03	m^3/ug	2.4E-08
	Cadmium	23.0	mg/kg	6.36E-06	mg/m^3	R	1.5E-07	mg/m^3	1.00E-05	mg/m^3	1.5E-02	2.1E-09	mg/m^3	1.80E-03	m^3/ug	3.7E-09
	Lead	250.5	mg/kg	6.94E-05	mg/m^3	R	1.6E-06	mg/m^3	N/A	mg/m^3	- -	2.3E-08	mg/m^3	N/A	m^3/ug	- -
	Selenium	1.1	mg/kg	3.01E-07	mg/m^3	R	6.9E-09	mg/m^3	2.00E-02	mg/m^3	3.4E-07	9.8E-11	mg/m^3	N/A	m^3/ug	- -
									Total Hazard Index for Inhalation		**4.1E-02**			Total Risk for Inhalation		**2.8E-08**

Table 7.3 A
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Surface Sediment
Exposure Point:	OU2 Surface Sediment (0 - 2 feet) DISCRETE
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	240	mg/kg	240	mg/kg	M	6.8E-05	mg/kg-day	4.0E-04	mg/kg-day	1.7E-01	9.7E-07	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1417	mg/kg	1417	mg/kg	M	2.4E-04	mg/kg-day	3.0E-04	mg/kg-day	8.0E-01	3.4E-06	mg/kg-day	1.50E+00	kg-day/mg	5.1E-06
	Cadmium	28.2	mg/kg	28.2	mg/kg	M	8.0E-06	mg/kg-day	1.0E-03	mg/kg-day	8.0E-03	1.1E-07	mg/kg-day	N/A	kg-day/mg	- -
	Lead	641	mg/kg	641	mg/kg	M	1.8E-04	mg/kg-day	N/A	mg/kg-day	- -	2.6E-06	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	14.2	mg/kg	14.2	mg/kg	M	4.0E-06	mg/kg-day	5.0E-03	mg/kg-day	8.0E-04	5.7E-08	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**9.8E-01**					**5.1E-06**
Dermal	Antimony	240	mg/kg	240	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1417	mg/kg	1417	mg/kg	M	1.2E-04	mg/kg-day	3.0E-04	mg/kg-day	3.9E-01	1.7E-06	mg/kg-day	1.50E+00	kg-day/mg	2.48E-06
	Cadmium	28.2	mg/kg	28.2	mg/kg	M	0.0E+00	mg/kg-day	2.5E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	641	mg/kg	641	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	14.2	mg/kg	14.2	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**3.9E-01**					**2.5E-06**
									Total Hazard Index for Ingestion and Dermal		**1.4E+00**		Total Risk for Ingestion and Dermal			**7.6E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Arsenic 0.6

Dermal Absorption Reference: *USEPA RAGS Part E, July 2004 and USEPA RSL User's Guide, May 2021*

Antimony	0.0%
Arsenic	3.0%
Cadmium	0.1%
Lead	N/A
Selenium	0.0%

Table 7.3 B
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Surface Sediment
Exposure Point:	OU2 Surface Sediment (0 - 0.5 feet) ISM
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	32	mg/kg	32	mg/kg	M	9.1E-06	mg/kg-day	4.0E-04	mg/kg-day	2.3E-02	1.3E-07	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	341	mg/kg	341	mg/kg	M	5.8E-05	mg/kg-day	3.0E-04	mg/kg-day	1.9E-01	8.3E-07	mg/kg-day	1.50E+00	kg-day/mg	1.2E-06
	Cadmium	26	mg/kg	25.7	mg/kg	M	7.3E-06	mg/kg-day	1.0E-03	mg/kg-day	7.3E-03	1.0E-07	mg/kg-day	N/A	kg-day/mg	- -
	Lead	776	mg/kg	776	mg/kg	M	2.2E-04	mg/kg-day	N/A	mg/kg-day	- -	3.1E-06	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	6	mg/kg	6.2	mg/kg	M	1.8E-06	mg/kg-day	5.0E-03	mg/kg-day	3.5E-04	2.5E-08	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**2.2E-01**					**1.2E-06**
Dermal	Antimony	32	mg/kg	32	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	341	mg/kg	341	mg/kg	M	2.8E-05	mg/kg-day	3.0E-04	mg/kg-day	9.3E-02	4.0E-07	mg/kg-day	1.50E+00	kg-day/mg	5.96E-07
	Cadmium	25.7	mg/kg	25.7	mg/kg	M	0.0E+00	mg/kg-day	2.5E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	776	mg/kg	776	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	6.2	mg/kg	6.2	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**9.3E-02**					**6.0E-07**
							Total Hazard Index for Ingestion and Dermal				**3.2E-01**	Total Risk for Ingestion and Dermal				**1.8E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Arsenic	0.6

Dermal Absorption Reference: *USEPA RAGS Part E, July 2004 and USEPA RSL User's Guide, May 2021*

Antimony	0.0%
Arsenic	3.0%
Cadmium	0.1%
Lead	N/A
Selenium	0.0%

Table 7.4
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Surface water
Exposure Medium:	Surface water
Exposure Point:	OU2 Surface water
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal	Antimony	2.40E-02	mg/L	2.40E-02	mg/L	M	2.9E-07	mg/kg-day	6.00E-05	mg/kg-day	4.8E-03	4.1E-09	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.39E-01	mg/L	1.39E-01	mg/L	M	1.7E-06	mg/kg-day	3.00E-04	mg/kg-day	5.6E-03	2.4E-08	mg/kg-day	1.50E+00	kg-day/mg	3.6E-08
	Cadmium	9.59E-04	mg/L	9.59E-04	mg/L	M	1.2E-08	mg/kg-day	2.50E-05	mg/kg-day	4.6E-04	1.7E-10	mg/kg-day	N/A	kg-day/mg	- -
	Lead	4.37E-03	mg/L	4.37E-03	mg/L	M	5.3E-09	mg/kg-day	N/A	N/A	- -	7.5E-11	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	4.60E-03	mg/L	4.60E-03	mg/L	M	5.6E-08	mg/kg-day	5.00E-03	mg/kg-day	1.1E-05	7.9E-10	mg/kg-day	N/A	kg-day/mg	- -
										Total Hazard Index for Dermal Exposure	**1.1E-02**				Total Cancer Risk for Dermal Exposure	**3.6E-08**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Reference: *RAGS Part E:Supplemental Guidance for Dermal Risk Assessment,* EPA/540/R/99/005, July 2004

Table 7.5
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater
Exposure Point:	OU2 Groundwater
Receptor Population:	Utility Worker
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Dermal	Antimony	6.80E-02	mg/L	6.80E-02	mg/L	M	8.21E-07	mg/kg-day	6.00E-05	mg/kg-day	1.37E-02	1.17E-08	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.27E+01	mg/L	1.27E+01	mg/L	M	1.54E-04	mg/kg-day	3.00E-04	mg/kg-day	5.13E-01	2.20E-06	mg/kg-day	1.50E+00	kg-day/mg	3.30E-06
	Cadmium	7.47E-02	mg/L	7.47E-02	mg/L	M	9.03E-07	mg/kg-day	2.50E-05	mg/kg-day	3.61E-02	1.29E-08	mg/kg-day	N/A	kg-day/mg	- -
	Lead	1.39E-01	mg/L	1.39E-01	mg/L	M	1.68E-07	mg/kg-day	N/A	N/A	- -	2.40E-09	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	2.86E-03	mg/L	2.86E-03	mg/L	M	3.45E-08	mg/kg-day	5.00E-03	mg/kg-day	6.90E-06	4.93E-10	mg/kg-day	N/A	kg-day/mg	- -
										Total Hazard Index for Dermal Exposure	**5.63E-01**				Total Cancer Risk for Dermal Exposure	**3.30E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.6
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Soil
Exposure Medium:	Surface Soil
Exposure Point:	OU2 Surface Soil (0 - 2 feet)
Receptor Population:	O&M Worker
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	51.4	mg/kg	51.4	mg/kg	M	3.7E-06	mg/kg-day	4.0E-04	mg/kg-day	9.2E-03	1.3E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	94.4	mg/kg	94	mg/kg	M	4.1E-06	mg/kg-day	3.0E-04	mg/kg-day	1.4E-02	1.5E-06	mg/kg-day	1.5E+00	kg-day/mg	2.2E-06
	Cadmium	3.5	mg/kg	3.5	mg/kg	M	2.5E-07	mg/kg-day	1.0E-03	mg/kg-day	2.5E-04	8.9E-08	mg/kg-day	N/A	kg-day/mg	- -
	Lead	262.1	mg/kg	262	mg/kg	M	1.9E-05	mg/kg-day	N/A	mg/kg-day	- -	6.7E-06	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.7	mg/kg	1.7	mg/kg	M	1.2E-07	mg/kg-day	5.0E-03	mg/kg-day	2.4E-05	4.3E-08	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**2.3E-02**					**2.2E-06**
Dermal	Antimony	51.4	mg/kg	51.4	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	94	mg/kg	94	mg/kg	M	8.6E-07	mg/kg-day	3.0E-04	mg/kg-day	2.9E-03	3.1E-07	mg/kg-day	1.5E+00	kg-day/mg	4.6E-07
	Cadmium	3.5	mg/kg	3.5	mg/kg	M	1.1E-09	mg/kg-day	2.5E-05	mg/kg-day	4.2E-05	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	262	mg/kg	262	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.7	mg/kg	1.7	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**2.9E-03**					**4.6E-07**
							Total Hazard Index for Ingestion and Dermal				**2.6E-02**	Total Risk for Ingestion and Dermal				**2.6E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Arsenic	0.6

Dermal Absorptior Reference: *USEPA RAGS Part E, July 2004 and USEPA RSL User's Guide, May 2021*

Antimony	0.0%
Arsenic	3.0%
Cadmium	0.1%
Lead	N/A
Selenium	0.0%

Table 7.7
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INHALATION
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Medium:	Soil
Exposure Medium:	Particulats in Air
Exposure Point:	OU2 Surface Soil (0 - 2 feet)
Receptor Population:	O&M Worker
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	IUR	IUR units	Cancer Risk
Inhalation	Antimony	51.4	mg/kg	3.78E-08	mg/m^3	R	7.2E-10	mg/m^3	3.0E-04	mg/m^3	2.4E-06	2.6E-10	mg/m^3	N/A	m^3/ug	- -
	Arsenic	94.4	mg/kg	6.94E-08	mg/m^3	R	1.3E-09	mg/m^3	1.5E-05	mg/m^3	8.9E-05	4.8E-10	mg/m^3	4.3E-03	m^3/ug	2.0E-09
	Cadmium	3.5	mg/kg	2.54E-09	mg/m^3	R	4.9E-11	mg/m^3	1.0E-05	mg/m^3	4.9E-06	1.7E-11	mg/m^3	1.8E-03	m^3/ug	3.1E-11
	Lead	262.1	mg/kg	1.93E-07	mg/m^3	R	3.7E-09	mg/m^3	N/A	mg/m^3	- -	1.3E-09	mg/m^3	N/A	m^3/ug	- -
	Selenium	1.7	mg/kg	1.22E-09	mg/m^3	R	2.3E-11	mg/m^3	2.0E-02	mg/m^3	1.2E-09	8.3E-12	mg/m^3	N/A	m^3/ug	- -
									Total Hazard Index for Inhalation		**9.6E-05**			Total Risk for Inhalation		**2.1E-09**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.8
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Surface Soil
Exposure Point:	OU2 Surface Soil (0 - 2 feet)
Receptor Population:	Trespasser
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	51.4	mg/kg	51.4	mg/kg	M	7.0E-06	mg/kg-day	4.0E-04	mg/kg-day	1.8E-02	2.0E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	94.4	mg/kg	94.4	mg/kg	M	7.8E-06	mg/kg-day	3.0E-04	mg/kg-day	2.6E-02	2.2E-06	mg/kg-day	1.50E+00	kg-day/mg	3.3E-06
	Cadmium	3.5	mg/kg	3.5	mg/kg	M	4.7E-07	mg/kg-day	1.0E-03	mg/kg-day	4.7E-04	1.4E-07	mg/kg-day	N/A	kg-day/mg	- -
	Lead	262.1	mg/kg	262.1	mg/kg	M	3.6E-05	mg/kg-day	N/A	mg/kg-day	- -	1.0E-05	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.7	mg/kg	1.7	mg/kg	M	2.3E-07	mg/kg-day	5.0E-03	mg/kg-day	4.5E-05	6.5E-08	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**4.4E-02**					**3.3E-06**
Dermal	Antimony	51.4	mg/kg	51.4	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	94.4	mg/kg	94.4	mg/kg	M	1.6E-06	mg/kg-day	3.0E-04	mg/kg-day	5.5E-03	4.7E-07	mg/kg-day	1.50E+00	kg-day/mg	7.02E-07
	Cadmium	3.5	mg/kg	3.5	mg/kg	M	2.0E-09	mg/kg-day	2.5E-05	mg/kg-day	8.0E-05	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	262.1	mg/kg	262.1	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.7	mg/kg	1.7	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**5.5E-03**					**7.0E-07**
							Total Hazard Index for Ingestion and Dermal				**5.0E-02**	Total Risk for Ingestion and Dermal				**4.0E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Arsenic	0.6

Dermal Absorptior Reference: *USEPA RAGS Part E, July 2004 and USEPA RSL User's Guide, May 2021*

Antimony	0.0%
Arsenic	3.0%
Cadmium	0.1%
Lead	N/A
Selenium	0.0%

Table 7.9

Human Health Risk Assessment

CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INHALATION

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Particulats in Air
Exposure Point:	OU2 Surface Soil (0 - 2 feet)
Receptor Population:	Trespasser
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	IUR	IUR units	Cancer Risk
Inhalation	Antimony	51.4	mg/kg	3.78E-08	mg/m^3	R	6.9E-10	mg/m^3	3.00E-04	mg/m^3	2.3E-06	2.0E-10	mg/m^3	N/A	m^3/ug	- -
	Arsenic	94.4	mg/kg	6.94E-08	mg/m^3	R	1.3E-09	mg/m^3	1.50E-05	mg/m^3	8.5E-05	3.6E-10	mg/m^3	4.30E-03	m^3/ug	1.6E-09
	Cadmium	3.5	mg/kg	2.54E-09	mg/m^3	R	4.6E-11	mg/m^3	1.00E-05	mg/m^3	4.6E-06	1.3E-11	mg/m^3	1.80E-03	m^3/ug	2.4E-11
	Lead	262.1	mg/kg	1.93E-07	mg/m^3	R	3.5E-09	mg/m^3	N/A	mg/m^3	- -	1.0E-09	mg/m^3	N/A	m^3/ug	- -
	Selenium	1.7	mg/kg	1.22E-09	mg/m^3	R	2.2E-11	mg/m^3	2.00E-02	mg/m^3	1.1E-09	6.4E-12	mg/m^3	N/A	m^3/ug	- -
									Total Hazard Index for Inhalation		**9.1E-05**			Total Risk for Inhalation		**1.6E-09**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.10 A
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Surface Sediment
Exposure Point:	OU2 Surface Sediment (0 - 2 feet) DISCRETE
Receptor Population:	Trespasser
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	240	mg/kg	240	mg/kg	M	3.3E-05	mg/kg-day	4.0E-04	mg/kg-day	8.2E-02	9.4E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1417	mg/kg	1417	mg/kg	M	1.2E-04	mg/kg-day	3.0E-04	mg/kg-day	3.9E-01	3.3E-05	mg/kg-day	1.50E+00	kg-day/mg	5.0E-05
	Cadmium	28.2	mg/kg	28.2	mg/kg	M	3.9E-06	mg/kg-day	1.0E-03	mg/kg-day	3.9E-03	1.1E-06	mg/kg-day	N/A	kg-day/mg	- -
	Lead	641	mg/kg	641	mg/kg	M	8.8E-05	mg/kg-day	N/A	mg/kg-day	- -	2.5E-05	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	14.2	mg/kg	14.2	mg/kg	M	1.9E-06	mg/kg-day	5.0E-03	mg/kg-day	3.9E-04	5.6E-07	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**4.7E-01**					**5.0E-05**
Dermal	Antimony	240	mg/kg	240	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1417	mg/kg	1417	mg/kg	M	1.1E-04	mg/kg-day	3.0E-04	mg/kg-day	3.5E-01	3.0E-05	mg/kg-day	1.50E+00	kg-day/mg	4.52E-05
	Cadmium	28.2	mg/kg	28.2	mg/kg	M	7.0E-08	mg/kg-day	2.5E-05	mg/kg-day	2.8E-03	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	641	mg/kg	641	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	14.2	mg/kg	14.2	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**3.5E-01**					**4.5E-05**
							Total Hazard Index for Ingestion and Inhalation				**8.3E-01**	Total Risk for Ingestion and Inhalation				**9.5E-05**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Table 7.10 B
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Surface Sediment
Exposure Point:	OU2 Surface Sediment (0 - 0.5 feet) ISM
Receptor Population:	Trespasser
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	32	mg/kg	32	mg/kg	M	4.4E-06	mg/kg-day	4.0E-04	mg/kg-day	1.1E-02	1.3E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	341	mg/kg	341	mg/kg	M	2.8E-05	mg/kg-day	3.0E-04	mg/kg-day	9.3E-02	8.0E-06	mg/kg-day	1.50E+00	kg-day/mg	1.2E-05
	Cadmium	25.7	mg/kg	25.7	mg/kg	M	3.5E-06	mg/kg-day	1.0E-03	mg/kg-day	3.5E-03	1.0E-06	mg/kg-day	N/A	kg-day/mg	- -
	Lead	776	mg/kg	776	mg/kg	M	1.1E-04	mg/kg-day	N/A	mg/kg-day	- -	3.0E-05	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	6.2	mg/kg	6.2	mg/kg	M	8.5E-07	mg/kg-day	5.0E-03	mg/kg-day	1.7E-04	2.4E-07	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**1.1E-01**					**1.2E-05**
Dermal	Antimony	32	mg/kg	32	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	341	mg/kg	341	mg/kg	M	2.5E-05	mg/kg-day	3.0E-04	mg/kg-day	8.5E-02	7.2E-06	mg/kg-day	1.50E+00	kg-day/mg	1.09E-05
	Cadmium	25.7	mg/kg	25.7	mg/kg	M	6.4E-08	mg/kg-day	2.5E-05	mg/kg-day	2.5E-03	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	776	mg/kg	776	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	6.2	mg/kg	6.2	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**8.7E-02**					**1.1E-05**
							Total Hazard Index for Ingestion and Inhalation				**2.0E-01**	Total Risk for Ingestion and Inhalation				**2.3E-05**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Table 7.11
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Surface water
Exposure Medium:	Surface water
Exposure Point:	OU2 Surface water
Receptor Population:	Trespasser
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	2.40E-02	mg/L	2.40E-02	mg/L	M	4.9E-07	mg/kg-day	4.00E-04	mg/kg-day	1.2E-03	1.4E-07	mg/kg-day	N/A	N/A	- -
	Arsenic	1.39E-01	mg/L	1.39E-01	mg/L	M	2.8E-06	mg/kg-day	3.00E-04	mg/kg-day	9.4E-03	8.0E-07	mg/kg-day	1.50E+00	kg-day/mg	1.2E-06
	Cadmium	9.59E-04	mg/L	9.59E-04	mg/L	M	1.9E-08	mg/kg-day	5.00E-04	mg/kg-day	3.9E-05	5.6E-09	mg/kg-day	N/A	N/A	- -
	Lead	4.37E-03	mg/L	4.37E-03	mg/L	M	8.9E-08	mg/kg-day	N/A	N/A	- -	2.5E-08	mg/kg-day	N/A	N/A	- -
	Selenium	4.60E-03	mg/L	4.60E-03	mg/L	M	9.3E-08	mg/kg-day	5.00E-03	mg/kg-day	1.9E-05	2.7E-08	mg/kg-day	N/A	N/A	- -
	(Total)										1.1E-02					1.2E-06
Dermal	Antimony	2.40E-02	mg/L	2.40E-02	mg/L	M	7.9E-07	mg/kg-day	6.00E-05	mg/kg-day	1.3E-02	2.3E-07	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.39E-01	mg/L	1.39E-01	mg/L	M	4.6E-06	mg/kg-day	3.00E-04	mg/kg-day	1.5E-02	1.3E-06	mg/kg-day	1.50E+00	kg-day/mg	2.0E-06
	Cadmium	9.59E-04	mg/L	9.59E-04	mg/L	M	3.2E-08	mg/kg-day	2.50E-05	mg/kg-day	1.3E-03	9.1E-09	mg/kg-day	N/A	kg-day/mg	- -
	Lead	4.37E-03	mg/L	4.37E-03	mg/L	M	1.4E-08	mg/kg-day	N/A	N/A	NA	4.1E-09	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	4.60E-03	mg/L	4.60E-03	mg/L	M	1.5E-07	mg/kg-day	5.00E-03	mg/kg-day	3.0E-05	4.3E-08	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										3.0E-02					2.0E-06
										Total Hazard Index for Dermal Exposure	**4.0E-02**				Total Cancer Risk for Dermal Exposure	**3.2E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.12
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Surface Soil
Exposure Point:	OU2 Surface Soil (0 - 2 feet)
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	51.4	mg/kg	51.4	mg/kg	M	1.2E-05	mg/kg-day	4.0E-04	mg/kg-day	3.0E-02	2.0E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	94.4	mg/kg	94	mg/kg	M	1.3E-05	mg/kg-day	3.0E-04	mg/kg-day	4.3E-02	2.2E-06	mg/kg-day	1.50E+00	kg-day/mg	3.4E-06
	Cadmium	3.5	mg/kg	3.5	mg/kg	M	8.0E-07	mg/kg-day	1.0E-03	mg/kg-day	8.0E-04	1.4E-07	mg/kg-day	N/A	kg-day/mg	- -
	Lead	262.1	mg/kg	262	mg/kg	M	6.0E-05	mg/kg-day	N/A	mg/kg-day	- -	1.0E-05	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.7	mg/kg	1.7	mg/kg	M	3.8E-07	mg/kg-day	5.0E-03	mg/kg-day	7.6E-05	6.5E-08	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**7.4E-02**					**3.4E-06**
Dermal	Antimony	51.4	mg/kg	51.4	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	94	mg/kg	94	mg/kg	M	6.9E-06	mg/kg-day	3.0E-04	mg/kg-day	2.3E-02	1.2E-06	mg/kg-day	1.50E+00	kg-day/mg	1.8E-06
	Cadmium	3.5	mg/kg	3.5	mg/kg	M	8.5E-09	mg/kg-day	2.5E-05	mg/kg-day	3.4E-04	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	262	mg/kg	262	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.7	mg/kg	1.7	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**2.3E-02**					**1.8E-06**
							Total Hazard Index for Ingestion and Dermal				**9.7E-02**	Total Risk for Ingestion and Dermal				**5.1E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Arsenic	0.6

Dermal Absorption Reference: *USEPA RAGS Part E, July 2004 and USEPA RSL User's Guide, May 2021*

Antimony	0.0%
Arsenic	3.0%
Cadmium	0.1%
Lead	N/A
Selenium	0.0%

Table 7.13
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INHALATION
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Soil
Exposure Medium:	Particulats in Air
Exposure Point:	OU2 Surface Soil (0 - 2 feet)
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	IUR	IUR units	Cancer Risk
Inhalation	Antimony	51.4	mg/kg	3.78E-08	mg/m^3	R	6.9E-10	mg/m^3	3.00E-04	mg/m^3	2.3E-06	1.2E-10	mg/m^3	N/A	m^3/ug	- -
	Arsenic	94.4	mg/kg	6.94E-08	mg/m^3	R	1.3E-09	mg/m^3	1.50E-05	mg/m^3	8.5E-05	2.2E-10	mg/m^3	4.30E-03	m^3/ug	9.3E-10
	Cadmium	3.5	mg/kg	2.54E-09	mg/m^3	R	4.6E-11	mg/m^3	1.00E-05	mg/m^3	4.6E-06	8.0E-12	mg/m^3	1.80E-03	m^3/ug	1.4E-11
	Lead	262.1	mg/kg	1.93E-07	mg/m^3	R	3.5E-09	mg/m^3	N/A	mg/m^3	- -	6.0E-10	mg/m^3	N/A	m^3/ug	- -
	Selenium	1.7	mg/kg	1.22E-09	mg/m^3	R	2.2E-11	mg/m^3	2.00E-02	mg/m^3	1.1E-09	3.8E-12	mg/m^3	N/A	m^3/ug	- -
										Total Hazard Index for Inhalation	**9.1E-05**				Total Risk for Inhalation	**9.5E-10**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.14 A

Human Health Risk Assessment

CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Surface Sediment
Exposure Point:	OU2 Surface Sediment (0 - 2 feet) DISCRETE
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	240.1	mg/kg	240.1	mg/kg	M	5.5E-05	mg/kg-day	4.0E-04	mg/kg-day	1.4E-01	9.5E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1417.0	mg/kg	1417.0	mg/kg	M	2.0E-04	mg/kg-day	3.0E-04	mg/kg-day	6.5E-01	3.4E-05	mg/kg-day	1.50E+00	kg-day/mg	5.0E-05
	Cadmium	28.2	mg/kg	28.2	mg/kg	M	6.5E-06	mg/kg-day	1.0E-03	mg/kg-day	6.5E-03	1.1E-06	mg/kg-day	N/A	kg-day/mg	- -
	Lead	640.5	mg/kg	640.5	mg/kg	M	1.5E-04	mg/kg-day	N/A	mg/kg-day	- -	2.5E-05	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	14.2	mg/kg	14.2	mg/kg	M	3.3E-06	mg/kg-day	5.0E-03	mg/kg-day	6.5E-04	5.6E-07	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**8.0E-01**					**5.0E-05**
Dermal	Antimony	240.1	mg/kg	240.1	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1417.0	mg/kg	1417.0	mg/kg	M	1.6E-04	mg/kg-day	3.0E-04	mg/kg-day	5.2E-01	2.7E-05	mg/kg-day	1.50E+00	kg-day/mg	4.0E-05
	Cadmium	28.2	mg/kg	28.2	mg/kg	M	1.0E-07	mg/kg-day	2.5E-05	mg/kg-day	4.1E-03	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	640.5	mg/kg	640.5	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	14.2	mg/kg	14.2	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**5.2E-01**					**4.0E-05**
							Total Hazard Index for Ingestion and Dermal				**1.3E+00**	Total Risk for Ingestion and Dermal				**9.0E-05**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Table 7.14 B

Human Health Risk Assessment

CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Surface Sediment
Exposure Point:	OU2 Surface Sediment (0 - 0.5 feet) ISM
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	32	mg/kg	32.1	mg/kg	M	7.4E-06	mg/kg-day	4.0E-04	mg/kg-day	1.8E-02	1.3E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	341	mg/kg	341.1	mg/kg	M	4.7E-05	mg/kg-day	3.0E-04	mg/kg-day	1.6E-01	8.1E-06	mg/kg-day	1.50E+00	kg-day/mg	1.2E-05
	Cadmium	25.7	mg/kg	25.7	mg/kg	M	5.9E-06	mg/kg-day	1.0E-03	mg/kg-day	5.9E-03	1.0E-06	mg/kg-day	N/A	kg-day/mg	- -
	Lead	776	mg/kg	776.4	mg/kg	M	1.8E-04	mg/kg-day	N/A	mg/kg-day	- -	3.1E-05	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	6.2	mg/kg	6.2	mg/kg	M	1.4E-06	mg/kg-day	5.0E-03	mg/kg-day	2.9E-04	2.4E-07	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**1.8E-01**					**1.2E-05**
Dermal	Antimony	32	mg/kg	32.1	mg/kg	M	0.0E+00	mg/kg-day	6.0E-05	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	341	mg/kg	341.1	mg/kg	M	3.8E-05	mg/kg-day	3.0E-04	mg/kg-day	1.3E-01	6.4E-06	mg/kg-day	1.50E+00	kg-day/mg	9.7E-06
	Cadmium	25.7	mg/kg	25.7	mg/kg	M	9.4E-08	mg/kg-day	2.5E-05	mg/kg-day	3.8E-03	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Lead	776	mg/kg	776.4	mg/kg	M	N/A	mg/kg-day	N/A	mg/kg-day	- -	N/A	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	6.2	mg/kg	6.2	mg/kg	M	0.0E+00	mg/kg-day	5.0E-03	mg/kg-day	0.0E+00	N/A	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										**1.3E-01**					**9.7E-06**
							Total Hazard Index for Ingestion and Dermal				**3.1E-01**	Total Risk for Ingestion and Dermal				**2.2E-05**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Ingestion Relative Bioavailability Factor for Soil/Sediment (unitless): Reference: *USEPA OSWER 9200.1-113, December 2012*

Table 7.15
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- INGESTION/DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Surface water
Exposure Medium:	Surface water
Exposure Point:	OU2 Surface water
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	2.40E-02	mg/L	2.40E-02	mg/L	M	8.2E-07	mg/kg-day	4.00E-04	mg/kg-day	2.0E-03	1.4E-07	mg/kg-day	N/A	N/A	- -
	Arsenic	1.39E-01	mg/L	1.39E-01	mg/L	M	4.7E-06	mg/kg-day	3.00E-04	mg/kg-day	1.6E-02	8.1E-07	mg/kg-day	1.50E+00	kg-day/mg	1.2E-06
	Cadmium	9.59E-04	mg/L	9.59E-04	mg/L	M	3.3E-08	mg/kg-day	5.00E-04	mg/kg-day	6.5E-05	5.6E-09	mg/kg-day	N/A	N/A	- -
	Lead	4.37E-03	mg/L	4.37E-03	mg/L	M	1.5E-07	mg/kg-day	N/A	N/A	- -	2.6E-08	mg/kg-day	N/A	N/A	- -
	Selenium	4.60E-03	mg/L	4.60E-03	mg/L	M	1.6E-07	mg/kg-day	5.00E-03	mg/kg-day	3.1E-05	2.7E-08	mg/kg-day	N/A	N/A	- -
	(Total)										1.8E-02					1.2E-06
Dermal	Antimony	2.40E-02	mg/L	2.40E-02	mg/L	M	1.2E-06	mg/kg-day	6.00E-05	mg/kg-day	2.0E-02	2.0E-07	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.39E-01	mg/L	1.39E-01	mg/L	M	6.8E-06	mg/kg-day	3.00E-04	mg/kg-day	2.3E-02	1.2E-06	mg/kg-day	1.50E+00	kg-day/mg	1.7E-06
	Cadmium	9.59E-04	mg/L	9.59E-04	mg/L	M	4.7E-08	mg/kg-day	2.50E-05	mg/kg-day	1.9E-03	8.0E-09	mg/kg-day	N/A	kg-day/mg	- -
	Lead	4.37E-03	mg/L	4.37E-03	mg/L	M	2.1E-08	mg/kg-day	N/A	N/A	- -	3.7E-09	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	4.60E-03	mg/L	4.60E-03	mg/L	M	2.3E-07	mg/kg-day	5.00E-03	mg/kg-day	4.5E-05	3.9E-08	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										4.4E-02					1.7E-06
										Total Hazard Index for Ingestion and Dermal Exposure	**6.2E-02**				Total Cancer Risk for Ingestion and Dermal Exposure	**3.0E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Reference: *RAGS Part E:Supplemental Guidance for Dermal Risk Assessment,* EPA/540/R/99/005, July 2004

	DA_{event} (mg/cm2-event):	Kp (cm/hr) (USEPA RAGS Part E)
Antimony	9.60E-08	1.0E-03
Arsenic	5.56E-07	1.0E-03
Cadmium	3.84E-09	1.0E-03
Lead	1.75E-09	1.0E-04
Selenium	1.84E-08	1.0E-03

Table 7.16
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Z1 Groundwater Seeps in Basements
Receptor Population:	OU1 Resident
Receptor Age:	Adult (>18 years)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	7.48E-01	mg/L	7.48E-01	mg/L	M	4.5E-06	mg/kg-day	4.00E-04	mg/kg-day	1.1E-02	1.3E-06	mg/kg-day	N/A	N/A	- -
	Arsenic	1.80E-01	mg/L	1.80E-01	mg/L	M	1.1E-06	mg/kg-day	3.00E-04	mg/kg-day	3.6E-03	3.1E-07	mg/kg-day	1.50E+00	kg-day/mg	4.7E-07
	Cadmium	1.57E-02	mg/L	1.57E-02	mg/L	M	9.5E-08	mg/kg-day	5.00E-04	mg/kg-day	1.9E-04	2.7E-08	mg/kg-day	N/A	N/A	- -
	Lead	1.67E-02	mg/L	1.67E-02	mg/L	M	1.0E-07	mg/kg-day	N/A	N/A	- -	2.9E-08	mg/kg-day	N/A	N/A	- -
	Selenium	3.66E-02	mg/L	3.66E-02	mg/L	M	2.2E-07	mg/kg-day	5.00E-03	mg/kg-day	4.5E-05	6.4E-08	mg/kg-day	N/A	N/A	- -
	(Total)										1.5E-02					4.7E-07
Dermal	Antimony	7.48E-01	mg/L	7.48E-01	mg/L	M	9.9E-06	mg/kg-day	6.00E-05	mg/kg-day	1.6E-01	2.8E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.80E-01	mg/L	1.80E-01	mg/L	M	2.4E-06	mg/kg-day	3.00E-04	mg/kg-day	7.9E-03	6.8E-07	mg/kg-day	1.50E+00	kg-day/mg	1.0E-06
	Cadmium	1.57E-02	mg/L	1.57E-02	mg/L	M	2.1E-07	mg/kg-day	2.50E-05	mg/kg-day	8.3E-03	5.9E-08	mg/kg-day	N/A	kg-day/mg	- -
	Lead	1.67E-02	mg/L	1.67E-02	mg/L	M	2.2E-08	mg/kg-day	N/A	N/A	- -	6.3E-09	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	3.66E-02	mg/L	3.66E-02	mg/L	M	4.8E-07	mg/kg-day	5.00E-03	mg/kg-day	9.7E-05	1.4E-07	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										1.8E-01					1.0E-06
										Total Hazard Index for Dermal Exposure	**2.0E-01**				Total Cancer Risk for Dermal Exposure	2.0E-06

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.17
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Z1 Groundwater Seeps in Basements
Receptor Population:	OU1 Resident
Receptor Age:	Adolescent (7 to 18 years)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	7.48E-01	mg/L	7.48E-01	mg/L	M	7.6E-06	mg/kg-day	4.00E-04	mg/kg-day	1.9E-02	1.3E-06	mg/kg-day	N/A	N/A	- -
	Arsenic	1.80E-01	mg/L	1.80E-01	mg/L	M	1.8E-06	mg/kg-day	3.00E-04	mg/kg-day	6.1E-03	3.2E-07	mg/kg-day	1.50E+00	kg-day/mg	4.7E-07
	Cadmium	1.57E-02	mg/L	1.57E-02	mg/L	M	1.6E-07	mg/kg-day	5.00E-04	mg/kg-day	3.2E-04	2.7E-08	mg/kg-day	N/A	N/A	- -
	Lead	1.67E-02	mg/L	1.67E-02	mg/L	M	1.7E-07	mg/kg-day	N/A	N/A	- -	2.9E-08	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	3.66E-02	mg/L	3.66E-02	mg/L	M	3.7E-07	mg/kg-day	5.00E-03	mg/kg-day	7.5E-05	6.4E-08	mg/kg-day	N/A	N/A	- -
	(Total)										2.6E-02					4.7E-07
Dermal	Antimony	7.48E-01	mg/L	7.48E-01	mg/L	M	1.5E-05	mg/kg-day	6.00E-05	mg/kg-day	2.4E-01	2.5E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.80E-01	mg/L	1.80E-01	mg/L	M	3.5E-06	mg/kg-day	3.00E-04	mg/kg-day	1.2E-02	6.0E-07	mg/kg-day	1.50E+00	kg-day/mg	9.1E-07
	Cadmium	1.57E-02	mg/L	1.57E-02	mg/L	M	3.1E-07	mg/kg-day	2.50E-05	mg/kg-day	1.2E-02	5.3E-08	mg/kg-day	N/A	kg-day/mg	- -
	Lead	1.67E-02	mg/L	1.67E-02	mg/L	M	3.3E-08	mg/kg-day	N/A	N/A	- -	5.6E-09	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	3.66E-02	mg/L	3.66E-02	mg/L	M	7.2E-07	mg/kg-day	5.00E-03	mg/kg-day	1.4E-04	1.2E-07	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										2.7E-01					9.1E-07
										Total Hazard Index for Dermal Exposure	**2.9E-01**				Total Cancer Risk for Dermal Exposure	**1.4E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.18
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Z1 Groundwater Seeps in Basements
Receptor Population:	OU1 Resident
Receptor Age:	Child (0 to 6 years)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	7.48E-01	mg/L	7.48E-01	mg/L	M	2.4E-05	mg/kg-day	4.00E-04	mg/kg-day	6.1E-02	2.1E-06	mg/kg-day	N/A	N/A	- -
	Arsenic	1.80E-01	mg/L	1.80E-01	mg/L	M	5.8E-06	mg/kg-day	3.00E-04	mg/kg-day	1.9E-02	5.0E-07	mg/kg-day	1.50E+00	kg-day/mg	7.5E-07
	Cadmium	1.57E-02	mg/L	1.57E-02	mg/L	M	5.1E-07	mg/kg-day	5.00E-04	mg/kg-day	1.0E-03	4.4E-08	mg/kg-day	N/A	N/A	- -
	Lead	1.67E-02	mg/L	1.67E-02	mg/L	M	5.4E-07	mg/kg-day	N/A	N/A	- -	4.6E-08	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	3.66E-02	mg/L	3.66E-02	mg/L	M	1.2E-06	mg/kg-day	5.00E-03	mg/kg-day	2.4E-04	1.0E-07	mg/kg-day	N/A	N/A	- -
	(Total)										8.1E-02					7.5E-07
Dermal	Antimony	7.48E-01	mg/L	7.48E-01	mg/L	M	2.1E-05	mg/kg-day	6.00E-05	mg/kg-day	3.5E-01	1.8E-06	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.80E-01	mg/L	1.80E-01	mg/L	M	5.0E-06	mg/kg-day	3.00E-04	mg/kg-day	1.7E-02	4.3E-07	mg/kg-day	1.50E+00	kg-day/mg	6.4E-07
	Cadmium	1.57E-02	mg/L	1.57E-02	mg/L	M	4.3E-07	mg/kg-day	2.50E-05	mg/kg-day	1.7E-02	3.7E-08	mg/kg-day	N/A	kg-day/mg	- -
	Lead	1.67E-02	mg/L	1.67E-02	mg/L	M	4.6E-08	mg/kg-day	N/A	N/A	- -	4.0E-09	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	3.66E-02	mg/L	3.66E-02	mg/L	M	1.0E-06	mg/kg-day	5.00E-03	mg/kg-day	2.0E-04	8.7E-08	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										3.8E-01					6.4E-07
										Total Hazard Index for Dermal Exposure	**4.6E-01**				Total Cancer Risk for Dermal Exposure	**1.4E-06**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.19
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Z2-3 Groundwater Seeps in Basements
Receptor Population:	OU1 Resident
Receptor Age:	Adult

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	9.75E-03	mg/L	9.75E-03	mg/L	M	5.9E-08	mg/kg-day	4.00E-04	mg/kg-day	1.5E-04	1.7E-08	mg/kg-day	N/A	N/A	- -
	Arsenic	1.87E-02	mg/L	1.87E-02	mg/L	M	1.1E-07	mg/kg-day	3.00E-04	mg/kg-day	3.8E-04	3.2E-08	mg/kg-day	1.50E+00	kg-day/mg	4.9E-08
	Cadmium	0.00E+00	mg/L	0.00E+00	mg/L	M	0.0E+00	mg/kg-day	5.00E-04	mg/kg-day	0.0E+00	0.0E+00	mg/kg-day	N/A	N/A	- -
	Lead	8.83E-03	mg/L	8.83E-03	mg/L	M	5.4E-08	mg/kg-day	N/A	N/A	- -	1.5E-08	mg/kg-day	N/A	N/A	- -
	Selenium	1.46E-03	mg/L	1.46E-03	mg/L	M	8.9E-09	mg/kg-day	5.00E-03	mg/kg-day	1.8E-06	2.5E-09	mg/kg-day	N/A	N/A	- -
	(Total)										5.3E-04					4.9E-08
Dermal	Antimony	9.75E-03	mg/L	0.0	mg/L	M	1.3E-07	mg/kg-day	6.00E-05	mg/kg-day	2.1E-03	3.7E-08	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.87E-02	mg/L	0.0	mg/L	M	2.5E-07	mg/kg-day	3.00E-04	mg/kg-day	8.2E-04	7.1E-08	mg/kg-day	1.50E+00	kg-day/mg	1.1E-07
	Cadmium	0.00E+00	mg/L	0.000	mg/L	M	0.0E+00	mg/kg-day	2.50E-05	mg/kg-day	0.0E+00	0.0E+00	mg/kg-day	N/A	kg-day/mg	- -
	Lead	8.83E-03	mg/L	0.01	mg/L	M	1.2E-08	mg/kg-day	N/A	N/A	- -	3.3E-09	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.46E-03	mg/L	0.001	mg/L	M	1.9E-08	mg/kg-day	5.00E-03	mg/kg-day	3.9E-06	5.5E-09	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										3.0E-03					1.1E-07
										Total Hazard Index for Dermal Exposure	**3.5E-03**				Total Cancer Risk for Dermal Exposure	**1.5E-07**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.20

Human Health Risk Assessment

CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- DERMAL

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Z2-3 Groundwater Seeps in Basements
Receptor Population:	OU1 Resident
Receptor Age:	Adolescent (7 to 18 years)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	9.75E-03	mg/L	9.75E-03	mg/L	M	1.0E-07	mg/kg-day	4.00E-04	mg/kg-day	2.5E-04	1.7E-08	mg/kg-day	N/A	N/A	- -
	Arsenic	1.87E-02	mg/L	1.87E-02	mg/L	M	1.9E-07	mg/kg-day	3.00E-04	mg/kg-day	6.4E-04	3.3E-08	mg/kg-day	1.50E+00	kg-day/mg	4.9E-08
	Cadmium	0.00E+00	mg/L	0.00E+00	mg/L	M	0.0E+00	mg/kg-day	5.00E-04	mg/kg-day	0.0E+00	0.0E+00	mg/kg-day	N/A	N/A	- -
	Lead	8.83E-03	mg/L	8.83E-03	mg/L	M	9.0E-08	mg/kg-day	N/A	N/A	- -	1.5E-08	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.46E-03	mg/L	1.46E-03	mg/L	M	1.5E-08	mg/kg-day	5.00E-03	mg/kg-day	3.0E-06	2.6E-09	mg/kg-day	N/A	N/A	- -
	(Total)										8.9E-04					4.9E-08
Dermal	Antimony	9.75E-03	mg/L	0.0	mg/L	M	1.9E-07	mg/kg-day	6.00E-05	mg/kg-day	3.2E-03	3.3E-08	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.87E-02	mg/L	0.02	mg/L	M	3.7E-07	mg/kg-day	3.00E-04	mg/kg-day	1.2E-03	6.3E-08	mg/kg-day	1.50E+00	kg-day/mg	9.4E-08
	Cadmium	0.00E+00	mg/L	0.000	mg/L	M	0.0E+00	mg/kg-day	2.50E-05	mg/kg-day	0.0E+00	0.0E+00	mg/kg-day	N/A	kg-day/mg	- -
	Lead	8.83E-03	mg/L	0.01	mg/L	M	1.7E-08	mg/kg-day	N/A	N/A	- -	3.0E-09	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.46E-03	mg/L	0.001	mg/L	M	2.9E-08	mg/kg-day	5.00E-03	mg/kg-day	5.7E-06	4.9E-09	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										4.4E-03					9.4E-08
										Total Hazard Index for Dermal Exposure	**5.3E-03**				Total Cancer Risk for Dermal Exposure	**1.4E-07**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 7.21
Human Health Risk Assessment
CALCULATION OF NON-CANCER HAZARDS AND CANCER RISKS -- DERMAL
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Medium:	Groundwater
Exposure Medium:	Groundwater Seeps
Exposure Point:	OU1 Z2-3 Groundwater Seeps in Basements
Receptor Population:	OU1 Resident
Receptor Age:	Child (0 to 6 years)

Exposure Route	Chemical of Interest	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation (1)	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Dose	Reference Dose Units	Hazard Quotient	Intake (Cancer)	Intake (Cancer) Units	Cancer Slope Factor	Cancer Slope Factor Units	Cancer Risk
Ingestion	Antimony	9.75E-03	mg/L	9.75E-03	mg/L	M	3.2E-07	mg/kg-day	4.00E-04	mg/kg-day	7.9E-04	2.7E-08	mg/kg-day	N/A	N/A	- -
	Arsenic	1.87E-02	mg/L	1.87E-02	mg/L	M	6.1E-07	mg/kg-day	3.00E-04	mg/kg-day	2.0E-03	5.2E-08	mg/kg-day	1.50E+00	kg-day/mg	7.8E-08
	Cadmium	0.00E+00	mg/L	0.00E+00	mg/L	M	0.0E+00	mg/kg-day	5.00E-04	mg/kg-day	0.0E+00	0.0E+00	mg/kg-day	N/A	N/A	- -
	Lead	8.83E-03	mg/L	8.83E-03	mg/L	M	2.9E-07	mg/kg-day	N/A	N/A	- -	2.5E-08	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.46E-03	mg/L	1.46E-03	mg/L	M	4.7E-08	mg/kg-day	5.00E-03	mg/kg-day	9.5E-06	4.1E-09	mg/kg-day	N/A	N/A	- -
	(Total)										2.8E-03					7.8E-08
Dermal	Antimony	9.75E-03	mg/L	9.75E-03	mg/L	M	2.7E-07	mg/kg-day	6.00E-05	mg/kg-day	4.5E-03	2.3E-08	mg/kg-day	N/A	kg-day/mg	- -
	Arsenic	1.87E-02	mg/L	1.87E-02	mg/L	M	5.2E-07	mg/kg-day	3.00E-04	mg/kg-day	1.7E-03	4.4E-08	mg/kg-day	1.50E+00	kg-day/mg	6.7E-08
	Cadmium	0.00E+00	mg/L	0.00E+00	mg/L	M	0.0E+00	mg/kg-day	2.50E-05	mg/kg-day	0.0E+00	0.0E+00	mg/kg-day	N/A	kg-day/mg	- -
	Lead	8.83E-03	mg/L	8.83E-03	mg/L	M	2.4E-08	mg/kg-day	N/A	N/A	- -	2.1E-09	mg/kg-day	N/A	kg-day/mg	- -
	Selenium	1.46E-03	mg/L	1.46E-03	mg/L	M	4.0E-08	mg/kg-day	5.00E-03	mg/kg-day	8.1E-06	3.5E-09	mg/kg-day	N/A	kg-day/mg	- -
	(Total)										6.2E-03					6.7E-08
										Total Hazard Index for Dermal Exposure	**9.1E-03**				Total Cancer Risk for Dermal Exposure	**1.4E-07**

(1) Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

Table 8.1
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface and Subsurface Soil	OU2 Surface Soil (0 - 6 feet)	Antimony	2.8E-02	0.0E+00	8.2E-04	2.8E-02	Antimony	- -	- -	- -	--
			Arsenic	3.5E-02	5.6E-03	2.6E-02	6.7E-02	Arsenic	2.2E-07	3.6E-08	2.4E-08	2.8E-07
			Cadmium	6.5E-03	8.3E-04	1.5E-02	2.2E-02	Cadmium	- -	- -	3.7E-09	3.7E-09
			Lead	- -	- -	- -	--	Lead	- -	- -	- -	- -
			Selenium	6.1E-05	0.0E+00	3.4E-07	6.2E-05	Selenium	- -	- -	- -	- -
			(Total)	6.9E-02	6.4E-03	4.1E-02	**1.2E-01**	(Total)	2.2E-07	3.6E-08	2.8E-08	**2.9E-07**
						Total Hazard Index	**1.2E-01**				Total Carcinogenic Risk	**2.9E-07**

Table 8.2 A

Human Health Risk Assessment

MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Antimony	1.7E-01	0.0E+00	N/A	1.7E-01	Antimony	- -	- -	N/A	- -
			Arsenic	8.0E-01	3.9E-01	N/A	1.2E+00	Arsenic	5.1E-06	2.5E-06	N/A	7.6E-06
			Cadmium	8.0E-03	0.0E+00	N/A	8.0E-03	Cadmium	- -	- -	N/A	- -
			Lead	- -	- -	N/A	- -	Lead	- -	- -	N/A	- -
			Selenium	8.0E-04	0.0E+00	N/A	8.0E-04	Selenium	- -	- -	N/A	- -
			(Total)	9.8E-01	3.9E-01	N/A	**1.4E+00**	(Total)	5.1E-06	2.5E-06	N/A	**7.6E-06**
						Total Hazard Index	**1.4E+00**				Total Carcinogenic Risk	**7.6E-06**

Table 8.2 B

Human Health Risk Assessment

MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Antimony	2.3E-02	0.0E+00	N/A	2.3E-02	Antimony	- -	- -	N/A	- -
			Arsenic	1.9E-01	9.3E-02	N/A	2.9E-01	Arsenic	1.2E-06	6.0E-07	N/A	1.8E-06
			Cadmium	7.3E-03	0.0E+00	N/A	7.3E-03	Cadmium	- -	- -	N/A	- -
			Lead	- -	- -	N/A	- -	Lead	- -	- -	N/A	- -
			Selenium	3.5E-04	0.0E+00	N/A	3.5E-04	Selenium	- -	- -	N/A	- -
			(Total)	2.2E-01	9.3E-02	N/A	**3.2E-01**	(Total)	1.2E-06	6.0E-07	N/A	**1.8E-06**
						Total Hazard Index	**3.2E-01**				Total Carcinogenic Risk	**1.8E-06**

Table 8.3
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Surace water	Surface water	OU2 Surface water	Antimony	N/A	4.8E-03	4.8E-03	Antimony	N/A	- -	- -
			Arsenic	N/A	5.6E-03	5.6E-03	Arsenic	N/A	3.6E-08	3.6E-08
			Cadmium	N/A	4.6E-04	4.6E-04	Cadmium	N/A	- -	- -
			Lead	N/A	- -	- -	Lead	N/A	- -	- -
			Selenium	N/A	1.1E-05	1.1E-05	Selenium	N/A	- -	- -
			(Total)	N/A	1.1E-02	**1.1E-02**	(Total)	N/A	3.6E-08	**3.6E-08**
					Total Hazard Index	**1.1E-02**			Total Carcinopgenic Risk	**3.6E-08**

Table 8.4
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Groundwater	Groundwater	OU2 Groundwater	Antimony	N/A	1.4E-02	1.4E-02	Antimony	N/A	- -	- -
			Arsenic	N/A	5.1E-01	5.1E-01	Arsenic	N/A	3.3E-06	3.3E-06
			Cadmium	N/A	3.6E-02	3.6E-02	Cadmium	N/A	- -	- -
			Lead	N/A	- -	- -	Lead	N/A	- -	- -
			Selenium	N/A	6.90E-06	6.90E-06	Selenium	N/A	- -	- -
			(Total)	N/A	5.6E-01	**5.6E-01**	(Total)	N/A	3.3E-06	**3.3E-06**
					Total Hazard Index	**5.6E-01**			Total Carcinogenic Risk	**3.3E-06**

Table 8.5
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	O&M Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	9.2E-03	0.0E+00	2.4E-06	9.2E-03	Antimony	- -	- -	- -	--
			Arsenic	1.4E-02	2.9E-03	8.9E-05	1.7E-02	Arsenic	2.2E-06	4.6E-07	2.0E-09	2.6E-06
			Cadmium	2.5E-04	4.2E-05	4.9E-06	3.0E-04	Cadmium	- -	- -	3.1E-11	3.1E-11
			Lead	- -	- -	- -	- -	Lead	- -	- -	- -	--
			Selenium	2.4E-05	0.0E+00	1.2E-09	2.4E-05	Selenium	- -	- -	- -	--
			(Total)	2.3E-02	2.9E-03	9.6E-05	**2.6E-02**	(Total)	2.2E-06	4.6E-07	2.1E-09	**2.6E-06**
						Total Hazard Index	**2.6E-02**				Total Carcinogenic Risk	**2.6E-06**

Table 8.6

Human Health Risk Assessment

MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	1.8E-02	0.0E+00	2.3E-06	1.8E-02	Antimony	- -	- -	- -	- -
			Arsenic	2.6E-02	5.5E-03	8.5E-05	3.1E-02	Arsenic	3.3E-06	7.0E-07	1.6E-09	4.0E-06
			Cadmium	4.7E-04	8.0E-05	4.6E-06	5.6E-04	Cadmium	- -	- -	2.4E-11	2.4E-11
			Lead	- -	- -	- -	- -	Lead	- -	- -	- -	--
			Selenium	4.5E-05	0.0E+00	1.1E-09	4.5E-05	Selenium	- -	- -	- -	- -
			(Total)	4.4E-02	5.5E-03	9.1E-05	**5.0E-02**	(Total)	3.3E-06	7.02E-07	1.58E-09	**4.0E-06**
						Total Hazard Index	**5.0E-02**				Total Carcinogenic Risk	**4.0E-06**

Table 8.7 A

Human Health Risk Assessment

MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Antimony	8.2E-02	0.0E+00	N/A	8.2E-02	Antimony	- -	- -	N/A	- -
			Arsenic	3.9E-01	3.5E-01	N/A	7.4E-01	Arsenic	5.0E-05	4.5E-05	N/A	9.5E-05
			Cadmium	3.9E-03	2.8E-03	N/A	6.6E-03	Cadmium	- -	- -	N/A	- -
			Lead	- -	- -	N/A	- -	Lead	- -	- -	N/A	- -
			Selenium	3.9E-04	0.0E+00	N/A	3.9E-04	Selenium	- -	- -	N/A	- -
			(Total)	4.7E-01	3.5E-01	N/A	**8.3E-01**	(Total)	5.0E-05	4.5E-05	N/A	**9.5E-05**
						Total Hazard Index	**8.3E-01**				Total Carcinogenic Risk	**9.5E-05**

Table 8.7 B

Human Health Risk Assessment

MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Antimony	1.1E-02	0.0E+00	N/A	1.1E-02	Antimony	- -	- -	N/A	- -
			Arsenic	9.3E-02	8.5E-02	N/A	1.8E-01	Arsenic	1.2E-05	1.1E-05	N/A	2.3E-05
			Cadmium	3.5E-03	2.5E-03	N/A	6.1E-03	Cadmium	- -	- -	N/A	- -
			Lead	- -	- -	N/A	- -	Lead	- -	- -	N/A	- -
			Selenium	1.7E-04	0.0E+00	N/A	1.7E-04	Selenium	- -	- -	N/A	- -
			(Total)	1.1E-01	8.7E-02	N/A	**2.0E-01**	(Total)	1.2E-05	1.1E-05	N/A	**2.3E-05**
						Total Hazard Index	**2.0E-01**				Total Carcinogenic Risk	**2.3E-05**

Table 8.8
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Surace water	Surface water	OU2 Surface water	Antimony	1.2E-03	1.3E-02	1.4E-02	Antimony	- -	- -	--
			Arsenic	9.4E-03	1.5E-02	2.5E-02	Arsenic	1.2E-06	2.0E-06	3.2E-06
			Cadmium	3.9E-05	1.3E-03	1.3E-03	Cadmium	- -	- -	--
			Lead	- -	NA	N/A	Lead	- -	- -	- -
			Selenium	1.9E-05	3.0E-05	4.9E-05	Selenium	- -	- -	--
			(Total)	--	3.0E-02	**3.0E-02**	(Total)	--	2.0E-06	**2.0E-06**
					Total Hazard Index	**3.0E-02**			Total Carcinogenic Risk	**2.0E-06**

Table 8.9
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	3.0E-02	0.0E+00	2.3E-06	3.0E-02	Antimony	- -	- -	- -	- -
			Arsenic	4.3E-02	2.3E-02	8.5E-05	6.7E-02	Arsenic	3.4E-06	1.8E-06	9.3E-10	5.1E-06
			Cadmium	8.0E-04	3.4E-04	4.6E-06	1.1E-03	Cadmium	- -	- -	1.4E-11	1.4E-11
			Lead	- -	- -	- -	- -	Lead	- -	- -	- -	- -
			Selenium	7.6E-05	0.0E+00	1.1E-09	7.6E-05	Selenium	- -	- -	- -	- -
			(Total)	7.4E-02	2.3E-02	9.1E-05	**9.7E-02**	(Total)	3.4E-06	1.8E-06	9.5E-10	**5.1E-06**
						Total Hazard Index	**9.7E-02**				Total Carcinogenic Risk	**5.1E-06**

Table 8.10 A

Human Health Risk Assessment

MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Antimony	1.4E-01	0.0E+00	N/A	1.4E-01	Antimony	- -	- -	N/A	- -
			Arsenic	6.5E-01	5.2E-01	N/A	1.2E+00	Arsenic	5.0E-05	4.0E-05	N/A	9.0E-05
			Cadmium	6.5E-03	4.1E-03	N/A	1.1E-02	Cadmium	- -	- -	N/A	- -
			Lead	- -	- -	N/A	- -	Lead	- -	- -	N/A	- -
			Selenium	6.5E-04	0.0E+00	N/A	6.5E-04	Selenium	- -	- -	N/A	- -
			(Total)	8.0E-01	5.2E-01	N/A	**1.3E+00**	(Total)	5.0E-05	4.0E-05	N/A	**9.0E-05**
						Total Hazard Index	**1.3E+00**				Total Carcinogenic Risk	**9.0E-05**

Table 8.10 B

Human Health Risk Assessment

MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient				Chemical	Carcinogenic Risk			
				Ingestion	Dermal	Inhalation	Exposure Routes Total		Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Antimony	1.8E-02	0.0E+00	N/A	1.8E-02	Antimony	- -	- -	N/A	- -
			Arsenic	1.6E-01	1.3E-01	N/A	2.8E-01	Arsenic	1.2E-05	9.7E-06	N/A	2.2E-05
			Cadmium	5.9E-03	3.8E-03	N/A	9.7E-03	Cadmium	- -	- -	N/A	- -
			Lead	- -	- -	N/A	- -	Lead	- -	- -	N/A	- -
			Selenium	2.9E-04	0.0E+00	N/A	2.9E-04	Selenium	- -	- -	N/A	- -
			(Total)	1.8E-01	1.3E-01	N/A	**3.1E-01**	(Total)	1.2E-05	9.7E-06	N/A	**2.2E-05**
						Total Hazard Index	**3.1E-01**				Total Carcinogenic Risk	**2.2E-05**

Table 8.11

Human Health Risk Assessment

MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Surace water	Surface water	OU2 Surface water	Antimony	2.0E-03	2.0E-02	2.2E-02	Antimony	- -	- -	- -
			Arsenic	1.6E-02	2.3E-02	3.8E-02	Arsenic	1.2E-06	1.7E-06	3.0E-06
			Cadmium	6.5E-05	1.9E-03	1.9E-03	Cadmium	- -	- -	- -
			Lead	- -	- -	- -	Lead	- -	- -	- -
			Selenium	3.1E-05	4.5E-05	7.6E-05	Selenium	- -	- -	- -
			(Total)	1.8E-02	4.4E-02	**6.2E-02**	(Total)	1.2E-06	1.7E-06	**3.0E-06**
					Total Hazard Index	**6.2E-02**			Total Carcinogenic Risk	**3.0E-06**

Table 8.12
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	1.1E-02	1.6E-01	1.8E-01	Antimony	- -	- -	- -
			Arsenic	3.6E-03	7.9E-03	1.2E-02	Arsenic	4.7E-07	1.0E-06	1.5E-06
			Cadmium	1.9E-04	8.3E-03	8.5E-03	Cadmium	- -	- -	- -
			Lead	- -	- -	- -	Lead	- -	- -	- -
			Selenium	4.5E-05	9.7E-05	1.4E-04	Selenium	- -	- -	- -
			(Total)	1.5E-02	1.8E-01	**2.0E-01**	(Total)	4.7E-07	1.0E-06	**1.5E-06**
					Total Hazard Index	**2.0E-01**			Total Carcinogenic Risk	**1.5E-06**

Table 8.13
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	1.9E-02	2.4E-01	2.6E-01	Antimony	- -	- -	- -
			Arsenic	6.1E-03	1.2E-02	1.8E-02	Arsenic	4.7E-07	9.1E-07	1.4E-06
			Cadmium	3.2E-04	1.2E-02	1.3E-02	Chromium	- -	- -	- -
			Lead	- -	- -	- -	Lead	- -	- -	- -
			Selenium	7.5E-05	1.4E-04	2.2E-04	Selenium	- -	- -	- -
			(Total)	2.6E-02	2.7E-01	**2.9E-01**	(Total)	4.7E-07	9.1E-07	**1.4E-06**
					Total Hazard Index	**2.9E-01**			Total Carcinogenic Risk	**1.4E-06**

Table 8.14

Human Health Risk Assessment

MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child (0 to 6 years)

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	6.1E-02	3.5E-01	4.1E-01	Antimony	- -	- -	- -
			Arsenic	1.9E-02	1.7E-02	3.6E-02	Arsenic	7.5E-07	6.4E-07	1.4E-06
			Cadmium	1.0E-03	1.7E-02	1.8E-02	Chromium	- -	- -	- -
			Lead	- -	- -	- -	Lead	- -	- -	- -
			Selenium	2.4E-04	2.0E-04	4.4E-04	Selenium	- -	- -	- -
			(Total)	8.1E-02	3.8E-01	**4.6E-01**	(Total)	7.5E-07	6.4E-07	**1.4E-06**
					Total Hazard Index	**4.6E-01**			Total Carcinogenic Risk	**1.4E-06**

Table 8.15
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adult (>18 years)

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	1.5E-04	2.1E-03	2.3E-03	Antimony	- -	- -	- -
			Arsenic	3.8E-04	8.2E-04	1.2E-03	Arsenic	4.9E-08	1.1E-07	1.5E-07
			Cadmium	0.0E+00	0.0E+00	0.0E+00	Cadmium	- -	- -	- -
			Lead	- -	- -	- -	Lead	- -	- -	- -
			Selenium	1.8E-06	3.9E-06	5.6E-06	Selenium	- -	- -	- -
			(Total)	5.3E-04	3.0E-03	**3.5E-03**	(Total)	4.9E-08	1.1E-07	**1.5E-07**
					Total Hazard Index	**3.5E-03**			Total Carcinogenic Risk	**1.5E-07**

Table 8.16
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	2.5E-04	3.2E-03	3.4E-03	Antimony	- -	- -	- -
			Arsenic	6.4E-04	1.2E-03	1.9E-03	Arsenic	4.9E-08	9.4E-08	1.4E-07
			Cadmium	0.0E+00	0.0E+00	0.0E+00	Chromium	- -	- -	- -
			Lead	- -	- -	- -	Lead	- -	- -	- -
			Selenium	3.0E-06	5.7E-06	8.7E-06	Selenium	- -	- -	- -
			(Total)	8.9E-04	4.4E-03	**5.3E-03**	(Total)	4.9E-08	9.4E-08	**1.4E-07**
					Total Hazard Index	**5.3E-03**			Total Carcinogenic Risk	**1.4E-07**

Table 8.17
Human Health Risk Assessment
MEDIUM-SPECIFIC SUMMARY OF NON-CANCER HAZARDS AND CANCER RISKS
USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child (0 to 6 years)

Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient			Chemical	Carcinogenic Risk		
				Ingestion	Dermal	Exposure Routes Total		Ingestion	Dermal	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	7.9E-04	4.5E-03	5.3E-03	Antimony	- -	- -	- -
			Arsenic	2.0E-03	1.7E-03	3.8E-03	Arsenic	7.8E-08	6.7E-08	1.4E-07
			Cadmium	0.0E+00	0.0E+00	0.0E+00	Chromium	- -	- -	- -
			Lead	- -	- -	- -	Lead	- -	- -	- -
			Selenium	9.5E-06	8.1E-06	1.8E-05	Selenium	- -	- -	- -
			(Total)	2.8E-03	6.2E-03	**9.1E-03**	(Total)	7.8E-08	6.7E-08	**1.4E-07**
					Total Hazard Index	**9.1E-03**			Total Carcinogenic Risk	**1.4E-07**

TABLE 9.1 A

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Antimony	Longevity, Blood	1.7E-01	0.0E+00	N/A	1.7E-01
			Arsenic	Skin	8.0E-01	3.9E-01	N/A	1.2E+00
			Cadmium	Kidney	8.0E-03	0.0E+00	N/A	8.0E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	8.0E-04	0.0E+00	N/A	8.0E-04
			Total		9.8E-01	3.9E-01	N/A	1.4E+00
		Exposure Point Total						1.4E+00
	Exposure Medium Total							1.4E+00
Medium Total								1.4E+00
Soil	Surface and Subsurface Soil	OU2 Surface and Subsurface Soil (0 - 6 feet)	Antimony	Longevity, Blood	2.8E-02	0.0E+00	8.2E-04	2.8E-02
			Arsenic	Skin	3.5E-02	5.6E-03	2.6E-02	6.7E-02
			Cadmium	Kidney	6.5E-03	8.3E-04	1.5E-02	2.2E-02
			Lead	Developmental	- -	- -	- -	--
			Selenium	Selenosis	6.1E-05	0.0E+00	3.4E-07	6.2E-05
			Total		6.9E-02	6.4E-03	4.1E-02	1.2E-01
		Exposure Point Total						1.2E-01
	Exposure Medium Total							1.2E-01
Medium Total								1.2E-01
OU2 Groundwater	Groundwater	OU2 Groundwater	Antimony	Longevity, Blood	N/A	1.4E-02	N/A	1.4E-02
			Arsenic	Skin	N/A	5.1E-01	N/A	5.1E-01
			Cadmium	Kidney	N/A	3.6E-02	N/A	3.6E-02
			Lead	Developmental	N/A	- -	N/A	- -
			Selenium	Selenosis	N/A	6.9E-06	N/A	6.9E-06
			Total		N/A	5.6E-01	N/A	5.6E-01
		Exposure Point Total						5.6E-01
	Exposure Medium Total							5.6E-01
Medium Total								5.6E-01
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	N/A	4.8E-03	N/A	4.8E-03
			Arsenic	Skin	N/A	5.6E-03	N/A	5.6E-03
			Cadmium	Kidney	N/A	4.6E-04	N/A	4.6E-04
			Lead	Developmental	N/A	- -	N/A	- -
			Selenium	Selenosis	N/A	1.1E-05	N/A	1.1E-05
			Total		N/A	1.1E-02	N/A	1.1E-02
		Exposure Point Total						1.1E-02
	Exposure Medium Total							1.1E-02
Medium Total								1.1E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	2E+00

TABLE 9.1 B

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest		Non-Carcinogenic Hazard Quotient			
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Antimony	Longevity, Blood	2.3E-02	0.0E+00	N/A	2.3E-02
			Arsenic	Skin	1.9E-01	9.3E-02	N/A	2.9E-01
			Cadmium	Kidney	7.3E-03	0.0E+00	N/A	7.3E-03
			Lead	Developmental	- -	- -	N/A	0.0E+00
			Selenium	Selenosis	3.5E-04	0.0E+00	N/A	3.5E-04
			Total		2.2E-01	9.3E-02	N/A	3.2E-01
		Exposure Point Total						3.2E-01
	Exposure Medium Total							3.2E-01
Medium Total								3.2E-01
Soil	Surface and Subsurface Soil	OU2 Surface and Subsurface Soil (0 - 6 feet)	Antimony	Longevity, Blood	2.8E-02	0.0E+00	8.2E-04	2.8E-02
			Arsenic	Skin	3.5E-02	5.6E-03	2.6E-02	6.7E-02
			Cadmium	Kidney	6.5E-03	8.3E-04	1.5E-02	2.2E-02
			Lead	Developmental	- -	- -	- -	--
			Selenium	Selenosis	6.1E-05	0.0E+00	3.4E-07	6.2E-05
			Total		6.9E-02	6.4E-03	4.1E-02	1.2E-01
		Exposure Point Total						1.2E-01
	Exposure Medium Total							1.2E-01
Medium Total								1.2E-01
OU2 Groundwater	Groundwater	OU2 Groundwater	Antimony	Longevity, Blood	N/A	1.4E-02	N/A	1.4E-02
			Arsenic	Skin	N/A	5.1E-01	N/A	5.1E-01
			Cadmium	Kidney	N/A	3.6E-02	N/A	3.6E-02
			Lead	Developmental	N/A	- -	N/A	- -
			Selenium	Selenosis	N/A	6.9E-06	N/A	6.9E-06
			Total		N/A	5.6E-01	N/A	5.6E-01
		Exposure Point Total						5.6E-01
	Exposure Medium Total							5.6E-01
Medium Total								5.6E-01
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	N/A	4.8E-03	N/A	4.8E-03
			Arsenic	Skin	N/A	5.6E-03	N/A	5.6E-03
			Cadmium	Kidney	N/A	4.6E-04	N/A	4.6E-04
			Lead	Developmental	N/A	- -	N/A	- -
			Selenium	Selenosis	N/A	1.1E-05	N/A	1.1E-05
			Total		N/A	1.1E-02	N/A	1.1E-02
		Exposure Point Total						1.1E-02
	Exposure Medium Total							1.1E-02
Medium Total								1.1E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	1E+00

TABLE 9.2

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	O&M Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient: Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	9.2E-03	0.0E+00	2.4E-06	9.2E-03
			Arsenic	Skin	1.4E-02	2.9E-03	8.9E-05	1.7E-02
			Cadmium	Kidney	2.5E-04	4.2E-05	4.9E-06	3.0E-04
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	2.4E-05	0.0E+00	1.2E-09	2.4E-05
			Total		2.3E-02	2.9E-03	9.6E-05	2.6E-02
		Exposure Point Total						2.6E-02
	Exposure Medium Total							2.6E-02
Medium Total								2.6E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	3E-02

TABLE 9.3 A

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Antimony	Longevity, Blood	8.2E-02	0.0E+00	N/A	8.2E-02
			Arsenic	Skin	3.9E-01	3.5E-01	N/A	7.4E-01
			Cadmium	Kidney	3.9E-03	2.8E-03	N/A	6.6E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	3.9E-04	0.0E+00	N/A	3.9E-04
			Total		4.7E-01	3.5E-01	N/A	8.3E-01
		Exposure Point Total						8.3E-01
	Exposure Medium Total							8.3E-01
Medium Total								8.3E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	1.8E-02	0.0E+00	2.3E-06	1.8E-02
			Arsenic	Skin	2.6E-02	5.5E-03	8.5E-05	3.1E-02
			Cadmium	Kidney	4.7E-04	8.0E-05	4.6E-06	5.6E-04
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	4.5E-05	0.0E+00	1.1E-09	4.5E-05
			Total		4.4E-02	5.5E-03	9.1E-05	5.0E-02
		Exposure Point Total						5.0E-02
	Exposure Medium Total							5.0E-02
Medium Total								5.0E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	1.2E-03	1.3E-02	N/A	1.4E-02
			Arsenic	Skin	9.4E-03	1.5E-02	N/A	2.5E-02
			Cadmium	Kidney	3.9E-05	1.3E-03	N/A	1.3E-03
			Lead	Developmental	- -	NA	N/A	N/A
			Selenium	Selenosis	1.9E-05	3.0E-05	N/A	4.9E-05
			Total		--	3.0E-02	N/A	3.0E-02
		Exposure Point Total						3.0E-02
	Exposure Medium Total							3.0E-02
Medium Total								3.0E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	9E-01

TABLE 9.3 B

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Antimony	Longevity, Blood	1.1E-02	0.0E+00	N/A	1.1E-02
			Arsenic	Skin	9.3E-02	8.5E-02	N/A	1.8E-01
			Cadmium	Kidney	3.5E-03	2.5E-03	N/A	6.1E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	1.7E-04	0.0E+00	N/A	1.7E-04
			Total		1.1E-01	8.7E-02	N/A	2.0E-01
		Exposure Point Total						2.0E-01
	Exposure Medium Total							2.0E-01
Medium Total								2.0E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	1.8E-02	0.0E+00	2.3E-06	1.8E-02
			Arsenic	Skin	2.6E-02	5.5E-03	8.5E-05	3.1E-02
			Cadmium	Kidney	4.7E-04	8.0E-05	4.6E-06	5.6E-04
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	4.5E-05	0.0E+00	1.1E-09	4.5E-05
			Total		4.4E-02	5.5E-03	9.1E-05	5.0E-02
		Exposure Point Total						5.0E-02
	Exposure Medium Total							5.0E-02
Medium Total								5.0E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	1.2E-03	1.3E-02	N/A	1.4E-02
			Arsenic	Skin	9.4E-03	1.5E-02	N/A	2.5E-02
			Cadmium	Kidney	3.9E-05	1.3E-03	N/A	1.3E-03
			Lead	Developmental	- -	NA	N/A	N/A
			Selenium	Selenosis	1.9E-05	3.0E-05	N/A	4.9E-05
			Total		--	3.0E-02	N/A	3.0E-02
		Exposure Point Total						3.0E-02
	Exposure Medium Total							3.0E-02
Medium Total								3.0E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	3E-01

TABLE 9.4 A

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient: Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Antimony	Longevity, Blood	1.4E-01	0.0E+00	N/A	1.4E-01
			Arsenic	Skin	6.5E-01	5.2E-01	N/A	1.2E+00
			Cadmium	Kidney	6.5E-03	4.1E-03	N/A	1.1E-02
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	6.5E-04	0.0E+00	N/A	6.5E-04
			Total		8.0E-01	5.2E-01	N/A	1.3E+00
		Exposure Point Total						1.3E+00
	Exposure Medium Total							1.3E+00
Medium Total								1.3E+00
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	3.0E-02	0.0E+00	2.3E-06	3.0E-02
			Arsenic	Skin	4.3E-02	2.3E-02	8.5E-05	6.7E-02
			Cadmium	Kidney	8.0E-04	3.4E-04	4.6E-06	1.1E-03
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	7.6E-05	0.0E+00	1.1E-09	7.6E-05
			Total		7.4E-02	2.3E-02	9.1E-05	9.7E-02
		Exposure Point Total						9.7E-02
	Exposure Medium Total							9.7E-02
Medium Total								9.7E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	2.0E-03	2.0E-02	N/A	2.2E-02
			Arsenic	Skin	1.6E-02	2.3E-02	N/A	3.8E-02
			Cadmium	Kidney	6.5E-05	1.9E-03	N/A	1.9E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	3.1E-05	4.5E-05	N/A	7.6E-05
			Total		1.8E-02	4.4E-02	N/A	6.2E-02
		Exposure Point Total						6.2E-02
	Exposure Medium Total							6.2E-02
Medium Total								6.2E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	1E+00

TABLE 9.4 B

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Antimony	Longevity, Blood	1.8E-02	0.0E+00	N/A	1.8E-02
			Arsenic	Skin	1.6E-01	1.3E-01	N/A	2.8E-01
			Cadmium	Kidney	5.9E-03	3.8E-03	N/A	9.7E-03
			Lead	Developmental	- -	- -	N/A	0.0E+00
			Selenium	Selenosis	2.9E-04	0.0E+00	N/A	2.9E-04
			Total		1.8E-01	1.3E-01	N/A	3.1E-01
		Exposure Point Total						3.1E-01
	Exposure Medium Total							3.1E-01
Medium Total								3.1E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	3.0E-02	0.0E+00	2.3E-06	3.0E-02
			Arsenic	Skin	4.3E-02	2.3E-02	8.5E-05	6.7E-02
			Cadmium	Kidney	8.0E-04	3.4E-04	4.6E-06	1.1E-03
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	7.6E-05	0.0E+00	1.1E-09	7.6E-05
			Total		7.4E-02	2.3E-02	9.1E-05	9.7E-02
		Exposure Point Total						9.7E-02
	Exposure Medium Total							9.7E-02
Medium Total								9.7E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	2.0E-03	2.0E-02	N/A	2.2E-02
			Arsenic	Skin	1.6E-02	2.3E-02	N/A	3.8E-02
			Cadmium	Kidney	6.5E-05	1.9E-03	N/A	1.9E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	3.1E-05	4.5E-05	N/A	7.6E-05
			Total		1.8E-02	4.4E-02	N/A	6.2E-02
		Exposure Point Total						6.2E-02
	Exposure Medium Total							6.2E-02
Medium Total								6.2E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	5E-01

TABLE 9.5

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adult (>18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	Longevity, Blood	1.1E-02	1.6E-01	N/A	1.8E-01
			Arsenic	Skin	3.6E-03	7.9E-03	N/A	1.2E-02
			Cadmium	Kidney	1.9E-04	8.3E-03	N/A	8.5E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	4.5E-05	9.7E-05	N/A	1.4E-04
			Total		1.5E-02	1.8E-01	N/A	2.0E-01
		Exposure Point Total						2.0E-01
	Exposure Medium Total							2.0E-01
Medium Total								2.0E-01
Receptor Total							Total Hazard Index (HI) Across All Media =	2E-01

TABLE 9.6

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest		Non-Carcinogenic Hazard Quotient			
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	Longevity, Blood	1.9E-02	2.4E-01	N/A	2.6E-01
			Arsenic	Skin	6.1E-03	1.2E-02	N/A	1.8E-02
			Cadmium	Kidney	3.2E-04	1.2E-02	N/A	1.3E-02
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	7.5E-05	1.4E-04	N/A	2.2E-04
			Total		2.6E-02	2.7E-01	N/A	2.9E-01
		Exposure Point Total						2.9E-01
	Exposure Medium Total							2.9E-01
Medium Total								2.9E-01
Receptor Total					Total Hazard Index (HI) Across All Media =			3E-01

TABLE 9.7

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child (0 to 6 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest		Non-Carcinogenic Hazard Quotient			
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	Longevity, Blood	6.1E-02	3.5E-01	N/A	4.1E-01
			Arsenic	Skin	1.9E-02	1.7E-02	N/A	3.6E-02
			Cadmium	Kidney	1.0E-03	1.7E-02	N/A	1.8E-02
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	2.4E-04	2.0E-04	N/A	4.4E-04
			Total		8.1E-02	3.8E-01	N/A	4.6E-01
		Exposure Point Total						4.6E-01
	Exposure Medium Total							4.6E-01
Medium Total								4.6E-01
Receptor Total					Total Hazard Index (HI) Across All Media =			5E-01

TABLE 9.7

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child-Adult (Lifetime)

Medium	Exposure Medium	Exposure Point	Chemical of Interest		Non-Carcinogenic Hazard Quotient			
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	Longevity, Blood	9.1E-02	7.5E-01	N/A	8.5E-01
			Arsenic	Skin	2.9E-02	3.6E-02	N/A	6.6E-02
			Cadmium	Kidney	1.5E-03	3.8E-02	N/A	3.9E-02
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	3.6E-04	4.4E-04	N/A	8.0E-04
			Total		1.2E-01	8.3E-01	N/A	9.5E-01
		Exposure Point Total						9.5E-01
	Exposure Medium Total							9.5E-01
Medium Total								9.5E-01
Receptor Total					Total Hazard Index (HI) Across All Media =			1E+00

TABLE 9.9

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adult (>18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	Longevity, Blood	1.5E-04	2.1E-03	N/A	2.3E-03
			Arsenic	Skin	3.8E-04	8.2E-04	N/A	1.2E-03
			Cadmium	Kidney	0.0E+00	0.0E+00	N/A	0.0E+00
			Lead	Developmental	- -	- -	N/A	0.0E+00
			Selenium	Selenosis	1.8E-06	3.9E-06	N/A	5.6E-06
			Total		5.3E-04	3.0E-03	N/A	3.5E-03
		Exposure Point Total						3.5E-03
	Exposure Medium Total							3.5E-03
Medium Total								3.5E-03
Receptor Total							Total Hazard Index (HI) Across All Media =	4E-03

TABLE 9.10

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Non-Carcinogenic Hazard Quotient				
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	Longevity, Blood	2.5E-04	3.2E-03	N/A	3.4E-03
			Arsenic	Skin	6.4E-04	1.2E-03	N/A	1.9E-03
			Cadmium	Kidney	0.0E+00	0.0E+00	N/A	0.0E+00
			Lead	Developmental	- -	- -	N/A	0.0E+00
			Selenium	Selenosis	3.0E-06	5.7E-06	N/A	8.7E-06
			Total		8.9E-04	4.4E-03	N/A	5.3E-03
		Exposure Point Total						5.3E-03
	Exposure Medium Total							5.3E-03
Medium Total								5.3E-03
Receptor Total							Total Hazard Index (HI) Across All Media =	5E-03

TABLE 9.11

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child (0 to 6 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest		Non-Carcinogenic Hazard Quotient			
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	Longevity, Blood	7.9E-04	4.5E-03	N/A	5.3E-03
			Arsenic	Skin	2.0E-03	1.7E-03	N/A	3.8E-03
			Cadmium	Kidney	0.0E+00	0.0E+00	N/A	0.0E+00
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	9.5E-06	8.1E-06	N/A	1.8E-05
			Total		2.8E-03	6.2E-03	N/A	9.1E-03
		Exposure Point Total						9.1E-03
	Exposure Medium Total							9.1E-03
Medium Total								9.1E-03
Receptor Total							Total Hazard Index (HI) Across All Media =	9E-03

TABLE 9.12

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child-Adult (Lifetime)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	Longevity, Blood	1.2E-03	9.8E-03	N/A	1.1E-02
			Arsenic	Skin	3.0E-03	3.8E-03	N/A	6.8E-03
			Cadmium	Kidney	0.0E+00	0.0E+00	N/A	0.0E+00
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	1.4E-05	1.8E-05	N/A	3.2E-05
			Total		4.2E-03	1.4E-02	N/A	1.8E-02
		Exposure Point Total						1.8E-02
	Exposure Medium Total							1.8E-02
Medium Total								1.8E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	2E-02

TABLE 10.1 A

RISK DRIVER SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult (>18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest		Non-Carcinogenic Hazard Quotient			
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Arsenic	Skin	8.0E-01	3.9E-01	N/A	1.2E+00
			Total		8.0E-01	3.9E-01	N/A	1.2E+00
		Exposure Point Total						1.2E+00
	Exposure Medium Total							1.2E+00
Medium Total								1.2E+00
Soil	Surface and Subsurface Soil	OU2 Surface and Subsurface Soil (0 - 6 feet)	Arsenic	Skin	3.5E-02	5.6E-03	2.6E-02	6.7E-02
			Total		3.5E-02	5.6E-03	2.6E-02	6.7E-02
		Exposure Point Total						6.7E-02
	Exposure Medium Total							6.7E-02
Medium Total								6.7E-02
OU2 Groundwater	Groundwater	OU2 Groundwater	Arsenic	Skin	N/A	5.1E-01	N/A	5.1E-01
			Total		N/A	5.1E-01	N/A	5.1E-01
		Exposure Point Total						5.1E-01
	Exposure Medium Total							5.1E-01
Medium Total								5.1E-01
Receptor Total							Total Hazard Index (HI) Across All Media =	2E+00

TABLE 10.1 B
RISK DRIVER SUMMARY OF RECEPTOR RISKS AND HAZARDS
REASONABLE MAXIMUM EXPOSURE
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult (>18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient: Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Arsenic	Skin	1.9E-01	9.3E-02	N/A	2.9E-01
			Total		1.9E-01	9.3E-02	N/A	2.9E-01
		Exposure Point Total						2.9E-01
	Exposure Medium Total							2.9E-01
Medium Total								2.9E-01
Soil	Surface and Subsurface Soil	OU2 Surface and Subsurface Soil (0 - 6 feet)	Arsenic	Skin	3.5E-02	5.6E-03	2.6E-02	6.7E-02
			Total		3.5E-02	5.6E-03	2.6E-02	6.7E-02
		Exposure Point Total						6.7E-02
	Exposure Medium Total							6.7E-02
Medium Total								6.7E-02
OU2 Groundwater	Groundwater	OU2 Groundwater	Arsenic	Skin	N/A	5.1E-01	N/A	5.1E-01
			Total		N/A	5.1E-01	N/A	5.1E-01
		Exposure Point Total						5.1E-01
	Exposure Medium Total							5.1E-01
Medium Total								5.1E-01
Receptor Total							Total Hazard Index (HI) Across All Media =	9E-01

TABLE 10.2 A

RISK DRIVER SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult (>18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Arsenic	Skin	3.9E-01	3.5E-01	N/A	7.4E-01
			Total		3.9E-01	3.5E-01	N/A	7.4E-01
		Exposure Point Total						7.4E-01
	Exposure Medium Total							7.4E-01
Medium Total								7.4E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Arsenic	Skin	2.6E-02	5.5E-03	8.5E-05	3.1E-02
			Total		2.6E-02	5.5E-03	8.5E-05	3.1E-02
		Exposure Point Total						3.1E-02
	Exposure Medium Total							3.1E-02
Medium Total								3.1E-02
Surface Water	Surface water	OU2 Surface water	Arsenic	Skin	9.4E-03	1.5E-02	N/A	2.5E-02
			Total		9.4E-03	1.5E-02	N/A	2.5E-02
		Exposure Point Total						2.5E-02
	Exposure Medium Total							2.5E-02
Medium Total								2.5E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	8E-01

TABLE 10.2 A

RISK DRIVER SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult (>18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient: Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Arsenic	Skin	9.3E-02	8.5E-02	N/A	1.8E-01
			Total		9.3E-02	8.5E-02	N/A	1.8E-01
		Exposure Point Total						1.8E-01
	Exposure Medium Total							1.8E-01
Medium Total								1.8E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Arsenic	Skin	2.6E-02	5.5E-03	8.5E-05	3.1E-02
			Total		2.6E-02	5.5E-03	8.5E-05	3.1E-02
		Exposure Point Total						3.1E-02
	Exposure Medium Total							3.1E-02
Medium Total								3.1E-02
Surface Water	Surface water	OU2 Surface water	Arsenic	Skin	9.4E-03	1.5E-02	N/A	2.5E-02
			Total		9.4E-03	1.5E-02	N/A	2.5E-02
		Exposure Point Total						2.5E-02
	Exposure Medium Total							2.5E-02
Medium Total								2.5E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	2E-01

TABLE 10.3 A

RISK DRIVER SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Arsenic	Skin	6.5E-01	5.2E-01	N/A	1.2E+00
			Total		6.5E-01	5.2E-01	N/A	1.2E+00
		Exposure Point Total						1.2E+00
	Exposure Medium Total							1.2E+00
Medium Total								1.2E+00
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Arsenic	Skin	4.3E-02	2.3E-02	8.5E-05	6.7E-02
			Total		4.3E-02	2.3E-02	8.5E-05	6.7E-02
		Exposure Point Total						6.7E-02
	Exposure Medium Total							6.7E-02
Medium Total								6.7E-02
Surface Water	Surface water	OU2 Surface water	Arsenic	Skin	1.6E-02	2.3E-02	N/A	3.8E-02
			Total		1.6E-02	2.3E-02	N/A	3.8E-02
		Exposure Point Total						3.8E-02
	Exposure Medium Total							3.8E-02
Medium Total								3.8E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	1E+00

TABLE 10.3 B

RISK DRIVER SUMMARY OF RECEPTOR RISKS AND HAZARDS

REASONABLE MAXIMUM EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Arsenic	Skin	1.6E-01	1.3E-01	N/A	2.8E-01
			Total		1.6E-01	1.3E-01	N/A	2.8E-01
		Exposure Point Total						2.8E-01
	Exposure Medium Total							2.8E-01
Medium Total								2.8E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Arsenic	Skin	4.3E-02	2.3E-02	8.5E-05	6.7E-02
			Total		4.3E-02	2.3E-02	8.5E-05	6.7E-02
		Exposure Point Total						6.7E-02
	Exposure Medium Total							6.7E-02
Medium Total								6.7E-02
Surface Water	Surface water	OU2 Surface water	Arsenic	Skin	1.6E-02	2.3E-02	N/A	3.8E-02
			Total		1.6E-02	2.3E-02	N/A	3.8E-02
		Exposure Point Total						3.8E-02
	Exposure Medium Total							3.8E-02
Medium Total								3.8E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	4E-01

ATTACHMENT 3 LEAD RISK MODELING

Attachment 3, Table 1
(RAGS D ADULT LEAD WORKSHEET)

Site Name: USS Lead Superfund Site
Receptor: Adult Utility Worker, Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration usedin Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Surface and Subsurface Soil (0 – 6’)	250.5	mg/kg	Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution	800	mg/kg	Recommended Soil Screening Level

2. Lead Model Questions

Question	Response
What lead model was used? Provide reference and version	Adult Model associated with EPA-540-R-03-001; Version date 06/14/2017
If the EPA Adult Lead Model (ALM) was not used provide rationale for model selected.	N/A
Where are the input values located in the risk assessment report?	Attachment 2, Table 4.1
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean concentration from Attachment 2, Table 3.1
What was the point of exposure and location?	OU2 Surface and Subsurface Soil (0 - 6 feet)
Where are the output values located in the risk assessment report?	Located in Attachment 3
What GSD value was used? (GSD from Analysis of NHANES 2009-2014)	1.8
What baseline blood lead concentration (PbB0) value was used? (PbBo from Analysis of NHANES 2009-2014)	0.6
Was the default exposure frequency (EF; 219 days/year) used?	No; 25 days/year used
Was the default BKSF used (0.4 ug/dL per ug/day) used?	Yes
Was the default absorption fraction (AF; 0.12) used?	Yes
Was the default soil ingestion rate (IR; 50 mg/day) used?	No; 330 mg/day used
If non-default values were used for any of the parameters listed above, where are the rationale for the values located in the risk assessment report?	Section 5.5.2.3 and 5.5.2.6

3. Final Result

Medium	Result	Comment/RBRG [1]
Surface and Subsurface Soil (0 – 6’)	Input value of 250.5 ppm in soil results in a probability of 0.08% of fetuses of exposed women predicted to have a blood lead level above 5 ug/dL. The 95th percentile PbB among fetuses of adult workers = 2.1 ug/dL.	Based on Site conditions, a RBRG calculation is not necessary.

1. RBRG = risk-based remedial goal
Attach the ALM spreadsheet output file

Attachment 3, Table 2
(RAGS D ADULT LEAD WORKSHEET)

Site Name: USS Lead Superfund Site
Receptor: Adult Utility Worker, Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration usedin Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Sediment (0 - 2 feet Discrete)	640.5	mg/kg	Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution	800	mg/kg	Recommended Soil Screening Level

2. Lead Model Questions

Question	Response
What lead model was used? Provide reference and version	Adult Model associated with EPA-540-R-03-001; Version date 06/14/2017
If the EPA Adult Lead Model (ALM) was not used provide rationale for model selected.	N/A
Where are the input values located in the risk assessment report?	Attachment 2, Table 4.2
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean concentration from Attachment 2, Table 3.2
What was the point of exposure and location?	OU2 Sediment (0 - 2 feet Discrete)
Where are the output values located in the risk assessment report?	Located in Attachment 3
What GSD value was used? (GSD from Analysis of NHANES 2009-2014)	1.8
What baseline blood lead concentration (PbB0) value was used? (PbBo from Analysis of NHANES 2009-2014)	0.6
Was the default exposure frequency (EF; 219 days/year) used?	No; 25 days/year used
Was the default BKSF used (0.4 ug/dL per ug/day) used?	Yes
Was the default absorption fraction (AF; 0.12) used?	Yes
Was the default soil ingestion rate (IR; 50 mg/day) used?	No; 330 mg/day used
If non-default values were used for any of the parameters listed above, where are the rationale for the values located in the risk assessment report?	Section 5.5.2.3 and 5.5.2.6

3. Final Result

Medium	Result	Comment/RBRG [1]
Sediment (0 – 2' Discrete)	Input value of 640.5 ppm in soil results in a probability of 0.66% of fetuses of exposed women predicted to have a blood lead level above 5 ug/dL. The 95th percentile PbB among fetuses of adult workers = 3.1 ug/dL.	Based on Site conditions, a RBRG calculation is not necessary.

1. RBRG = risk-based remedial goal
Attach the ALM spreadsheet output file

Attachment 3, Table 3
(RAGS D ADULT LEAD WORKSHEET)

Site Name: USS Lead Superfund Site
Receptor: Adult Utility Worker, Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration usedin Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Sediment (0 – 0.5 feet ISM)	776.4	mg/kg	Arithmetic Mean	800	mg/kg	Recommended Soil Screening Level

2. Lead Model Questions

Question	Response
What lead model was used? Provide reference and version	Adult Model associated with EPA-540-R-03-001; Version date 06/14/2017
If the EPA Adult Lead Model (ALM) was not used provide rationale for model selected.	N/A
Where are the input values located in the risk assessment report?	Attachment 2, Table 4.2
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Arithmetic mean concentration from Attachment 2, Table 3.2
What was the point of exposure and location?	OU2 Sediment (0 – 0.5 feet ISM)
Where are the output values located in the risk assessment report?	Located in Attachment 3
What GSD value was used? (GSD from Analysis of NHANES 2009-2014)	1.8
What baseline blood lead concentration (PbB0) value was used? (PbBo from Analysis of NHANES 2009-2014)	0.6
Was the default exposure frequency (EF; 219 days/year) used?	No; 25 days/year used
Was the default BKSF used (0.4 ug/dL per ug/day) used?	Yes
Was the default absorption fraction (AF; 0.12) used?	Yes
Was the default soil ingestion rate (IR; 50 mg/day) used?	No; 330 mg/day used
If non-default values were used for any of the parameters listed above, where are the rationale for the values located in the risk assessment report?	Section 5.5.2.3 and 5.5.2.6

3. Final Result

Medium	Result	Comment/RBRG [1]
Sediment (0 – 0.5' ISM)	Input value of 776.4 ppm in soil results in a probability of 1.1% of fetuses of exposed women predicted to have a blood lead level above 5 ug/dL. The 95th percentile PbB among fetuses of adult workers = 3.4 ug/dL.	Based on Site conditions, a RBRG calculation is not necessary.

1. RBRG = risk-based remedial goal
Attach the ALM spreadsheet output file

Attachment 3, Table 4
(RAGS D ADULT LEAD WORKSHEET)

Site Name: USS Lead Superfund Site
Receptor: Adult O&M Worker, Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration usedin Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Surface Soil (0 – 2’)	262.1	mg/kg	Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution	800	mg/kg	Recommended Soil Screening Level

2. Lead Model Questions

Question	Response
What lead model was used? Provide reference and version	Adult Model associated with EPA-540-R-03-001; Version date 06/14/2017
If the EPA Adult Lead Model (ALM) was not used provide rationale for model selected.	N/A
Where are the input values located in the risk assessment report?	Attachment 2, Table 4.5
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean concentration from Attachment 2, Table 3.1
What was the point of exposure and location?	OU2 Surface Soil (0 - 2 feet)
Where are the output values located in the risk assessment report?	Located in Attachment 3
What GSD value was used? (GSD from Analysis of NHANES 2009-2014)	1.8
What baseline blood lead concentration (PbB0) value was used? (PbBo from Analysis of NHANES 2009-2014)	0.6
Was the default exposure frequency (EF; 219 days/year) used?	No; 21 days/year used
Was the default BKSF used (0.4 ug/dL per ug/day) used?	Yes
Was the default absorption fraction (AF; 0.12) used?	Yes
Was the default soil ingestion rate (IR; 50 mg/day) used?	No; 100 mg/day used
If non-default values were used for any of the parameters listed above, where are the rationale for the values located in the risk assessment report?	Section 5.5.2.3 and 5.5.2.6

3. Final Result

Medium	Result	Comment/RBRG [1]
Surface Soil (0 – 2’)	Input value of 262.1 ppm in soil results in a probability of 0.02% of fetuses of exposed women predicted to have a blood lead level above 5 ug/dL. The 95th percentile PbB among fetuses of adult workers = 1.6 ug/dL.	Based on Site conditions, a RBRG calculation is not necessary.

1. RBRG = risk-based remedial goal
Attach the ALM spreadsheet output file

Attachment 3, Table 5
(RAGS D ADULT LEAD WORKSHEET)

Site Name: USS Lead Superfund Site
Receptor: Adult/Adolescent Trespasser, Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration usedin Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Surface Soil (0 – 2')	262.1	mg/kg	Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution	800	mg/kg	Recommended Soil Screening Level

2. Lead Model Questions

Question	Response
What lead model was used? Provide reference and version	Adult Model associated with EPA-540-R-03-001; Version date 06/14/2017
If the EPA Adult Lead Model (ALM) was not used provide rationale for model selected.	N/A
Where are the input values located in the risk assessment report?	Attachment 2, Table 4.6, Table 4.9
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean concentration from Attachment 2, Table 3.1
What was the point of exposure and location?	OU2 Surface Soil (0 - 2 feet)
Where are the output values located in the risk assessment report?	Located in Attachment 3
What GSD value was used? (GSD from Analysis of NHANES 2009-2014)	1.8
What baseline blood lead concentration (PbB0) value was used? (PbBo from Analysis of NHANES 2009-2014)	0.6
Was the default exposure frequency (EF; 219 days/year) used?	No; 40 days/year used
Was the default BKSF used (0.4 ug/dL per ug/day) used?	Yes
Was the default absorption fraction (AF; 0.12) used?	Yes
Was the default soil ingestion rate (IR; 50 mg/day) used?	No; 100 mg/day used
If non-default values were used for any of the parameters listed above, where are the rationale for the values located in the risk assessment report?	Section 5.5.2.3 and 5.5.2.6

3. Final Result

Medium	Result	Comment/RBRG [1]
Surface Soil (0 – 2')	Input value of 262.1 ppm in soil results in a probability of 0.03% of fetuses of exposed women predicted to have a blood lead level above 5 ug/dL. The 95th percentile PbB among fetuses of adult workers = 1.7 ug/dL.	Based on Site conditions, a RBRG calculation is not necessary.

1. RBRG = risk-based remedial goal
Attach the ALM spreadsheet output file

Attachment 3, Table 6
(RAGS D ADULT LEAD WORKSHEET)

Site Name: USS Lead Superfund Site
Receptor: Adult/Adolescent Trespasser, Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration usedin Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Sediment (0 - 2 feet Discrete)	640.5	mg/kg	Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution	800	mg/kg	Recommended Soil Screening Level

2. Lead Model Questions

Question	Response
What lead model was used? Provide reference and version	Adult Model associated with EPA-540-R-03-001; Version date 06/14/2017
If the EPA Adult Lead Model (ALM) was not used provide rationale for model selected.	N/A
Where are the input values located in the risk assessment report?	Attachment 2, Table 4.7, Table 4.10
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean concentration from Attachment 2, Table 3.2
What was the point of exposure and location?	OU2 Sediment (0 - 2 feet Discrete)
Where are the output values located in the risk assessment report?	Located in Attachment 3
What GSD value was used? (GSD from Analysis of NHANES 2009-2014)	1.8
What baseline blood lead concentration (PbB0) value was used? (PbBo from Analysis of NHANES 2009-2014)	0.6
Was the default exposure frequency (EF; 219 days/year) used?	No; 40 days/year used
Was the default BKSF used (0.4 ug/dL per ug/day) used?	Yes
Was the default absorption fraction (AF; 0.12) used?	Yes
Was the default soil ingestion rate (IR; 50 mg/day) used?	No; 100 mg/day used
If non-default values were used for any of the parameters listed above, where are the rationale for the values located in the risk assessment report?	Section 5.5.2.3 and 5.5.2.6

3. Final Result

Medium	Result	Comment/RBRG [1]
Sediment (0 – 2' Discrete)	Input value of 640.5 ppm in soil results in a probability of 0.12% of fetuses of exposed women predicted to have a blood lead level above 5 ug/dL. The 95th percentile PbB among fetuses of adult workers = 2.2 ug/dL.	Based on Site conditions, a RBRG calculation is not necessary.

1. RBRG = risk-based remedial goal
Attach the ALM spreadsheet output file

Attachment 3, Table 7
(RAGS D ADULT LEAD WORKSHEET)

Site Name: USS Lead Superfund Site
Receptor: Adult/Adolescent Trespasser, Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration usedin Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
Sediment (0 – 0.5 feet ISM)	776.4	mg/kg	Arithmetic mean	800	mg/kg	Recommended Soil Screening Level

2. Lead Model Questions

Question	Response
What lead model was used? Provide reference and version	Adult Model associated with EPA-540-R-03-001; Version date 06/14/2017
If the EPA Adult Lead Model (ALM) was not used provide rationale for model selected.	N/A
Where are the input values located in the risk assessment report?	Attachment 2, Table 4.7, Table 4.10
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Arithmetic mean concentration from Attachment 2, Table 3.2
What was the point of exposure and location?	OU2 Sediment (0 – 0.5 feet ISM)
Where are the output values located in the risk assessment report?	Located in Attachment 3
What GSD value was used? (GSD from Analysis of NHANES 2009-2014)	1.8
What baseline blood lead concentration (PbB0) value was used? (PbBo from Analysis of NHANES 2009-2014)	0.6
Was the default exposure frequency (EF; 219 days/year) used?	No; 40 days/year used
Was the default BKSF used (0.4 ug/dL per ug/day) used?	Yes
Was the default absorption fraction (AF; 0.12) used?	Yes
Was the default soil ingestion rate (IR; 50 mg/day) used?	No; 100 mg/day used
If non-default values were used for any of the parameters listed above, where are the rationale for the values located in the risk assessment report?	Section 5.5.2.3 and 5.5.2.6

3. Final Result

Medium	Result	Comment/RBRG [1]
Sediment (0 – 0.5' ISM)	Input value of 776.4 ppm in soil results in a probability of 0.18% of fetuses of exposed women predicted to have a blood lead level above 5 ug/dL. The 95th percentile PbB among fetuses of adult workers = 2.4 ug/dL.	Based on Site conditions, a RBRG calculation is not necessary.

1. RBRG = risk-based remedial goal
Attach the ALM spreadsheet output file

Attachment 3, Table 8
(RAGS D IEUBK LEAD WORKSHEET)
Site Name: USS Lead Superfund Site
Receptor: Young Child (0 to 6 years) Resident Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration Used in Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead Screening Level
	Value	Units		Value	Units	
OU1 Z1 Groundwater Seeps in Basements	16.7	ug/L	Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution	N/A	ug/L	N/A

2. Lead Model Questions

Question	Response for Residential Lead Model
What lead model (version and date) was used?	IEUBK Model Version 2.0, Build 1.66 (May 2021)
Where are the input values located in the risk assessment report?	Located in Attachment 2, Table 3.5, Table 4.14
What range of media concentrations were used for the model?	Model defaults were used for all media concentrations other than groundwater
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean concentrations from Attachment 2, Table 3.5
Was soil sample taken from top 2 cm? If not, why?	N/A
Was soil sample sieved? What size screen was used? If not sieved, provide rationale.	N/A
What was the point of exposure/location?	OU1 Z1 Groundwater Seeps in Basements
Where are the output values located in the risk assessment report?	Located in Attachment 3
Was the model run using default values only?	No; Water consumption in L/day was modified to reflect incidental ingestion of groundwater seeping into OU1 residential basements
Was the default soil bioavailability used?	Yes
Was the default soil ingestion rate used?	Yes
If non-default values were used, where are the rationale for the values located in the risk assessment report?	Located in Attachment 3, Table 4.14

3. Final Result

Medium	Result	Comment/PRG [1]
OU1 Z1 Groundwater Seeps in Basements	Input value of 16.7 ug/L in groundwater seep results in 4.656% of young children above a blood lead level of 5 ug/dL. Geometric meanblood lead = 2.271 ug/dL. This meets the blood lead goal of no more than 5% ofchildren exceeding 5 ug/dL blood lead.	Based on site conditions, a PRG calculation is not necessary.

1. PRG = preliminary remediation goal
Attach the IEUBK text output file and graph.

Attachment 3, Table 9
(RAGS D IEUBK LEAD WORKSHEET)
Site Name: USS Lead Superfund Site
Receptor: Young Child (0 to 6 years) Resident Exposure to Media as Described

1. Lead Screening Questions

Medium	Lead Concentration Used in Model Run		Basis for Lead Concentration Used For Model Run	Lead Screening Concentration		Basis for Lead ScreeningLevel
	Value	Units		Value	Units	
OU1 Z2-3 Groundwater Seeps in Basements	8.826	ug/L	Mean calculated by ProUCL (Version 5.1.002) for the identified data distribution	N/A	ug/L	N/A

2. Lead Model Questions

Question	Response for Residential Lead Model
What lead model (version and date) was used?	IEUBK Model Version 2.0, Build 1.66 (May 2021)
Where are the input values located in the risk assessment report?	Located in Attachment 2, Table 3.5, Table 4.14
What range of media concentrations were used for the model?	Model defaults were used for all media concentrations other than groundwater
What statistics were used to represent the exposure concentration terms and where are the data on concentrations in the risk assessment that support use of these statistics?	Mean concentrations from Attachment 2, Table 3.5
Was soil sample taken from top 2 cm? If not, why?	N/A
Was soil sample sieved? What size screen was used? If not sieved, provide rationale.	N/A
What was the point of exposure/location?	OU1 Z2-3 Groundwater Seeps in Basements
Where are the output values located in the risk assessment report?	Located in Attachment 3
Was the model run using default values only?	No; Water consumption in L/day was modified to reflect incidental ingestion of groundwater seeping into OU1 residential basements
Was the default soil bioavailability used?	Yes
Was the default soil ingestion rate used?	Yes
If non-default values were used, where are the rationale for the values located in the risk assessment report?	Located in Attachment 3, Table 4.14

3. Final Result

Medium	Result	Comment/PRG [1]
OU1 Z2-3 Groundwater Seeps in Basements	Input value of 8.826 ug/L in groundwater seep results in 4.480% of young children above a blood lead level of 5 ug/dL. Geometric meanblood lead = 2.251 ug/dL. This meets the blood lead goal of no more than 5% ofchildren exceeding 5 ug/dL blood lead.	Based on site conditions, a PRG calculation is not necessary.

1. PRG = preliminary remediation goal
Attach the IEUBK text output file and graph.

OU2 Utility Worker
Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead
Version date 06/14/2017

Variable	Description of Variable	Units	OU2 Soil (0 - 6 feet) GSDi and PbBo from Analysis of NHANES 2009-2014	OU2 Sediment (0 - 2 feet DISCRETE) GSDi and PbBo from Analysis of NHANES 2009-2014	OU2 Sediment (0 - 0.5 feet ISM) GSDi and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	250.5	640.5	776.4
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.8	1.8
PbB_0	Baseline PbB	µg/dL	0.6	0.6	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.330	0.330	0.330
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	--
K_{SD}	Mass fraction of soil in dust	--	--	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	25	25	25
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	365	365
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	0.9	1.3	1.4
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	2.1	3.1	3.4
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**5.0**	**5.0**	**5.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**0.08%**	**0.66%**	**1.1%**

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

OU2 O&M Worker

Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas

U.S. EPA Technical Review Workgroup for Lead

Version date 06/14/2017

OU2 Soil (0 - 2 feet)

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	262.1
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4
GSD_i	Geometric standard deviation PbB	--	1.8
PbB_0	Baseline PbB	µg/dL	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--
K_{SD}	Mass fraction of soil in dust	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	21
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	0.7
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	1.6
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**5.0**
P(PbB_{fetal} > PbB_t)	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	%	**0.02%**

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

OU2 Adult/Adolescent Trespasser
Calculations of Blood Lead Concentrations (PbBs) and Risk in Nonresidential Areas
U.S. EPA Technical Review Workgroup for Lead
Version date 06/14/2017

Variable	Description of Variable	Units	OU2 Soil (0 - 2 feet) GSDi and PbBo from Analysis of NHANES 2009-2014	OU2 Sediment (0 - 2 feet DISCRETE) GSDi and PbBo from Analysis of NHANES 2009-2014	OU2 Sediment (0 - 0.5 feet ISM) GSDi and PbBo from Analysis of NHANES 2009-2014
PbS	Soil lead concentration	µg/g or ppm	262.1	640.5	776.4
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	µg/dL per µg/day	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	1.8	1.8	1.8
PbB_0	Baseline PbB	µg/dL	0.6	0.6	0.6
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	0.100	0.100
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	--
K_{SD}	Mass fraction of soil in dust	--	--	--	--
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	40	40	40
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	365	365
PbB_{adult}	PbB of adult worker, geometric mean	µg/dL	0.7	0.9	1.0
$PbB_{fetal, 0.95}$	95th percentile PbB among fetuses of adult workers	µg/dL	1.7	2.2	2.4
PbB_t	Target PbB level of concern (e.g., 2-8 ug/dL)	µg/dL	**5.0**	**5.0**	**5.0**
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB exceeds target PbB, assuming lognormal distribution**	**%**	**0.03%**	**0.12%**	**0.18%**

Source: U.S. EPA (1996). Recommendations of the Technical Review Workgroup for Lead for an Interim Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil

LEAD MODEL FOR WINDOWS Version 2.0

These IEUBK Model results are valid as long as they were produced with an official, unmodified version of the IEUBK Model with a software certificate.

While IEUBK Model output is generally written with three digits to the right of the decimal point, the true precision of the output is strongly influenced by least precise input values.

==
Model Version: 2.0 Build1
User Name:
Date:
Site Name:
Operable Unit:
Run Mode: Research
==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Month	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
6-12	1.000	3.216	32.000	0.100
12-24	2.000	4.970	32.000	0.100
24-36	3.000	6.086	32.000	0.100
36-48	4.000	6.954	32.000	0.100
48-60	4.000	7.682	32.000	0.100
60-72	4.000	8.318	32.000	0.100
72-84	4.000	8.887	32.000	0.100

****** Diet ******

Month	Diet Intake(µg/day)
6-12	2.660
12-24	5.030
24-36	5.210
36-48	5.380
48-60	5.640
60-72	6.040
72-84	5.950

****** Drinking Water ******

Water Consumption:

Month	Water (L/day)
6-12	0.015
12-24	0.015
24-36	0.015
36-48	0.015
48-60	0.015
60-72	0.015
72-84	0.015

Drinking Water Concentration: 16.700 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 150.000 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Month	Soil (µg Pb/g)	House Dust (µg Pb/g)
6-12	200.000	150.000
12-24	200.000	150.000
24-36	200.000	150.000
36-48	200.000	150.000
48-60	200.000	150.000
60-72	200.000	150.000
72-84	200.000	150.000

******** Alternate Intake ********

Month	Alternate (µg Pb/day)
6-12	0.000
12-24	0.000
24-36	0.000
36-48	0.000
48-60	0.000
60-72	0.000
72-84	0.000

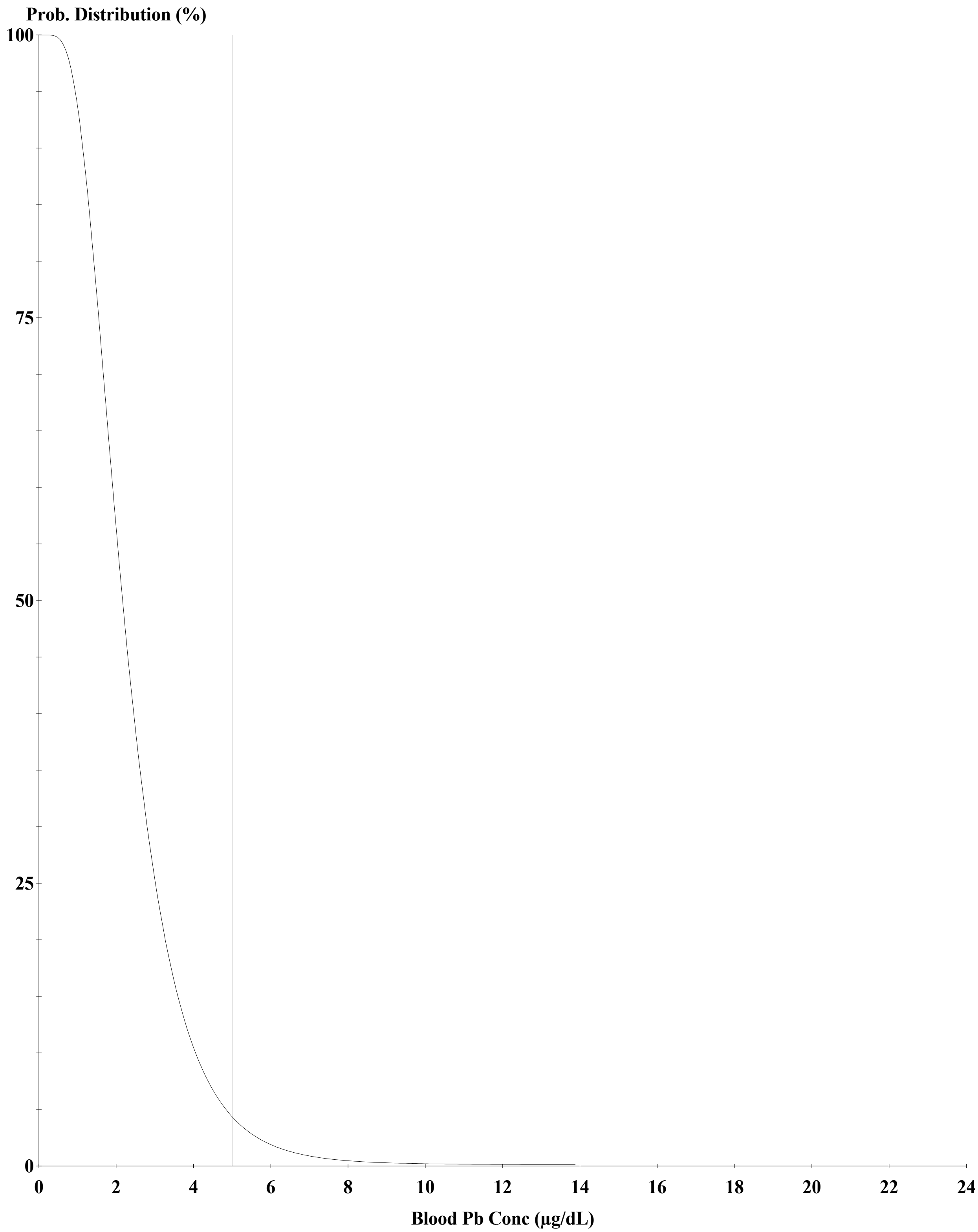
******** Maternal Contribution: Infant Model ********

Maternal Blood Concentration: 0.600 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Month	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
6-12	0.034	1.249	0.000	0.116
12-24	0.057	2.364	0.000	0.116
24-36	0.075	2.493	0.000	0.118
36-48	0.093	2.592	0.000	0.119
48-60	0.102	2.726	0.000	0.119
60-72	0.111	2.938	0.000	0.120
72-84	0.118	2.899	0.000	0.120

Month	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
6-12	4.178	5.577	3.0
12-24	4.573	7.110	3.0
24-36	3.318	6.005	2.4
36-48	3.142	5.946	2.1
48-60	3.352	6.300	2.0
60-72	2.618	5.787	1.9
72-84	2.774	5.912	1.7



Cutoff = 5.000 µg/dl
Geo Mean = 2.271
GSD = 1.600
% Above = 4.656

Age Range = 0 to 84 months

Run Mode = Research

These IEUBK Model results are valid as long as they were produced with an official, unmodified version of the IEUBK Model with a softw
While IEUBK Model output is generally written with three digits to the right of the decimal point, the true precision of the output is strong

LEAD MODEL FOR WINDOWS Version 2.0

These IEUBK Model results are valid as long as they were produced with an official, unmodified version of the IEUBK Model with a software certificate.

While IEUBK Model output is generally written with three digits to the right of the decimal point, the true precision of the output is strongly influenced by least precise input values.

==

Model Version: 2.0 Build1
User Name:
Date:
Site Name:
Operable Unit:
Run Mode: Research

==

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Month	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
6-12	1.000	3.216	32.000	0.100
12-24	2.000	4.970	32.000	0.100
24-36	3.000	6.086	32.000	0.100
36-48	4.000	6.954	32.000	0.100
48-60	4.000	7.682	32.000	0.100
60-72	4.000	8.318	32.000	0.100
72-84	4.000	8.887	32.000	0.100

****** Diet ******

Month	Diet Intake(µg/day)
6-12	2.660
12-24	5.030
24-36	5.210
36-48	5.380
48-60	5.640
60-72	6.040
72-84	5.950

****** Drinking Water ******

Water Consumption:

Month	Water (L/day)
6-12	0.015
12-24	0.015
24-36	0.015
36-48	0.015
48-60	0.015
60-72	0.015
72-84	0.015

Drinking Water Concentration: 8.826 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 150.000 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Month	Soil (µg Pb/g)	House Dust (µg Pb/g)
6-12	200.000	150.000
12-24	200.000	150.000
24-36	200.000	150.000
36-48	200.000	150.000
48-60	200.000	150.000
60-72	200.000	150.000
72-84	200.000	150.000

****** Alternate Intake ******

Month	Alternate (µg Pb/day)
6-12	0.000
12-24	0.000
24-36	0.000
36-48	0.000
48-60	0.000
60-72	0.000
72-84	0.000

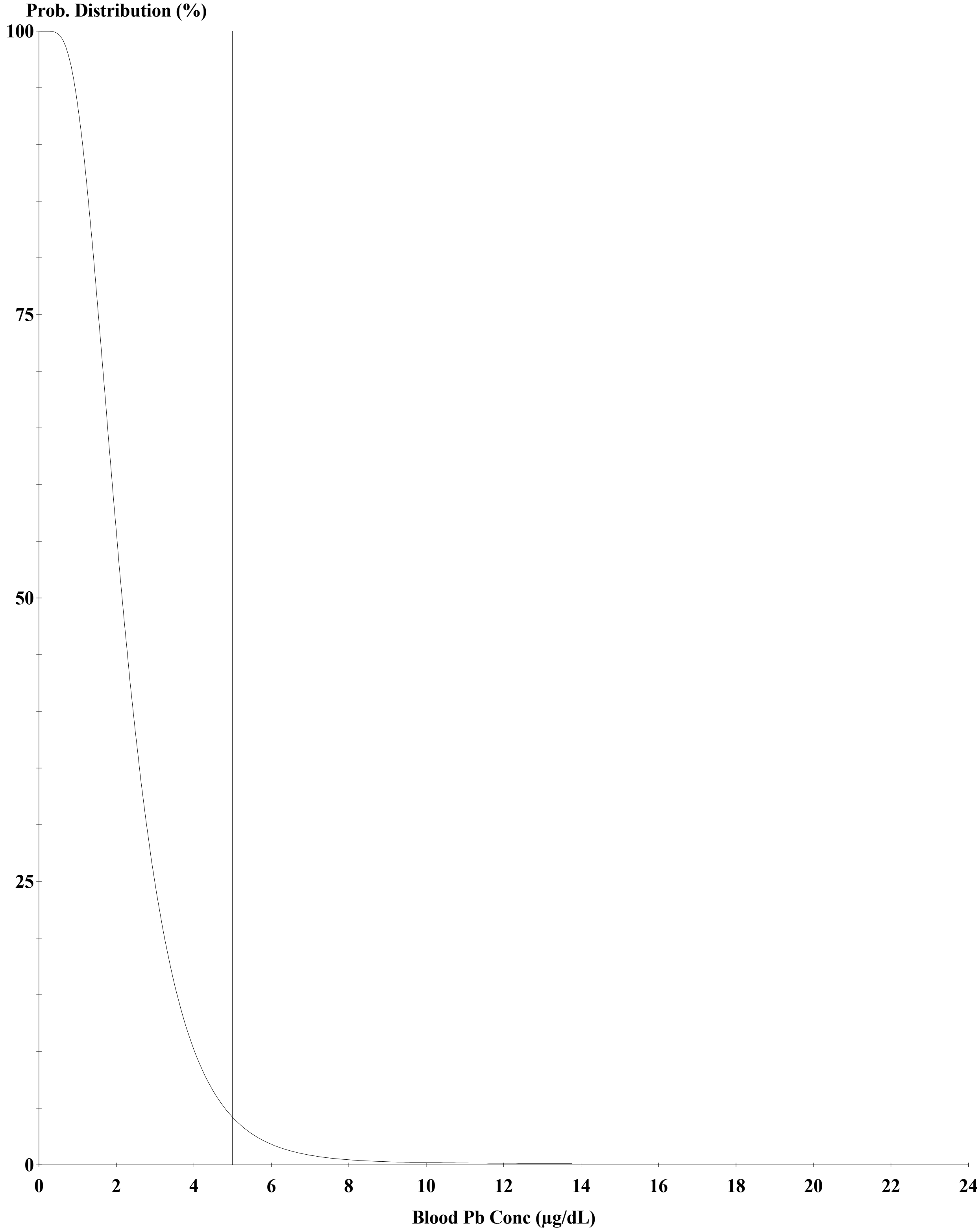
****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 0.600 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Month	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
6-12	0.034	1.249	0.000	0.061
12-24	0.057	2.365	0.000	0.061
24-36	0.075	2.494	0.000	0.063
36-48	0.093	2.593	0.000	0.063
48-60	0.102	2.727	0.000	0.063
60-72	0.111	2.939	0.000	0.064
72-84	0.118	2.900	0.000	0.064

Month	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
6-12	4.181	5.525	3.0
12-24	4.575	7.059	3.0
24-36	3.319	5.951	2.4
36-48	3.143	5.891	2.1
48-60	3.353	6.245	2.0
60-72	2.619	5.732	1.8
72-84	2.775	5.857	1.7



Cutoff = 5.000 µg/dl
Geo Mean = 2.251
GSD = 1.600
% Above = 4.480

Age Range = 0 to 84 months

Run Mode = Research

These IEUBK Model results are valid as long as they were produced with an official, unmodified version of the IEUBK Model with a softw
While IEUBK Model output is generally written with three digits to the right of the decimal point, the true precision of the output is strong

ATTACHMENT 4 RAGS PART D TABLES, CENTRAL TENDENCY EXPOSURE

TABLE 9.1 A
CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS
CENTRAL TENDENCY EXPOSURE
USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Antimony	Longevity, Blood	8.8E-02	0.0E+00	N/A	8.8E-02
			Arsenic	Skin	2.8E-01	1.3E-01	N/A	4.1E-01
			Cadmium	Kidney	4.7E-03	0.0E+00	N/A	4.7E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	5.6E-04	0.0E+00	N/A	5.6E-04
			Total		3.7E-01	1.3E-01	N/A	5.0E-01
		Exposure Point Total						5.0E-01
	Exposure Medium Total							5.0E-01
Medium Total								5.0E-01
Soil	Surface and Subsurface Soil	OU2 Surface and Subsurface Soil (0 - 6 feet)	Antimony	Longevity, Blood	1.8E-02	0.0E+00	5.3E-04	1.8E-02
			Arsenic	Skin	2.4E-02	3.8E-03	1.8E-02	4.5E-02
			Cadmium	Kidney	3.6E-03	4.6E-04	8.0E-03	1.2E-02
			Lead	Developmental	- -	- -	- -	--
			Selenium	Selenosis	3.7E-05	0.0E+00	2.1E-07	3.8E-05
			Total		4.5E-02	4.3E-03	2.6E-02	7.6E-02
		Exposure Point Total						7.6E-02
	Exposure Medium Total							7.6E-02
Medium Total								7.6E-02
OU2 Groundwater	Groundwater	OU2 Groundwater	Antimony	Longevity, Blood	N/A	9.2E-03	N/A	9.2E-03
			Arsenic	Skin	N/A	7.3E-02	N/A	7.3E-02
			Cadmium	Kidney	N/A	1.4E-02	N/A	1.4E-02
			Lead	Developmental	N/A	- -	N/A	- -
			Selenium	Selenosis	N/A	4.3E-06	N/A	4.3E-06
			Total		N/A	9.6E-02	N/A	9.6E-02
		Exposure Point Total						9.6E-02
	Exposure Medium Total							9.6E-02
Medium Total								9.6E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	N/A	3.4E-03	N/A	3.4E-03
			Arsenic	Skin	N/A	2.8E-03	N/A	2.8E-03
			Cadmium	Kidney	N/A	4.1E-04	N/A	4.1E-04
			Lead	Developmental	N/A	- -	N/A	- -
			Selenium	Selenosis	N/A	1.1E-05	N/A	1.1E-05
			Total		N/A	6.6E-03	N/A	6.6E-03
		Exposure Point Total						6.6E-03
	Exposure Medium Total							6.6E-03
Medium Total								6.6E-03
Receptor Total							Total Hazard Index (HI) Across All Media =	7E-01

TABLE 9.1 B

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Future
Receptor Population:	Utility Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Antimony	Longevity, Blood	2.1E-02	0.0E+00	N/A	2.1E-02
			Arsenic	Skin	1.8E-01	8.7E-02	N/A	2.7E-01
			Cadmium	Kidney	7.0E-03	0.0E+00	N/A	7.0E-03
			Lead	Developmental	- -	- -	N/A	0.0E+00
			Selenium	Selenosis	3.3E-04	0.0E+00	N/A	3.3E-04
			Total		2.1E-01	8.7E-02	N/A	3.0E-01
		Exposure Point Total						3.0E-01
	Exposure Medium Total							3.0E-01
Medium Total								3.0E-01
Soil	Surface and Subsurface Soil	OU2 Surface and Subsurface Soil (0 - 6 feet)	Antimony	Longevity, Blood	1.8E-02	0.0E+00	5.3E-04	1.8E-02
			Arsenic	Skin	2.4E-02	3.8E-03	1.8E-02	4.5E-02
			Cadmium	Kidney	3.6E-03	4.6E-04	8.0E-03	1.2E-02
			Lead	Developmental	- -	- -	- -	--
			Selenium	Selenosis	3.7E-05	0.0E+00	2.1E-07	3.8E-05
			Total		4.5E-02	4.3E-03	2.6E-02	7.6E-02
		Exposure Point Total						7.6E-02
	Exposure Medium Total							7.6E-02
Medium Total								7.6E-02
OU2 Groundwater	Groundwater	OU2 Groundwater	Antimony	Longevity, Blood	N/A	9.2E-03	N/A	9.2E-03
			Arsenic	Skin	N/A	7.3E-02	N/A	7.3E-02
			Cadmium	Kidney	N/A	1.4E-02	N/A	1.4E-02
			Lead	Developmental	N/A	- -	N/A	- -
			Selenium	Selenosis	N/A	4.3E-06	N/A	4.3E-06
			Total		N/A	9.6E-02	N/A	9.6E-02
		Exposure Point Total						9.6E-02
	Exposure Medium Total							9.6E-02
Medium Total								9.6E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	N/A	3.4E-03	N/A	3.4E-03
			Arsenic	Skin	N/A	2.8E-03	N/A	2.8E-03
			Cadmium	Kidney	N/A	4.1E-04	N/A	4.1E-04
			Lead	Developmental	N/A	- -	N/A	- -
			Selenium	Selenosis	N/A	1.1E-05	N/A	1.1E-05
			Total		N/A	6.6E-03	N/A	6.6E-03
		Exposure Point Total						6.6E-03
	Exposure Medium Total							6.6E-03
Medium Total								6.6E-03
Receptor Total							Total Hazard Index (HI) Across All Media =	5E-01

TABLE 9.2

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	O&M Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	5.4E-03	0.0E+00	1.4E-06	5.4E-03
			Arsenic	Skin	7.5E-03	1.6E-03	4.9E-05	9.1E-03
			Cadmium	Kidney	1.8E-04	3.0E-05	3.4E-06	2.1E-04
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	1.4E-05	0.0E+00	6.8E-10	1.4E-05
			Total		1.3E-02	1.6E-03	5.4E-05	1.5E-02
		Exposure Point Total						1.5E-02
	Exposure Medium Total							1.5E-02
Medium Total								1.5E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	1E-02

TABLE 9.3 A

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Antimony	Longevity, Blood	4.2E-02	0.0E+00	N/A	4.2E-02
			Arsenic	Skin	1.3E-01	1.2E-01	N/A	2.5E-01
			Cadmium	Kidney	2.3E-03	1.7E-03	N/A	3.9E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	2.7E-04	0.0E+00	N/A	2.7E-04
			Total		1.8E-01	1.2E-01	N/A	3.0E-01
		Exposure Point Total						3.0E-01
	Exposure Medium Total							3.0E-01
Medium Total								3.0E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	1.0E-02	0.0E+00	1.3E-06	1.0E-02
			Arsenic	Skin	1.4E-02	3.0E-03	4.6E-05	1.7E-02
			Cadmium	Kidney	3.3E-04	5.7E-05	3.3E-06	3.9E-04
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	2.7E-05	0.0E+00	6.5E-10	2.7E-05
			Total		2.5E-02	3.1E-03	5.1E-05	2.8E-02
		Exposure Point Total						2.8E-02
	Exposure Medium Total							2.8E-02
Medium Total								2.8E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	8.5E-04	9.2E-03	N/A	1.0E-02
			Arsenic	Skin	4.7E-03	7.7E-03	N/A	1.2E-02
			Cadmium	Kidney	3.4E-05	1.1E-03	N/A	1.1E-03
			Lead	Developmental	- -	NA	N/A	N/A
			Selenium	Selenosis	1.9E-05	3.0E-05	N/A	4.9E-05
			Total		--	1.8E-02	N/A	1.8E-02
		Exposure Point Total						1.8E-02
	Exposure Medium Total							1.8E-02
Medium Total								1.8E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	3E-01

TABLE 9.3 B

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Antimony	Longevity, Blood	1.0E-02	0.0E+00	N/A	1.0E-02
			Arsenic	Skin	8.8E-02	7.9E-02	N/A	1.7E-01
			Cadmium	Kidney	3.4E-03	2.4E-03	N/A	5.8E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	1.6E-04	0.0E+00	N/A	1.6E-04
			Total		1.0E-01	8.2E-02	N/A	1.8E-01
		Exposure Point Total						1.8E-01
	Exposure Medium Total							1.8E-01
Medium Total								1.8E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	1.0E-02	0.0E+00	1.3E-06	1.0E-02
			Arsenic	Skin	1.4E-02	3.0E-03	4.6E-05	1.7E-02
			Cadmium	Kidney	3.3E-04	5.7E-05	3.3E-06	3.9E-04
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	2.7E-05	0.0E+00	6.5E-10	2.7E-05
			Total		2.5E-02	3.1E-03	5.1E-05	2.8E-02
		Exposure Point Total						2.8E-02
	Exposure Medium Total							2.8E-02
Medium Total								2.8E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	8.5E-04	9.2E-03	N/A	1.0E-02
			Arsenic	Skin	4.7E-03	7.7E-03	N/A	1.2E-02
			Cadmium	Kidney	3.4E-05	1.1E-03	N/A	1.1E-03
			Lead	Developmental	- -	NA	N/A	N/A
			Selenium	Selenosis	1.9E-05	3.0E-05	N/A	4.9E-05
			Total		--	1.8E-02	N/A	1.8E-02
		Exposure Point Total						1.8E-02
	Exposure Medium Total							1.8E-02
Medium Total								1.8E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	2E-01

TABLE 9.4 A

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient: Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 2 feet) DISCRETE	Antimony	Longevity, Blood	7.1E-02	0.0E+00	N/A	7.1E-02
			Arsenic	Skin	2.2E-01	1.8E-01	N/A	4.0E-01
			Cadmium	Kidney	3.8E-03	2.5E-03	N/A	6.3E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	4.6E-04	0.0E+00	N/A	4.6E-04
			Total		3.0E-01	1.8E-01	N/A	4.8E-01
		Exposure Point Total						4.8E-01
	Exposure Medium Total							4.8E-01
Medium Total								4.8E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	1.7E-02	0.0E+00	1.3E-06	1.7E-02
			Arsenic	Skin	2.4E-02	1.3E-02	4.6E-05	3.7E-02
			Cadmium	Kidney	5.6E-04	2.4E-04	3.3E-06	8.1E-04
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	4.5E-05	0.0E+00	6.5E-10	4.5E-05
			Total		4.2E-02	1.3E-02	5.1E-05	5.5E-02
		Exposure Point Total						5.5E-02
	Exposure Medium Total							5.5E-02
Medium Total								5.5E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	1.4E-03	1.4E-02	N/A	1.5E-02
			Arsenic	Skin	7.9E-03	1.1E-02	N/A	1.9E-02
			Cadmium	Kidney	5.7E-05	1.6E-03	N/A	1.7E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	3.1E-05	4.5E-05	N/A	7.6E-05
			Total		9.4E-03	2.7E-02	N/A	3.6E-02
		Exposure Point Total						3.6E-02
	Exposure Medium Total							3.6E-02
Medium Total								3.6E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	6E-01

TABLE 9.4 B

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 2

Scenario Timeframe:	Current/Future
Receptor Population:	Trespasser
Receptor Age:	Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient: Ingestion	Dermal	Inhalation	Exposure Routes Total
Sediment	Surface Sediment	OU2 Surface Sediment (0 - 0.5 feet) ISM	Antimony	Longevity, Blood	1.7E-02	0.0E+00	N/A	1.7E-02
			Arsenic	Skin	1.5E-01	1.2E-01	N/A	2.6E-01
			Cadmium	Kidney	5.7E-03	3.6E-03	N/A	9.3E-03
			Lead	Developmental	- -	- -	N/A	0.0E+00
			Selenium	Selenosis	2.7E-04	0.0E+00	N/A	2.7E-04
			Total		1.7E-01	1.2E-01	N/A	2.9E-01
		Exposure Point Total						2.9E-01
	Exposure Medium Total							2.9E-01
Medium Total								2.9E-01
Soil	Surface Soil	OU2 Surface Soil (0 - 2 feet)	Antimony	Longevity, Blood	1.7E-02	0.0E+00	1.3E-06	1.7E-02
			Arsenic	Skin	2.4E-02	1.3E-02	4.6E-05	3.7E-02
			Cadmium	Kidney	5.6E-04	2.4E-04	3.3E-06	8.1E-04
			Lead	Developmental	- -	- -	- -	- -
			Selenium	Selenosis	4.5E-05	0.0E+00	6.5E-10	4.5E-05
			Total		4.2E-02	1.3E-02	5.1E-05	5.5E-02
		Exposure Point Total						5.5E-02
	Exposure Medium Total							5.5E-02
Medium Total								5.5E-02
Surface Water	Surface water	OU2 Surface water	Antimony	Longevity, Blood	1.4E-03	1.4E-02	N/A	1.5E-02
			Arsenic	Skin	7.9E-03	1.1E-02	N/A	1.9E-02
			Cadmium	Kidney	5.7E-05	1.6E-03	N/A	1.7E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	3.1E-05	4.5E-05	N/A	7.6E-05
			Total		9.4E-03	2.7E-02	N/A	3.6E-02
		Exposure Point Total						3.6E-02
	Exposure Medium Total							3.6E-02
Medium Total								3.6E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	4E-01

TABLE 9.5

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adult (>18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient			
					Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	Longevity, Blood	2.8E-03	4.0E-02	N/A	4.3E-02
			Arsenic	Skin	1.6E-03	3.4E-03	N/A	5.0E-03
			Cadmium	Kidney	9.7E-05	4.2E-03	N/A	4.3E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	1.4E-05	3.1E-05	N/A	4.5E-05
			Total		4.5E-03	4.8E-02	N/A	5.3E-02
		Exposure Point Total						5.3E-02
	Exposure Medium Total							5.3E-02
Medium Total								5.3E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	5E-02

TABLE 9.6

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest		Non-Carcinogenic Hazard Quotient			
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	Longevity, Blood	4.7E-03	6.0E-02	N/A	6.5E-02
			Arsenic	Skin	2.6E-03	5.1E-03	N/A	7.7E-03
			Cadmium	Kidney	1.6E-04	6.3E-03	N/A	6.4E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	2.4E-05	4.6E-05	N/A	7.0E-05
			Total		7.5E-03	7.1E-02	N/A	7.9E-02
		Exposure Point Total						7.9E-02
	Exposure Medium Total							7.9E-02
Medium Total								7.9E-02
Receptor Total					Total Hazard Index (HI) Across All Media =			8E-02

TABLE 9.7

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child (0 to 6 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	Longevity, Blood	1.5E-02	8.5E-02	N/A	1.0E-01
			Arsenic	Skin	8.4E-03	7.2E-03	N/A	1.6E-02
			Cadmium	Kidney	5.2E-04	8.9E-03	N/A	9.4E-03
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	7.6E-05	6.5E-05	N/A	1.4E-04
			Total		2.4E-02	1.0E-01	N/A	1.2E-01
		Exposure Point Total						1.2E-01
	Exposure Medium Total							1.2E-01
Medium Total								1.2E-01
Receptor Total					Total Hazard Index (HI) Across All Media =			1E-01

TABLE 9.7

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child-Adult (Lifetime)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient: Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z1 Groundwater Seeps in Basements	Antimony	Longevity, Blood	2.2E-02	1.9E-01	N/A	2.1E-01
			Arsenic	Skin	1.3E-02	1.6E-02	N/A	2.8E-02
			Cadmium	Kidney	7.8E-04	1.9E-02	N/A	2.0E-02
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	1.1E-04	1.4E-04	N/A	2.6E-04
			Total		3.6E-02	2.2E-01	N/A	2.6E-01
		Exposure Point Total						2.6E-01
	Exposure Medium Total							2.6E-01
Medium Total								2.6E-01
Receptor Total				Total Hazard Index (HI) Across All Media =				3E-01

TABLE 9.9

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adult (>18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient: Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	Longevity, Blood	1.2E-04	1.7E-03	N/A	1.8E-03
			Arsenic	Skin	1.7E-04	3.7E-04	N/A	5.4E-04
			Cadmium	Kidney	0.0E+00	0.0E+00	N/A	0.0E+00
			Lead	Developmental	- -	- -	N/A	0.0E+00
			Selenium	Selenosis	1.5E-06	3.2E-06	N/A	4.6E-06
			Total		2.9E-04	2.1E-03	N/A	2.4E-03
		Exposure Point Total						2.4E-03
	Exposure Medium Total							2.4E-03
Medium Total								2.4E-03
Receptor Total							Total Hazard Index (HI) Across All Media =	2E-03

TABLE 9.10

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Adolescent (7 to 18 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest		Non-Carcinogenic Hazard Quotient			
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	Longevity, Blood	2.0E-04	2.5E-03	N/A	2.7E-03
			Arsenic	Skin	2.9E-04	5.5E-04	N/A	8.4E-04
			Cadmium	Kidney	0.0E+00	0.0E+00	N/A	0.0E+00
			Lead	Developmental	- -	- -	N/A	0.0E+00
			Selenium	Selenosis	2.5E-06	4.7E-06	N/A	7.2E-06
			Total		4.9E-04	3.1E-03	N/A	3.6E-03
		Exposure Point Total						3.6E-03
	Exposure Medium Total							3.6E-03
Medium Total								3.6E-03
Receptor Total							Total Hazard Index (HI) Across All Media =	4E-03

TABLE 9.11

CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS

CENTRAL TENDENCY EXPOSURE

USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child (0 to 6 years)

Medium	Exposure Medium	Exposure Point	Chemical of Interest	Primary Target Organ(s)	Non-Carcinogenic Hazard Quotient Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	Longevity, Blood	6.3E-04	3.6E-03	N/A	4.2E-03
			Arsenic	Skin	9.1E-04	7.8E-04	N/A	1.7E-03
			Cadmium	Kidney	0.0E+00	0.0E+00	N/A	0.0E+00
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	7.8E-06	6.7E-06	N/A	1.4E-05
			Total		1.5E-03	4.4E-03	N/A	5.9E-03
		Exposure Point Total						5.9E-03
	Exposure Medium Total							5.9E-03
Medium Total								5.9E-03
Receptor Total							Total Hazard Index (HI) Across All Media =	6E-03

TABLE 9.12
CUMULATIVE RISK SUMMARY OF RECEPTOR RISKS AND HAZARDS
CENTRAL TENDENCY EXPOSURE
USS Lead Superfund Site - Operable Unit 1

Scenario Timeframe:	Current/Future
Receptor Population:	OU1 Resident
Receptor Age:	Child-Adult (Lifetime)

Medium	Exposure Medium	Exposure Point	Chemical of Interest		Non-Carcinogenic Hazard Quotient			
				Primary Target Organ(s)	Ingestion	Dermal	Inhalation	Exposure Routes Total
Groundwater	Groundwater Seeps	OU1 Z2-3 Groundwater Seeps in Basements	Antimony	Longevity, Blood	9.4E-04	7.8E-03	N/A	8.7E-03
			Arsenic	Skin	1.4E-03	1.7E-03	N/A	3.1E-03
			Cadmium	Kidney	0.0E+00	0.0E+00	N/A	0.0E+00
			Lead	Developmental	- -	- -	N/A	- -
			Selenium	Selenosis	1.2E-05	1.5E-05	N/A	2.6E-05
			Total		2.3E-03	9.5E-03	N/A	1.2E-02
		Exposure Point Total						1.2E-02
	Exposure Medium Total							1.2E-02
Medium Total								1.2E-02
Receptor Total							Total Hazard Index (HI) Across All Media =	1E-02

ATTACHMENT 5 USEPA RSL OUTPUT

Site-specific
Construction Worker Inputs

Variable	Construction Worker Soil - Unpaved Default Value	Form-input Value
L_R (length of road segment) ft	147.58077	147.58077
A (Dispersion Constant)	12.9351	12.9351
A_R (surface area of contaminated road segment) m^2	274.21393	274.21393
W_R (width of road segment) ft	20	20
B (Dispersion Constant)	5.7383	5.7383
C (Dispersion Constant)	71.7711	71.7711
distance (road length) km/day	0.04498	0.04498
F_D Unitless Dispersion Correction Factor	0.185837208	0.185837208
M_{dry} (road surface material moisture content under dry, uncontrolled conditions) %	0.2	0.2
number of cars	.	5.
number of trucks	.	5.
p (days per year with at least .01" of precipitation) days/year	.	130.
Q/C_{sr} (inverse of the ratio of the 1-h. geometric mean air concentration to the emission flux along a straight road segment bisecting a square site (g/) g/m^2-s per kg/m^3	23.01785	23.01785
s (road surface silt content) %	8.5	8.5
A_s (PEF_{sc} - acres)	0.5	0.5
AF_{cw} (skin adherence factor - construction worker) mg/cm^2	0.3	0.3
AT_{cw} (averaging time - construction worker) days	365	365
BW_{cw} (body weight - construction worker) kg	80	80
ED_{cw} (exposure duration - construction worker) yr	1	1
EF_{cw} (exposure frequency - construction worker) day/yr	250	250
ET_{cw} (exposure time - construction worker) hr/day	8	8
THQ (target hazard quotient) unitless	0.1	0.1
IRS_{cw} (soil ingestion rate - construction worker) mg/day	330	330
LT (lifetime) yr	70	70
SA_{cw} (surface area - construction worker) cm^2/day	3527	3527
TR (target cancer risk) unitless	1.0E-06	1.0E-06
t_c (overall duration of construction) hours	8400	8400
T_c (overall duration of construction) s	30240000	30240000
T_t (overall duration of traffic) s	7200000	7200000

Site-specific
Construction Worker Inputs

Variable	Construction Worker Soil - Unpaved Default Value	Form-input Value
tons/car	.	2.
tons/truck	.	20.

Site-specific

Construction Worker Regional Screening Levels (RSL) for Soil - Unpaved Road Traffic

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF_o (mg/kg-day)$^{-1}$	SF_o Ref	IUR (ug/m^3)$^{-1}$	IUR Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	GIABS	ABS
Antimony (metallic)	7440-36-0	No	No	Inorganics	-		-		4.00E-04	P /Subchronic	1.00E-03	A /Subchronic	0.15	-
Arsenic, Inorganic	7440-38-2	No	No	Inorganics	1.50E+00	I	4.30E-03	I	3.00E-04	I /Chronic	1.50E-05	C /Chronic	1	0.03
Cadmium (Diet)	7440-43-9	No	No	Inorganics	-		1.80E-03	I	5.00E-04	A /Subchronic	1.00E-05	A /Chronic	0.025	0.001
Selenium	7782-49-2	No	No	Inorganics	-		-		5.00E-03	H /Subchronic	2.00E-02	C /Chronic	1	-

RBA	Soil Saturation Concentration (mg/kg)	S (mg/L)	K_{oc}\ (cm^3/g)	K_d\ (cm^3/g)	HLC (atm-m^3/mole)	Henry's Law Constant Used in Calcs (unitless)	H` and HLC Ref	Normal Boiling Point BP (K)	BP Ref	Critical Temperature T_c\ (K)	T_c\ Ref	Chemical Type	D_{ia}\ (cm^2/s)	D_{iw}\ (cm^2/s)
1	-	-	-	4.50E+01	-	-		1908.15	PHYSPROP	5070	YAWS	INORGANIC	-	-
0.6	-	-	-	2.90E+01	-	-		888.15	PHYSPROP	1673	CRC	INORGANIC	-	-
1	-	-	-	7.50E+01	-	-		1038.15	PHYSPROP	2291	YAWS	INORGANIC	-	-
1	-	-	-	5.00E+00	-	-		958.15	PHYSPROP	1766	CRC	INORGANIC	-	-

D_A\ (cm^2/s)	Particulate Emission Factor (m³/kg)	Volatilization Factor (m³/kg)	Ingestion SL TR=1E-06 (mg/kg)	Dermal SL TR=1E-06 (mg/kg)	Inhalation SL TR=1E-06 (mg/kg)	Carcinogenic SL TR=1E-06 (mg/kg)	Ingestion SL THQ=0.1 (mg/kg)	Dermal SL THQ=0.1 (mg/kg)	Inhalation SL THQ=0.1 (mg/kg)	Noncarcinogenic SL THI=0.1 (mg/kg)	Screening Level (mg/kg)
-	3.61E+06	-	-	-	-	-	1.36E+01	-	1.52E+03	1.35E+01	1.35E+01 nc
-	3.61E+06	-	2.75E+01	1.72E+02	2.57E+02	2.17E+01	1.70E+01	1.06E+02	2.28E+01	8.90E+00	8.90E+00 nc
-	3.61E+06	-	-	-	6.15E+02	6.15E+02	1.70E+01	1.32E+02	1.52E+01	7.55E+00	7.55E+00 nc
-	3.61E+06	-	-	-	-	-	1.70E+02	-	3.03E+04	1.69E+02	1.69E+02 nc

Site-specific
Recreator Soil Inputs

Variable	Recreator Soil Default Value	Form-input Value
A (PEF Dispersion Constant)	16.2302	16.2302
A (VF Dispersion Constant)	11.911	11.911
A (VF Dispersion Constant - mass limit)	11.911	11.911
B (PEF Dispersion Constant)	18.7762	18.7762
B (VF Dispersion Constant)	18.4385	18.4385
B (VF Dispersion Constant - mass limit)	18.4385	18.4385
City (PEF Climate Zone) Selection	Default	Default
City (VF Climate Zone) Selection	Default	Default
C (PEF Dispersion Constant)	216.108	216.108
C (VF Dispersion Constant)	209.7845	209.7845
C (VF Dispersion Constant - mass limit)	209.7845	209.7845
foc (fraction organic carbon in soil) g/g	0.006	0.006
F(x) (function dependent on U_m/U_t) unitless	0.194	0.194
n (total soil porosity) L_{pore}/L_{soil}	0.43396	0.43396
p_b (dry soil bulk density) g/cm^3	1.5	1.5
p_b (dry soil bulk density - mass limit) g/cm^3	1.5	1.5
PEF (particulate emission factor) m^3/kg	1359344438	1359344438
p_s (soil particle density) g/cm^3	2.65	2.65
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	93.77
Q/C_{vol} (g/m^2-s per kg/m^3)	68.18	68.18
Q/C_{vol} (g/m^2-s per kg/m^3 - mass limit)	68.18	68.18
A_s (PEF acres)	0.5	0.5
A_s (VF acres)	0.5	0.5
A_s (VF mass-limit acres)	0.5	0.5
AF_{0-2} (skin adherence factor) mg/cm^2	0.2	0.2
AF_{2-6} (skin adherence factor) mg/cm^2	0.2	0.2
AF_{6-16} (skin adherence factor) mg/cm^2	0.07	0.07
AF_{16-30} (skin adherence factor) mg/cm^2	0.07	0.07
AF_{rec-a} (skin adherence factor - adult) mg/cm^2	0.07	0.07
AF_{rec-c} (skin adherence factor - child) mg/cm^2	0.2	0.2
AT_{rec} (averaging time)	365	365

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Site-specific
Recreator Soil Inputs

Variable	Recreator Soil Default Value	Form-input Value
BW_{0-2} (body weight) kg	15	15
BW_{2-6} (body weight) kg	15	15
BW_{6-16} (body weight) kg	80	80
BW_{16-30} (body weight) kg	80	80
BW_{rec-a} (body weight - adult) kg	80	80
BW_{rec-c} (body weight - child) kg	15	15
$DFS_{rec-adj}$ (age-adjusted soil dermal factor) mg/kg	.	4222.4
$DFSM_{rec-adj}$ (mutagenic age-adjusted soil dermal factor) mg/kg	.	8444.8
ED_{rec} (exposure duration - recreator) years	26	26
ED_{0-2} (exposure duration) year	2	2
ED_{2-6} (exposure duration) year	4	4
ED_{6-16} (exposure duration) year	10	10
ED_{16-30} (exposure duration) year	10	10
ED_{rec-c} (exposure duration - child) years	6	6
EF_{rec} (exposure frequency) days/year	.	30.769
EF_{0-2} (exposure frequency) days/year	.	0.
EF_{2-6} (exposure frequency) days/year	.	0.
EF_{6-16} (exposure frequency) days/year	.	40.
EF_{16-30} (exposure frequency) days/year	.	40.
EF_{rec-a} (exposure frequency - adult) days/year	.	40
EF_{rec-c} (exposure frequency - child) days/year	.	0
ET_{rec} (exposure time - recreator) hours/day	.	3.077
ET_{0-2} (exposure time) hours/day	.	0.
ET_{2-6} (exposure time) hours/day	.	0.
ET_{6-16} (exposure time) hours/day	.	4.
ET_{16-30} (exposure time) hours/day	.	4.
ET_{rec-a} (adult exposure time) hours/day	.	4
ET_{rec-c} (child exposure time) hours/day	.	0
THQ (target hazard quotient) unitless	0.1	0.1
$IFS_{rec-adj}$ (age-adjusted soil ingestion factor) mg/kg	.	1000
$IFSM_{rec-adj}$ (mutagenic age-adjusted soil ingestion factor) mg/kg	.	2000

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Site-specific Recreator Soil Inputs

Variable	Recreator Soil Default Value	Form-input Value
IRS_{0-2} (soil intake rate) mg/day	200	200
IRS_{2-6} (soil intake rate) mg/day	200	200
IRS_{6-16} (soil intake rate) mg/day	100	100
IRS_{16-30} (soil intake rate) mg/day	100	100
IRS_{rec-a} (soil intake rate - adult) mg/day	100	100
IRS_{rec-c} (soil intake rate - child) mg/day	200	200
LT (lifetime - recreator) years	70	70
SA_{0-2} (skin surface area) cm^2/day	2373	2373
SA_{2-6} (skin surface area) cm^2/day	2373	2373
SA_{6-16} (skin surface area) cm^2/day	6032	6032
SA_{16-30} (skin surface area) cm^2/day	6032	6032
SA_{rec-a} (skin surface area - adult) cm^2/day	6032	6032
SA_{rec-c} (skin surface area - child) cm^2/day	2373	2373
TR (target risk) unitless	1.0E-06	1.0E-06
T_w (groundwater temperature) Celsius	25	25
$Theta_a$ (air-filled soil porosity) L_{air}/L_{soil}	0.28396	0.28396
$Theta_w$ (water-filled soil porosity) L_{water}/L_{soil}	0.15	0.15
T (exposure interval) s	819936000	819936000
T (exposure interval) yr	26	26
U_m (mean annual wind speed) m/s	4.69	4.69
U_t (equivalent threshold value)	11.32	11.32
V (fraction of vegetative cover) unitless	0.5	0.5

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Site-specific

Recreator Regional Screening Levels (RSL) for Soil

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	SF_o (mg/kg-day)$^{-1}$	SF_o Ref	IUR (ug/m^3)$^{-1}$	IUR Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	GIABS	ABS	RBA	Soil Saturation Concentration (mg/kg)	S (mg/L)
Antimony (metallic)	7440-36-0	No	No	Inorganics	-		-		4.00E-04	I	3.00E-04	A	0.15	-	1	-	-
Arsenic, Inorganic	7440-38-2	No	No	Inorganics	1.50E+00	I	4.30E-03	I	3.00E-04	I	1.50E-05	C	1	0.03	0.6	-	-
Cadmium (Diet)	7440-43-9	No	No	Inorganics	-		1.80E-03	I	1.00E-03	I	1.00E-05	A	0.025	0.001	1	-	-
Selenium	7782-49-2	No	No	Inorganics	-		-		5.00E-03	I	2.00E-02	C	1	-	1	-	-

Output generated 20SEP2021:14:40:02

Site-specific

Recreator Regional Screening Levels (RSL) for Soil

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

K_{oc}\ (cm^3/g)	K_d\ (cm^3/g)	HLC ($atm\text{-}m^3/mole$)	Henry's Law Constant Used in Calcs (unitless)	H` and HLC Ref	Normal Boiling Point BP (K)	BP Ref	Critical Temperature T_C\ (K)	T_C\ Ref	Chemical Type	D_{ia}\ (cm^2/s)	D_{iw}\ (cm^2/s)	D_A\ (cm^2/s)	Particulate Emission Factor (m^3/kg)	Volatilization Factor (m^3/kg)
-	4.50E+01	-	-		1908.15	PHYSPROP	5070	YAWS	INORGANIC	-	-	-	1.36E+09	-
-	2.90E+01	-	-		888.15	PHYSPROP	1673	CRC	INORGANIC	-	-	-	1.36E+09	-
-	7.50E+01	-	-		1038.15	PHYSPROP	2291	YAWS	INORGANIC	-	-	-	1.36E+09	-
-	5.00E+00	-	-		958.15	PHYSPROP	1766	CRC	INORGANIC	-	-	-	1.36E+09	-

Output generated 20SEP2021:14:40:02

Site-specific

Recreator Regional Screening Levels (RSL) for Soil

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Ingestion SL TR=1E-06 (mg/kg)	Dermal SL TR=1E-06 (mg/kg)	Inhalation SL TR=1E-06 (mg/kg)	Carcinogenic SL TR=1E-06 (mg/kg)	Ingestion SL Child THQ=0.1 (mg/kg)	Dermal SL Child THQ=0.1 (mg/kg)	Inhalation SL Child THQ=0.1 (mg/kg)	Noncarcinogenic SL Child THI=0.1 (mg/kg)	Ingestion SL Adult THQ=0.1 (mg/kg)	Dermal SL Adult THQ=0.1 (mg/kg)	Inhalation SL Adult THQ=0.1 (mg/kg)	Noncarcinogenic SL Adult THI=0.1 (mg/kg)	Screening Level (mg/kg)
-	-	-	-	-	-	-	-	2.92E+02	-	2.23E+06	2.92E+02	2.92E+02 nc
2.84E+01	1.34E+02	7.87E+04	2.34E+01	-	-	-	-	3.65E+02	1.73E+03	1.12E+05	3.01E+02	2.34E+01 ca
-	-	1.88E+05	1.88E+05	-	-	-	-	7.30E+02	4.32E+03	7.44E+04	6.19E+02	6.19E+02 nc
-	-	-	-	-	-	-	-	3.65E+03	-	1.49E+08	3.65E+03	3.65E+03 nc

Site-specific
Recreator Surface Water Inputs

Variable	Recreator Surface Water Default Value	Form-input Value
BW_{0-2} (body weight) kg	15	15
BW_{2-6} (body weight) kg	15	15
BW_{6-16} (body weight) kg	80	80
BW_{16-30} (body weight) kg	80	80
BW_{a} (body weight - adult) kg	80	80
BW_{rec-a} (body weight - adult) kg	80	80
$DFW_{rec-adj}$ (age-adjusted dermal factor) cm^2-event/kg	.	60320
$DFWM_{rec-adj}$ (mutagenic age-adjusted dermal factor) cm^2-event/kg	.	120640
ED_{rec} (exposure duration - recreator) years	26	26
ED_{0-2} (exposure duration) years	2	2
ED_{2-6} (exposure duration) years	4	4
ED_{6-16} (exposure duration) years	10	10
ED_{16-30} (exposure duration) years	10	10
ED_{rec-a} (exposure duration - adult) years	20	20
EF_{rec-w} (exposure frequency) days/year	.	30.769
EF_{2-6} (exposure frequency) days/year	.	0.
EF_{6-16} (exposure frequency) days/year	.	40.
EF_{16-30} (exposure frequency) days/year	.	40.
EF_{rec-a} (adult exposure frequency) days/year	.	40
ET_{0-2} (exposure time) hours/event	.	0.
ET_{2-6} (exposure time) hours/event	.	0.
ET_{6-16} (exposure time) hours/event	.	4.
ET_{16-30} (exposure time) hours/event	.	4.
ET_{rec-a} (adult exposure time) hours/event	.	4
EV_{0-2} (events) events/day	.	0.
EV_{2-6} (events) events/day	.	0.
EV_{6-16} (events) events/day	.	1.
EV_{16-30} (events) events/day	.	1.
EV_{rec-a} (adult) events/day	.	1
THQ (target hazard quotient) unitless	0.1	0.1

Output generated 20SEP2021:14:43:55

Site-specific
Recreator Surface Water Inputs

Variable	Recreator Surface Water Default Value	Form-input Value
$IFW_{rec-adj}$ (age-adjusted water intake rate) L/kg	.	0.6
$IFWM_{rec-adj}$ (mutagenic age-adjusted water intake rate) L/kg	.	1.184
IRW_{0-2} (water intake rate) L/hour	0.12	0.12
IRW_{2-6} (water intake rate) L/hour	0.12	0.12
IRW_{6-16} (water intake rate) L/hour	0.124	0.0148
IRW_{16-30} (water intake rate) L/hour	0.0985	0.0148
IRW_{rec} (water intake rate - adult) L/day	0.11	0.015
IRW_{rec-a} (water intake rate - adult) L/hr	0.11	0.015
LT (lifetime - recreator) years	70	70
SA_{0-2} (skin surface area) cm^2	6365	6365
SA_{2-6} (skin surface area) cm^2	6365	6365
SA_{6-16} (skin surface area) cm^2	19652	6032
SA_{16-30} (skin surface area) cm^2	19652	6032
SA_{rec} (skin surface area - adult) cm^2	19652	6032
SA_{rec-a} (skin surface area - adult) cm^2	19652	6032
Apparent thickness of stratum corneum (cm)	0.001	0.001
TR (target risk) unitless	1.0E-06	1.0E-06

Output generated 20SEP2021:14:43:55

Site-specific

Recreator Regional Screening Levels (RSL) for Surface Water

Key: I = IRIS; P = PPRTV; O = OPP; A = ATSDR; C = Cal EPA; X = PPRTV Screening Level; H = HEAST; D = DWSHA; W = TEF applied; E = RPF applied; G = see user's guide; U = user provided; ca = cancer; nc = noncancer; * = where: nc SL < 100X ca SL; ** = where nc SL < 10X ca SL; SSL values are based on DAF=1; max = ceiling limit exceeded; sat = Csat exceeded.

Chemical	CAS Number	Mutagen?	Volatile?	Chemical Type	Chemical Type	SF_o (mg/kg-day)$^{-1}$	SF_o Ref	RfD (mg/kg-day)	RfD Ref	RfC (mg/m^3)	RfC Ref	RAGSe GIABS (unitless)	K_p (cm/hr)	MW	FA (unitless)	In EPD?
Antimony (metallic)	7440-36-0	No	No	Inorganics	Inorganics	-		4.00E-04	I	3.00E-04	A	0.15	0.001	121.76	1	Yes
Arsenic, Inorganic	7440-38-2	No	No	Inorganics	Inorganics	1.50E+00	I	3.00E-04	I	1.50E-05	C	1	0.001	74.922	1	Yes
Cadmium (Water)	7440-43-9	No	No	Inorganics	Inorganics	-		5.00E-04	I	1.00E-05	A	0.05	0.001	112.4	1	Yes
Selenium	7782-49-2	No	No	Inorganics	Inorganics	-		5.00E-03	I	2.00E-02	C	1	0.001	78.96	1	Yes

$DA_{event (ca)}$	$DA_{event (nc child)}$	$DA_{event (nc adult)}$	Ingestion SL TR=1E-06 (ug/L)	Dermal SL TR=1E-06 (ug/L)	Carcinogenic SL TR=1E-06 (ug/L)	Ingestion SL (Child) THQ=0.1 (ug/L)	Dermal SL (Child) THQ=0.1 (ug/L)	Noncarcinogenic SL (Child) THQ=0.1 (ug/L)	Ingestion SL (Adult) THQ=0.1 (ug/L)	Dermal SL (Adult) THQ=0.1 (ug/L)	Noncarcinogenic SL (Adult) THQ=0.1 (ug/L)	Screening Level (ug/L)
-	-	0.0007261	-	-	-	-	-	-	4.87E+02	1.82E+02	1.32E+02	1.32E+02 nc
0.0002824	-	0.0036306	2.84E+01	9.18E+01	2.17E+01	-	-	-	3.65E+02	9.08E+02	2.60E+02	2.17E+01 ca
-	-	0.0003026	-	-	-	-	-	-	6.08E+02	7.56E+01	6.73E+01	6.73E+01 nc
-	-	0.0605106	-	-	-	-	-	-	6.08E+03	1.51E+04	4.34E+03	4.34E+03 nc

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ERM's Rolling Meadows Office
1701 Golf Road, Suite 1-700
Rolling Meadows, IL 60008

T: +1 847 258 8900
F: +1 847 258 8901

www.erm.com

APPENDIX N BASELINE ECOLOGICAL RISK ASSESSMENT

Prepared for:

U.S. Smelter and Lead Refinery, Inc.
(USS Lead)

Baseline Ecological Risk Assessment

USS Lead Superfund Site, Operable Unit 2,
5300 Kennedy Ave, East Chicago, IN

September 2021

Project No.: 0432213

The business of sustainability

ERM

Signature Page

September 2021

Baseline Ecological Risk Assessment

USS Lead Superfund Site, Operable Unit 2, 5300 Kennedy Ave, East Chicago, IN

Daniel W. Petersen, Ph.D.
Partner-in-Charge

Timothy R. Barber, Ph.D.
Technical Director, Project Coordinator

Laura Judd, M.S.
Senior Project Manager
Risk Assessment Practitioner

Environmental Resources Management
1701 Golf Road, Suite 1-700
Rolling Meadows, IL 60008

CONTENTS

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Acronyms and Abbreviations

Name	Description
µmol/goc	Micromoles per gram of organic carbon
AUF	Area use factor
AVS	Acid volatile sulfide
AWQC	Ambient water quality criteria
BAF	Bioaccumulation factors
BERA	Baseline ecological risk assessment
BW	Body weight
CAMU	Corrective Action Management Unit
CBR	Critical body residue
COI	Chemical of interest
CSM	Conceptual site model
DU	Decision unit
Eco-SSL	Ecological soil screening level
EMF	Exposure modifying factor
EPC	Exposure point concentration
ERAGS	Ecological Risk Assessment Guidance for Superfund
ERM	Environmental Resources Management, Inc.
ESA	Ecologically sensitive area
FIR	Food ingestion rate
foc	Fraction of organic carbon
FS	Feasibility Study
FSP	Field Sampling Plan
HQ	Hazard quotient
IR	Ingestion rate
kg	Kilogram
L/day	Liters per day
L/kg	Liters per kilogram
LOAEL	Lowest observed adverse effect level
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
NOAEL	No observed adverse effect level
OU	Operable Unit
PEC	Probable effect concentration
RI	Remedial Investigation
SEM	Simultaneously-extracted metal
SLERA	Screening-level ecological risk assessment
T&E	Threatened and endangered
TF	Temporal factor
TRV	Toxicity reference value
UCL	Upper confidence limit
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USEPA	U.S. Environmental Protection Agency
USS Lead	U.S. Smelter and Lead Refinery, Inc.
WP	Work Plan

1. INTRODUCTION

1.1 Purpose

This Appendix provides the baseline ecological risk assessment (BERA) for Operable Unit 2 (OU2) of the USS Lead Superfund Site (the "Site"). Environmental Resources Management, Inc. (ERM) was retained by U.S. Smelter and Lead Refinery, Inc. (USS Lead) to perform this BERA as part of the Remedial Investigation and Feasibility Study (RI/FS) for the Site located at 5300 Kennedy Avenue, East Chicago, Indiana. This BERA was prepared following U.S. Environmental Protection Agency (USEPA) guidance, as well as the USEPA-approved RI/FS Work Plan (WP; ERM 2018a). The goal of the BERA process is to determine if there are contaminants present in Site media that may pose unacceptable risk to ecological receptors, and if identified, provide the information necessary to support risk management decisions.

1.2 Scope and Approach

This BERA has been prepared in accordance with the eight-step process as established in USEPA's Ecological Risk Assessment Guidance for Superfund (ERAGS): Process for Designing and Conducting Ecological Risk Assessments, June 5, 1997 (USEPA 1997) and related guidance (Section 1.3). The first two steps of the BERA eight-step process are (USEPA 1997): Step 1 (Screening-Level Problem Formulation and Toxicity Evaluation), and Step 2 (Screening-Level Exposure Estimate and Risk Calculation). Together these steps comprise a screening-level ecological risk assessment (SLERA). The primary goal of a SLERA is to establish the chemicals of interest (COIs) and a preliminary conceptual site model (CSM) that identifies the primary exposure pathways for each medium and receptor population of concern.

The SLERA for OU2 was largely completed as part of the Data Gaps Analysis presented in Section 4.0 in the RI/FS Field Sampling Plan (FSP) and BERA WP presented in Section 8.0 of the RI/FS WP (ERM 2018a), where it was determined based on historic sampling data that the Site-specific COIs are antimony, arsenic, cadmium, lead, and selenium. These metals were identified as COIs because they are present in wetland sediment, soil and surface water at levels exceeding conservative ecological screening benchmarks, and thus require evaluation as part of a BERA. While Section 8.0 of the RI/FS WP identified iron as a potential COI, iron was not evaluated in this BERA for the following reasons:

- Iron is recognized as a commonly occurring element in environmental media;
- Iron is essential for plant growth and is well-regulated by plants;
- Iron generally lacks toxicological benchmarks because it is non-toxic under normal pH conditions; and
- Iron was measured in OU2 media as a geochemical tracer element for use in interpreting data for other redox-sensitive metals, not risk assessment purposes.

In combination with what was provided in the RI/FS WP and FSP, the RI Report provides a summary of the screening effort undertaken during the preparation of those reports, and is not duplicated here. For this report, the five metals identified as COIs that were sampled as part of the RI/FS FSP are screened using maximum site concentrations and USEPA Region 4 conservative default ecological benchmarks for soil (protective of birds, mammals, plants, and terrestrial invertebrates), sediment (protective of benthic invertebrates), and surface water (protective of aquatic biota). Screening results (see Attachment A) confirm that these five metals remain COIs requiring further evaluation. The remaining components of a SLERA are provided in this report, which include a threatened and endangered (T&E) species evaluation and the results of a habitat survey and wetland delineation to refine the evaluation of potential ecological exposures and pathways of concern.

Section 8.0 of the RI/FS WP detailed the proposed approach for refining and interpreting the SLERA information to provide a more realistic assessment of potential ecological exposure and to focus the BERA to protect site-specific receptors of concern (Step 3). The RI/FS FSP outlined the design and implementation of field sampling conducted to support the assessment of potential ecological risk to these receptors (Steps 4–6). This document presents an analysis of those data (Step 6) and integrates this analysis with a detailed exposure assessment and ecological effects assessment to form overall conclusions regarding potential ecological risk at OU2 (Step 7). Risks are characterized using a weight-of-evidence approach that considers site-specific information and other pertinent factors that are required to support decision-making as part of a final risk management phase (Step 8). It should be noted that because the Site has been investigated and interim remedial activities have occurred on-Site since the 1990s, the BERA is focused on an area of the Site not fully characterized previously. This area is known as the southern wetland area, which lies adjacent to the south of the former USS Lead Canal along the Grand Calumet River.

1.3 Risk Assessment Guidance and Other Documents

The BERA for OU2 was prepared in general accordance with USEPA guidance including but not limited to the following:

- Wildlife exposure factors handbook. EPA/600/R-93/187. December 1993.
- ERAGS: Process for Designing and Conducting Ecological Risk Assessments. Interim Final. EPA 540-R-97-006, OSWER 9285.7-25, PB97-963211. June 1997.
- Ecological Risk Assessment and Risk Management Principles for Superfund Sites. (Issuance of Final Guidance). OSWER Directive 9285.7-28 P. October 1999.
- Role of Screening Level Risk Assessment and Refining Chemicals of Potential Concern in BERAs. EPA 540/F-01/014, Publication 9345.0-14. June 2001.
- Generic Ecological Assessment Endpoints for Ecological Risk Assessment. EPA/630/P-02/004F. October 2003.
- Framework for Metals Risk Assessment. EPA 120/R-07/001. March 2007.
- Region 4 Ecological Risk Assessment Supplemental Guidance. Supplemental Guidance to ERAGS: Region 4, Ecological Risk Assessment. Originally published November 1995 and updated March 2018.

Additional regulatory guidance employed to complete specific tasks in the BERA are noted throughout the BERA text, as appropriate.

1.4 Document Organization

The remainder of the BERA is organized according to the following Sections:

- Section 2. Site Setting: This section provides an overview of the site setting and ecological resources within OU2.
- Section 3. Problem Formulation: This section provides the CSM that describes the ecological receptors and exposure pathways evaluated, and defines assessment and measurement endpoints for the BERA.
- Section 4. Exposure Assessment: This section provides the methods and results for estimating exposure point concentrations (EPCs) and uptake doses for each receptor group evaluated in the BERA.

- Section 5. Ecological Effects Assessment: This section provides the toxicity reference values (TRVs) and other benchmarks used to estimate the effects of exposure for each receptor group evaluated in the BERA.
- Section 6. Risk Characterization: This section synthesizes the exposure and effects assessments to estimate risk for each receptor group evaluated in the BERA, including a discussion of the lines of evidence in an overall weight-of-evidence approach to characterizing risk. The uncertainties associated with the assumptions and models used in the BERA are discussed.
- Section 7. Uncertainty Evaluation
- Section 8. Summary of Results: This section summarizes the results of the BERA, identifies potential risk drivers and provides input for making risk-management decisions in OU2.
- Section 9. References: This section provides the literature references for citations in this Appendix.

Supporting information and analyses are provided as Attachments to this Appendix.

2. SITE SETTING

The USS Lead Facility was constructed in the early 1900s and was primarily used for primary and secondary lead smelting until 1985, when operations ceased. The Site is approximately 79 acres, with industrial land use areas to the north, east, and south. The areas to the west include both undeveloped wetlands and industrial land use. The Site has been the subject of investigation and interim remedial activities beginning in 1993, and the majority of the Site where former operations occurred has been remediated, including the removal of impacted soil and a portion of the sediments in the wetlands.[1] The USS Lead Facility property includes the following features, shown on Figure 1.3-1 (RI Report):

- An approximately 10-acre Resource Conservation and Recovery Act Corrective Action Management Unit (CAMU) and related structures;
- A 39-acre wetland area located south and southeast of the Canal;
- Several surface water ponds to the north, west, and south of the CAMU; and
- A forested uplands area that has remnants of the original dune and swale topography in the northwest corner of the USS Lead Facility covering approximately 20 acres.

The Site is located at an elevation of between approximately 580 and 620 feet above mean sea level, where the highest elevations are located within the dune and swale complex and the CAMU. The Site is located along the north bank of Calumet River and the entirety of the areas southwest and south of the CAMU are part of the 100-year floodplain.

As noted previously, the focus of the BERA for OU2 is on ecologically sensitive areas (ESAs) that have not been previously well studied or remediated, and their potential to impact adjacent ESAs. Specifically, the focus is on the 39-acre wetlands in the southern portion of OU2, which lie adjacent to the former USS Lead Canal and the Grand Calumet River.

2.1 Identification of Ecological Resources

The Site is situated within the Headwaters of Grand Calumet River watershed, which drains approximately 39 square miles of surface area to Lake Michigan, approximately four miles north of the Site. The Site is currently a controlled site consisting of undeveloped land, the CAMU, wetlands, surface water bodies (three ponds and a canal), and a wooded area with remnants of the original dune and swale

[1] Section 1.3 of the RI Report provides more detail on overall site characteristics and history.

complex. The open water marshes surrounding the CAMU drain to the open water canal within the central portion of the Site, which drains all surface waters to its confluence with the Calumet River.

An ecological evaluation was conducted as part of the RI. It included a wetland and habitat assessment that were based on a desktop review and field survey. The purpose of the field survey was to qualitatively characterize land use covertypes, including wetlands; assess the value and function of potential ecological habitats; and observe wildlife. The following three (3) land use covertypes were identified during the field survey:

- Emergent Wetlands
- Open Water Wetlands
- Dune and Swale Complex

The approximate boundaries of these covertypes are depicted on Figure 2.8-1 (RI Report). A full habitat characterization is provided in the RI (Section 2.8). In general, all of these covertypes are highly disturbed as the Study Area was formerly a primary and secondary lead smelter and is located in an area with a long history of heavy industrial development and anthropogenic disturbances. Specific habitat and wildlife information pertinent to the BERA is provided in the following subsections.

2.1.1 *Emergent Wetlands and Open Water Habitat*

The emergent wetland covertype at the USS Lead Facility includes both aquatic and terrestrial components as described below. This covertype occupies approximately 22.8 acres across the former USS Lead facility. In general, this area is dominated by invasive species and shows evidence of past disturbance (e.g., excavating, filling, etc.). All decision units (DUs) investigated as part of the current RI field activities were located within the emergent wetland covertype.

Ubiquitous and dominant within the emergent wetland are *Phragmites* (*Phragmites australis*), which have the ability to rapidly colonize and subsequently thrive in disturbed areas. Areas within the emergent wetland that exhibited standing water (approximately 1-15 inches deep) were classified as aquatic habitat, and vegetation consisted of nearly all *Phragmites* with one select zone dominated instead by cattail (*Typha x glauca*). All DUs were located in the portions of the emergent wetland covertype that exhibit aquatic characteristics.

Less saturated areas of the emergent wetland are more accurately characterized as terrestrial (riparian) habitat. These areas exhibited sandy substrate and a larger variety of shrub and herbaceous wetland species. These species included red osier dogwood (*Cornus sericea*), black willow (*Salix nigra*), jewelweed (*Impatiens capensis*), dogbane (*Apocynum cannabinum*), glossy buckthorn (*Rhamnus cathartica*), purple loosestrife (*Lythrum salicaria*), and scouring rush (*Equisetum hyemale*). Trees were absent within this covertype with the exception of a small patch of black willows and several dead snags.

Table 2.8-1 (RI Report) lists the various ecological receptors that were visually observed or otherwise noted to be present within the emergent wetland covertype. The majority of these observations were made at the margins of the emergent wetland due to access restrictions resulting from the density of *Phragmites* and the depth of standing water. The height (10 -12 feet) and density of *Phragmites* also limited the ability to make visual observations while investigating the interior areas of this covertype. Receptor observations while investigating the interior of this covertype included dragonflies (*Anisoptera spp.*) and mosquitos (*Culicidae spp.*).

It is likely that many of the receptors observed along the margins of the emergent wetland covertype (e.g., songbirds, water fowl, wading birds, deer, rabbit) use the area periodically for some of their daily needs (i.e., hunting, grazing, resting, etc.) but do not wholly reside within or rely on this area to fulfill all of their needs. For example, outside of the red-winged blackbird (*Agelaius phoeniceus*), which can nest in *Phragmites* and cattail stands, all other insectivorous bird species observed within this covertype could potentially utilize the area above the *Phragmites* for hunting but would not be able to nest or breed in this area as there are no trees or shrubs. Invertivorous bird species observed in this area, such as the American robin (*Turdus migratorius*), could potentially hunt or forage at the boundary of this covertype where vegetation was observed to be less dense, but would not be able to utilize interior areas. Similarly, white tailed deer (*Odocoileus virginianus*) and the eastern cottontail (*Sylvilagus floridanus*) may be able to use select locations at the fringe of this covertype for resting or grazing, but would need to utilize other surrounding habitats to fulfill the majority of their needs. Snail and insect species observed in the area, outside of the monarch butterfly (*Danaus plexippus*), would be more likely to utilize this covertype to fulfill a majority of their daily needs.

Mammal trails were observed at several locations within the emergent wetland covertype in areas connecting an open water channel feature outside the covertype to the open water wetlands described below. Observations indicate that these features could be a result of American beaver (*Castor canadensis*) and/or muskrat (*Ondatra zibethicus*) activity. No structures associated with either of these species (e.g., huts, lodges) were visually observed. It is possible that other animals could use these trails as well in addition to beavers and muskrats.

2.1.2 *Open Water Wetlands*

The open water wetland covertype was observed in two distinct areas south of the CAMU and at three distinct locations west and north of the CAMU (Figure 2.8-1 [RI Report]).This covertype occupies approximately 6 acres of the USS Lead Facility. The open water wetlands appeared to be a result of past excavation, and the steep drop offs in the open water areas support this conclusion. Standing water was present in all areas, but approximate depth was not determined due to restricted access. Eurasian watermilfoil (*Myriophyllum spicatum*), a true aquatic plant and an invasive species, was observed throughout this covertype.

As above, ecological receptors identified in this covertype are listed in Table 2.8-1 (RI Report). Due to do access restrictions, only a small portion of this covertype was assessed on foot. Yet, observations support the homogeneity of this covertype throughout. Several aquatic macroinvertebrate species were noted within this covertype, as well as fish and amphibians. In addition, it is possible that the nesting pair of bald eagles (*Haliaeetus leucocephalus*) observed at the USS Lead Facility could use this covertype for hunting fish. Little habitat structural diversity (e.g., coarse woody debris, mudflats, sandbars, undercut banks, shade, etc.) was observed in this covertype.

2.1.3 *Dune and Swale Habitat*

The dune and swale complex was observed in the northwest portion of the USS Lead facility (Figure 2.8-1 [RI Report]). This covertype exhibited both upland and wetland features, where the higher elevation dune portion of the covertype consisted of sandy, well-drained soils and upland species. Dominant species in the tree stratum included black oak (*Quercus velutina*), while tartarian honeysuckle (*Lonicera tatarica*) and common buckthorn (*Rhamnus cathartica*) dominated the shrub stratum. Very few herbaceous plants were noted in the herbaceous stratum due to the thick tree and shrub overstory.

The linear wetland, or swale, portions of this covertype consisted of a mixed scrub-shrub and emergent wetlands that were dominated by common buckthorn and *Phragmites*.

Many of the species included in Table 2.8-1 (RI Report) could utilize this covertype for shelter or a water and/or food source; however, none of the species noted were observed directly within the dune and swale complex.

2.2 Identification of Potentially Exposed Ecological Receptors

The identification of potentially exposed ecological receptors is based on current understanding of habitats, as provided in Section 2.1. The focus of the BERA is the southern wetland area, which is approximately 39 acres dominated by the common reed (*Phragmites australis*), and lies adjacent to the former USS Lead Canal and the Grand Calumet River. As noted previously, the ecological habitats at the Site have been modified by industrial and remedial activities, however, there are still numerous potential ecological receptor groups identified for the southern wetlands, including the following:

- Plants (aquatic and wetland/riparian)
- Benthic or litter invertebrates
- Amphibians and reptiles
- Semi-aquatic birds and mammals
- Wetland and riparian birds and mammals
- Carnivorous birds

The emergent wetland portions of the Site include berms that are terrestrial (riparian) in nature and provide conditions sufficient for the limited growth of terrestrial wetland plant species but not true aquatic plants. The majority of animal species observed within the emergent wetland covertype would have limited use of the aquatic portions of this area due to the density of vegetation and the lack of habitat structural diversity. Transient use of the southern wetlands by mammalian carnivores such as fox was considered possible. However, the prey base would be limited due to the limited potential for the presence of small mammals within dense stands of *Phragmites*, and the low abundance of small mammals found in this type of habitat. Similarly, dense monotypic *Phragmites* stands are suboptimal habitat for larger carnivorous mammals due to a limited prey base and significant impediments to movement. Therefore, potential exposure pathways to top mammalian predators are considered incomplete.

2.2.1 *Threatened & Endangered Species*

Several federal and state listed T&E species are known to occur within Lake County, Indiana and within 0.5 miles of the Site as indicated in the U.S. Fish and Wildlife Service report and the Indiana Department of Natural Resources Division of Nature Preserves report included in Appendix E (RI report). These species are listed in Table 2.8-2 (RI Report).

ERM reviewed all possible listed animal species known to occur within the vicinity of the Site, and compared their likelihood to be present at the Site with the habitats noted during the field survey.

The focused U.S. Fish and Wildlife Service and Indiana Department of Natural Resource Division of Nature Preserves review indicated there was the potential for two bats (Indiana bat and northern long-eared bat), one squirrel (Franklin's ground squirrel), four birds (black tern, marsh wren, Virginia rail, bald eagle) and one insect (moth) to be located at or in proximity to the Site, as summarized in Table 2.8-2 (RI Report). One of the birds, the bald eagle, is known to be present at the Site and has an active nest along the southeast side of the dune/swale complex (Figure 2.8-1 [RI Report]). Table 2.8-2 (RI Report) includes an evaluation of the potential for these species to be found at the Site, based on the known habitat needs for each species. In all cases, sufficient habitat exists within OU2 that could be potentially utilized by these species; however, other than the bald eagle, none were observed during the field survey.

3. PROBLEM FORMULATION

The problem formulation establishes the goals and focus of the BERA, and is based on a refinement of the screening-level problem formulation that was presented in the RI/FS WP using the additional information collected for the purposes of the BERA. Elements of BERA problem formulation consist of the following:

- Refining the characterization of the environmental setting, ecological resources, and potential ecological receptors, including T&E species and species of special concern (this information was provided in Section 2.0);
- Refining the characterization of the ecological effects of the COIs;
- Refining the understanding of contaminant fate and transport mechanisms, complete exposure pathways; and representative ecological receptors;
- Selecting assessment and measurement endpoints; and
- Development of a BERA CSM.

The assessment endpoint(s) define the biological value(s) that the site offers, which are targeted for protection; and the measurement endpoint(s) define the parameters and/or metrics to be used to assess the assessment endpoint(s). Measurement endpoints in a SLERA include the use of constituent concentrations in environmental media and effect concentrations for the identified receptors of concern. In the BERA, measurement endpoints are expanded and refined to include more Site-specific data and information. The following data were collected as part of the BERA investigation to fully characterize risks to plants, invertebrates, birds and mammals in the southern wetlands:

- Wetland sediment analytical data (bulk sediment and acid volatile sulfide (AVS) and simultaneously-extracted metals (SEM) were collected to characterize risks for plants and benthic or litter invertebrates, and to represent incidental ingestion exposure in upper trophic level mammalian and avian wildlife receptors.
- Wetland vegetation tissue data (*Phragmites* new shoots and leaves) were collected to characterize risks for mammalian and avian wetland herbivores.
- Wetland invertebrate tissue data (mixed genera) were collected to characterize risks for wetland avian invertivores and riparian avian and mammalian invertivores, and may be used to model uptake into prey items consumed by carnivorous birds.

The RI Report and appendices provide detail regarding the type, frequency, and location of all sampling conducted as part of the RI and an in-depth analysis on the nature and distribution of COIs within OU2.

3.1 Ecological Effects of the Chemicals of Interest

The COIs identified at the Site include antimony, arsenic, cadmium, lead, and selenium. Each of these metals occur naturally in soil, sediment, and surface water; however, they are present at higher concentrations in environmental media in OU2. The potential for metals to exert adverse toxicological effects to ecological receptors of concern depends on a number of factors relative to the type and condition of the receptor that is exposed, and the geochemical properties of the exposure medium. Geochemical factors that favor complexation with organic matter, sulfides, and minerals (e.g., iron oxides) function to reduce metal bioavailability thus minimizing or eliminating the potential for adverse effects resulting from ecological exposure. In aquatic systems, it is the free ionic form of the metal that is considered the bioavailable fraction responsible for exerting toxic effects through binding to gill membranes. In addition, the free ionic metal species can be taken up by the roots of plants.

It should be noted that most biota are capable of regulating the uptake, distribution and excretion of metals through physiological mechanisms, particularly with respect to essential metals. However, even in the case of non-essential metals (with the exception of selenium, the COIs identified for OU2 are not generally categorized as essential metals), aquatic and terrestrial organisms have documented mechanisms for detoxification and storage of accumulated metals resulting from elevated exposures. Accumulation strategies are more sophisticated in upper trophic level organisms, whereby excess non-essential metals that are not excreted are sequestered in tissues to remove and minimize their potential to exert toxicity (McGeer et al. 2004). For these reasons, the use of critical body residues (CBRs) as thresholds for potential adverse effects of metals in biota tissue is highly uncertain.

When metals are present in bioavailable forms in excess of an organism's capacity to acclimate to or assimilate them, they can cause cellular toxicity, reproductive failure, endocrine system disruption, and alter digestive processes and nutrient uptake. Consistent with USEPA guidance (1997), the principal effects evaluated in this BERA include the reduced survival, growth and reproduction of ecological receptors of concern exposed to environmental media at the Site.

3.2 Chemicals of Interest Sources, Fate and Transport

Previous reports documenting historic operations at the Facility indicate that blast furnace lead-bearing slag was placed adjacent to or directly in the southern wetlands area, just south of the CAMU. This source material was remediated by excavation; however, when present, the slag deposits were subject to overland flow during rain events, potentially discharging contaminated material into the larger southern wetlands area. In addition, a National Pollutant Discharge Elimination System permitted outfall, used for the discharge of blast furnace non-contact process cooling water and water from in-plant storm drains, may have mixed with storm water leachates from the slag pile area and discharged into the southern wetlands area.

The COIs identified at the Site include antimony, arsenic, cadmium, lead, and selenium. Once released to the environment, these metals will partition to particulate matter in soil, sediment and the water column. The migration and fate of metals is highly site-specific and primarily takes place through the physical and geochemical interactions with the particulates to which they are attached. As noted previously, important geochemical factors include complexation with organic matter, sulfides, and minerals (e.g., iron oxides), which will have a significant influence on the transport of these COIs.[2]

Currently, direct drainage to the Grand Calumet River from the USS Lead Facility is impeded by the upland wooded area to the northwest, the canal berm, and the wetlands. Groundwater flow is generally to the west-southwest towards the Grand Calumet River. Metals can enter the food chain through the uptake or absorption by plants and prey, which are then consumed by upper trophic level organisms. While the COIs evaluated in this BERA have the potential to bioaccumulate in plant and animal tissue, they do not biomagnify.

3.3 Exposure Pathways

An exposure pathway defines the connection between contamination and a receptor of concern. According to USEPA (1997), an exposure pathway generally consists of the following four elements:

1. A contaminant source,
2. A release, retention, or transport medium (e.g., soil, sediment or surface water),
3. A point of potential contact with the impacted medium, and

[2] Section 7.3 of the RI Report provides more detail on the fate and transport characteristics of the COIs.

4. An exposure route (e.g., ingestion or dermal contact).

In some situations, the source itself is the exposure point, without a release to any other medium. An exposure pathway may be complete, incomplete, or potentially complete but the potential exposure is low and considered less significant than other risk-driving exposure pathways.

At the former USS Lead facility, former slag deposits in the southern wetlands had the potential to directly impact wetland soil, sediment and surface water in this area. Aquatic, semi-aquatic and terrestrial (riparian) ecological receptors may come into direct contact with media associated with elevated concentrations of COIs.

Because the COIs are metals, it is only the bioavailable fraction of the metal that is a concern for biota exposed to contaminated media. Plants that are in direct contact with wetland soil, sediment, and surface water that may take up COIs through their roots. For upper trophic level receptors (both mammals and birds) the primary exposure route is through the ingestion of these media during foraging or preening activities, or through the diet via the consumption of contaminated plants or prey. Dermal contact is not an exposure route of concern for most animals due to the nature of the external epithelium and presence of fur or feathers. However, soft-bodied sediment and soil dwelling organisms may be exposed to contamination by absorption through the epidermis (McGreer et al. 2004).

3.4 Representative Receptors

As noted in Section 2.2, plants, benthic invertebrates, birds, and mammals are potential ecological receptors in OU2. Because it is not possible to evaluate all potentially exposed bird and mammal species, indicator species are selected to represent different trophic levels and feeding guilds from those known or expected to be abundant in OU2 and/or the broader region. Therefore, in order to evaluate potential food web effects of the COIs, the following representative receptors were selected:

- Semi-Aquatic Mammalian Herbivore (Muskrat) - Muskrat scat was observed within the southern wetland area and are likely the primary aquatic mammal inhabiting OU2, thus the muskrat is the selected receptor species for this trophic level and feeding guild.
- Semi-Aquatic Avian Herbivore (Canada Goose) - Canada geese were observed within the southern wetland area and are a good representation of water fowl that may forage and/or nest in various parts of the emergent wetlands in OU2, thus they are the selected receptor species for this trophic level and feeding guild.
- Wetland Avian Invertivore (Red-Winged Blackbird) - Red winged blackbirds were observed within the southern wetland area and are a good representation of invertivorous passerine birds that may forage for adult insects emerging from the open water and emergent wetlands in OU2, thus they are the selected receptor species for this trophic level and feeding guild.
- Riparian Avian Invertivore (American Robin) - American robins were observed within the southern wetland area and are a good representation of invertivorous passerine birds that may forage for benthic or soil-dwelling invertebrates along the riparian edges of the wetlands in OU2, thus they are the selected receptor species for this trophic level and feeding guild.
- Riparian Mammalian Invertivore (Short-Tailed Shrew) – Shrews, mice and voles were not directly observed within the southern wetland area; however, the short-tailed shrew is a good representation of invertivorous mammals that may forage for invertebrates along the riparian edges of the wetlands in OU2, thus they are the selected receptor species for this trophic level and feeding guild.
- Terrestrial avian carnivore (American Kestrel) - American kestral were not directly observed within the southern wetland area; however, the Peregrine falcon and red-tailed hawk were. Based on the similarity of their dietary preferences, kestrel are a good representation of carnivorous raptors that

may forage for rodents on the edges of the emergent wetlands in OU2, thus they are the selected receptor species for this trophic level and feeding guild.

As noted previously, transient use of the southern wetlands by mammalian carnivores such as fox may occur; however, potential exposures are not likely to be significant. The prey base would be limited due to the limited potential for the presence of small mammals within dense stands of *Phragmites*, and the low abundance of small mammals found in this type of habitat. Similarly, dense monotypic *Phragmites* stands are suboptimal habitat for larger carnivorous mammals due to a limited prey base and significant impediments to movement.

3.5 Assessment and Measurement Endpoints

A key product of the problem formulation phase of this BERA is the establishment of ecological endpoints. Ecological endpoints are defined as measurable or estimable biological or ecological attributes associated with one or more levels of biological organization that serve as the focus of the risk assessment (USEPA 1997). Levels of biological organization can span and encompass the biochemical and cellular levels through individuals, populations, communities, and ecosystems.

Assessment endpoints are explicit expressions of the unique or critical ecosystem characteristics or features that are to be protected. Assessment endpoints developed for this BERA are based on the characteristics of the ecosystem potentially at risk and the constituent pathways within that ecosystem.

In accordance with USEPA guidance, and standard practices, the assessment endpoints for the BERA include:

- Protection of plants from adverse effects on survival, growth, or reproduction associated with exposure to antimony, arsenic, cadmium, lead, and selenium in soil or wetland sediment.
- Protection of benthic or litter invertebrates from adverse effects on survival, growth, or reproduction associated with exposure to antimony, arsenic, cadmium, lead, and selenium in surface water, soil, or wetland sediment.
- Protection of amphibians and reptiles from adverse effects on survival, growth, or reproduction associated with exposure to antimony, arsenic, cadmium, lead, and selenium in surface water, soil, or wetland sediment.
- Protection of semi-aquatic avian and mammalian herbivores from adverse effects on survival, growth, or reproduction associated with exposure to antimony, arsenic, cadmium, lead, and selenium in soil or wetland sediment. This category includes herbivorous birds and mammals. Herbivorous birds and mammals may feed on *Phragmites* that may biotransfer antimony, arsenic, cadmium, lead, and selenium from water, soil, or wetland sediment, and may also be in direct contact with the source media.
- Protection of wetland and riparian avian and mammalian invertivores from adverse effects on survival, growth, or reproduction associated with exposure to antimony, arsenic, cadmium, lead, and selenium in soil or wetland sediment. Invertivorous birds and mammals may feed on soil and litter invertebrates or on emerging insects that may biotransfer antimony, arsenic, cadmium, lead, iron, and selenium from water, soil, or wetland sediment, but otherwise would not be expected to contact source media directly.
- Protection of carnivorous birds (i.e., raptors) from adverse effects on survival, growth, or reproduction associated with exposure to antimony, arsenic, cadmium, lead, and selenium in soil or wetland sediment. Carnivorous birds may feed on small mammals or birds that may have bioaccumulated antimony, arsenic, cadmium, lead, and selenium from water, soil, wetland sediment, or prey, but otherwise carnivorous birds would not be expected to contact source media directly.

Measurement endpoints are biological or ecological variables that can be measured or observed and are related to the valued characteristic of the ecosystem as described by the selected assessment endpoints. Because assessment endpoints often cannot be measured directly, measurement endpoints are developed that can be related, either qualitatively or quantitatively, to the selected assessment endpoint(s).

The measurement endpoints for this BERA are published toxicity thresholds for the COIs in soil, sediment, and surface water, as well as calculated dietary intakes for wildlife receptors compared to TRVs from literature studies on growth, reproduction and survival.

3.6 Conceptual Site Model

Based on information generated above, exposure pathways for each medium are identified in an ecological CSM. The CSM describes how ecological receptors may be exposed to COIs.

A diagram of the ecological CSM is provided in Figure 7.1-1 (RI Report). It is not feasible to evaluate every species that may occur on the Site; therefore, a guild and representative receptor approach was used to assess potential ecological risk. As illustrated in the ecological CSM, receptors are grouped into taxonomic and trophic guilds. Potential risks to representative species are used to infer risks to other members of the guild. It is important to note that not all potentially ecologically relevant exposure pathways are subject to quantification using predictive methods in a BERA. This is because of the lack of widely recognized TRVs and/or exposure parameters needed to address particular exposure routes and species. For example, reptiles are not commonly quantitatively assessed due to a paucity of agency-recognized ecotoxicity and exposure information.

3.7 Risk Analysis Plan

The overall analysis plan in this BERA is to address the following study questions:

Study question #1: Are antimony, arsenic, cadmium, lead, and selenium concentrations in media at the Site impacting the viability (survival, growth and reproduction) of the assessment endpoints (plant community, invertebrate community, amphibian and reptile populations, avian or mammalian populations)?

Study question #2: Does the spatial distribution of antimony, arsenic, cadmium, lead, and selenium in site media indicate a potential for migration and/or impacts to the former USS Lead Canal or other surface water bodies at the Site?

The information needed to address the study questions was obtained through new data collection and from existing information, and was used to answer the study questions as follows:

- Plants — antimony, arsenic, cadmium, lead and selenium concentrations in wetland sediment and soil were compared to soil screening values based on plant toxicity. In addition, site-specific plant antimony, arsenic, cadmium, lead, iron and selenium tissue concentrations were compared to CBRs indicative of potential toxicity;
- Benthic or Litter Invertebrates— Several lines of evidence were used to evaluate invertebrates: (1) antimony, arsenic, cadmium, lead and selenium concentrations in wetland sediment and soil were compared to sediment and soil screening values; (2) site-specific invertebrate antimony, arsenic, cadmium, lead, iron and selenium tissue concentrations were compared to CBRs indicative of potential toxicity; and (3) AVS/SEM results were used to estimate the fraction of divalent metals in sediment available to exert potential toxicity.
- Reptiles and Amphibians – Antimony, arsenic, cadmium, lead, and selenium levels in sediment surface water were compared to bulk sediment and surface water screening values for the protection

of aquatic biota. Results of the AVS/SEM analyses were also used to evaluate bioavailability of cadmium and lead to biota.

- Semi-Aquatic Mammalian Herbivore (Muskrat) - The dietary dose was estimated using food web models based on antimony, arsenic, cadmium, lead, and selenium concentrations in sediment and vegetation tissue. Exposure doses were compared to literature–based ingestion TRVs for mammals.
- Semi-Aquatic Avian Herbivore (Canada Goose) - The dietary dose was estimated using food web models based on antimony, arsenic, cadmium, lead, and selenium concentrations in sediment and vegetation tissue. Exposure doses were compared to literature–based ingestion TRVs for birds.
- Wetland Avian Invertivore (Red-Winged Blackbird) - The dietary dose was estimated using food web models based on antimony, arsenic, cadmium, lead, and selenium concentrations in sediment and invertebrate tissue. Exposure doses were compared to literature–based ingestion TRVs for birds.
- Riparian Avian Invertivore (American Robin) - The dietary dose was estimated using food web models based on antimony, arsenic, cadmium, lead, and selenium concentrations in soil and invertebrate tissue. Exposure doses were compared to literature–based ingestion TRVs for birds.
- Riparian Mammalian Invertivore (Short-Tailed Shrew) - The dietary dose was estimated using food web models based on antimony, arsenic, cadmium, lead, and selenium concentrations in soil and invertebrate tissue. Exposure doses were compared to literature–based ingestion TRVs for mammals.
- Terrestrial avian carnivore (American Kestrel) - The dietary dose was estimated using food web models based on antimony, arsenic, cadmium, lead, and selenium concentrations modeled from soil or sediment and small mammal tissue. Exposure doses were compared to literature–based ingestion TRVs for birds.

Attachment B provide the food web modeling spreadsheets and the literature-based screening values, CBRs and TRVs used in this BERA are presented in Section 5.0.

3.7.1 *Risk Metrics*

Direct exposure of plants and benthic or litter invertebrates to antimony, arsenic, cadmium, lead, and selenium in surface sediment was evaluated by comparing surface sediment concentrations to direct exposure bulk sediment screening values. For invertebrates, this was accomplished by comparing various statistics for generated for the DU-specific sediment dataset (e.g., the 95% upper confidence limit (UCL) on the mean, mean, median or maximum concentrations) to a probable effect concentration (PEC) (MacDonald et al. 2000). The site-wide sediment UCL that incorporates both the historic data in addition to the DU-specific data was also compared to the PEC to provide perspective. In the absence of bulk sediment screening thresholds for plants exposed to COIs in wetlands, USEPA's ecological soil screening levels (Eco-SSLs) for plants were used to compare to the DU-specific and site-wide sediment UCLs. In addition to bulk sediment screening, discrete sediment samples collected from the DUs were analyzed for AVS/SEM metals (cadmium, copper, lead, nickel, silver, and zinc). The AVS/SEM method predicts the toxicity divalent metals pose to benthic organisms by utilizing the causal link between toxicity and bioavailability.

Historic surface water data were evaluated on a site-wide basis by comparing a site-wide surface water UCL to USEPA chronic ambient water quality criteria (AWQC) for the protection of aquatic organisms. In the absence of amphibian or reptile toxicity thresholds, the comparison of sediment and surface water to PECs and AWQC, respectively, was used as a surrogate for evaluating these receptors.

Direct exposure of plants and soil invertebrates to antimony, arsenic, cadmium, lead, and selenium in surface soil was evaluated by comparing 0 – 2 foot soil concentrations to direct exposure screening values. This was accomplished by comparing the site-wide soil UCL that incorporates both the historic data in addition to the newly collected RI data to USEPA's Eco-SSLs for plants and soil invertebrates.

Invertebrate and plant tissue concentrations of COIs were compared to CBRs for potential adverse effects. Invertebrate tissue concentrations were evaluated on a DU-specific basis based on the samples collected as part of the RI. Ratios between invertebrate tissue concentrations of COIs and sediment concentrations of COIs were used to calculate site-specific bioaccumulation factors (BAFs). These site-specific BAFs were multiplied times sediment PECs to calculate CBRs to compare to the invertebrate tissue concentrations of COIs from samples collected in the DUs. Similarly, the site-specific ratios of plant tissue to sediment COI concentrations were used to calculate site-specific BAFs for plant uptake of COIs. These site-specific BAFs were multiplied times plant Eco-SSLs to calculate CBRs to compare to the plant tissue concentrations of COIs from samples collected from the DUs.

Risks to birds and mammals were evaluated through food web modeling. Intake doses for birds and mammals were calculated using UCL concentrations for sediment, soil and/or biota (vegetation or invertebrate tissue, as appropriate) aggregated on a site-wide basis using food web models. The plant and invertebrate BAFs calculated for sediment (from the DU data collected in the RI) were used to estimate site-specific vegetation and invertebrate uptake of COIs in the terrestrial (riparian) areas outside the DUs. Following the incorporation of plant or invertebrate tissue, and soil or sediment data into the food web models, estimated exposure doses are compared to no observed adverse effect level (NOAEL)-based and lowest observed adverse effect level (LOAEL)-based TRVs to calculate hazard quotients (HQs). HQs were calculated by dividing the intake doses by the NOAELs and LOAELs. The magnitude of NOAEL and LOAEL exceedance can be related to the level of organization to be protected in the assessment (population or individual special status species).

3.7.2 *Decision Units*

Potential risks are estimated on both a DU-specific basis and a site-wide basis for plants and invertebrates, and on a site-wide basis for birds and mammals represented by the 95% UCL on the mean. Where risks are identified, additional detail is provided in the RI to analyze the information spatially and in the context of site-specific measures of bioavailability, in order to identify risk-driving hot spots that may be targeted for risk management decision-making.

4. EXPOSURE ASSESSMENT

4.1 Data Used in the Evaluation

Site-specific data have been collected in support of the RI/FS, including:

- Wetland sediment analytical data (bulk sediment and AVS/SEM).
- Wetland vegetation tissue data (Phragmites new shoots and leaves).
- Wetland invertebrate tissue data (mixed genera).
- Surface soil analytical data.

These data were compiled into a project database that also includes vetted historical data for sediment, soil and surface water to facilitate the manipulation, sharing and reproducibility of the analyses performed. More detail on the project database, including decision criteria for vetting and incorporating historical information, is provided in the RI Report.

Biota sampling of plant and mixed invertebrate tissues provide a direct measure of COIs in items consumed by higher trophic level receptors. Measures of COIs in biological tissue, bulk soil and sediment, and whole water samples allow for the evaluation of direct toxicity to plants, aquatic and semi-aquatic biota and ingestion risk in wildlife.

4.1.1 *Site-Specific Data Considerations*

Site-wide UCLs aggregate data spatially and temporally. While the depth interval for samples collected during the RI is known, there is uncertainty with respect to the depth intervals of the historic data. For the purposes of the BERA, the project database include historic soil and sediment collected within the 0 – 2 foot depth range. Sediment samples collected during the RI were from biologically active zone between 0 – 6 inches, and soil samples from 0 – 2 feet. The RI provides additional details regarding the project database, the historic dataset, and the sample collection activities undertaken during the RI.

4.1.2 *AVS/SEM*

For the divalent metals cadmium and lead, the results of the AVS/SEM analyses can be used to determine the bioavailability of these metals in sediment, and thus their potential to exert adverse effects to benthic or litter invertebrates. For the other metals of interest (antimony, arsenic, and selenium) the ratio of the extracted metal concentration to the bulk sediment concentration can be an indicator for the fraction of bioavailable metal present.

4.2 Exposure Point Concentration Calculations

EPCs used in the food web modeling are based on a 95% UCL on the mean calculated using USEPA’s ProUCL program (v 5.1.002). The ProUCL-recommended UCL from the appropriate distribution (normal, gamma, lognormal, or nonparametric) was selected. When more than one distribution is identified as appropriate for the data set, the higher of the recommended UCLs was used. See Attachment 1 of the HHRA for 95% UCL datasets and calculations.

Both total metals and dissolved metals surface water data are available. However, the data were not paired. As a conservative measure, the higher of the total concentration and dissolved concentration in surface water was selected as the EPC for each metal.

4.3 Wildlife Dose Estimates

Receptor-specific exposure parameters including body weight, ingestion rates (IRs), and dietary composition are used in combination with EPCs to estimate average daily doses from the ingestion of dietary items (plant or prey) and water, and the incidental ingestion of sediment or soil. It was assumed that the Canada goose, red-winged blackbird, muskrat and kestrel are exposed in the emergent wetland areas associated with sediment exposure, and that the robin, shrew and kestrel are exposed in the terrestrial (riparian) areas near the edges of the wetlands associated with soil exposure.

4.3.1 *Exposure Input Parameters*

The USEPA’s Wildlife Exposure Factors Handbook was used as the primary reference for exposure assumptions. Additional sources were used to supplement exposure assumptions as necessary. Exposure parameters for each receptor scenario are presented in Attachment B. Most parameter values are selected to represent the central tendency of the data using mean, geometric mean, or median estimates. Additional details are provided in the following subsections.

4.3.1.1 Food Ingestion Rates

The food ingestion rates (FIR) for all receptors except the red-winged blackbird were taken from the species profile in USEPA's Wildlife Exposure Factors Handbook. These rates were generally based on estimations using metabolic rate, energy content of the diet, and assimilation efficiency. The FIR for the red-winged blackbird was taken from U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM 2004) Development of Terrestrial Exposure and Bioaccumulation Information for the Army Risk Assessment Modeling System (ARAMS). The FIR for the blackbird was estimated using an allometric FIR equation by Nagy (1987). The allometric estimate includes an assumption about the relationship between body weight and IR based on metabolic rate data, and is commonly used when species-specific is not available. Species-specific values for FIR are presented below.

Receptor	Food Ingestion Rate (kg/kg BW/d)
Canada Goose	0.031
Muskrat	0.3
Red-Winged Blackbird	0.12
American Robin	1.21
Short-Tailed Shrew	0.555
American Kestrel	0.3

4.3.1.2 Soil and Sediment Ingestion Rates

Ingestion (intentional and incidental) of soil and sediment is an exposure pathway for wildlife receptors. Beyer, et al. (1994) has published soil/sediment ingestion rates (presented as a dry weight percentage of diets) for 28 species estimated from the acid-insoluble ash content of wildlife scats adjusted for digestibility and soil mineral content. Where a soil/sediment ingestion value from Beyer, et al (1994) was not available for a measurement receptor, a surrogate value was used based on the available species studied. Soil ingestion rates for the red-winged blackbird was obtained from USACHPPM (2004). Soil ingestion rates for the shrew was obtained from USEPA (2007a). The absorbed dose from soil/sediment ingestion is calculated using the sediment exposure concentration, soil/sediment rate (percentage), and receptor food ingestion rate. Receptor-specific soil/sediment ingestion rates are presented below.

Receptor	Soil/Sediment Ingestion Rate (%)	Reference Source
Canada Goose	8.2	Beyer et al. (1994)
Muskrat	9.4	Beyer et al. (1994); surrogate Opossum
Red-Winged Blackbird	9.3	USACHPPM (2004)
American Robin	10.4	Beyer et al. (1994); surrogate American Woodcock
Short-Tailed Shrew	1.1	USEPA (2007); mean value
American Kestrel	0	As specified in Work Plan; Assumed negligible based on diet

4.3.1.3 Water Ingestion Rates

The water ingestion rate (IR) was calculated using Equations 3-15 (for bird) and 3-17 (for mammals) taken from the Wildlife Exposure Factors Handbook (USEPA 1993), which are based on allometric equations developed by Calder and Braun (1983) using body weight (BW). The equations for water ingestion rate are:

Birds: IR_{water} (L/day) = 0.059 x $BW^{0.67}$

Mammals: IR_{water} (L/day) = 0.099 x $BW^{0.90}$

Rates were converted to L/kg (liters per kilogram) BW/day by dividing by the body weight. Body weight (kilograms [kg]) was assigned based on the average body weight for adult females and adult males.

A summary of receptor-specific water ingestion rates is presented below.

Receptor	Water Ingestion Rate (L/d)	Body Weight (kg)	Water Ingestion Rate (L/kg BW/d)
Canada Goose	0.146	3.88	0.038
Muskrat	0.114	1.17	0.097
Red-Winged Blackbird	0.00866	0.057	0.152
American Robin	0.0110	0.081	0.135
Short-Tailed Shrew	0.00253	0.017	0.149
American Kestrel	0.0143	0.12	0.119

4.3.1.4 Dietary Composition

Dietary composition was modeled as a simplified diet providing conservative estimates for the feeding guild as indicated in the WP. The Canada goose and muskrat were modeled as consuming 100% plants. The red-winged blackbird, American robin, and short-tailed shrew were modeled as consuming 100% invertebrates. The American kestrel was modeled as consuming 100% mammals. Actual diets for these receptors and others represented by the feeding guild may be less than 100% of the modeled food item.

4.3.1.5 Exposure Modifying Factor

Exposure modifying factors (EMF) may include bioavailability, home range, mobility, and life-cycle attributes. Two common EMFs rely on an area use factor (AUF) or a temporal factor (TF) concept. An AUF is the ratio of the home range (feeding/foraging range) to the affected area. Receptor home ranges were obtained from the Wildlife Exposure Factors Handbook (USEPA 1993), except for the red-winged blackbird, which was obtained from the USACHPPM document (2004). The only receptor species with home ranges larger than the area of OU2 (79 acres or 32 hectares) are the Canada goose and American kestrel; thus, a site-specific AUF less than one based on ratio of home range to Site area was used for these species. A TF may take into consideration migration or other temporal activity patterns. To be conservative the food web modeling assumed that receptors are present year-round (i.e., TF = 1) and COIs are 100% bioavailable. Bioavailability, AUF and TF values may realistically range from zero to one. A summary of home ranges and AUFs for the Canada good and American kestrel is presented below.

Receptor	Home Range (hectares)	AUF
Canada Goose	983	0.033
American Kestrel	154	0.208

4.3.1.6 Bioaccumulation Factors

To estimate food-chain transfer and bioaccumulation potential for species whose food web is associated with terrestrial (riparian) soil, site-specific BAFs were utilized. Site-specific soil-to-plant and soil-to-invertebrate BAFs for COIs were developed based on sediment, plant, and invertebrate concentrations in samples collected from the eight DUs. BAFs were based on average sediment concentrations measured in each DU compared to the DU-specific plant and invertebrate concentration.

For food web modeling based on sediment-associated exposure, plant and invertebrate BAFs were not necessary as plant leaf tissue concentration and invertebrate tissue concentrations were directly measured. Because hervivorous species (goose and muskrat) may consume roots of *Phragmites* in addition to new shoots and leaves, a root concentration was estimated from the leaf data using a root/leaf ratio identified in the literature. A conservative root/leaf ratio of 1 was used for antimony, arsenic, and selenium because no specific literature was located on the distribution of these COIs in *Phragmites*, and in fact, data from Bonanno (2011) indicated that there was no uptake of these COIs in *Phragmites australis* from sediment. A root/leaf ratio of 6.2 for cadmium and 18.6 for lead was calculated based an average of data from two studies (Duman et al. 2007; Vymazal et al. 2007) related to the distribution of these COIs in *Phragmites australis*.

To model the uptake of COIs into small mammal tissue consumed by kestrel, soil/sediment-to-mammal BAFs for COIs were based on equations provided in USEPA's (2005, 2007b) Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs).

4.3.2 *Calculation of Dose*

Food chain exposure to measurement receptors was modeled using oral daily dose to estimate uptake of COIs via ingestion of food items and media (i.e., soil, sediment, and surface water, as applicable). The equation for oral daily dose is:

$$Dose = [Soil/Sediment_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + \left[\sum_i^N B_i \times P_i \times FIR \times AF_{ai}\right]) \times AUF$$

Soil/Sediment a = Concentration of analyte a (COI a) in soil/sediment (mg/kg dry weight)

Water a = Concentration of analyte a (COI a) in water (mg/L)

N = Number of different biota types in diet (food types)

B i = Analyte a (COI a) in biota type (i) (mg/kg dry weight)

P i = Proportion of biota type (i) in diet

FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight

WIR = Water ingestion rate (L/kg BW [wet weight]/day)

AF ai = Absorbed fraction of analyte a (COI a) from biota type (i); default of 1

AF as = Absorbed fraction of analyte a (COI a) from soil (s); default of 1

Ps = Soil ingestion as a proportion of diet

AUF = Area use factor ([home range factor] and [temporal factor, TF])

Exposure doses for each receptor are presented in Attachment B.

5. ECOLOGICAL EFFECTS ASSESSMENT

The ecological effects assessment links concentrations of COIs to adverse effects in receptors. Ecological effects of most concern are generally those that affect populations (or higher levels of biological organization). These include adverse effects on development, reproduction, and survivorship. Community level effects also can be of concern, but toxicity data on community-level receptors is generally limited. A combination of literature sources and field studies were used to provide the information for demonstrating this association.

5.1 Wildlife Toxicity Reference Values

For the purposes of modeling chronic exposure to wildlife, TRVs were derived using the USEPA-vetted mammalian and avian NOAEL and LOAEL datasets for reproduction and growth endpoints as tabulated by USEPA for each COI in their Eco-SSL documentation (2005a, 2005b, 2005c, 2005d, 2007c). These NOAEL and LOAEL studies were used by USEPA to calculate Eco-SSLs. Endpoints based on mortality were not used in the calculation of the TRVs in this BERA because lethal effects predominantly occur at concentrations greater than those that elicit chronic, sub-lethal effects, and their inclusion would result in a less conservative TRV. The geometric mean of the bounded values (NOAEL and LOAEL values experimentally derived from within the same study) for reproduction and growth was used to represent the TRV. NOAEL and LOAEL studies from the USEPA Eco-SSL documents and calculated geometric mean TRVs based on bounded NOAEL and LOAEL values for reproduction and growth are presented in Attachment C. NOAEL and LOAEL studies with mortality endpoints are shown for completeness, but as discussed above, not included in the geometric mean calculations for TRVs.

According to USEPA, NOAEL and LOAEL values in the Eco-SSL documents are derived from a pooled dataset of available toxicological values, judged to be of sufficient quality, across multiple studies, test species, and endpoints. As such, on a milligram (mg) contaminant per kilogram (kg) body weight per day basis, they are applicable to any selected receptor species without adjustment (i.e., allometric body scaling is not necessary).

Analyte	Units	Mammalian NOAEL TRV	Mammalian LOAEL TRV	Avian NOAEL TRV	Avian LOAEL TRV
Antimony	mg/kg bw/day	3.27	15.9	NA	NA
Arsenic	mg/kg bw/day	4.48	10.0	2.24	4.51
Cadmium	mg/kg bw/day	1.86	9.17	1.46	5.88
Lead	mg/kg bw/day	34.9	137	7.33	42.7
Selenium	mg/kg bw/day	0.404	0.843	0.593	1.39

NOAEL and LOAEL avian TRVs for antimony were not identified in the antimony Eco-SSL document, or the literature (USEPA 2005a). Therefore, antimony in birds could not be quantitatively evaluated.

5.2 Sediment Toxicity Thresholds

5.2.1 *Probable Effect Concentrations*

The PECs were developed from published sediment quality guidelines and identify contaminant concentrations above which adverse biological effects to sediment-dwelling organisms are likely to occur

(MacDonald et al. 2000). As such, PECs were used as sediment toxicity thresholds for benthic/litter macroinvertebrates and as a surrogate for potential toxicity to amphibians/reptiles that may be associate with wetland sediment (e.g., the green frog, painted turtle, etc.). The use of PECs to evaluate potential effects to biota in sediment, while less conservative than the use of threshold effect concentrations, is appropriate at former industrial Sites located in an urbanized region such as the former USS Lead facility.

5.2.2 *AVS/SEM*

The discrete sediment samples collected from the DUs were analyzed for AVS, SEM metals (cadmium, copper, lead, nickel, silver, and zinc), and fraction of organic carbon (f_{oc}). The AVS/SEM method predicts the toxicity divalent metals pose to benthic organisms by utilizing the causal link between toxicity and bioavailability (USEPA 2005e). The stoichiometry of the uptake of divalent metals by AVS is such that one mole of AVS will stabilize one mole of SEM. Predicted sediment toxicity of cadmium, copper, lead, nickel, silver, and zinc to benthic invertebrates is estimated as:

- Likely bioavailability when (∑SEM - AVS) / f_{oc} is >3,000 micromoles per gram of organic carbon (µmol/g_{oc});
- Uncertain bioavailability when (∑SEM - AVS) / f_{oc} is between 130 and 3,000 µmol/g_{oc};
- Unlikely bioavailability when (∑SEM - AVS) / f_{oc} is < 130 µmol/g_{oc}.

It should be noted that of SEM metals, only cadmium and lead are Site-specific COIs. However, as part of the RI, antimony and arsenic in sediment were also subjected to the SEM extraction procedure as a means of making a conservative estimate of the bioavailability for these metals of concern. These estimates were based on the ratio of the extracted metal concentration to the total bulk sediment concentration.

5.3 Soil Toxicity Thresholds

USEPA Eco-SSLs were used as soil toxicity thresholds (2005a, 2005b, 2005c, 2005d, 2007c). Eco-SSLs are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with and/or consume biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. However, because wildlife (birds and mammals) are being evaluated separately using food web models, the Eco-SSLs for these receptors were not used. Consequently, Eco-SSLs for plants and invertebrates were the primary toxicity thresholds used for terrestrial soils.

Because plants such as *Phragmites* and other rooted vascular plants are not true aquatic plants, the Eco-SSLs for plants were also used to compare to sediment COI concentrations as a conservative threshold for potential effects to vascular plants in wetland sediment.

5.4 Surface Water Toxicity Thresholds

USEPA AWQC were used as surface water toxicity thresholds (2002). The USEPA bases Aquatic Life AWQC on how much of a chemical can be present in surface water before it is likely to harm plant and animal life. The USEPA designs aquatic life criteria to protect freshwater organisms from both short-term and long-term exposure. Aquatic Life AWQC – Criterion Continuous Concentrations were used as toxicity thresholds for aquatic biota and as a surrogate for potential toxicity to amphibians/reptiles that may be associate with surface water at the Site (e.g., the green frog, painted turtle, etc.). AWQC- Criterion Continuous Concentrations were compared to surface water concentrations with an assumed hardness of 100 mg/L Calcium carbonate for hardness dependent metals (cadmium, lead). Historic surface water data included a combination of total and dissolved metals concentrations values. Dissolved concentrations were used where available, but if only total metals was available, that value was used as a conservative measure.

5.5 Tissue Residue Toxicity Thresholds

Because Site-specific BAFs are available for plants and benthic/litter invertebrates, tissue residue toxicity thresholds (also termed CBRs) were derived as the product of the toxicity thresholds for these receptors in sediment and the BAF (under the assumption that body burdens resulting from exposure at sediment threshold concentrations are tolerated without appreciable effect). BAFs were based on average bulk sediment concentrations measured in each DU compared to the DU-specific plant and invertebrate concentration. There is a high degree of uncertainty in the relying on default literature-based soil/sediment toxicity thresholds for this calculation due to the high degree of variability in effect concentrations for metals resulting from Site-specific conditions, especially conditions that do not favor metal bioavailability. Therefore, although CBRs were developed for plants and benthic/litter invertebrate tissues to avoid a data gap, the overall confidence in these values is low.

6. RISK CHARACTERIZATION

Per USEPA guidance (USEPA 1997), the risk characterization is the final evaluation phase of the ecological risk assessment. The risk characterization integrates the analyses from the exposure assessment and ecological effects assessment to form overall conclusions regarding potential ecological risk at OU2. Uncertainties associated with methodological assumptions, and the strengths and limitations of the analyses underlying the risk estimates are also be presented in the BERA risk characterization.

Food web risks are estimated using the HQ approach described above on a site-wide basis for each receptor-media pair. The HQ is calculated as the ratio of the intake dose to the TRV (HQ = Dose/TRV). An HQ less than or equal to 1 indicates that exposure to the COI is unlikely to result in adverse ecological effects. For the purposes of bracketing the risk estimates, HQs are calculated using both the NOAEL TRVs and the LOAEL TRVs. NOAEL-based HQs less than 1 indicate that adverse effects for the specified receptor-media pair are unlikely. LOAEL-based HQs greater than 1 indicate there is a potential for COI exposure to result in adverse effects; however, these potential risks require further characterization using a weight-of-evidence approach that integrates factors such as site-specific bioavailability and other pertinent factors.

The magnitude and spatial distribution of antimony, arsenic, cadmium, lead, and selenium concentrations, in combination with the results of the habitat survey and wetland delineation tasks of the RI Field Program, are used to understand if there are interactions between the southern wetland area in OU2 and adjacent ESAs. In DUs or discrete areas outside the DUs where metal HQs are low and spatially isolated, it may be concluded that potential site-related ecological exposures in adjacent ESAs are low.

6.1 Plant and Invertebrate Receptors in Sediment

The comparison of sediment COI concentrations to toxicity thresholds for plants and invertebrates exposed to sediment on-Site is provided below.

COI	ISM Sample Average Sediment Concentration (3 samples per DU)								Site-Wide Sediment				PEC	Plant Eco-SSL
									ISM			Discrete		
	DU1	DU2	DU3	DU4	DU5	DU6	DU7	DU8	Max	Mean	UCL	UCL		
Antimony	49	29	13	14	34	28	14	46	51	29.1	32.1	51.37	25	--
Arsenic	367	323	263	233	570	340	187	297	590	320.2	341.1	94.4	33	18
Cadmium	13	4.9	6.6	7.5	18	59	32	59	65	24.6	25.7	3.458	5	32

Lead	1060	517	333	353	700	840	640	1600	1800	776.4	829.1	440.9	128	120
Selenium	3.1	5.6	6.3	5.0	10.3	6.2	3.4	5.8	11	5.8	6.2	1.656	2.9 (R4)	0.52

Notes:

Concentrations are in mg/kg-dry

R4 = EPA Region 4 (R4) refinement screening level used because a PEC for selenium is not available (USEPA R4, 2018)

Max: Maximum concentration

UCL: 95% Upper Confidence Limit on the mean concentration

Mean: Mean concentration associated with UCL and data distribution

Exceedances of the PECs are noted for antimony in DU1, DU2, DU5, DU6, and DU8 sediment; however, these exceedances are relatively marginal in that sediment concentrations in these DUs are less than two times the PEC. Exceedances of the PECs for the remaining COIs occur across all DUs (except for cadmium at DU2) in varying degrees, with arsenic exceeding the PEC by the largest magnitude. This is also the case when sediment is evaluated on a Site-wide basis compared to the PEC. Similarly, the plant Eco-SSL for arsenic is exceeded by the largest magnitude on a DU-specific or Site-wide basis, followed by lead and selenium. It should be noted that the Eco-SSLs are conservative default screening levels that do not incorporate any Site-specific information, and are not intended for use as potential remediation standards.

AVS/SEM can also inform the potential for toxicity to benthic organisms from divalent metals in sediment. The results of the AVS/SEM analyses are provided in Table 7.4-2 (RI Report) and depicted in Figure 1 below.

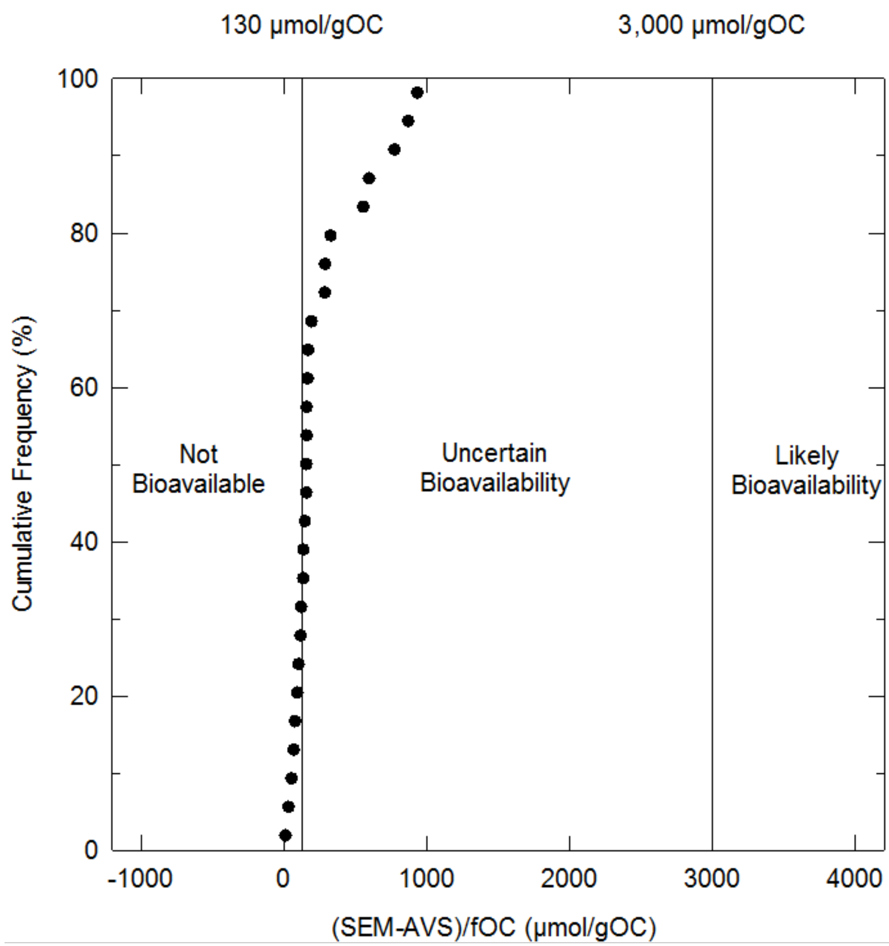

Figure 1: Cumulative Frequency Plot of the Organic Carbon-Normalized Excess SEM

The results show that the SEM metals range from being largely not bioavailable to the low-end of uncertain bioavailability.

Bioavailability is also estimated using bulk sediment and metals extraction results for antimony, arsenic, cadmium and lead, which indicate that the bioavailability of non-divalent metals (i.e., antimony and arsenic) is limited: <1% to approximately 70% for antimony and approximately 2 to 75% for arsenic. Bioavailability calculations based on concentrations in bulk sediment and SEM extraction for each sample within the 8 DUs are presented in Attachment D. For antimony, the highest single sample bioavailability estimate (69%) was associated with DU8. Two other ISM sample results for DU8 show little antimony bioavailability (1% and 2%) within DU8. For arsenic, the upper range bioavailability estimate of 75% was associated with a single ISM result from DU1. A second ISM sample result in DU1 shows that arsenic bioavailability within DU1 can be as low as 5%. Using data for all 24 ISM samples collected across 8 DUs, geometric mean bioavailability of 5% for antimony and 14% for arsenic support limited adverse effects to benthic invertebrates (and plants) due to limited bioavailability.

6.2 Plant and Invertebrate Receptors in Soil

The comparison of soil COI concentrations to toxicity thresholds for plants and invertebrates exposed to soil on-Site is provided below.

COI	Site-Wide Soil			Invert	Plant
	Max	Mean	UCL	Eco-SSL	Eco-SSL
Antimony	210	29.9	51.37	78	--
Arsenic	630	51.9	94.4	NA	18
Cadmium	14	2.445	3.458	140	32
Lead	1800	262.1	440.9	1700	120
Selenium	5.8	0.97	1.656	4.1	0.52

Notes:
Concentrations are in mg/kg-dry.
Max: Maximum concentration
UCL: 95% Upper Confidence Limit on the mean concentration
Mean: Mean concentration associated with UCL and data distribution

Based on the site-wide mean and UCL soil concentrations, there are exceedances of the plant Eco-SSL for arsenic, lead, and selenium. In contrast, there are no exceedances of the invertebrate Eco-SSLs for any of the COIs based on Site-wide soil means or UCLs. As noted previously, the Eco-SSLs are conservative default screening levels that do not incorporate any Site-specific information, and are not intended for use as potential remediation standards.

6.3 Sediment-Associated Plant Tissue

The comparison of plant tissue COI concentrations to toxicity thresholds (CBRs) for plants associated with sediment in the southern wetland area DUs is provided below.

COI	DU1	DU2	DU3	DU4	DU5	DU6	DU7	DU8	DU Max	DU Mean	DU UCL	Plant Eco-SSL	Sediment-to-Plant Leaf BAF	Plant CBR
Antimony	0.1	0.1	0.105	0.1	0.105	0.1	0.1	0.1	0.105	0.101	0.103	--	0.0048	---
Arsenic	0.11	0.22	0.56	0.11	0.091	0.051	0.056	0.1	0.56	0.16	0.37	18	0.0006	0.011
Cadmium	0.033	0.05	0.05	0.05	0.055	0.049	0.036	0.049	0.055	0.047	0.052	32	0.0043	0.138
Lead	0.068	0.063	0.26	0.15	0.51	0.035	0.099	0.055	0.51	0.16	0.26	120	0.0003	0.037
Selenium	0.255	0.25	0.26	0.25	0.265	0.245	0.25	0.245	0.27	0.25	0.26	0.52	0.0520	0.027

Notes:
Concentrations are in mg/kg-wet, except Plant Eco-SSL which is in mg/kg-dry
Max: Maximum concentration
UCL: 95% Upper Confidence Limit on the mean concentration
Mean: Mean concentration associated with UCL and data distribution

Based on the site-wide UCL plant tisue concentrations, there are exceedances of the plant tissue CBRs for arsenic, lead, and selenium. As noted, there is a high degree of uncertainty in the relying on conservative default Eco-SSLs for this calculation due to the high degree of variability in effect concentrations for metals resulting from Site-specific conditions, especially conditions that do not favor metal bioavailability. Therefore, the overall confidence in the results of this screening evaluation is low.

6.4 Sediment-Associated Invertebrate Tissue

The comparison of invertebrate tissue COI concentrations to toxicity thresholds (CBRs) for invertebrates associated with sediment in the southern wetland area DUs is provided below.

COI	DU1	DU2	DU3	DU4	DU5	DU6	DU7	DU8	DU Max	DU Mean	DU UCL	PEC	Sediment-to-Invertebrate BAF	Invert-ebrate CBR
Antimony	0.76	0.33	0.95	0.69	1	0.59	0.18	1.6	1.6	0.763	1.057	25	0.0330	0.825
Arsenic	8.8	27	40	9.8	12	11	4.1	170	170	35.34	119.1	33	0.1200	3.960
Cadmium	0.46	0.094	0.11	0.044	0.039	0.021	0.062	0.087	0.46	0.115	0.297	5	0.0110	0.055
Lead	8.2	3.8	9.6	7.3	8.6	12	2.7	17	17	8.65	11.68	128	0.0140	1.792
Selenium	0.56	0.57	0.72	0.65	0.79	0.47	0.46	0.58	0.79	0.6	0.677	2.9	0.1200	0.348

Notes:

Concentrations are in mg/kg-wet, except PEC which is in mg/kg-dry

Max: Maximum concentration

UCL: 95% Upper Confidence Limit on the mean concentration

Mean: Mean concentration associated with UCL and data distribution

Based on the site-wide mean and UCL invertebrate tissue concentrations, there are exceedances of the invertebrate tissue CBRs for all COIs. Arsenic in DU sediment exceeds the CBR by the greatest margin. As noted, there is a high degree of uncertainty in the relying on literature-based thresholds for this calculation due to the high degree of variability in effect concentrations for metals resulting from site-specific conditions, especially conditions that do not favor metal bioavailability. Therefore, the overall confidence in the results of this screening evaluation is low.

6.5 Aquatic Biota Receptors in Surface Water

The comparison of surface water COI dissolved concentrations to AWQC for aquatic biota receptors exposed to surface water on-Site is provided below.

COI	Site-Wide Max	Site-Wide Mean	Site-Wide UCL	Site-Wide Num Ds	Site-Wide Num NDs	Chronic AWQC
Antimony	0.13	0.02259	0.0385	17	5	0.19
Arsenic	0.61	0.1052	0.1637	24	0	0.15
Cadmium	0.0012	0.000496	0.000585	7	17	0.00079
Lead	0.041	0.005945	0.01123	14	10	0.0032
Selenium	0.012	0.003648	0.004768	3	18	0.005

Notes:

Concentrations are in mg/L

Max: Maximum concentration

UCL: 95% Upper Confidence Limit on the mean concentration

Mean: Mean concentration associated with UCL and data distribution

Based on the site-wide mean and UCL surface water concentrations, two COIs exceed the AWQC, arsenic and lead. The arsenic exceedance is minor, with the UCL being slightly greater than the chronic AWQC (0.16 mg/L vs. 0.15 mg/L) and the mean not exceeding the AWQC. Ten of 24 lead results were non-detect. The mean and UCL for lead are skewed by two upper end concentrations, 0.041 mgL collected on 1/22/2020 in the open water wetland canal and 0.020 mg/L collected on 3/26/2007 in the open water wetland area A. Subsequent and more recent surface water sampling results in the open water wetland former canal and open water wetland area A do not confirm these concentrations. Based on these considerations, surface water COI concentrations do not pose a risk to aquatic biota receptors.

6.6 Semi-Aquatic Wildlife Receptors

The semi-aquatic wildlife receptors evaluated in the BERA included:

- Muskrat (mammalian herbivore)
- Canada Goose (avian herbivore)
- Red-Winged Blackbird (avian invertivore)
- American Kestrel (avian carnivore)

The American Kestrel (avian carnivore) was modeled as a representative species in both the semi-aquatic and terrestrial food web models in order to understand potential risks to raptors that may feed predominantly in either the wetland habitats or the riparian habitats on-Site. The results of the food web modeling for semi-aquatic wildlife receptors are presented below.

6.6.1 *Avian Wildlife*

HQs calculated for semi-aquatic avian wildlife are presented below for exposure to OU2 sediment and surface water. HQs are presented separately for site-wide discrete (0-2') sediment samples and ISM (0-6") sediment samples.

Site-Wide Sediment (Discrete) and Surface Water:

COI	Receptor Species					
	Canada Goose		Red-Winged Blackbird		American Kestrel	
	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	NA	NA	NA	NA	NA	NA
Arsenic	0.0533	0.0265	13.4	6.68	0.085	0.0422
Cadmium	0.00175	0.000435	0.24	0.0595	0.0589	0.0146
Lead	0.0153	0.00262	2.17	0.372	0.219	0.0376
Selenium	0.00247	0.00105	0.406	0.173	0.184	0.0786

Site-Wide Sediment (ISM) and Surface Water:

COI	Receptor Species					
	Canada Goose		Red-Winged Blackbird		American Kestrel	
	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	NA	NA	NA	NA	NA	NA
Arsenic	0.013	0.00647	8.1	4.02	0.0277	0.0138
Cadmium	0.00161	0.0004	0.221	0.0549	0.0563	0.014
Lead	0.00986	0.00169	1.45	0.249	0.179	0.0308
Selenium	0.00134	0.000571	0.255	0.109	0.136	0.058

NOAEL-based HQs are above one for arsenic and lead exposure to avian invertivores that may consume insects as they emerge from wetland sediment. Only the LOAEL-based HQ for arsenic exceeds one for these receptors. There are no risks identified for migratory birds including herbivorous fowl and raptors related to Site exposure. It should be noted that the potential risk to avian invertivores is likely overestimated due to conservative input assumptions used in the modeling, including the assumption that these birds will spend 100% of their time annually both feeding and reproducing within the on-Site habitats. In addition, it is assumed that a proportion of the invertivores diet is incidentally ingested sediment, which is unlikely to be a complete exposure pathway in the dense stands of *Phragmites* that dominate the Site's wetland habitats. The potential risk to red-winged blackbirds from arsenic is primarily through the diet (~47% to 79%, discrete and ISM sediment, respectively) via the consumption of benthic/litter invertebrate tissue (emergent insect tissue concentrations are assumed to be equal to benthic/litter invertebrate tissue concentrations).

6.6.2 *Mammalian Wildlife*

HQs calculated for semi-aquatic mammal are presented below for exposure to OU2 sediment and surface water. HQs are presented separately for site-wide discrete (0-2') sediment samples and ISM (0-6") sediment samples.

Site-Wide Sediment (Discrete) and Surface Water:

COI	Receptor Species	
	Muskrat	
	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	2.08	0.428
Arsenic	8.96	4.01
Cadmium	0.458	0.0928
Lead	1.07	0.274
Selenium	1.19	0.569

Site-Wide Sediment (ISM) and Surface Water:

COI	Receptor Species	
	Muskrat	
	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	0.287	0.059
Arsenic	2.18	0.975
Cadmium	0.42	0.0853
Lead	0.693	0.176
Selenium	0.627	0.301

NOAEL-based HQs are above one for discrete sediment antimony, arsenic, lead and selenium exposure to mammalian herbivores that may consume plants growing in the wetland sediments. Only the LOAEL-based HQ for arsenic exceeds one for these receptors. Potential risk from arsenic exposure on a Site-wide basis is driven by the incidental ingestion of sediment (~99% to 100%, discrete and ISM sediment, respectively), because only low concentrations of metals were observed in *Phragmites* tissue. The Site-wide discrete sediment UCL includes historic sampling data from outside of the DUs.

When considering the more representative site-wide ISM sediment results, all NOAEL and LOAEL-based HQs are less than one, except for arsenic. Arsenic NAOEL-based HQ was greater than one but not the LOAEL-based HQ.

6.7 Terrestrial (Riparian) Wildlife Receptors

The terrestrial (riparian) wildlife receptors evaluated in the BERA included:

- American Robin (avian invertivore)
- Short-Tailed Shrew (mammalian invertivore)
- American Kestrel (avian carnivore)

The American Kestrel (avian carnivore) was modeled as a representative species in both the semi-aquatic and terrestrial food web models in order to understand potential risks to raptors that may feed predominantly in either the wetland habitats or the riparian habitats on-Site. The results of the food web modeling for terrestrial (riparian) wildlife receptors are presented below.

6.7.1 *Avian Wildlife*

HQs for terrestrial (riparian) avian wildlife are presented below for site-wide soil (0-2') and surface water.

COI	Receptor Species			
	American Robin		American Kestrel	
	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	NA	NA	NA	NA
Arsenic	11.1	5.53	0.0109	0.0054
Cadmium	0.324	0.0803	0.0218	0.00542
Lead	8.55	1.47	0.136	0.0233
Selenium	0.746	0.318	0.0837	0.0357

NOAEL-based HQs are above 1 for arsenic and lead exposure to avian invertivores that may consume invertebrates in terrestrial (riparian) soil. The LOAEL-based HQs for arsenic and lead also exceed 1 for these receptors. There are no risks identified for migratory raptors related to Site exposure. It should be noted that the potential risk to avian invertivores is likely overestimated due to conservative input assumptions used in the modeling, including the assumption that these birds will spend 100% of their time annually both feeding and reproducing within the on-Site habitats. The potential risk to American robins from arsenic is primarily through the diet (~53%) via the consumption of soil invertebrate tissue (where it is presumed that the uptake of metals in terrestrial (riparian) soil by invertebrates is equal to that observed for benthic/litter invertebrates in sediment). Whereas, the potential risk to American robins from lead is primarily through the incidental ingestion of soil (~88%), resulting from an EPC based on the Site-wide UCL for lead (440.9 mg/kg). If the EPC for avian invertivores was based on the average lead concentration from samples collected during the RI alone (2018 and 2019), the LOAEL-based HQ would be acceptable (1).

6.7.2 *Mammalian Wildlife*

HQs for terrestrial (riparian) mammal are presented below for site-wide soil (0-2') and surface water.

COI	Receptor Species	
	Short-Tailed Shrew	
	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	0.385	0.0791
Arsenic	1.48	0.663
Cadmium	0.0211	0.00428
Lead	0.174	0.0444
Selenium	0.294	0.141

NOAEL-based HQs are above 1 for arsenic exposure to mammalian invertivores that may consume invertebrates in terrestrial (riparian) soil. No LOAEL-based HQs exceed one.

6.8 Overall Findings

Potential wildlife risks are noted for the following receptor-media pairs based on NOAEL-based HQs greater than one (1):

- Avian invertivores ingesting arsenic (HQ=13.4) and lead (HQ=2.17) in sediment and sediment-associated prey (represented by the red-winged blackbird);
- Avian invertivores ingesting arsenic (HQ=11.1) and lead (HQ=8.55) in soil and soil-associated prey (represented by the American robin);
- Mammalian herbivores ingesting antimony (HQ=2.08), arsenic (HQ=8.96), lead (HQ=1.07), and selenium (HQ=1.19) in sediment and sediment-associated plants (represented by the muskrat); and
- Mammalian herbivores ingesting arsenic (HQ=1.48) in soil and soil-associated plants (represented by the short-tailed shrew).

Potential wildlife risks are noted for the following receptor-media pairs based on LOAEL-based HQs greater than one (1);

- Avian invertivores ingesting arsenic (HQ=6.68) in sediment and sediment-associated prey (represented by the red-winged blackbird);
- Avian invertivores ingesting arsenic (HQ=5.53) and lead (HQ=1.47) in soil and soil-associated prey (represented by the American robin); and
- Mammalian herbivores ingesting arsenic (HQ=4.01) in sediment and sediment-associated plants (represented by the muskrat).

As would be anticipated, with respect to the potential for adverse effects to plant and invertebrate receptors, there are exceedances of default literature-based toxicity thresholds (or site-specific CBRs that rely on such thresholds) for COIs measured in sediment, soil, and biological tissue. The results of the AVS/SEM analyses, and the antimony and arsenic extraction tests (Section 6.1), demonstrate that conditions are present in the southern wetlands that limit metal bioavailability and thus their potential to exert adverse effects to benthic invertebrates (and plants). This conclusion is supported by the relatively low uptake of COIs in plant tissue, and largely the invertebrate tissue as well. However, the uptake of arsenic from sediment into invertebrate tissue is occurring and underlies potential wildlife risk for invertivorous receptors. Site-wide surface water does not present potential risk to aquatic biota.

7. UNCERTAINTY EVALUATION

Uncertainties may arise at every step of a risk assessment, and may influence conclusions about the nature and extent of the risks estimates, or general conclusions drawn in the BERA. Risk assessments are not intended to estimate actual risks to a receptor associated with exposure to chemicals in the environment. In fact, estimating actual risks is impossible because of the variability in the exposed or potentially exposed populations. Therefore, risk assessment is a means of estimating the probability that an adverse effect (e.g., impaired reproduction) will occur in a receptor. There are numerous conservative assumptions used in risk assessments, which in general guards against the underestimation of wildlife risk. This section presents a qualitative discussion of the uncertainties associated with the BERA for OU2 at the USS Lead facility.

Risk estimates are calculated by combining Site data, assumptions about wildlife receptor exposures to media, and toxicity data. The uncertainties with performing these calculations in this risk assessment can be grouped into the following categories:

- Uncertainties in environmental sampling and data representativeness;
- Uncertainties related to assumptions in receptor exposures; and
- Uncertainties in toxicity thresholds.

The uncertainties associated with each of the categories are discussed below.

7.1.1 *Environmental Sampling and Data Representativeness*

The BERA is based on the sampling results obtained from multiple investigations over time. A significant component of the current RI/FS was to consolidate valid historic sampling data with data collected during the RI, to form a project database sufficient to characterize current Site conditions. Although every effort was made to include only valid historic data, unquantifiable errors related to data handling prior to the current RI/FS may be transferred to the project database. The potential impact of such errors on the risk estimates are unknown, but are likely to be low. The current RI sampling locations were selected to investigate the portions of the southern wetland area not previously sampled in order to complete the characterization of the Site with respect to the COI; therefore, the sampling and analysis data should be sufficient to characterize COI concentrations and distributions in OU2, and subsequently the associated potential risks.

7.1.2 *Exposure Estimates*

The exposure estimates made in the BERA are likely associated with the largest number of uncertainties. Wildlife dose estimates were based on EPCs using Site-wide datasets for soil or sediment that combines historic and current sampling data. Discrete samples were biased toward higher end concentrations as site investigation activities are focused on identification of contaminated areas. Inclusion of higher end concentrations in localized areas in the datasets used to calculate site-wide 95% UCLs may overestimate exposure across the site and potential risk to wildlife. A Site-wide exposure assumption may over- or under-estimate potential wildlife risks. Sampling depth for historic sediment and soil data was limited to the 0 – 2 foot interval, which may be appropriate for soil but not sediment, where the biologically active zone is typically limited to top six-inch interval. Limitations in the historic sediment dataset precluded a more granular representation of these sampling results. It is unknown whether this could lead to a potential over- or under-estimation of potential risks related to sediment exposure. These concerns are mitigated by the fact that acceptable EPCs in soil or sediment may be back-calculated from the food web models for each of the receptors of concern, and compared to individual sampling points or localized sampling areas as part of Risk Management analyses for the Site. It should also be noted that soil and sediment sampling collected as part of the RI within the DUs other areas in OU2 were collected from the appropriate depths, thus reducing the uncertainties associated with the historic dataset for these media.

Several features of the food web modeling are likely to result in an over-estimation of potential risk. These include the assumption that wildlife will spend 100% of their time annually both feeding and reproducing within OU2 habitats. It is expected that avian wildlife (as represented by geese, red-winged blackbirds and robins) will migrate for parts, if not all winter months when the ground is frozen and food availability is low. In addition, it is assumed that the metal COIs are 100% bioavailable upon ingestion by wildlife, which based on Site-specific AVS/SEM analyses will result in an over-estimation of potential risk. Lastly, the food web model conservatively assumes that a receptor ingests 100% of a food type representative of its feeding guild. This method produces a worst-case estimate of intake for that feeding guild, members of which in reality are likely to consume a mixture of food types in their typical diet.

A component of the food web modeling for terrestrial (riparian) receptors (robin, shrew, kestrel) included the application of soil-to-plant or soil-to-invertebrate BAFs based on Site-specific sediment-to-plant or sediment-to-invertebrate BAFs calculated as the average of the DU-specific results. The application of sediment BAFs to riparian soils in OU2 introduces uncertainty into the risk estimates for the riparian receptors, and may result in the potential over- or under-estimation of potential risks related to these exposures.

7.1.3 *Toxicity Thresholds*

Toxicity thresholds for wetland benthic/litter invertebrates were based upon consensus sediment quality guidelines representative of probable effect concentrations (MacDonald et al. 2000) and USEPA's chronic AWQC (2002). These toxicity thresholds cannot fully account for Site-specific metals bioavailability, thus risks related to exceeding these thresholds are potentially over-estimated. Toxicity thresholds for wetland/riparian plants and soil invertebrates have similar limitations. As a result of these limitations, tissue residue thresholds (i.e., CBRs) derived from these thresholds may similarly result in overly conservative estimates of potential risk. Metals in aquatic biota are highly regulated and body burdens are not consistently correlated with adverse effects; thus, there is a low degree of confidence associated with tissue-based toxicity thresholds. Toxicity thresholds identified under artificial laboratory conditions are not reflective of field conditions with complex environmental interactions. Lastly, the potential risk to amphibians and reptiles based on sediment and water toxicity thresholds is considered highly uncertain due to the uncertain applicability of these thresholds for these receptor groups.

The derivation of wildlife TRVs from animal tests is a significant source of uncertainty in a risk assessment. There may be important but unidentified differences in uptake, metabolism, and distribution of chemicals in the body between the test species and target wildlife species. Typically, animals are administered doses of a chemical in a standard diet that are higher than would be experienced in an environmental setting. Species are known to vary with respect to sensitivity to specific chemicals (USEPA 1997; Calabrese and Baldwin 1993). Ranges of sensitivity for members within a class of vertebrates are commonly up to 100-fold (Calabrese and Baldwin 1993). Although a range in sensitivity may be described, little is known about the relative chemical-specific sensitivity (and the "direction" of sensitivity) for species in the wild compared to laboratory test species.

It should be noted that wildlife TRVs for arsenic are typically based on laboratory tests using inorganic arsenic salts, and in the absence of Site-specific testing, the BERA assumes that the total arsenic measured in benthic/litter invertebrate tissue is comparable to the TRV (i.e., present in an inorganic form). However, numerous studies of arsenic bioaccumulation have shown that inorganic arsenic has a limited tendency to bioaccumulate (BAF of 1 or lower), and often greater than 90% of the arsenic in biota tissue occurs in organic forms, such as arsenobetaine, arsenocholine and dimethylarsinic acid. It is also well established that these organic forms are virtually nontoxic. Hence, total arsenic is an inaccurate measure of food chain risk if it is simply assumed that the arsenic measured in tissues is in the toxic inorganic form, and leads to a significant over-estimation of wildlife risks due to arsenic exposure.

Effects due to exposure to multiple COIs were not accounted for in this BERA. Metals are known to have synergistic, antagonistic, or neutral influence on the toxicity of other metals (Calabrese and Baldwin 1993). In several cases, the magnitude of these interactions is related to relative concentrations of the COIs. Although conservatively assumed to result in underestimates of potential risks, given the relative paucity of data for species in the wild, characterizing the magnitude of potential effects due to cumulative exposures to multiple COIs is considered speculative.

8. SUMMARY AND CONCLUSIONS

As would be anticipated, with respect to the potential for adverse effects to plant and invertebrate receptors, there are exceedances of default literature-based toxicity thresholds (or site-specific CBRs that rely on such thresholds) for COIs measured in sediment, soil, and biological tissue. The results of the AVS/SEM analyses, and the antimony and arsenic extraction tests (see Section 6.1), demonstrate that conditions are present in the southern wetlands that limit metal bioavailability and thus their potential to exert adverse effects to benthic invertebrates (and plants). Site-wide surface water presents potential risk to aquatic biota for lead exposure.

Risks to birds and mammals were evaluated through food web modeling based on estimated exposure doses compared to NOAEL-based and LOAEL-based TRVs. HQs calculated by dividing the intake doses by the NOAEL and LOAEL TRVs are summarized below.

COI	Wetland Receptor Species							
	Canada Goose		Red-Winged Blackbird		American Kestrel		Muskrat	
	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	NA	NA	NA	NA	NA	NA	2.08	0.428
Arsenic	0.0533	0.0265	13.4	6.68	0.085	0.0422	8.96	4.01
Cadmium	0.00175	0.000435	0.24	0.0595	0.0589	0.0146	0.458	0.0928
Lead	0.0153	0.00262	2.17	0.372	0.219	0.0376	1.07	0.274
Selenium	0.00247	0.00105	0.406	0.173	0.184	0.0786	1.19	0.569

Note: Sediment (Discrete) and Surface Water Exposure

COI	Wetland Receptor Species							
	Canada Goose		Red-Winged Blackbird		American Kestrel		Muskrat	
	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	NA	NA	NA	NA	NA	NA	0.287	0.059
Arsenic	0.013	0.00647	8.1	4.02	0.0277	0.0138	2.18	0.975
Cadmium	0.00161	0.0004	0.221	0.0549	0.0563	0.014	0.42	0.0853
Lead	0.00986	0.00169	1.45	0.249	0.179	0.0308	0.693	0.176
Selenium	0.00134	0.000571	0.255	0.109	0.136	0.058	0.627	0.301

Note: Sediment (ISM) and Surface Water Exposure

COI	Terrestrial (Riparian) Receptor Species					
	American Robin		American Kestrel		Short-Tailed Shrew	
	HQ_{NOAEL}	HQ_{LOAEL}	HQ_{NOAEL}	HQ_{NOAEL}	HQ_{NOAEL}	HQ_{LOAEL}
Antimony	NA	NA	NA	NA	0.385	0.0791
Arsenic	11.1	5.53	0.0109	0.0109	1.48	0.663
Cadmium	0.324	0.0803	0.0218	0.0218	0.0211	0.00428
Lead	8.55	1.47	0.136	0.136	0.174	0.0444
Selenium	0.746	0.318	0.0837	0.0837	0.294	0.141

Note: Soil and Surface Water Exposure

The uptake of arsenic from sediment or soil into invertebrate tissue is occurring and underlies potential wildlife risk for invertivorous receptors (American robin, muskrat and red-winged blackbird). Lead in terrestrial (riparian) soil is also a risk-driver for the American robin.

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ATTACHMENT A COMPARISON OF SITE REPRESENTATIVE CONCENTRATIONS TO ECOLOGICAL SCREENING VALUES

Table 1

Comparison of Maximum Soil Concentrations to Ecological Screening Values

USS Lead Superfund Site - OU2

East Chicago, Indiana

Area	Constituent	Maximum Concentration	EPA Region 4 ESV Plants	EPA Region 4 ESV Soil Invertebrates	EPA Region 4 ESV Mammals	EPA Region 4 ESV Birds	EPA Region 4 ESV All Receptors	HQ	Screening Outcome
OU2 (0-2')	Antimony	210	5	78	0.27	NA	0.27	778	Retain as COI
	Arsenic	630	18	6.8	46	43	18	35	Retain as COI
	Cadmium	14	32	140	0.36	0.77	0.36	39	Retain as COI
	Lead	1800	120	1700	56	11	11	164	Retain as COI
	Selenium	5.8	0.52	4.1	0.63	1.2	0.52	11	Retain as COI

Notes:

EPA Region 4 Ecological Screening Value (ESV), March 2108; soil screening values, all receptors, table 3

Hazard Quotient (HQ) = Site Concentration / ESV (All Receptors)

Concentrations are in mg/kg dry weight.

Table 2
Comparison of Maximum Sediment Concentrations to Ecological Screening Values
USS Lead Superfund Site - OU2
East Chicago, Indiana

Area	Constituent	Maximum Concentration	EPA Region 4 ESV	HQ	Screening Outcome
OU2 (0-2' Discrete Samples)	Antimony	3710	2	1855	Retain as COI
	Arsenic	5700	9.8	582	Retain as COI
	Cadmium	160	1	160	Retain as COI
	Lead	20000	35.8	559	Retain as COI
	Selenium	43.9	0.72	61	Retain as COI
OU2 (0-6" ISM Samples)	Antimony	51	2	26	Retain as COI
	Arsenic	590	9.8	60	Retain as COI
	Cadmium	65	1	65	Retain as COI
	Lead	1800	35.8	50	Retain as COI
	Selenium	11	0.72	15	Retain as COI

Notes:
EPA Region 4 Ecological Screening Value (ESV), March 2108; freshwater sediment screening values, table 2a
Hazard Quotient (HQ) = Site Concentration / ESV
Concentrations are in mg/kg dry weight.

Table 3

Comparison of Maximum Surface Water Concentrations to Ecological Screening Values

USS Lead Superfund Site - OU2

East Chicago, Indiana

Area	Constituent	Maximum Concentration	EPA Region 4 ESV	HQ	Screening Outcome
OU2	Antimony (Dissolved)	130	190	0.68	Not SW COI*
	Arsenic (Dissolved)	610	150	4.1	Retain as COI
	Cadmium (Dissolved)	1.2	0.45	2.7	Retain as COI
	Lead (Dissolved)	41	1.25	33	Retain as COI
	Selenium (Dissolved)	12	5	2.4	Retain as COI
OU2	Antimony (Total)	46	190	0.24	Not SW COI*
	Arsenic (Total)	300	150	2.0	Retain as COI
	Cadmium (Total)	1.2	0.45	2.7	Retain as COI
	Lead (Total)	19	1.25	15	Retain as COI
	Selenium (Total)	4.6	5	0.92	Not SW COI

Notes:

EPA Region 4 Ecological Screening Value (ESV), March 2108; freshwater chronic values, table 1a

Hazard Quotient (HQ) = Site Concentration / ESV

Concentrations are in ug/L.

**Antimony in surface water is less than the surface water ESV, and is therefore not a COI for surface water. Antimony is a COI for soil and sediment*
For completeness, Antimony surface water concentrations are included in HQ calculations for birds and mammals.

Table 4

Comparison of Maximum Ground Water Concentrations to Ecological Screening Values

USS Lead Superfund Site - OU2

East Chicago, Indiana

Area	Constituent	Maximum Ground Water Concentration	EPA Region 4 Surface Water ESV	HQ	Screening Outcome	Assessment of Migration/Future Risk to OU2 Surface Water from OU2 Ground Water
OU2	Antimony	170	190	0.89	Not SW COI	Screening indicates that antimony in OU2 GW is not a concern for migration/future risk to OU2 SW. Antimony concentrations in OU2 SW do not pose a risk to aquatic biota and wildlife*. Antimony in OU2 GW has not resulted in current risk via OU2 SW, and is not anticipated to result in future risk via OU2 SW.
	Arsenic	23000	150	153	Retain as SW COI	Screening indicates that arsenic in OU2 GW is a potential concern for migration/future risk to OU2 SW. Arsenic concentrations in OU2 SW do not pose a risk to aquatic biota and wildlife*. Arsenic in OU2 GW has not resulted in current risk via OU2 SW, and is not anticipated to result in future risk via OU2 SW.
	Cadmium	210	0.45	467	Retain as SW COI	Screening indicates that cadmium in OU2 GW is a potential concern for migration/future risk to OU2 SW. Cadmium concentrations in OU2 SW do not pose a risk to aquatic biota and wildlife*. Cadmium in OU2 GW has not resulted in current risk via OU2 SW, and is not anticipated to result in future risk via OU2 SW.
	Lead	1200	1.25	960	Retain as SW COI	Screening indicates that lead in OU2 GW is a potential concern for migration/future risk to OU2 SW. Lead concentrations in OU2 SW do not pose a risk to aquatic biota and wildlife*. Lead in OU2 GW has not resulted in current risk via OU2 SW, and is not anticipated to result in future risk via OU2 SW.
	Selenium	5.6	5	1.1	Retain as SW COI	Screening indicates that selenium in OU2 GW is a potential concern for migration/future risk to OU2 SW. Selenium concentrations in OU2 SW do not pose a risk to aquatic biota and wildlife*. Selenium in OU2 GW has not resulted in current risk via OU2 SW, and is not anticipated to result in future risk via OU2 SW.

Notes:

Screening of GW concentrations with SW ESVs were performed as requested by USEPA.

EPA Region 4 Ecological Screening Value (ESV), March 2108; freshwater chronic values, table 1a

Hazard Quotient (HQ) = Site Concentration / ESV

Concentrations are in ug/L.

**The results of wildlife risk model hazard quotient calculations indicate that risk is primarily attributable to soil/sediment concentrations, not surface water concentrations.*

ATTACHMENT B HAZARD QUOTIENT CALCULATIONS

SOIL HAZARD QUOTIENT CALCULATIONS

American Robin		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.081	BW
Soil ingestion proportion	0.104	Ps
Water ingestion rate (L/kg BW/d)	0.135	WIR
Food ingestion rate (kg/kg BW/d)	1.205	FIR
Proportion of diet, plants	0	Pp
Proportion of diet, soil inverts	1	Pi
Proportion of diet, mammals	0	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	0	Pbi
Area use factor	1	AUF
Time (temporal) factor	1	TF

	Media Concentration		TRV		Absorbed Concentration from Media and Biota							HQ	
COPEC	**Soil Concentration (0-2')**	**Surface Water Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	51.37	0.03805	NA	NA	6.44	0.00514	-	2.04	-	-	-	NA	NA
Arsenic	94.4	0.1637	2.24	4.51	11.8	0.0221	-	13.1	-	-	-	11.1	5.53
Cadmium	3.458	0.000959	1.46	5.88	0.433	0.000129	-	0.0392	-	-	-	0.324	0.0803
Lead	440.9	0.01123	7.33	42.7	55.3	0.00152	-	7.37	-	-	-	8.55	1.47
Selenium	1.656	0.004768	0.593	1.39	0.208	0.000644	-	0.234	-	-	-	0.746	0.318

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Soil concentrations are in mg/kg dry weight. Surface water concentrations are in mg/L.
Soil-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
Soil-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy.150 pp.
Site-specific soil-to-plant and soil-to-invertebrate BAFs are based on site dry weight concentrations of sediment and biota. For the absorbed concentration, the calculated food concentration was adjusted for food moisture content (site values 86.5% for plant, 76.5% invertebrate).

$$HQ = \frac{([Soil_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a = Hazard Quotient for analyte a (COPEC a) (unitless)
Soil a = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
Water a = Concentration of analyte a (COPEC a) in water (mg/L)
N = Number of different biota types in diet (food types)
B i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR = Water ingestion rate (L/kg BW [wet weight]/day)
AF ai = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps = Soil ingestion as a proportion of diet
AUF = Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Soil-to-mammal BAF	Soil-to-Plant BAF	Soil-to-Invertebrate BAF
Antimony	Cm = 0.001 * 50 * Cd	0.14	0.14
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471	0.49	0.49
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571	0.04	0.04
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761	0.059	0.059
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158	0.5	0.5

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

HQ Calculations for OU-2 Site-Wide Soil and Surface Water: Short-Tailed Shrew
USS Lead Superfund Site - OU2
East Chicago, Indiana

Short-Tailed Shrew		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.017	BW
Soil ingestion proportion	0.011	Ps
Water ingestion rate (L/kg BW/d)	0.149	WIR
Food ingestion rate (kg/kg BW/d)	0.555	FIR
Proportion of diet, plants	0	Pp
Proportion of diet, soil inverts	1	Pi
Proportion of diet, mammals	0	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	0	Pbi
Area use factor	1	AUF
Time (temporal) factor	1	TF

	Media Concentration		**TRV**		**Absorbed Concentration from Media and Biota**							**HQ**	
COPEC	**Soil Concentration (0-2')**	**Surface Water Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	51.37	0.03805	3.27	15.9	0.314	0.00567	-	0.938	-	-	-	0.385	0.0791
Arsenic	94.4	0.1637	4.48	10	0.576	0.0244	-	6.03	-	-	-	1.48	0.663
Cadmium	3.458	0.000959	1.86	9.17	0.0211	0.000143	-	0.018	-	-	-	0.0211	0.00428
Lead	440.9	0.01123	34.9	137	2.69	0.00167	-	3.39	-	-	-	0.174	0.0444
Selenium	1.656	0.004768	0.404	0.843	0.0101	0.00071	-	0.108	-	-	-	0.294	0.141

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Soil concentrations are in mg/kg dry weight. Surface water concentrations are in mg/L.
Soil-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
Soil-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge
Site-specific soil-to-plant and soil-to-invertebrate BAFs are based on site dry weight concentrations of sediment and biota. For the absorbed concentration, the calculated food concentration was adjusted for food

$$HQ = \frac{([Soil_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a = Hazard Quotient for analyte a (COPEC a) (unitless)
Soil a = Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
Water a = Concentration of analyte a (COPEC a) in water (mg/L)
N = Number of different biota types in diet (food types)
B i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR = Water ingestion rate (L/kg BW [wet weight]/day)
AF ai = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps = Soil ingestion as a proportion of diet
AUF = Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Soil-to-mammal BAF	Soil-to-Plant BAF	Soil-to-Invertebrate BAF
Antimony	Cm = 0.001 * 50 * Cd	0.14	0.14
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471	0.49	0.49
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571	0.04	0.04
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761	0.059	0.059
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158	0.5	0.5

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

HQ Calculations for OU-2 Site-Wide Soil and Surface Water: American Kestrel
USS Lead Superfund Site - OU2
East Chicago, Indiana

American Kestrel		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.12	BW
Soil ingestion proportion	0	Ps
Water ingestion rate (L/kg BW/d)	0.119	WIR
Food ingestion rate (kg/kg BW/d)	0.3	FIR
Proportion of diet, plants	0	Pp
Proportion of diet, soil inverts	0	Pi
Proportion of diet, mammals	1	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	0	Pbi
Area use factor	0.208	AUF
Time (temporal) factor	1	TF

	Media Concentration		**TRV**		**Absorbed Concentration from Media and Biota**							**HQ**	
COPEC	**Soil Concentration (0-2')**	**Surface Water Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	51.37	0.03805	NA	NA	-	0.00453	-	-	0.771	-	-	NA	NA
Arsenic	94.4	0.1637	2.24	4.51	-	0.0195	-	-	0.0975	-	-	0.0109	0.0054
Cadmium	3.458	0.000959	1.46	5.88	-	0.000114	-	-	0.153	-	-	0.0218	0.00542
Lead	440.9	0.01123	7.33	42.7	-	0.00134	-	-	4.78	-	-	0.136	0.0233
Selenium	1.656	0.004768	0.593	1.39	-	0.000567	-	-	0.238	-	-	0.0837	0.0357

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Soil concentrations are in mg/kg dry weight. Surface water concentrations are in mg/L.
Soil-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
Soil-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge
Site-specific soil-to-plant and soil-to-invertebrate BAFs are based on site dry weight concentrations of sediment and biota. For the absorbed concentration, the calculated food concentration was adjusted for food

$$HQ = \frac{([Soil_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a	=	Hazard Quotient for analyte a (COPEC a) (unitless)
Soil a	=	Concentration of analyte a (COPEC a) in soil (mg/kg dry weight)
Water a	=	Concentration of analyte a (COPEC a) in water (mg/L)
N	=	Number of different biota types in diet (food types)
B i	=	Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i	=	Proportion of biota type (i) in diet
FIR	=	Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR	=	Water ingestion rate (L/kg BW [wet weight]/day)
AF ai	=	Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as	=	Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a	=	The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps	=	Soil ingestion as a proportion of diet
AUF	=	Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Soil-to-mammal BAF	Soil-to-Plant BAF	Soil-to-Invertebrate BAF
Antimony	Cm = 0.001 * 50 * Cd	0.14	0.14
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471	0.49	0.49
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571	0.04	0.04
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761	0.059	0.059
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158	0.5	0.5

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

DISCRETE SEDIMENT HAZARD QUOTIENT CALCULATIONS

HQ Calculations for OU-2 Site-Wide Sediment (Discrete) and Surface Water: Canada Goose
USS Lead Superfund Site - OU2
East Chicago, Indiana

Canada Goose		
Parameter	**Value**	**Symbol**
Body weight (kg)	3.88	BW
Soil ingestion proportion	0.082	Ps
Water ingestion rate (L/kg BW/d)	0.038	WIR
Food ingestion rate (kg/kg BW/d)	0.031	FIR
Proportion of diet, plants	1	Pp
Proportion of diet, soil inverts	0	Pi
Proportion of diet, mammals	0	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	0	Pbi
Area use factor	0.033	AUF
Time (temporal) factor	1	TF

	Media Concentration		**Tissue Concentration**		**TRV**		**Absorbed Concentration from Media and Biota**							**HQ**	
COPEC	**Sediment Concentration (0-2' Discrete Samples)**	**Surface Water Concentration**	**Phragmites australis Concentration**	**Benthic Invertebrate Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	240.1	0.03805	0.1	1.057	NA	NA	0.61	0.00145	0.0031	-	-	-	-	NA	NA
Arsenic	1417	0.1637	0.37	119.1	2.24	4.51	3.6	0.00622	0.0115	-	-	-	-	0.0533	0.0265
Cadmium	28.15	0.000959	0.19	0.297	1.46	5.88	0.0716	0.0000364	0.00589	-	-	-	-	0.00175	0.000435
Lead	1302	0.01123	2.58	11.68	7.33	42.7	3.31	0.000427	0.08	-	-	-	-	0.0153	0.00262
Selenium	14.21	0.004768	0.26	0.677	0.593	1.39	0.0361	0.000181	0.00806	-	-	-	-	0.00247	0.00105

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Sediment concentrations are in mg/kg dry weight. Biota concentrations are in mg/kg wet weight. Surface water concentrations are in mg/L.
For carnivore, sediment-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
For carnivore, sediment-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy.150 pp.
Plant ingestion, if included in diet, was assumed as 50% leaf and 50% root. Root-to-leaf factor of 1 (antimony, arsenic, selenium), 6.2 (cadmium), and 18.6 (lead) were applied to reported plant leaf concentration to estimate plant root concentration.

$$HQ = \frac{([Sediment_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a = Hazard Quotient for analyte a (COPEC a) (unitless)
Sediment a = Concentration of analyte a (COPEC a) in sediment (mg/kg dry weight)
Water a = Concentration of analyte a (COPEC a) in water (mg/L)
N = Number of different biota types in diet (food types)
B i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR = Water ingestion rate (L/kg BW [wet weight]/day)
AF ai = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps = Soil ingestion as a proportion of diet
AUF = Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Soil/sediment-to-mammal BAF
Antimony	Cm = 0.001 * 50 * Cd
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571
Iron	NA
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

HQ Calculations for OU-2 Site-Wide Sediment (Discrete) and Surface Water: Muskrat
USS Lead Superfund Site - OU2
East Chicago, Indiana

Muskrat		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.17	BW
Soil ingestion proportion	0.094	Ps
Water ingestion rate (L/kg BW/d)	0.097	WIR
Food ingestion rate (kg/kg BW/d)	0.3	FIR
Proportion of diet, plants	1	Pp
Proportion of diet, soil inverts	0	Pi
Proportion of diet, mammals	0	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	0	Pbi
Area use factor	1	AUF
Time (temporal) factor	1	TF

	Media Concentration		**Tissue Concentration**		**TRV**		**Absorbed Concentration from Media and Biota**							**HQ**	
COPEC	**Sediment Concentration (0-2' Discrete Samples)**	**Surface Water Concentration**	**Phragmites australis Concentration**	**Benthic Invertebrate Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	240.1	0.03805	0.1	1.057	3.27	15.9	6.77	0.00369	0.03	-	-	-	-	2.08	0.428
Arsenic	1417	0.1637	0.37	119.1	4.48	10	40	0.0159	0.111	-	-	-	-	8.96	4.01
Cadmium	28.15	0.000959	0.19	0.297	1.86	9.17	0.794	0.000093	0.057	-	-	-	-	0.458	0.0928
Lead	1302	0.01123	2.58	11.68	34.9	137	36.7	0.00109	0.774	-	-	-	-	1.07	0.274
Selenium	14.21	0.004768	0.26	0.677	0.404	0.843	0.401	0.000462	0.078	-	-	-	-	1.19	0.569

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Sediment concentrations are in mg/kg dry weight. Biota concentrations are in mg/kg wet weight. Surface water concentrations are in mg/L.
For carnivore, sediment-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
For carnivore, sediment-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy.150 pp.
Plant ingestion, if included in diet, was assumed as 50% leaf and 50% root. Root-to-leaf factor of 1 (antimony, arsenic, selenium), 6.2 (cadmium), and 18.6 (lead) were applied to reported plant leaf concentration to estimate plant root concentration.

$$HQ = \frac{([Sediment_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a = Hazard Quotient for analyte a (COPEC a) (unitless)
Sediment a = Concentration of analyte a (COPEC a) in sediment (mg/kg dry weight)
Water a = Concentration of analyte a (COPEC a) in water (mg/L)
N = Number of different biota types in diet (food types)
B i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR = Water ingestion rate (L/kg BW [wet weight]/day)
AF ai = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps = Soil ingestion as a proportion of diet
AUF = Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Sediment-to-mammal BAF
Antimony	Cm = 0.001 * 50 * Cd
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

HQ Calculations for OU-2 Site-Wide Sediment (Discrete) and Surface Water: Red-Winged Blackbird
USS Lead Superfund Site - OU2
East Chicago, Indiana

Red-Winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.057	BW
Soil ingestion proportion	0.093	Ps
Water ingestion rate (L/kg BW/d)	0.152	WIR
Food ingestion rate (kg/kg BW/d)	0.12	FIR
Proportion of diet, plants	0	Pp
Proportion of diet, soil inverts	0	Pi
Proportion of diet, mammals	0	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	1	Pbi
Area use factor	1	AUF
Time (temporal) factor	1	TF

	Media Concentration		**Tissue Concentration**		**TRV**		**Absorbed Concentration from Media and Biota**							**HQ**	
COPEC	**Sediment Concentration (0-2' Discrete Samples)**	**Surface Water Concentration**	**Phragmites australis Concentration**	**Benthic Invertebrate Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	240.1	0.03805	0.1	1.057	NA	NA	2.68	0.00578	-	-	-	-	0.127	NA	NA
Arsenic	1417	0.1637	0.37	119.1	2.24	4.51	15.8	0.0249	-	-	-	-	14.3	13.4	6.68
Cadmium	28.15	0.000959	0.19	0.297	1.46	5.88	0.314	0.000146	-	-	-	-	0.0356	0.24	0.0595
Lead	1302	0.01123	2.58	11.68	7.33	42.7	14.5	0.00171	-	-	-	-	1.4	2.17	0.372
Selenium	14.21	0.004768	0.26	0.677	0.593	1.39	0.159	0.000725	-	-	-	-	0.0812	0.406	0.173

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Sediment concentrations are in mg/kg dry weight. Biota concentrations are in mg/kg wet weight. Surface water concentrations are in mg/L.
For carnivore, sediment-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
For carnivore, sediment-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy.150 pp.
Plant ingestion, if included in diet, was assumed as 50% leaf and 50% root. Root-to-leaf factor of 1 (antimony, arsenic, selenium), 6.2 (cadmium), and 18.6 (lead) were applied to reported plant leaf concentration to estimate plant root concentration.

$$HQ = \frac{([Sediment_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a = Hazard Quotient for analyte a (COPEC a) (unitless)
Sediment a = Concentration of analyte a (COPEC a) in sediment (mg/kg dry weight)
Water a = Concentration of analyte a (COPEC a) in water (mg/L)
N = Number of different biota types in diet (food types)
B i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR = Water ingestion rate (L/kg BW [wet weight]/day)
AF ai = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps = Soil ingestion as a proportion of diet
AUF = Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Sediment-to-mammal BAF
Antimony	Cm = 0.001 * 50 * Cd
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

HQ Calculations for OU-2 Site-Wide Sediment (Discrete) and Surface Water: American Kestrel
USS Lead Superfund Site - OU2
East Chicago, Indiana

American Kestrel		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.12	BW
Soil ingestion proportion	0	Ps
Water ingestion rate (L/kg BW/d)	0.119	WIR
Food ingestion rate (kg/kg BW/d)	0.3	FIR
Proportion of diet, plants	0	Pp
Proportion of diet, soil inverts	0	Pi
Proportion of diet, mammals	1	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	0	Pbi
Area use factor	0.208	AUF
Time (temporal) factor	1	TF

	Media Concentration		**Tissue Concentration**		**TRV**		**Absorbed Concentration from Media and Biota**							**HQ**	
COPEC	**Sediment Concentration (0-2' Discrete Samples)**	**Surface Water Concentration**	**Phragmites australis Concentration**	**Benthic Invertebrate Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	240.1	0.03805	0.1	1.057	NA	NA	-	0.00453	-	-	3.6	-	-	NA	NA
Arsenic	1417	0.1637	0.37	119.1	2.24	4.51	-	0.0195	-	-	0.896	-	-	0.085	0.0422
Cadmium	28.15	0.000959	0.19	0.297	1.46	5.88	-	0.000114	-	-	0.413	-	-	0.0589	0.0146
Lead	1302	0.01123	2.58	11.68	7.33	42.7	-	0.00134	-	-	7.72	-	-	0.219	0.0376
Selenium	14.21	0.004768	0.26	0.677	0.593	1.39	-	0.000567	-	-	0.525	-	-	0.184	0.0786

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Sediment concentrations are in mg/kg dry weight. Biota concentrations are in mg/kg wet weight. Surface water concentrations are in mg/L.
For carnivore, sediment-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
For carnivore, sediment-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy.150 pp.
Plant ingestion, if included in diet, was assumed as 50% leaf and 50% root. Root-to-leaf factor of 1 (antimony, arsenic, selenium), 6.2 (cadmium), and 18.6 (lead) were applied to reported plant leaf concentration to estimate plant root concentration.

$$HQ = \frac{([Sediment_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a = Hazard Quotient for analyte a (COPEC a) (unitless)
Sediment a = Concentration of analyte a (COPEC a) in sediment (mg/kg dry weight)
Water a = Concentration of analyte a (COPEC a) in water (mg/L)
N = Number of different biota types in diet (food types)
B i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR = Water ingestion rate (L/kg BW [wet weight]/day)
AF ai = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps = Soil ingestion as a proportion of diet
AUF = Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Sediment-to-mammal BAF
Antimony	Cm = 0.001 * 50 * Cd
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

ISM SEDIMENT HAZARD QUOTIENT CALCULATIONS

HQ Calculations for Site-Wide Sediment (ISM) and Surface Water: Canada Goose
USS Lead Superfund Site - OU2
East Chicago, Indiana

Canada Goose		
Parameter	**Value**	**Symbol**
Body weight (kg)	3.88	BW
Soil ingestion proportion	0.082	Ps
Water ingestion rate (L/kg BW/d)	0.038	WIR
Food ingestion rate (kg/kg BW/d)	0.031	FIR
Proportion of diet, plants	1	Pp
Proportion of diet, soil inverts	0	Pi
Proportion of diet, mammals	0	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	0	Pbi
Area use factor	0.033	AUF
Time (temporal) factor	1	TF

	Media Concentration		Tissue Concentration		TRV		Absorbed Concentration from Media and Biota							HQ	
COPEC	Sediment Concentration (0-6" ISM Samples)	Surface Water Concentration	Phragmites australis Concentration	Benthic Invertebrate Concentration	TRV_{NOAEL}	TRV_{LOAEL}	Soil/ Sediment	Water	Plants	Soil Inverts	Mammals	Birds	Benthic Inverts	NOAEL	LOAEL
Antimony	32.1	0.03805	0.1	1.057	NA	NA	0.0816	0.00145	0.0031	-	-	-	-	NA	NA
Arsenic	341.1	0.1637	0.37	119.1	2.24	4.51	0.867	0.00622	0.0115	-	-	-	-	0.013	0.00647
Cadmium	25.7	0.000959	0.19	0.297	1.46	5.88	0.0653	0.0000364	0.00589	-	-	-	-	0.00161	0.0004
Lead	829.1	0.01123	2.58	11.68	7.33	42.7	2.11	0.000427	0.08	-	-	-	-	0.00986	0.00169
Selenium	6.2	0.004768	0.26	0.677	0.593	1.39	0.0158	0.000181	0.00806	-	-	-	-	0.00134	0.000571

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Sediment concentrations are in mg/kg dry weight. Biota concentrations are in mg/kg wet weight. Surface water concentrations are in mg/L.
For carnivore, sediment-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
For carnivore, sediment-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy.150 pp.
Plant ingestion, if included in diet, was assumed as 50% leaf and 50% root. Root-to-leaf factor of 1 (antimony, arsenic, selenium), 6.2 (cadmium), and 18.6 (lead) were applied to reported plant leaf concentration to estimate plant root concentration.

$$HQ = \frac{([Sediment_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a	=	Hazard Quotient for analyte a (COPEC a) (unitless)
Sediment a	=	Concentration of analyte a (COPEC a) in sediment (mg/kg dry weight)
Water a	=	Concentration of analyte a (COPEC a) in water (mg/L)
N	=	Number of different biota types in diet (food types)
B i	=	Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i	=	Proportion of biota type (i) in diet
FIR	=	Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR	=	Water ingestion rate (L/kg BW [wet weight]/day)
AF ai	=	Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as	=	Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a	=	The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps	=	Soil ingestion as a proportion of diet
AUF	=	Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Soil/sediment-to-mammal BAF
Antimony	Cm = 0.001 * 50 * Cd
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571
Iron	NA
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

HQ Calculations for Site-Wide Sediment (ISM) and Surface Water: Muskrat
USS Lead Superfund Site - OU2
East Chicago, Indiana

Muskrat		
Parameter	**Value**	**Symbol**
Body weight (kg)	1.17	BW
Soil ingestion proportion	0.094	Ps
Water ingestion rate (L/kg BW/d)	0.097	WIR
Food ingestion rate (kg/kg BW/d)	0.3	FIR
Proportion of diet, plants	1	Pp
Proportion of diet, soil inverts	0	Pi
Proportion of diet, mammals	0	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	0	Pbi
Area use factor	1	AUF
Time (temporal) factor	1	TF

	Media Concentration		**Tissue Concentration**		**TRV**		**Absorbed Concentration from Media and Biota**							**HQ**	
COPEC	**Sediment Concentration (0-6" ISM Samples)**	**Surface Water Concentration**	**Phragmites australis Concentration**	**Benthic Invertebrate Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	32.1	0.03805	0.1	1.057	3.27	15.9	0.905	0.00369	0.03	-	-	-	-	0.287	0.059
Arsenic	341.1	0.1637	0.37	119.1	4.48	10	9.62	0.0159	0.111	-	-	-	-	2.18	0.975
Cadmium	25.7	0.000959	0.19	0.297	1.86	9.17	0.725	0.000093	0.057	-	-	-	-	0.42	0.0853
Lead	829.1	0.01123	2.58	11.68	34.9	137	23.4	0.00109	0.774	-	-	-	-	0.693	0.176
Selenium	6.2	0.004768	0.26	0.677	0.404	0.843	0.175	0.000462	0.078	-	-	-	-	0.627	0.301

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Sediment concentrations are in mg/kg dry weight. Biota concentrations are in mg/kg wet weight. Surface water concentrations are in mg/L.
For carnivore, sediment-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
For carnivore, sediment-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy.150 pp.
Plant ingestion, if included in diet, was assumed as 50% leaf and 50% root. Root-to-leaf factor of 1 (antimony, arsenic, selenium), 6.2 (cadmium), and 18.6 (lead) were applied to reported plant leaf concentration to estimate plant root concentration.

$$HQ = \frac{([Sediment_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a = Hazard Quotient for analyte a (COPEC a) (unitless)
Sediment a = Concentration of analyte a (COPEC a) in sediment (mg/kg dry weight)
Water a = Concentration of analyte a (COPEC a) in water (mg/L)
N = Number of different biota types in diet (food types)
B i = Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i = Proportion of biota type (i) in diet
FIR = Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR = Water ingestion rate (L/kg BW [wet weight]/day)
AF ai = Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as = Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a = The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps = Soil ingestion as a proportion of diet
AUF = Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Sediment-to-mammal BAF
Antimony	Cm = 0.001 * 50 * Cd
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

HQ Calculations for Site-Wide Sediment (ISM) and Surface Water: Red-Winged Blackbird
USS Lead Superfund Site - OU2
East Chicago, Indiana

Red-Winged Blackbird		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.057	BW
Soil ingestion proportion	0.093	Ps
Water ingestion rate (L/kg BW/d)	0.152	WIR
Food ingestion rate (kg/kg BW/d)	0.12	FIR
Proportion of diet, plants	0	Pp
Proportion of diet, soil inverts	0	Pi
Proportion of diet, mammals	0	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	1	Pbi
Area use factor	1	AUF
Time (temporal) factor	1	TF

	Media Concentration		Tissue Concentration		TRV		Absorbed Concentration from Media and Biota							HQ	
COPEC	**Sediment Concentration (0-6" ISM Samples)**	**Surface Water Concentration**	**Phragmites australis Concentration**	**Benthic Invertebrate Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	32.1	0.03805	0.1	1.057	NA	NA	0.358	0.00578	-	-	-	-	0.127	NA	NA
Arsenic	341.1	0.1637	0.37	119.1	2.24	4.51	3.81	0.0249	-	-	-	-	14.3	8.1	4.02
Cadmium	25.7	0.000959	0.19	0.297	1.46	5.88	0.287	0.000146	-	-	-	-	0.0356	0.221	0.0549
Lead	829.1	0.01123	2.58	11.68	7.33	42.7	9.25	0.00171	-	-	-	-	1.4	1.45	0.249
Selenium	6.2	0.004768	0.26	0.677	0.593	1.39	0.0692	0.000725	-	-	-	-	0.0812	0.255	0.109

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Sediment concentrations are in mg/kg dry weight. Biota concentrations are in mg/kg wet weight. Surface water concentrations are in mg/L.
For carnivore, sediment-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
For carnivore, sediment-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy.150 pp.
Plant ingestion, if included in diet, was assumed as 50% leaf and 50% root. Root-to-leaf factor of 1 (antimony, arsenic, selenium), 6.2 (cadmium), and 18.6 (lead) were applied to reported plant leaf concentration to estimate plant root concentration.

$$HQ = \frac{([Sediment_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a	=	Hazard Quotient for analyte a (COPEC a) (unitless)
Sediment a	=	Concentration of analyte a (COPEC a) in sediment (mg/kg dry weight)
Water a	=	Concentration of analyte a (COPEC a) in water (mg/L)
N	=	Number of different biota types in diet (food types)
B i	=	Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i	=	Proportion of biota type (i) in diet
FIR	=	Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR	=	Water ingestion rate (L/kg BW [wet weight]/day)
AF ai	=	Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as	=	Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a	=	The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps	=	Soil ingestion as a proportion of diet
AUF	=	Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Sediment-to-mammal BAF
Antimony	Cm = 0.001 * 50 * Cd
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

HQ Calculations for Site-Wide Sediment (ISM) and Surface Water: American Kestrel
USS Lead Superfund Site - OU2
East Chicago, Indiana

American Kestrel		
Parameter	**Value**	**Symbol**
Body weight (kg)	0.12	BW
Soil ingestion proportion	0	Ps
Water ingestion rate (L/kg BW/d)	0.119	WIR
Food ingestion rate (kg/kg BW/d)	0.3	FIR
Proportion of diet, plants	0	Pp
Proportion of diet, soil inverts	0	Pi
Proportion of diet, mammals	1	Pm
Proportion of diet, birds	0	Pb
Proportion of diet, benthic inverts	0	Pbi
Area use factor	0.208	AUF
Time (temporal) factor	1	TF

	Media Concentration		Tissue Concentration		TRV		Absorbed Concentration from Media and Biota							HQ	
COPEC	**Sediment Concentration (0-6" ISM Samples)**	**Surface Water Concentration**	**Phragmites australis Concentration**	**Benthic Invertebrate Concentration**	**TRV_{NOAEL}**	**TRV_{LOAEL}**	**Soil/ Sediment**	**Water**	**Plants**	**Soil Inverts**	**Mammals**	**Birds**	**Benthic Inverts**	**NOAEL**	**LOAEL**
Antimony	32.1	0.03805	0.1	1.057	NA	NA	-	0.00453	-	-	0.482	-	-	NA	NA
Arsenic	341.1	0.1637	0.37	119.1	2.24	4.51	-	0.0195	-	-	0.279	-	-	0.0277	0.0138
Cadmium	25.7	0.000959	0.19	0.297	1.46	5.88	-	0.000114	-	-	0.395	-	-	0.0563	0.014
Lead	829.1	0.01123	2.58	11.68	7.33	42.7	-	0.00134	-	-	6.32	-	-	0.179	0.0308
Selenium	6.2	0.004768	0.26	0.677	0.593	1.39	-	0.000567	-	-	0.387	-	-	0.136	0.058

Notes:
- Not Applicable
95% UCL values were used to represent exposure point concentrations. Sediment concentrations are in mg/kg dry weight. Biota concentrations are in mg/kg wet weight. Surface water concentrations are in mg/L.
For carnivore, sediment-to-mammal BAFs for arsenic, cadmium, lead, and selenium were based on Sample et al. 1998. Development and Validation of Bioaccumulation Models for Small Mammals. Oak Ridge National Laboratory. ES/ER/TM-219.
For carnivore, sediment-to-mammal BAF for antimony was based on Baes et al. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture.Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy.150 pp.
Plant ingestion, if included in diet, was assumed as 50% leaf and 50% root. Root-to-leaf factor of 1 (antimony, arsenic, selenium), 6.2 (cadmium), and 18.6 (lead) were applied to reported plant leaf concentration to estimate plant root concentration.

$$HQ = \frac{([Sediment_a \times P_s \times FIR \times AF_{as}] + [Water_a \times WIR] + [\sum_i^N B_i \times P_i \times FIR \times AF_{ai}]) \times AUF}{TRV}$$

Where:

HQ a	=	Hazard Quotient for analyte a (COPEC a) (unitless)
Sediment a	=	Concentration of analyte a (COPEC a) in sediment (mg/kg dry weight)
Water a	=	Concentration of analyte a (COPEC a) in water (mg/L)
N	=	Number of different biota types in diet (food types)
B i	=	Analyte a (COPEC a) in biota type (i) (mg/kg dry weight)
P i	=	Proportion of biota type (i) in diet
FIR	=	Food ingestion rate (kg food [dry weight]/kg BW [wet weight]/day); BW = body weight
WIR	=	Water ingestion rate (L/kg BW [wet weight]/day)
AF ai	=	Absorbed fraction of analyte a (COPEC a) from biota type (i)
AF as	=	Absorbed fraction of analyte a (COPEC a) from soil (s)
TRV a	=	The estimated no adverse effect dose (mg/kg BW/day) for the surrogate species
Ps	=	Soil ingestion as a proportion of diet
AUF	=	Area use factor ([home range factor] and [temporal factor, TF])

COPEC	Sediment-to-mammal BAF
Antimony	Cm = 0.001 * 50 * Cd
Arsenic	ln(Cm) = 0.8188 * ln(Cs) - 4.8471
Cadmium	ln(Cm) = 0.4723 * ln(Cs) - 1.2571
Lead	ln(Cm) = 0.4422 * ln(Cs) + 0.0761
Selenium	ln(Cm) = 0.3764 * ln(Cs) - 0.4158

where:
Cs=Concentration in soil (mg/kg dry weight)
Cm=Concentration in mammal (mg/kg dry weight)
Cd=Concentration in diet (mg/kg dry weight), where mammal diet is assumed 100% earthworm.

ATTACHMENT C TOXICITY REFERENCE VALUES: STUDIES AND CALCULATIONS

Table 1
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Antimony to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Reproduction																	
12	Rossi et al., 1987	Rat (Rattus norvegicus)	3	U	DR	31	d	NR	NR	GE	F	REP	PRWT	WO	0.0590	0.590	78
13	Gurnani et al., 1993	Mouse (Mus musculus)	4	U	GV	14	d	8	w	JV	M	REP	SPCV	WO	835		79
Growth																	
14	Shroeder etal., 1970	Rat (Rattus norvegicus)	2	U	DR	725	d	21	d	JV	M	GRO	BDWT	WO	0.533		67
15	Kanisawa and Shroeder,	Mouse (Mus musculus)	2	U	DR	519	d	21	d	JV	B	GRO	BDWT	WO	0.664		67
16	Poon et al., 1998	Rat (Rattus norvegicus)	5	UX	DR	13	w	7	w	JV	M	GRO	BDWT	WO	5.60	42.0	82
17	Dieter, 1992	Rat (Rattus norvegicus)	6	U	DR	14	d	8	w	JV	B	GRO	BDWT	WO	67.0		78
18	Dieter, 1992	Mouse (Mus musculus)	6	U	DR	14	d	8	w	JV	F	GRO	BDWT	WO	106	161	84
19	Hext et al., 1999	Rat (Rattus norvegicus)	4	UX	FD	90	d	NR	NR	AD	M	GRO	BDWT	WO	1410		85
20	Rossi et al., 1987	Rat (Rattus norvegicus)	3	U	DR	20	d	NR	NR	GE	F	GRO	BDWT	WO		0.0590	72
21	Shroeder et al., 1968	Mouse (Mus musculus)	2	U	DR	339	d	21	d	JV	F	GRO	BDWT	WO		0.678	66
Survival																	
22	Poon et al., 1998	Rat (Rattus norvegicus)	5	UX	DR	13	w	NR	NR	IM	F	MOR	MORT	WO	46.0		74
23	Ainsworth et al., 1991	Short-tailed vole (Microtus agrestis	2	U	FD	60	d	35	d	NR	M	MOR	MORT	WO	60.9		70
24	Dieter, 1992	Rat (Rattus norvegicus)	6	U	DR	14	d	8	w	JV	B	MOR	SURV	WO	66.6		78
25	Dieter, 1992	Mouse (Mus musculus)	6	U	DR	14	d	8	w	JV	M	MOR	MORT	WO	108	161	84
26	Gurnani et al., 1993	Mouse (Mus musculus)	4	U	GV	21	d	8	w	JV	M	MOR	MORT	WO	557	835	91
27	Ainsworth et al., 1991	Short-tailed vole (Microtus agrestis	3	U	FD	21	d	NR	NR	NR	NR	MOR	MORT	WO	673		73
28	Ainsworth et al., 1991	Mouse (Mus musculus)	3	U	FD	18	d	NR	NR	NR	NR	MOR	MORT	WO	826		73
29	Hext et al., 1999	Rat (Rattus norvegicus)	4	UX	FD	90	d	NR	NR	AD	M	MOR	MORT	WO	1408		86
30	Ainsworth et al., 1991	Short-tailed vole (Microtus agrestis	3	U	FD	12	d	35	d	NR	M	MOR	MORT	WO	2440		74
31	Shroeder etal., 1970	Rat (Rattus norvegicus)	2	U	DR	784	d	21	d	JV	F	MOR	TDTH	WO		0.533	68
								geomean bounded only (R-G)=							3.27	15.9	

Source: Ecological Soil Screening Levels for Antimony Interim Final, OSWER Directive 9285.7-61. February 2005.

Table 2
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Arsenic to Birds
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Reproduction (REP)																	
8	Holcman and Stibilj, 1997	Chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	LB	F	REP	PROG	WO	2.24		72
Growth (GRO)																	
9	Holcman and Stibilj, 1997	Chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	S	F	GRO	BDWT	WO	2.24		66
10	Camardese et al, 1990	Mallard duck (*Anas platyrhynchos*)	4	UX	FD	2	w	1	d	JV	F	GRO	GGRO	WO		1.49	83
11	Howell and Hill, 1978	Chicken (*Gallus domesticus*)	2	U	FD	21	d	1	d	JV	B	GRO	BDWT	WO		3.55	76
12	Hoffman et al, 1992	Mallard duck (*Anas platyrhynchos*)	2	UX	FD	4	w	1	d	JV	B	GRO	BDWT	WO		17.3	82
Survival (MOR)																	
13	Holcman and Stibilj, 1997	Chicken (*Gallus domesticus*)	4	U	FD	19	d	49	w	S	F	MOR	MORT	WO	2.24		74
14	Howell and Hill, 1978	Chicken (*Gallus domesticus*)	2	U	FD	21	d	1	d	JV	B	MOR	MORT	WO	3.55		77
15	Camardese et al, 1990	Mallard duck (*Anas platyrhynchos*)	4	UX	FD	10	w	1	d	JV	B	MOR	MORT	WO	3.72		84
16	Hoffman et al, 1992	Mallard duck (*Anas platyrhynchos*)	2	UX	FD	4	w	1	d	JV	B	MOR	SURV	WO	17.3		83
														geomean (R-G)=	2.24	4.51	
														geomean bounded only (R-G)=	no bounded values		

Source: Ecological Soil Screening Levels for Arsenic Interim Final, OSWER Directive 9285.7-62. March 2005.

Table 3
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Arsenic to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
Reproduction (REP)																	
76	Savabieasfahani et al, 1998	Cotton rat (*Sigmodon hispidus*)	3	U	DR	6	w	NR	NR	A	M	REP	TEWT	TE	0.601		70
77	Nemec et al, 1998	Rabbit (*Oryctolagus cuniculus*)	4	M	GV	12	d	NR	NR	G	F	REP	RSEM	WO	0.750	3.0	90
78	Morris et al, 1938	Rat (*Rattus norvegicus*)	3	U	FD	340	d	26-27	d	JV	M	REP	PRWT	WO	7.47		71
79	Nemec et al, 1998	Mouse (*Mus musculus*)	4	M	GV	9	d	NR	NR	G	F	REP	PROG	WO	24.0	48.0	92
80	Healy et al., 1998	Mouse (*Mus musculus*)	3	U	DR	91	d	76	d	JV	M	REP	TEWT	TE		0.00650	74
81	Schroeder and Mitchener, 1971	Mouse (*Mus musculus*)	2	U	DR	6	m	21	d	JV	F	REP	PROG	WO		0.548	67
82	Skalnaya et al, 1996	Mouse (*Mus musculus*)	2	U	OR	30	d	NR	NR	G	F	REP	PRWT	WO		5.66	81
83	Seidenberg et al 1986	Mouse (*Mus musculus*)	2	U	GV	5	d	NR	NR	G	F	REP	PROG	WO		43.4	86
Growth (GRO)																	
84	Hughes and Thompson, 1996	Mouse (*Mus musculus*)	3	U	DR	28	d	96	d	S	F	GRO	BDWT	WO	0.0859		69
85	Coulson et al, 1935	Rat (*Rattus norvegicus*)	2	M	FD	52	w	33-35	d	JV	B	GRO	BDWT	WO	0.447		74
86	Kanisawa and Schroeder, 1969	Rat (*Rattus norvegicus*)	2	U	DR	519	d	21	d	JV	B	GRO	BDWT	WO	0.533		72
87	Schroeder et al, 1968	Rat (*Rattus norvegicus*)	2	U	DR	69	d	21-23	d	JV	B	GRO	BDWT	WO	0.571		72
88	Obermeyer et al, 1971	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	NR	GRO	BDWT	WO	0.913		77
89	Neiger and Osweiler 1989	Dog (*Canis familiaris*)	4	U	FD	8	w	8	mo	JV	F	GRO	BDWT	WO	1.04	1.66	87
90	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO	1.39		68
91	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	U	FD	8	w	NR	NR	JV	M	GRO	BDWT	WO	1.65		68
92	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	GRO	BDWT	WO	1.88		72
93	Byron et al, 1967	Dog (*Canis familiaris*)	5	U	FD	2	yr	6	mo	JV	B	GRO	BDWT	WO	2.25	5.62	82
94	Schmolke et al 1992	Rat (*Rattus norvegicus*)	3	U	FD	15	w	7	w	JV	F	GRO	BDWT	WO	2.52		68
95	Fowler and Woods 1979	Mouse (*Mus musculus*)	4	U	DR	6	w	NR	NR	JV	M	GRO	BDWT	WO	2.84	5.69	78
96	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	GRO	BDWT	WO	3.22		72
97	Ghosh et al 1999	Rat (*Rattus norvegicus*)	3	U	GV	28	d	35	d	JV	F	GRO	BDWT	WO	3.78		73
98	Fowler et al., 1977	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	GRO	BDWT	WO	4.43	9.42	78
99	Hunder et al, 1999	Rat (*Rattus norvegicus*)	4	U	FD	3	w	NR	NR	JV	F	GRO	BDWT	WO	5.52		68
100	Bencko 1972	Mouse (*Mus musculus*)	3	U	DR	64	d	NR	NR	JV	M	GRO	BDWT	WO	6.00		73
101	Benese and Bencko, 1981	Mouse (*Mus musculus*)	4	U	DR	32	d	NR	NR	JV	M	GRO	BDWT	WO	6.43	32.4	77
102	Morris et al, 1938	Rat (*Rattus norvegicus*)	3	U	FD	340	d	26-27	d	JV	M	GRO	BDWT	WO	7.47		69
103	Hunder et al, 1999	Mouse (*Mus musculus*)	4	U	FD	3	w	NR	NR	JV	F	GRO	BDWT	WO	7.69		68
104	Brown et al., 1976	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	GRO	BDWT	WO	9.40	10.7	78
105	Byron et al, 1967	Rat (*Rattus norvegicus*)	6	U	FD	12	w	NR	NR	JV	B	GRO	BDWT	WO	9.84	19.7	83
106	Byron et al, 1967	Rat (*Rattus norvegicus*)	6	U	FD	12	w	NR	NR	JV	M	GRO	BDWT	WO	10.3	20.6	83
107	Kanisawa and Schroeder, 1967	Mouse (*Mus musculus*)	2	U	DR	338	d	20-22	d	JV	M	GRO	BDWT	WO		0.663	72
108	Schroeder and Balassa, 1967	Mouse (*Mus musculus*)	2	U	DR	339	d	21	d	JV	B	GRO	BDWT	WO		0.665	72
109	Hunder et al, 1999	Guinea pig (*Cavia porcellus*)	4	U	FD	3	w	NR	NR	JV	F	GRO	BDWT	WO		0.844	77
110	Nagaraja and Desiraju, 1994	Rat (*Rattus norvegicus*)	2	U	GV	20	d	2	d	JV	B	GRO	BDWT	WO		5.00	84
111	Nagaraja and Desiraju 1993	Rat (*Rattus norvegicus*)	2	U	FD	90	d	90	d	JV	NR	GRO	BDWT	WO		5.0	75
112	Nagaraja and Desiraju 1993	Rat (*Rattus norvegicus*)	2	U	GV	18	d	2	d	JV	B	GRO	BDWT	WO		5.0	84
113	Kiyono et al, 1974	Rat (*Rattus norvegicus*)	4	U	GV	10	d	1	d	JV	M	GRO	BDWT	WO		5.0	84
114	Nagaraja and Desiraju, 1994	Rat (*Rattus norvegicus*)	2	U	FD	90	d	90	d	JV	B	GRO	BDWT	WO		5.00	77
115	Glattre et. al.,	Rat (*Rattus norvegicus*)	2	U	DR	4	w	NR	NR	JV	M	GRO	BDWT	WO		6.36	76
116	Morrison and Chavez, 1983	Pig (*Sus scrofa*)	2	U	FD	2	w	21	d	JV	B	GRO	BDWT	WO		9.44	78
117	Biswas et al, 1998	Goat (*Capra hircus*)	2	U	DR	9	w	1	yr	JV	F	GRO	BDWT	WO		14.4	76
118	Biswas, et al, 2000	Goat (*Ovis aries*)	2	U	OR	9	w	12	mo	A	F	GRO	BDWT	WO		14.4	77
Survival (MOR)																	
119	Schroeder et al, 1968	Rat (*Rattus norvegicus*)	2	U	DR	1575	d	21-23	d	JV	B	MOR	SURV	WO	0.533		73
120	Nemec et al, 1998	Rabbit (*Oryctolagus cuniculus*)	4	M	GV	12	d	NR	NR	G	F	MOR	MORT	WO	0.750	3.00	89
121	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	M	MOR	MORT	WO	1.39		78
122	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	U	FD	8	w	NR	NR	JV	M	MOR	SURV	WO	1.65		69
123	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	MOR	MORT	WO	1.88		82
124	Byron et al, 1967	Dog (*Canis familiaris*)	5	U	FD	2	yr	6	mo	JV	B	MOR	MORT	WO	2.25	5.62	83
125	Byron et al, 1967	Dog (*Canis familiaris*)	5	U	FD	13.5	m	6	mo	JV	B	MOR	MORT	WO	2.25	5.62	83
126	Nemec et al, 1998	Rabbit (*Oryctolagus cuniculus*)	6	M	GV	12	d	NR	NR	G	F	MOR	MORT	WO	2.25	4.50	91
127	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	MOR	MORT	WO	3.22		73
128	Kiyono et al, 1974	Rat (*Rattus norvegicus*)	4	U	GV	21	d	1	d	JV	M	MOR	MORT	WO	5.0	7.5	91
129	Cabe, et al., 1979	Rat (*Rattus norvegicus*)	2	U	DR	18	w	50	d	JV	M	MOR	MORT	WO	5.81		73
130	Fowler et al., 1977	Rat (*Rattus norvegicus*)	4	U	DR	6	w	NR	NR	JV	M	MOR	MORT	WO	9.63		73
131	Byron et al, 1967	Rat (*Rattus norvegicus*)	6	U	FD	78	w	NR	NR	JV	B	MOR	SURV	WO	9.65	19.3	84
132	Byron et al, 1967	Rat (*Rattus norvegicus*)	6	U	FD	2	yr	NR	NR	JV	B	MOR	SURV	WO	9.99	20.0	84
133	Nemec et al, 1998	Mouse (*Mus musculus*)	4	M	GV	9	d	NR	NR	G	F	MOR	MORT	WO	24.0	48.0	91
134	Tripathi et al 1997	Rat (*Rattus norvegicus*)	2	U	DR	16	w	NR	NR	JV	M	MOR	MORT	WO	32.0		74
135	Schroeder and Balassa, 1967	Mouse (*Mus musculus*)	2	U	DR	519	d	21	d	JV	M	MOR	SURV	WO		0.675	73
136	Biswas et al, 1998	Goat (*Capra hircus*)	2	U	DR	78	d	1	yr	JV	F	MOR	MORT	WO		14.4	77
137	Biswas, et al, 2000	Goat (*Ovis aries*)	2	U	OR	12	w	12	mo	A	F	MOR	MORT	WO		14.4	78

Table 3
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Arsenic to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
138	Seidenberg et al 1986	Mouse (*Mus musculus*)	2	U	GV	5	d	NR	NR	G	F	MOR	MORT	WO		43.4	85
								geomean bounded only (R-G)=							4.48	10.0	

Source: Ecological Soil Screening Levels for Arsenic Interim Final, OSWER Directive 9285.7-62. March 2005.

Table 4
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Cadmium to Birds
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Reproduction																	
44	Leach et al, 1978	Chicken (Gallus domesticus)	2	U	FD	12	w	8	mo	LB	F	REP	EGPN	WO	0.593	2.37	82
45	Leach et al, 1978	Chicken (Gallus domesticus)	3	U	FD	12	mo	6	mo	LB	F	REP	PROG	WO	0.593	2.37	82
46	Bokori et al, 1996	Chicken (Gallus domesticus)	1	U	FD	39	w	14	d	IM	M	REP	TEWT	TE	0.799	2.40	85
47	White and Finley, 1978	Mallard (Anas platyrhychos)	1	M	FD	90	d	1	yr	AD	F	REP	Other	NR	1.53	21.1	83
48	White et al 1978	Mallard (Anas platyrhynchos	1	M	FD	90	d	1	yr	AD	B	REP	TEWT	TE	1.53	21.1	87
49	Di Giulio and Scanlon,	Mallard (Anas platyrhychos)	1	U	FD	42	d	32	w	JV	M	REP	TEWT	TE	4.20		73
50	Sell, 1975	Chicken (Gallus domesticus)	1	U	FD	23	d	16	mo	LB	F	REP	PROG	WO		2.40	79
51	Bokori et al, 1995	Chicken (Gallus domesticus)	2	U	FD	5	w	21	d	JV	M	REP	TEDG	TE		3.71	79
52	Bokori, et al, 1995	Japanese Quail (Coturnix	1	U	FD	37	d	NR	NR	LB	F	REP	PROG	WO		7.65	79
53	Richardson et al, 1974	Japanese Quail (Coturnix	1	U	FD	6	w	1	d	JV	M	REP	TEWT	TE		10.4	79
Growth																	
54	Jacobs et al, 1978	Japanese Quail (Coturnix	6	U	FD	7	d	7	d	JV	B	GRO	BDWT	WO	0.125		69
55	Stoewsand et al 1986	Japanese Quail (Coturnix	2	M	FD	63	d	1	d	JV	B	GRO	BDWT	WO	0.260		75
56	Lefevre et al, 1982	Chicken (Gallus domesticus)	3	U	FD	5	w	1	d	JV	NR	GRO	BDWT	WO	0.708	7.08	82
57	Leach et al, 1978	Chicken (Gallus domesticus)	4	U	FD	6	w	1	d	JV	M	GRO	BDWT	WO	0.826	3.30	81
58	Cain et al, 1983	Mallard (Anas platyrhychos)	4	M	FD	12	w	1	d	JV	B	GRO	BDWT	WO	0.858		82
59	Hill, 1974	Chicken (Gallus domesticus)	2	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO	1.25		76
60	Bokori et al, 1996	Chicken (Gallus domesticus)	3	U	FD	4	w	14	d	JV	M	GRO	BDWT	WO	1.55	4.66	83
61	Hill 1979	Chicken (Gallus domesticus)	4	U	FD	2	w	1	d	JV	F	GRO	BDWT	WO	1.72	3.44	82
62	Hill, 1974	Chicken (Gallus domesticus)	6	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO	1.72	3.44	82
63	Di Giulio and Scanlon,	Mallard (Anas platyrhychos)	3	U	FD	42	d	32	w	JV	M	GRO	BDWT	WO	4.20		78
64	Blalock and Hill, 1988	Chicken (Gallus domesticus)	4	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO	4.24		68
65	Mayack et al, 1981	Wood duck (Aix sponsa)	4	M	FD	12	w	1	w	JV	B	GRO	BDWT	WO	5.76		73
66	Hill 1979	Chicken (Gallus domesticus)	2	U	FD	2	w	1	d	JV	F	GRO	BDWT	WO	6.44		74
67	Di Giulio and Scanlon,	Mallard (Anas platyrhychos)	4	U	FD	42	d	11	mo	JV	M	GRO	BDWT	WO	12.5	37.6	84
68	Fadil and Magid, 1996	Chicken (Gallus domesticus)	3	U	DR	30	d	1	d	JV	NR	GRO	BDWT	WO		1.05	71
69	Hill, 1990	Chicken (Gallus domesticus)	2	U	FD	18	d	1	d	JV	F	GRO	BDWT	WO		4.26	76
70	Bafundo et al. 1984	Chicken (Gallus domesticus)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO		4.80	76
71	Hill, 1974	Chicken (Gallus domesticus)	2	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO		4.90	76
72	Bokori et al, 1995	Chicken (Gallus domesticus)	4	U	FD	1	w	21	d	JV	M	GRO	BDWT	WO		5.63	77
73	Pritzl et al, 1974	Chicken (Gallus domesticus)	5	U	FD	20	d	2	w	JV	M	GRO	BDWT	WO		9.57	77
74	Freeland and Cousins,	Chicken (Gallus domesticus)	2	U	FD	2	w	1	d	JV	M	GRO	BDWT	WO		9.75	77
75	Richardson et al, 1974	Japanese Quail (Coturnix	2	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO		12.2	77
76	Richardson and Fox,	Japanese Quail (Coturnix	2	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO		12.8	77
77	Rama and Planas, 1981	Chicken (Gallus domesticus)	2	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO		13.0	77
78	Hill, 1980	Chicken (Gallus domesticus)	2	U	FD	1	w	1	d	JV	F	GRO	BDWT	WO		13.8	69
79	Spivey et al, 1971	Japanese Quail (Coturnix	2	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO		14.7	77
Survival																	
80	Bokori et al, 1996	Chicken (Gallus domesticus)	3	U	FD	12	w	14	d	JV	M	MOR	MORT	WO	3.00		78
81	Blalock and Hill, 1988	Chicken (Gallus domesticus)	4	U	FD	3	w	1	d	JV	NR	MOR	MORT	WO	4.24		69
82	Mayack et al, 1981	Wood duck (Aix sponsa)	4	M	FD	12	w	1	w	JV	B	MOR	MORT	WO	5.78		74
83	Hill, 1974	Chicken (Gallus domesticus)	6	U	FD	5	w	1	d	JV	B	MOR	MORT	WO	8.59		77
84	Pritzl et al, 1974	Chicken (Gallus domesticus)	5	U	FD	20	d	2	w	JV	M	MOR	MORT	WO	9.57	14.3	84
85	Richardson et al, 1974	Japanese Quail (Coturnix	2	U	FD	4	w	1	d	JV	B	MOR	MORT	WO	10.5		69
86	Van Vleet et al, 1981	Duck (Anas sp .)	3	U	FD	15	d	NR	NR	JV	M	MOR	MORT	WO	13.4		77
87	Spivey et al, 1971	Japanese Quail (Coturnix	2	U	FD	2	w	1	d	JV	NR	MOR	MORT	WO	14.2		69
88	Bokori, et al, 1995	Japanese Quail (Coturnix	4	U	FD	37	d	NR	NR	SM	F	MOR	MORT	WO	15.3	30.6	84
89	White and Finley, 1978	Mallard (Anas platyrhychos)	4	M	FD	90	d	1	yr	AD	B	MOR	MORT	WO	16.9		80
90	White et al 1978	Mallard (Anas platyrhynchos	4	M	FD	90	d	1	yr	AD	B	MOR	MORT	WO	21.1		84
91	Bokori et al, 1995	Chicken (Gallus domesticus)	4	U	FD	4	w	21	d	JV	M	MOR	MORT	WO	22.3	44.6	84
92	Hill, 1974	Chicken (Gallus domesticus)	2	U	FD	2	w	1	d	JV	B	MOR	MORT	WO		4.90	77
93	Van Vleet et al, 1981	Duck (Anas sp .)	2	U	FD	28	d	NR	NR	JV	M	MOR	MORT	WO		66.9	77
									geomean bounded only (R-G)=						1.46	5.88	

Source: Ecological Soil Screening Levels for Cadmium Interim Final, OSWER Directive 9285.7-65. March 2005.

Table 5
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Cadmium to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
Reproduction																	
163	Wills et al 1981	Rat (Rattus norvegicus)	3	U	FD	64	w	NR	NR	GE	B	REP	PROG	WO	0.0069		74
164	Webster, 1988	Mouse (Mus musculus)	4	U	DR	60	d	8	w	GE	F	REP	PRWT	WO	0.0939	15.6	76
165	Sorell and Braziano, 1990	Rat (Rattus norvegicus)	4	U	DR	14	d	NR	NR	GE	F	REP	PRWT	WO	0.651	4.88	78
166	Combs et al, 1983	Rat (Rattus norvegicus)	5	U	FD	57	d	NR	NR	JV	M	REP	TEWT	TE	0.890		70
167	Sutou, et al, 1980	Rat (Rattus norvegicus)	4	U	GV	6	w	5	w	GE	F	REP	Other	WO	1.00	10.0	85
168	Sutou et al, 1980	Rat (Rattus norvegicus)	4	U	GV	6	w	5	w	GE	F	REP	RSEM	WO	1.00	10.0	90
169	Sawicka-Kapusta et al 1994	Mouse (Mus musculus)	4	U	FD	6	d	NR	NR	GE	F	REP	DEYO	WO	1.14	2.28	84
170	Ahokas et al 1980	Rat (Rattus norvegicus)	4	U	DR	21	d	NR	NR	GE	F	REP	PRWT	WO	1.57	4.50	79
171	Loeser and Lorke 1977	Rat (Rattus norvegicus)	5	U	FD	3	mo	NR	NR	JV	B	REP	SPCL	SM	2.53		70
172	Baranski and Sitarek, 1987	Rat (Rattus norvegicus)	5	U	GV	7	w	3	mo	JV	F	REP	GREP	WO	4.00	40.0	85
173	Baranski et al, 1983	Rat (Rattus norvegicus)	4	U	GV	8	w	3	mo	GE	F	REP	RSEM	WO	4.00		72
174	Zielinska-Psuja et al, 1979	Rat (Rattus norvegicus)	3	U	FD	3	mo	NR	NR	JV	M	REP	TEWT	TE	5.40	54.0	83
175	Sasser et al, 1985	Rat (Rattus norvegicus)	4	U	DR	21	d	5	mo	GE	F	REP	PRWT	WO	6.00	10.0	81
176	Machemer and Lorke, 1981	Rat (Rattus norvegicus)	5	U	GV	9	d	4	mo	GE	F	REP	FERT	WO	6.13	18.4	92
177	Kotsonis and Klassen, 1978	Rat (Rattus norvegicus)	4	U	DR	24	w	70	d	JV	M	REP	PRFM	WO	6.44		66
178	Zenick et al 1982	Rat (Rattus norvegicus)	4	U	DR	11	w	100	d	JV	M	REP	SPCL	SM	7.41		67
179	Caflisch, 1994	Rat (Rattus norvegicus)	3	U	DR	40	d	NR	NR	AD	M	REP	TEWT	TE	11.4		74
180	Machemer and Lorke, 1981	Rat (Rattus norvegicus)	4	U	FD	9	d	4	mo	GE	F	REP	FERT	WO	12.5		74
181	Desi et al, 1998	Rat (Rattus norvegicus)	4	U	GV	16	d	12	w	GE	F	REP	PRWT	WO	13.9		77
182	Cornwall et al, 1984	Rat (Rattus norvegicus)	2	U	GV	13	d	NR	NR	GE	F	REP	RSEM	WO	25.0		79
183	Seidenberg et al 1986	Mouse (Mus musculus)	2	U	GV	4	d	NR	NR	GE	F	REP	PRWT	WO	41.1		80
184	Wardell et al., 1982	Rat (Rattus norvegicus)	5	U	GV	12	d	NR	NR	GE	F	REP	RSEM	WO	50.0	75	92
185	Simmons et al, 1984	Rat (Rattus norvegicus)	4	U	GV	13	d	NR	NR	GE	F	REP	RSEM	WO	50.0		77
186	Whelton et al, 1988	Mouse (Mus musculus)	3	U	FD	252	d	68	d	GE	F	REP	PROG	WO		0.661	79
187	Webster, 1978	Mouse (Mus musculus)	4	U	DR	19	d	NR	NR	GE	F	REP	PRWT	WO		1.42	80
188	Schroeder and Mitchener,	Mouse (Mus musculus)	2	U	DR	6	mo	21	d	JV	F	REP	DEYO	WO		1.45	67
189	Swiergosz et al 1998	Bank vole (Clethrionomys	3	U	FD	6	mo	5	mo	JV	M	REP	SPCL	TE		1.87	79
190	Hastings et al, 1978	Rat (Rattus norvegicus)	2	U	DR	111	d	NR	NR	GE	F	REP	PRWT	WO		2.14	68
191	Steibert et al., 1984	Rat (Rattus norvegicus)	2	U	DR	170	d	NR	NR	GE	F	REP	PRWT	WO		3.93	75
192	Mallol et al., 1984	Rat (Rattus norvegicus)	2	U	DR	25	d	2	w	JV	B	REP	TEWT	TE		4.61	73
193	Webster, 1979	Mouse (Mus musculus)	2	U	DR	19	d	NR	NR	GE	F	REP	PRWT	WO		5.59	74
194	Steibert et al., 1984	Rat (Rattus norvegicus)	2	U	DR	170	d	7	w	JV	F	REP	PRWT	WO		5.82	74
195	Gupta et al., 1993	Rat (Rattus norvegicus)	2	U	DR	28	d	NR	NR	GE	F	REP	PRWT	WO		6.30	73
196	Saxena, et.al, 1989	Rat (Rattus norvegicus)	2	U	DR	120	d	NR	NR	JV	M	REP	SPCL	TE		7.28	69
197	Pond and Walker, 1975	Rat (Rattus norvegicus)	2	U	FD	21	d	12	w	GE	F	REP	PRWT	WO		236	80
Growth																	
198	Wills et al 1981	Rat (Rattus norvegicus)	3	U	FD	64	w	NR	NR	JV	B	GRO	BDWT	WO	0.00690		72
199	Vreman et al, 1988	Cattle (Bos taurus)	2	M	FD	330	d	NR	NR	JV	M	GRO	BDWT	WO	0.00792		69
200	Vreman et al, 1988	Cattle (Bos taurus)	2	M	FD	328	d	NR	NR	JV	M	GRO	BDWT	WO	0.00884		69
201	Vreman et al, 1988	Cattle (Bos taurus)	2	M	FD	330	d	NR	NR	JV	M	GRO	BDWT	WO	0.0187		69
202	Lind et al., 1997	Mouse (Mus musculus)	2	M	FD	5	w	NR	NR	JV	F	GRO	BDWT	WO	0.0584		74
203	King et al, 1992	Pig (Sus scrofa)	5	M	FD	128	d	NR	NR	JV	F	GRO	BDWT	WO	0.0793		74
204	Merali and Singhal, 1980	Rat (Rattus norvegicus)	3	U	GV	7	d	1	d	JV	M	GRO	BDWT	WO	0.100	1.0	88
205	Rastogi et al 1977	Rat (Rattus norvegicus)	3	U	GV	30	d	1	d	JV	NR	GRO	BDWT	WO	0.100	1.0	83
206	Williams et al 1978	Vole (Microtus	2	U	FD	40	d	NR	NR	JV	NR	GRO	BDWT	WO	0.179		69
207	Ahokas et al 1980	Rat (Rattus norvegicus)	4	U	DR	21	d	NR	NR	GE	F	GRO	BDWT	WO	0.207	1.6	75
208	Cousins et al 1977	Rat (Rattus norvegicus)	3	U	FD	14	w	NR	NR	JV	M	GRO	BDWT	WO	0.268	1.3	82
209	Koo and Winslow, 1983	Rat (Rattus norvegicus)	3	U	FD	11	w	NR	NR	JV	M	GRO	BDWT	WO	0.323		72
210	Baranski and Sitarek, 1987	Rat (Rattus norvegicus)	5	U	GV	12	w	3	mo	JV	F	GRO	BDWT	WO	0.400	4.0	83
211	Doyle et al, 1974	Sheep (Ovis aires)	5	U	FD	163	d	4	mo	JV	M	GRO	BDWT	WO	0.448	0.909	80
212	Williams et al 1978	Vole (Microtus	3	U	FD	40	d	NR	NR	JV	NR	GRO	BDWT	WO	0.478		69
213	Williams et al 1978	Vole (Microtus	2	U	FD	40	d	NR	NR	JV	NR	GRO	BDWT	WO	0.579		69
214	Ogoshi et al., 1989	Rat (Rattus norvegicus)	3	U	DR	4	w	21	d	JV	F	GRO	BDWT	WO	0.581	1.2	77
215	Schroeder et al, 1963	Rat (Rattus norvegicus)	2	U	DR	32	d	28	d	JV	B	GRO	BDWT	WO	0.593		66
216	Perry et al, 1977	Rat (Rattus norvegicus)	7	U	DR	24	mo	21	d	JV	F	GRO	BDWT	WO	0.645	1.6	74
217	Yuhas et al 1979	Rat (Rattus norvegicus)	4	U	DR	2	w	35	d	JV	M	GRO	BDWT	WO	0.770	7.70	72
218	Combs et al, 1983	Rat (Rattus norvegicus)	5	U	FD	57	d	NR	NR	JV	M	GRO	BDWT	WO	0.890		69
219	Combs et al, 1983	Rat (Rattus norvegicus)	5	U	FD	57	d	NR	NR	JV	M	GRO	BDWT	WO	0.890		69
220	Sutou, et al, 1980	Rat (Rattus norvegicus)	4	U	GV	6	w	5	w	GE	F	GRO	BDWT	WO	1.00	10.0	83
221	Takashima et al 1980	Rat (Rattus norvegicus)	4	U	FD	19	mo	NR	NR	JV	M	MPH	GMPH	BO	1.04	5.2	81
222	Bhattacharyya et al, 1988	Mouse (Mus musculus)	3	U	FD	252	d	68	d	GE	F	GRO	BDWT	WO	1.08	10.8	82
223	Loeser and Lorke, 1977	Dog (Canis familiaris)	5	U	FD	3	mo	4-6	mo	JV	B	GRO	BDWT	WO	1.36		68
224	Sugawara and Sugawara,	Rat (Rattus norvegicus)	2	U	DR	36	d	27	d	JV	F	GRO	BDWT	WO	1.78		72
225	Machemer and Lorke, 1981	Rat (Rattus norvegicus)	5	U	GV	9	d	2	mo	GE	F	GRO	BDWT	WO	1.84	6.13	88
226	Mitra et al, 1995	Rat (Rattus norvegicus)	2	M	FD	6	w	1	mo	JV	NR	GRO	BDWT	WO	1.85		76
227	Mangler et al., 1988	Rat (Rattus norvegicus)	2	U	DR	18	mo	28	d	JV	F	GRO	BDWT	WO	2.22		73
228	Loeser and Lorke 1977	Rat (Rattus norvegicus)	5	U	FD	3	mo	NR	NR	JV	B	GRO	BDWT	WO	2.53		68
229	Yuyama 1982	Rat (Rattus norvegicus)	4	U	FD	2	w	5	w	JV	M	GRO	BDWT	WO	2.65	10.6	82
230	Washko and Cousins 1977	Rat (Rattus norvegicus)	2	U	DR	8	w	NR	NR	JV	M	GRO	BDWT	WO	2.78		72
231	Lee et al., 1994	Rat (Rattus norvegicus)	4	U	GV	8	w	60	d	JV	M	GRO	BDWT	WO	3.00	10.0	88
232	Mitsumori et al., 1998	Rat (Rattus norvegicus)	5	U	FD	4	d	5	w	JV	F	GRO	BDWT	WO	3.08	15.4	82
233	Steibert et al., 1984	Rat (Rattus norvegicus)	2	U	DR	170	d	NR	mo	AD	F	GRO	BDWT	WO	3.73		73
234	Cousins et al., 1973	Pig (Sus scrofa)	5	U	FD	6	w	55	d	JV	M	GRO	BDWT	WO	4.05	12.1	84

Table 5
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Cadmium to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Total
235	Chetty et al, 1980	Rat (Rattus norvegicus)	4	U	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO	4.36	8.71	83
236	Koller and Roan, 1977	Mouse (Mus musculus)	4	U	DR	70	d	28	d	JV	NR	GRO	BDWT	WO	4.44	44.4	76
237	Watanabe et al, 1986	Mouse (Mus musculus)	6	M	FD	2	yr	7	w	AD	F	GRO	BDWT	WO	4.97		74
238	Swiergosz et al 1998	Bank vole (Clethrionomys	3	U	FD	6	mo	5	mo	JV	M	GRO	BDWT	WO	4.99		68
239	Zielinska-Psuja et al, 1979	Rat (Rattus norvegicus)	3	U	FD	3	mo	NR	NR	JV	M	GRO	BDWT	WO	5.40	54.0	81
240	Sugawara and Sugawara,	Rat (Rattus norvegicus)	2	U	DR	330	d	27	d	JV	F	GRO	BDWT	WO	5.54		72
241	Gustafson and Mercer, 1984	Rat (Rattus norvegicus)	7	U	FD	21	d	NR	NR	JV	M	GRO	BDWT	WO	6.06	15.2	83
242	Blakely, 1984	Mouse (Mus musculus)	4	U	DR	3	w	6	w	JV	F	GRO	BDWT	WO	7.23		71
243	Zenick et al 1982	Rat (Rattus norvegicus)	4	U	DR	80	d	100	d	JV	M	GRO	BDWT	WO	7.38		72
244	Weber and Reid 1969	Mouse (Mus musculus)	4	U	FD	3	w	NR	NR	JV	B	GRO	BDWT	WO	8.53		69
245	Ogoshi et al., 1989	Rat (Rattus norvegicus)	6	U	DR	4	w	24	w	AD	NR	GRO	BDWT	WO	8.54	17.1	77
246	Tanaka et al 1995	Rat (Rattus norvegicus)	3	M	FD	5	mo	3	w	JV	M	GRO	BDWT	WO	8.61		73
247	Wlostowski et al, 2000	Bank vole (Clethrionomys	3	UX	FD	6	w	1	mo	JV	M	GRO	BDWT	WO	10.5		82
248	Watanabe et al, 1986	Mouse (Mus musculus)	5	M	FD	2	yr	10	w	GE	F	GRO	BDWT	WO	11.8		74
249	Machemer and Lorke, 1981	Rat (Rattus norvegicus)	4	U	FD	9	d	4	mo	GE	F	GRO	BDWT	WO	12.5		72
250	Kodama et al., 1989	Dog (Canis familiaris)	6	U	FD	250	w	8	mo	JV	B	MPH	GMPH	BO	12.5		68
251	Wlostowski and Krasowska,	Bank vole (Clethrionomys	3	UX	FD	6	w	1	mo	JV	M	GRO	BDWT	WO	12.6		83
252	Ogoshi et al., 1989	Rat (Rattus norvegicus)	3	U	DR	4	w	2	yr	AD	NR	MPH	GMPH	FM	16.9		67
253	King et al, 1992	Pig (Sus scrof a)	3	M	FD	132	d	NR	NR	JV	F	GRO	BDWT	WO	21.3		74
254	Nation et al., 1990	Rat (Rattus norvegicus)	2	U	FD	61	d	50	d	JV	M	GRO	BDWT	WO	31.3		68
255	Exon et al., 1979	Mouse (Mus musculus)	5	U	DR	6	w	NR	NR	JV	M	GRO	BDWT	WO	43.0	85.9	73
256	Hamada et al, 1991	Dog (Canis familiaris)	6	U	FD	9	yr	6-8	mo	JV	B	GRO	BDWT	WO	50.0	100	87
257	Weigel et al 1987	Rat (Rattus norvegicus)	3	M	FD	6	w	NR	NR	JV	M	GRO	BDWT	WO		0.0744	76
258	Bakry et al, 1992	Rat (Rattus norvegicus)	2	U	GV	2	w	NR	NR	JV	B	MPH	GMPH	WO		0.143	84
259	Smith et al, 1985	Rat (Rattus norvegicus)	2	U	GV	14	d	5	d	JV	M	DVP	GDPV	EY		1.00	84
260	Rajanna et al, 1984	Rat (Rattus norvegicus)	4	U	FD	180	d	6	w	JV	M	GRO	BDWT	WO		1.97	77
261	Groten et al, 1991	Rat (Rattus norvegicus)	2	M	FD	7	d	5	w	JV	B	GRO	BDWT	WO		3.01	82
262	Wilson et al 1940	Rat (Rattus norvegicus)	6	U	FD	25	d	NR	NR	JV	M	GRO	BDWT	WO		3.21	77
263	Osuna and Edds, 1980	Pig (Sus scrofa)	2	M	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO		3.43	83
264	Pond et al, 1973	Pig (Sus scrofa)	2	U	FD	50	d	NR	NR	JV	NR	GRO	BDWT	WO		3.88	78
265	Suzuki and Yoshida, 1978	Rat (Rattus norvegicus)	2	U	FD	14	d	NR	NR	JV	M	GRO	BDWT	WO		4.06	78
266	Suzuki and Yoshida 1979	Rat (Rattus norvegicus)	4	U	FD	28	d	NR	NR	JV	M	GRO	BDWT	WO		4.58	77
267	Suzuki and Yoshida 1978	Rat (Rattus norvegicus)	2	U	FD	9	d	NR	NR	JV	M	GRO	BDWT	WO		5.08	77
268	Suzuki and Yoshida 1979	Rat (Rattus norvegicus)	2	U	FD	14	d	NR	NR	JV	M	GRO	BDWT	WO		5.18	77
269	Meyer et al 1982	Rat (Rattus norvegicus)	3	U	FD	30	d	NR	NR	JV	M	GRO	BDWT	WO		5.44	78
270	Lynch et al., 1976	Cattle (Bos taurus)	2	U	OR	63	d	NR	NR	JV	M	GRO	BDWT	WO		5.74	79
271	Steibert et al., 1984	Rat (Rattus norvegicus)	2	U	DR	170	d	7	w	JV	F	GRO	BDWT	WO		5.82	72
272	Ando et al., 1978	Rat (Rattus norvegicus)	2	U	GV	2	mo	64	d	JV	F	MPH	GMPH	BO		6.13	84
273	Freundt and Irbahim, 1990	Rat (Rattus norvegicus)	2	U	DR	5	w	NR	NR	AD	F	GRO	BDWT	WO		6.89	72
274	Nakamura et al., 1983	Rat (Rattus norvegicus)	2	U	FD	11	w	NR	NR	NR	F	GRO	BDWT	WO		9.54	78
275	Banis et al 1969	Rat (Rattus norvegicus)	2	U	FD	30	d	NR	NR	JV	M	GRO	BDWT	WO		9.70	77
276	Iguchi and Sano, 1982	Rat (Rattus norvegicus)	3	U	FD	8	w	NR	NR	YO	M	MPH	GMPH	TB		10.0	77
277	Banis et al 1969	Rat (Rattus norvegicus)	2	U	FD	3	w	5	w	JV	B	GRO	BDWT	WO		10.4	77
278	Eakin et al 1980	Rat (Rattus norvegicus)	2	U	FD	16	w	NR	NR	JV	M	GRO	BDWT	WO		13.2	72
279	Kajikawa et al 1981	Rat (Rattus norvegicus)	2	U	DR	91	w	NR	NR	JV	M	GRO	BDWT	WO		14.7	72
280	Pond and Walker, 1975	Rat (Rattus norvegicus)	2	U	FD	21	d	12	w	GE	F	GRO	BDWT	WO		16.8	78
281	Suzuki and Yoshida 1977	Rat (Rattus norvegicus)	2	U	FD	10	d	NR	NR	JV	M	GRO	BDWT	WO		20.7	77
282	Van Vleet et al, 1981	Pig (Sus scrofa)	2	U	FD	2	w	NR	NR	JV	M	GRO	BDWT	WO		75.8	77
283	Dodds-Smith et al., 1992	Shrew (Sorex araneus)	2	U	FD	12	w	NR	NR	JV	B	GRO	BDWT	WO		103	77
284	Weber and Reid 1969	Mouse (Mus musculus)	4	U	FD	3	w	NR	NR	JV	B	GRO	BDWT	WO		571	78
Survival																	
285	Wills et al 1981	Rat (Rattus norvegicus)	3	U	FD	64	w	NR	NR	JV	B	MOR	MORT	WO	0.0069		73
286	Loeser and Lorke, 1977	Dog (Canis familiaris)	5	U	FD	3	mo	4-6	mo	JV	B	MOR	MORT	WO	1.36		78
287	Swiergosz et al 1998	Bank vole (Clethrionomys	3	U	FD	6	mo	5	mo	JV	M	MOR	MORT	WO	1.87	4.99	84
288	Mangler et al., 1988	Rat (Rattus norvegicus)	2	U	DR	18	mo	28	d	JV	F	MOR	MORT	WO	2.22		74
289	Loeser and Lorke 1977	Rat (Rattus norvegicus)	5	U	FD	3	mo	NR	NR	JV	B	MOR	MORT	WO	2.53		69
290	Groten et al, 1991	Rat (Rattus norvegicus)	2	M	FD	56	d	5	w	JV	B	MOR	MORT	WO	2.61		83
291	Baranski and Sitarek, 1987	Rat (Rattus norvegicus)	5	U	GV	13	w	3	mo	JV	F	MOR	MORT	WO	4.00	40.0	84
292	Baranski et al, 1983	Rat (Rattus norvegicus)	4	U	GV	8	w	3	mo	GE	F	MOR	SURV	WO	4.00		76
293	Whelton et al, 1988	Mouse (Mus musculus)	3	U	FD	252	d	68	d	GE	F	MOR	MORT	WO	6.61		78
294	Sutou, et al, 1980	Rat (Rattus norvegicus)	4	U	GV	6	w	5	w	JV	B	MOR	MORT	WO	10.0		85
295	Sasser et al, 1985	Rat (Rattus norvegicus)	4	U	DR	21	d	5	mo	GE	F	MOR	MORT	WO	10.0		74
296	Machemer and Lorke, 1981	Rat (Rattus norvegicus)	4	U	FD	9	d	4	mo	GE	F	MOR	MORT	WO	12.5		73
297	Van Vleet et al, 1981	Pig (Sus scrofa)	2	U	FD	10	w	NR	NR	JV	M	MOR	MORT	WO	21.3		77
298	Seidenberg et al 1986	Mouse (Mus musculus)	2	U	GV	4	d	NR	NR	GE	F	MOR	MORT	WO	41.1		79
299	Cousins et al., 1973	Pig (Sus scrofa)	5	U	FD	6	w	55	d	JV	M	MOR	MORT	WO	67.3		70
300	Dodds-Smith et al., 1992	Shrew (Sorex araneus)	2	U	FD	12	w	NR	NR	JV	B	MOR	MORT	WO	103		78
301	Weber and Reid 1969	Mouse (Mus musculus)	4	U	FD	3	w	NR	NR	JV	B	MOR	MORT	WO	571	2160	83
302	Schroeder et al, 1963	Rat (Rattus norvegicus)	2	U	DR	6	mo	28	d	JV	M	MOR	SURV	WO		0.551	67
303	Schroeder et al, 1964	Mouse (Mus musculus)	2	U	DR	18	mo	21	d	JV	B	MOR	SURV	WO		0.620	73
304	Lynch et al., 1976	Cattle (Bos taurus)	2	U	OR	63	d	NR	NR	JV	M	MOR	SURV	WO		5.74	80
									geomean bounded only (R-G)=						1.86	9.17	

Source: Ecological Soil Screening Levels for Cadmium Interim Final, OSWER Directive 9285.7-65. March 2005.

Table 6
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Lead to Birds
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Reproduction (R)																	
50	Edens and Garlich, 1983	Japanese quail (Coturnix japonica)	4	U	FD	5	w	6	w	LB	F	REP	PROG	W	0.194	1.94	77
51	Edens and Garlich, 1983	Chicken (Gallus domesticus)	3	U	FD	4	w	NR	NR	LB	F	REP	PROG	W	1.63	3.26	79
52	Meluzzi et al., 1996	Chicken (Gallus domesticus)	4	U	FD	30	d	22	w	LB	F	EGG	ALWT	EG	2.69	4.04	81
53	Haegele et al. 1974	Mallard (Anas platyrhynchos)	2	U	FD	76	d	NR	NR	SM	F	EGG	ESTH	EG	5.63		71
54	Pattec 1984	American kestrel (Falco sparverius)	3	M	FD	6	mo	1-6	yr	AD	F	REP	RSUC	W	12.0		90
55	Morgan et al., 1975	Japanese quail (Coturnix japonica)	5	U	FD	5	w	6	d	JV	M	REP	TEWT	TE	12.6	126	78
56	Morgan et al., 1975	Japanese quail (Coturnix japonica)	5	U	FD	5	w	1	d	JV	M	REP	TEWT	TE	67.4	135	80
57	Stone and Soares, 1976	Japanese quail (Coturnix japonica)	3	U	FD	32	d	NR	NR	AD	F	REP	PROG	W	125		67
58	Edens et al., 1976	Japanese quail (Coturnix japonica)	5	U	FD	12	w	0	d	LB	B	REP	EGPN	EG		0.110	77
59	Edens and Garlich, 1983	Japanese quail (Coturnix japonica)	4	U	FD	12	w	NR	NR	LB	F	REP	PROG	W		0.194	75
60	Edens and Garlich, 1983	Chicken (Gallus domesticus)	5	U	FD	10	w	NR	NR	LB	F	REP	PROG	W		3.26	75
61	Kendall and Scanlon, 1981	Ringed Turtle Dove (Streptopelia	2	U	DR	11	w	NR	NR	AD	M	REP	TEWT	TE		11.8	68
62	Edens and Melvin, 1989	Japanese quail (Coturnix japonica)	2	U	FD	1	w	14	w	JV	F	REP	TPRD	W		93.1	75
63	Stone and Soares, 1976	Japanese quail (Coturnix japonica)	2	U	FD	27	d	NR	NR	AD	F	REP	PROG	W		377	74
Growth (G)																	
64	Edens and Garlich, 1983	Japanese quail (Coturnix japonica)	3	U	FD	5	w	1	d	JV	F	GRO	BDWT	W	1.56	15.6	77
65	Stone and Fox, 1984	Japanese quail (Coturnix japonica)	3	U	FD	2	w	1	d	JV	B	GRO	BDWT	W	2.77		72
66	Stone et al., 1977	Japanese quail (Coturnix japonica)	2	U	FD	2	w	1	d	JV	NR	GRO	BDWT	W	4.64		70
67	Edens and Melvin, 1989	Japanese quail (Coturnix japonica)	3	U	FD	4	w	0	d	JV	F	GRO	BDWT	W	5.93	59.3	76
68	Damron et al, 1969	Chicken (Gallus domesticus)	4	U	FD	4	w	4	w	JV	NR	GRO	BDWT	W	6.14	61.4	76
69	Damron et al, 1969	Chicken (Gallus domesticus)	4	U	FD	4	w	4	w	JV	NR	GRO	BDWT	W	7.10	71.0	76
70	Edens et al., 1976	Japanese quail (Coturnix japonica)	5	U	FD	12	w	0	d	JV	F	GRO	BDWT	W	11.1	111	79
71	Edens, 1985	Japanese quail (Coturnix japonica)	5	U	FD	12	w	1	w	JV	F	GRO	BDWT	W	11.2	112	76
72	Morgan et al., 1975	Japanese quail (Coturnix japonica)	5	U	FD	2	w	6	d	JV	NR	GRO	BDWT	W	12.6	126	76
73	Morgan et al., 1975	Japanese quail (Coturnix japonica)	5	U	FD	1	w	1	d	JV	NR	GRO	BDWT	W	13.5	67.4	76
74	Howell and Hill, 1978	Chicken (Gallus domesticus)	2	U	FD	21	d	1	d	JV	B	GRO	BDWT	W	14.2		67
75	Jeng et. al, 1979	Duck (Anas platyrhynchos)	3	U	GV	3	mo	24	w	MA	F	GRO	BDWT	W	20.0		87
76	Hoffman et al., 1985	American kestrel (Falco sparverius)	4	U	GV	10	d	1	d	JV	NR	GRO	BDWT	W	25.0	125	88
77	Howell and Hill, 1978	Chicken (Gallus domesticus)	2	U	FD	20	d	1	d	JV	B	GRO	BDWT	W	28.4		67
78	Stone et al., 1981	Japanese quail (Coturnix japonica)	5	U	FD	14	d	1	d	JV	B	GRO	BDWT	W	34.5		77
79	Custer et al., 1984	American kestrel (Falco sparverius)	4	M	FD	60	d	1-2	yr	AD	B	GRO	BDWT	W	54.3		68
80	Berg et al., 1980	Chicken (Gallus domesticus)	5	U	FD	2	w	1	d	JV	M	GRO	BDWT	W	61.3	123	83
81	Frederick, 1976	Mallard (Anas platyrhynchos)	4	U	FD	8	d	9	d	JV	NR	GRO	BDWT	W	66.9		67
82	Donaldson and McGowan,	Chicken (Gallus domesticus)	5	U	FD	20	d	1	d	JV	M	GRO	BDWT	W		38.2	72
83	Latta and Donaldson, 1986	Chicken (Gallus domesticus)	2	U	FD	3	w	1	d	JV	M	GRO	BDWT	W		53.1	71
84	Stone and Soares, 1976	Japanese quail (Coturnix japonica)	3	U	FD	32	d	NR	NR	AD	F	GRO	BDWT	W		64.3	72
85	Leeming and Donaldson,	Chicken (Gallus domesticus)	2	U	FD	19	d	1	d	JV	M	GRO	BDWT	W		76.3	71
86	Berg et al., 1980	Chicken (Gallus domesticus)	3	U	FD	2	w	1	d	JV	M	GRO	BDWT	W		124	77
87	Bafundo et al. 1984	Chicken (Gallus domesticus)	4	U	FD	14	d	8	d	JV	M	GRO	BDWT	W		152	71
88	Donaldson, 1986	Chicken (Gallus domesticus)	2	U	FD	20	d	1	d	JV	M	GRO	BDWT	W		163	72
89	Khan, et al, 1993	Chicken (Gallus domesticus)	2	U	OR	4	w	NR	NR	JV	B	GRO	BDWT	W		200	74
90	Cupo and Donaldson,	Chicken (Gallus domesticus)	2	U	FD	7	d	1	d	JV	M	GRO	BDWT	W		262	72
91	Berg et al., 1980	Chicken (Gallus domesticus)	2	U	FD	2	w	1	d	JV	M	GRO	BDWT	W		270	77
92	Franson and Custer, 1982	Chicken (Gallus domesticus)	2	U	FD	7	d	1	d	IM	NR	GRO	BDWT	W		273	72
93	Bafundo et al. 1984	Chicken (Gallus domesticus)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	W		282	71
Survival (S)																	
94	Finley et al., 1976	Mallard (Anas platyrhynchos)	4	M	FD	12	w	1	yr	AD	M	MOR	MORT	W	2.47		80
95	Barthalmus et al., 1977	Pigeon (Columba livia)	4	U	GV	40	d	NR	NR	AD	M	MOR	MORT	W	12.5	25.0	82
96	Howell and Hill, 1978	Chicken (Gallus domesticus)	2	U	FD	21	d	1	d	JV	B	MOR	MORT	W	14.2		77
97	Howell and Hill, 1978	Chicken (Gallus domesticus)	2	U	FD	20	d	1	d	JV	B	MOR	MORT	W	28.4		77
98	Custer et al., 1984	American kestrel (Falco sparverius)	4	M	FD	60	d	1-2	yr	AD	B	MOR	MORT	W	54.3		78
99	Frederick, 1976	Mallard (Anas platyrhynchos)	4	U	FD	8	d	9	d	JV	NR	MOR	MORT	W	66.9		77
100	Hoffman et al., 1985	American kestrel (Falco sparverius)	4	U	GV	10	d	1	d	JV	NR	MOR	SURV	W	125	625	89
101	Vengris and Mare, 1974	Chicken (Gallus domesticus)	7	U	GV	35	d	6	w	JV	B	MOR	MORT	W	160	320	86
102	Donaldson and McGowan,	Chicken (Gallus domesticus)	5	U	FD	20	d	1	d	JV	M	MOR	MORT	W	163		66
103	Johnsen and Damron	Goose (Anser cygnides)	5	U	FD	12	w	26	w	JV	NR	MOR	MORT	W	196		73
104	Anders et al., 1982	Pigeon (Columba livia)	2	U	GV	4	w	NR	NR	AD	M	MOR	MORT	W		6.25	73
105	Cupo and Donaldson,	Chicken (Gallus domesticus)	2	U	FD	21	d	1	d	JV	M	MOR	MORT	W		194	73
106	Khan et al, 1993	Chicken (Gallus domesticus)	2	U	GV	7	d	43	d	JV	F	MOR	MORT	W		400	80
								geomean bounded only (R-G)=							7.33	42.7	

Source: USEPA Ecological Soil Screening Levels for Lead Interim Final, OSWER Directive 9285.7-70. March 2005.

Table 7
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Lead to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Reproduction (R)																	
121	Grant et al., 1980	Rat (Rattus norvegicus)	5	U	DR	62	d	21	d	GE	F	REP	PRWT	W	0.710	7.00	77
122	Dilts and Ahokas, 1979	Rat (Rattus norvegicus)	6	U	DR	21	d	NR	NR	GE	F	REP	PRWT	W	1.00	5.00	74
123	Gandley et al., 1999	Rat (Rattus norvegicus)	3	U	DR	35	d	NR	NR	AD	M	REP	RSUC	W	2.60	26.0	72
124	Grant et al., 1980	Rat (Rattus norvegicus)	4	U	DR	62	d	21	d	GE	B	REP	PRWT	W	3.00	6.0	79
125	Carson et al., 1973	Sheep (Ovis aries)	3	U	FD	27	w	NR	NR	GE	F	REP	RSUC	W	4.50		68
126	Dilts and Ahokas, 1980	Rat (Rattus norvegicus)	6	U	DR	21	d	NR	NR	GE	F	REP	PRWT	W	5.00	10.0	76
127	Sierra and Tiffany-Castiglioni, 1992	Guinea pig (Cavia porcellus)	3	U	DR	40	d	NR	NR	GE	F	REP	PRWT	W	5.50		73
128	Jessup and Shott, 1969	Rat (Rattus norvegicus)	5	U	FD	92	w	21	d	JV	M	REP	TEWT	TE	7.50	74.9	78
129	Kimmel et al., 1980	Rat (Rattus norvegicus)	4	U	DR	23.8	d	21	d	LC	F	REP	Other	W	8.90		76
130	Kimmel et al., 1980	Rat (Rattus norvegicus)	5	U	DR	23.8	d	21	d	GE	F	REP	Other	W	9.10	45.0	73
131	McMurry et al., 1995	Cotton rat (Sigmodon	3	U	DR	7	w	NR	NR	AD	M	REP	RHIS	RT	12.4	170	67
132	Barratt et al., 1989	Rat (Rattus norvegicus)	4	U	GV	9	w	10	w	JV	M	REP	SPCV	TE	18.0	180	85
133	Zenick et al., 1979	Rat (Rattus norvegicus)	3	U	DR	100	d	21	d	GE	F	REP	PRWT	W	25.4		68
134	Cerklewski, 1980	Rat (Rattus norvegicus)	2	U	FD	35	d	70	d	LC	F	REP	PRWT	W	27.5		66
135	Chowdhury et al., 1984	Rat (Rattus norvegicus)	4	U	DR	60	d	NR	NR	SM	M	REP	TEWT	TE	31.6	63.2	71
136	Bull, et.. al., 1978	Rat (Rattus norvegicus)	4	U	DR	56	d	70	d	LC	F	REP	PROG	W	32.5		69
137	Winder et al., 1984	Rat (Rattus norvegicus)	3	U	DR	31	d	NR	d	LC	F	REP	PRWT	W	33.3	111	72
138	Miller et al., 1982	Rat (Rattus norvegicus)	4	U	GV	41	d	NR	NR	GE	F	REP	PRWT	W	41.0	54.6	87
139	Wolfe et al, 1996	Rat (Rattus norvegicus)	5	U	DR	1	w	94	d	JV	M	REP	SPCL	SM	47.3	82.0	84
140	Sourgens et al., 1987	Rat (Rattus norvegicus)	4	U	DR	30	d	NR	NR	SM	M	REP	Other	SV	56.0	285	73
141	Carpenter, 1982	Hamster (Mesocricetus	2	U	DR	51	d	15	w	GE	F	REP	PROG	W	64.8		69
142	Carpenter, 1982	Hamster (Mesocricetus	2	U	DR	14	d	11	w	GE	F	REP	PROG	W	64.9		67
143	Ronis et al., 1998	Rat (Rattus norvegicus)	4	U	DR	37	d	NR	NR	GE	F	REP	PRWT	W	90.1	270	74
144	Wardell et al., 1982	Rat (Rattus norvegicus)	5	U	GV	12	d	NR	NR	GE	F	REP	RSEM	EM	100	150	87
145	Hamilton and O'Flaherty, 1994	Rat (Rattus norvegicus)	3	U	DR	68	d	25	d	GE	F	REP	PRWT	W	115		72
146	Hamilton et al., 1994	Rat (Rattus norvegicus)	4	U	DR	77	d	25	d	GE	F	REP	PRWT	W	116		68
147	Fox et al., 1977	Rat (Rattus norvegicus)	2	U	DR	21	d	NR	NR	LC	F	REP	PRWT	W	120		68
148	Eyden et al, 1978	Mouse (Mus musculus)	3	U	FD	8	w	2	mo	GE	M	REP	SPCV	TE	144	1440	78
149	Maker et al., 1973	Mouse (Mus musculus)	7	U	FD	30	d	NR	NR	LC	F	REP	PRWT	W	202	506	79
150	Maker et al., 1973	Mouse (Mus musculus)	7	U	FD	30	d	NR	NR	LC	F	REP	PRWT	W	202	506	79
151	Cramer et al, 1980	Rat (Rattus norvegicus)	4	U	DR	21	d	NR	NR	GE	F	REP	DEYO	W	276	552	74
152	Nathan et al., 1992	Rat (Rattus norvegicus)	5	U	DR	10	w	NR	NR	AD	M	REP	TEWT	MT	294	587	71
153	Brady, et al, 1975	Rat (Rattus norvegicus)	2	U	GV	102	d	30	d	GE	F	REP	PRWT	W	441		69
154	Wenda-Rozewicka et al., 1996	Rat (Rattus norvegicus)	2	U	DR	9	mo	NR	NR	SM	M	REP	RHIS	TE	600		66
155	Barrett and Livesey, 1983	Rat (Rattus norvegicus)	4	U	FD	4	d	NR	NR	LC	F	REP	PRWT	W	601	1500	86
156	Piasekand Kostial, 1987	Rat (Rattus norvegicus)	4	U	DR	13	w	NR	NR	JV	M	REP	FERT	W	639		66
157	Junaid et al., 1997	Mouse (Mus musculus)	4	U	GV	60	d	NR	NR	AD	F	REP	RPRD	OV		2.00	77
158	Morris et al, 1938	Rat (Rattus norvegicus)	3	U	FD	339	d	26-	d	JV	B	REP	PRWT	W		2.49	74
159	Schroeder and Mitchener, 1971	Rat (Rattus norvegicus)	2	U	DR	9	mo	21	d	JV	F	REP	DEYO	W		2.94	67
160	Schroeder and Mitchener, 1971	Mouse (Mus musculus)	2	U	DR	6	mo	21	d	JV	F	REP	DEYO	W		3.62	67
161	Gupta et al., 1995	Mouse (Mus musculus)	4	U	GV	52	d	2	mo	GE	F	REP	PROG	EM		5.50	81
162	Saxena et. al. 1989	Rat (Rattus norvegicus)	2	U	DR	120	d	1	d	GE	M	REP	SPCL	TE		6.76	69
163	Cernochova and Kamarad, 1992	Mouse (Mus musculus)	2	U	DR	5	w	NR	NR	AD	M	REP	TEDG	TE		16.6	66
164	Al-Omar et al, 2000	Mouse (Mus musculus)	2	M	GV	2	w	NR	NR	JV	M	REP	SPCL	SM		46.4	86
165	Winneke et al., 1977	Rat (Rattus norvegicus)	2	U	FD	102	d	NR	NR	GE	F	REP	PROG	W		49.6	78
166	Batra et al., 1998	Rat (Rattus norvegicus)	2	U	GV	3	mo	8	w	SM	M	REP	TEDG	TE		50.0	81
167	Hayashi, 1983	Rat (Rattus norvegicus)	2	U	DR	18	d	NR	NR	GE	F	REP	PRWT	W		55.5	68
168	Kempinas et. al 1988	Rat (Rattus norvegicus)	3	U	DR	90	d	NR	NR	AD	M	REP	SPCL	SM		61.2	69
169	Donald et al., 1981	Mouse (Mus musculus)	2	U	DR	23	d	NR	NR	GE	F	REP	PRWT	W		78.6	69
170	Donald et al., 1986	Mouse (Mus musculus)	2	U	DR	62	d	NR	NR	GE	F	REP	PRWT	W		99.8	69
171	Talcott and Koller, 1983	Mouse (Mus musculus)	2	U	DR	18	w	6-8	w	LC	F	REP	PRWT	W		137	69
172	Johansson and Wide, 1986	Mouse (Mus musculus)	2	U	DR	12	w	9	w	SM	M	REP	PRFM	W		139	74
173	Jacquet et al., 1997	Mouse (Mus musculus)	4	U	FD	18	d	NR	NR	GE	F	REP	PRWT	W		154	72
174	Wolfe et al, 1996	Rat (Rattus norvegicus)	2	M	DR	4	w	99	d	JV	M	REP	SPCL	SM		171	78
175	Blanusa, et al, 1989	Rat (Rattus norvegicus)	5	U	DR	6	w	4	mo	GE	F	REP	RHIS	W		175	69
176	Cramer et al, 1980	Rat (Rattus norvegicus)	2	U	DR	22	d	NR	NR	GE	F	REP	PRWT	W		178	69
177	Sokol et al., 1985	Rat (Rattus norvegicus)	3	U	DR	30	d	52	d	JV	M	REP	GREP	PG		198	71
178	Hallen et al., 1995	Rat (Rattus norvegicus)	2	U	DR	13	w	NR	NR	GE	F	REP	PRWT	W		200	73
179	Rabe et al., 1985	Rat (Rattus norvegicus)	2	U	DR	21	d	80	d	JV	F	REP	PRWT	W		218	70
180	Mykkanen et al., 1980	Rat (Rattus norvegicus)	4	U	FD	3	w	NR	NR	LC	F	REP	PRWT	W		221	73
181	Hsu, 1980	Rat (Rattus norvegicus)	2	U	FD	1	w	19	w	LC	F	REP	PRWT	W		222	73
182	Mykkanen et al., 1980	Rat (Rattus norvegicus)	4	U	FD	3	w	NR	NR	LC	F	REP	PRWT	W		230	73
183	Alfano and Petit, 1982	Rat (Rattus norvegicus)	3	U	FD	25	d	NR	NR	LC	F	REP	PRWT	W		258	78
184	Yu et al, 1996	Rat (Rattus norvegicus)	2	U	DR	21	d	NR	NR	LC	F	REP	PRWT	W		330	68
185	Sokol, 1989	Rat (Rattus norvegicus)	2	U	DR	30	d	52	d	JV	M	REP	SPCL	SM		354	69
186	Ronis et al., 1998	Rat (Rattus norvegicus)	2	U	DR	17	d	NR	NR	GE	F	REP	PRWT	W		360	68
187	Ronis et al., 1998	Rat (Rattus norvegicus)	2	U	DR	24	d	NR	NR	LC	F	REP	PRWT	W		360	68

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East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
188	Ronis et al., 1996	Rat (Rattus norvegicus)	2	U	DR	12	d	NR	NR	GE	F	REP	PRWT	W		362	69
189	Sokol, 1989	Rat (Rattus norvegicus)	2	U	DR	30	d	27	d	JV	M	REP	SPCL	SM		364	69
190	Pinon-Lataillade et al., 1995	Mouse (Mus musculus)	2	U	DR	44	d	NR	NR	GE	F	REP	PRWT	W		381	68
191	Draski et al., 1989	Mouse (Mus musculus)	2	U	DR	14	d	NR	NR	LC	F	REP	PRWT	W		381	68
192	Ronis et al., 1996	Rat (Rattus norvegicus)	2	U	DR	50	d	24	d	JV	F	REP	RBEH	W		381	69
193	Rasile et. al. 1995	Mouse (Mus musculus)	2	U	DR	45	d	50-	d	GE	F	REP	ODVP	W		404	69
194	Thoreux-Manlay et al., 1995	Rat (Rattus norvegicus)	2	U	DR	22	d	NR	NR	GE	F	REP	PRWT	W		420	68
195	Donald et al., 1987	Mouse (Mus musculus)	2	U	DR	48	d	NR	NR	GE	F	REP	PRWT	W		437	70
196	Marchlewicz et al., 1993	Rat (Rattus norvegicus)	2	U	DR	9	mo	3	mo	SM	M	REP	SPCL	TE		579	69
197	Piasecka et. al. 1995	Rat (Rattus norvegicus)	2	U	DR	9	mo	NR	NR	SM	M	REP	TEDG	TE		600	69
198	Piasek et al, 1988	Rat (Rattus norvegicus)	2	U	DR	3	w	14	w	LC	F	REP	PRWT	W		635	69
199	Jacquet, 1977	Mouse (Mus musculus)	2	U	FD	7	d	NR	NR	GE	F	REP	RSUC	EM		646	73
200	Selvin-Testa et. al. 1997	Rat (Rattus norvegicus)	2	U	DR	126	d	1	d	GE	F	REP	PROG	W		651	66
201	Piasek and Kostial 1991	Rat (Rattus norvegicus)	2	U	DR	20	w	10	w	GE	F	REP	PRWT	W		750	73
202	Epstein, et.al. 1991	Mouse (Mus musculus)	2	U	DR	4	d	NR	NR	LC	F	REP	PRWT	W		762	68
203	Holtzman et al., 1981	Rat (Rattus norvegicus)	2	U	FD	2	w	NR	NR	LC	F	REP	PRWT	W		828	78
204	Holtzman et al, 1978	Rat (Rattus norvegicus)	2	U	FD	7	d	NR	NR	LC	F	REP	PRWT	W		833	78
205	Barlow et al., 1977	Rat (Rattus norvegicus)	2	U	FD	21	d	NR	NR	LC	F	REP	PRWT	W		991	74
206	Gulati et al, 1985	Mouse (Mus musculus)	4	M	DR	18	w	11	w	JV	F	REP	TEWT	W		1370	75
207	McConnell and Berry, 1979	Rat (Rattus norvegicus)	2	U	FD	30	d	NR	NR	LC	F	REP	PRWT	W		1770	73
208	Sharma and Kanwar, 1985	Mouse (Mus musculus)	2	U	DR	14	w	NR	NR	GE	B	REP	PROG	W		1990	70
209	Goldstein et al, 1974	Rat (Rattus norvegicus)	2	U	FD	16	d	NR	NR	LC	F	REP	PROG	W		2570	78
210	Holtzman et al, 1980	Rat (Rattus norvegicus)	2	U	FD	7	d	NR	NR	LC	F	REP	PRWT	W		2570	78
211	Krigman et al., 1974	Rat (Rattus norvegicus)	2	U	FD	25	d	NR	NR	LC	F	REP	PRWT	W		2570	78
212	Pentschew and Garro 1966	Rat (Rattus norvegicus)	M	FD	27	d	NR	NR	LC	F	C	REP	PROG	W		2840	78
213	Sharma and Kanwar, 1985	Mouse (Mus musculus)	2	U	DR	14	w	21	d	JV	B	REP	PROG	W		3630	70
214	Michaelson and Sauerhoff, 1974	Rat (Rattus norvegicus)	2	U	FD	17	d	NR	NR	LC	F	REP	PRWT	W		6170	74
Growth (G)																	
215	Willoughby et al., 1972	Horse (Equus caballus)	2	U	FD	15	w	20	w	JV	M	GRO	BDWT	W	0.150		68
216	Fox et.al., 1982	Rat (Rattus norvegicus)	2	U	FD	21	d	0	d	JV	F	GRO	BDWT	W	0.500		67
217	Dilts and Ahokas, 1979	Rat (Rattus norvegicus)	6	U	DR	21	d	NR	NR	GE	F	GRO	BDWT	W	1.00	5.00	72
218	Kimmel et al., 1980	Rat (Rattus norvegicus)	5	U	DR	7	d	50	d	AD	F	GRO	BDWT	W	1.27	13.0	73
219	Lynch et al, 1975	Cattle (Bos taurus)	4	U	OR	7	w	1	w	JV	M	GRO	BDWT	W	1.99		75
220	Wiebe and Barr, 1988	Rat (Rattus norvegicus)	3	U	DR	14	d	21	d	JV	F	GRO	BDWT	W	2.40		72
221	Schroeder et al, 1963	Rat (Rattus norvegicus)	2	U	DR	332	d	28	d	JV	B	GRO	BDWT	W	2.98		66
222	Kimmel et al., 1980	Rat (Rattus norvegicus)	4	U	DR	7	w	21	d	GE	F	GRO	BDWT	W	4.70	8.90	80
223	Horwitt and Cowgill, 1937	Dog (Canis familiaris)	3	M	FD	7	mo	NR	NR	JV	NR	GRO	BDWT	W	4.71		68
224	Zheng et al., 1996	Rat (Rattus norvegicus)	3	U	DR	30	d	22-	d	JV	M	GRO	BDWT	W	5.64	28.2	71
225	Hammond et al., 1989	Rat (Rattus norvegicus)	4	U	DR	23	d	22	d	JV	F	GRO	BDWT	W	5.80	29.0	73
226	Lynch et al., 1976	Cattle (Bos taurus)	3	U	OR	84	d	NR	NR	JV	M	GRO	BDWT	W	7.79		80
227	Rader et al., 1981	Rat (Rattus norvegicus)	2	U	OR	6	w	NR	NR	AD	M	GRO	BDWT	W	9.10		67
228	Nehru et al., 1997	Rat (Rattus norvegicus)	2	U	GV	8	w	NR	NR	JV	F	GRO	BDWT	W	10.0		78
229	Gruber et al., 1997	Rat (Rattus norvegicus)	3	U	DR	6	mo	NR	NR	AD	M	GRO	BDWT	W	10.6	532	69
230	Lorenzo et al., 1978	Rabbit (Oryctolagus	3	U	GV	10	d	1	d	JV	F	GRO	BDWT	W	10.7	50.4	78
231	El-Gazzar et al, 1978	Rat (Rattus norvegicus)	2	U	DR	140	d	21	d	JV	M	GRO	BDWT	W	10.7		67
232	Rader et al., 1981	Rat (Rattus norvegicus)	2	U	DR	6	w	NR	NR	JV	M	GRO	BDWT	W	15.1		71
233	Mahaffey et al., 1977	Rat (Rattus norvegicus)	2	UX	FD	10	w	NR	NR	JV	M	GRO	BDWT	W	15.4		79
234	Rader et al., 1981	Rat (Rattus norvegicus)	2	U	OR	6	w	NR	NR	AD	M	GRO	BDWT	W	15.5		74
235	Rader et. al. 1981	Rat (Rattus norvegicus)	2	U	DR	7	w	NR	NR	JV	M	GRO	BDWT	W	16.1		71
236	Gerber et al, 1978	Mouse (Mus musculus)	3	U	DR	14	d	0	d	JV	NR	GRO	BDWT	W	16.3	163	71
237	Barratt et al., 1989	Rat (Rattus norvegicus)	4	U	GV	9	w	10	w	JV	M	GRO	BDWT	W	18.0	180	83
238	Morris et al, 1938	Rat (Rattus norvegicus)	3	U	FD	339	d	26-	d	JV	B	GRO	BDWT	W	18.3		72
239	Tafelski and Lamperti, 1975	Rat (Rattus norvegicus)	4	U	GV	29	d	NR	NR	SM	F	GRO	BDWT	W	18.9		71
240	Mahaffey et al., 1973	Rat (Rattus norvegicus)	7	U	DR	10	w	NR	NR	JV	M	GRO	BDWT	W	24.3		71
241	Bull, et.. al., 1978	Rat (Rattus norvegicus)	4	U	DR	56	d	70	d	LC	F	GRO	BDWT	W	32.5		67
242	Fick et al., 1976	Sheep (Ovis aries)	5	U	FD	84	d	NR	NR	JV	M	GRO	BDWT	W	32.7		66
243	Bankowska and Hine, 1985	Rat (Rattus norvegicus)	2	U	DR	10	w	NR	NR	JV	M	GRO	BDWT	W	38.5		67
244	Logner et al., 1984	Cattle (Bos taurus)	4	U	FD	7	w	16	w	JV	M	GRO	BDWT	W	43.0		72
245	Agodi et al., 1990	Rat (Rattus norvegicus)	2	U	GV	28	d	2	d	JV	B	GRO	BDWT	W	50.0		79
246	Wolfe et al, 1996	Rat (Rattus norvegicus)	5	M	DR	4	w	94	d	JV	M	GRO	BDWT	W	71.5	178	82
247	Gelman and Michaelson, 1979	Rat (Rattus norvegicus)	4	U	GV	12	d	2	d	JV	B	GRO	BDWT	W	75.0	225	85
248	Rudra Pal et al., 1975	Rat (Rattus norvegicus)	2	U	FD	4	w	NR	NR	JV	M	GRO	BDWT	W	100		67
249	Goyer et al., 1970	Rat (Rattus norvegicus)	6	U	DR	10	w	NR	NR	JV	M	GRO	BDWT	W	120	383	71
250	Eyden et al, 1978	Mouse (Mus musculus)	3	U	FD	4	w	3	mo	JV	B	GRO	BDWT	W	136	1360	76
251	Talcott and Koller, 1983	Mouse (Mus musculus)	2	U	DR	18	w	6-8	w	LC	F	GRO	BDWT	W	137		67
252	Johansson and Wide, 1986	Mouse (Mus musculus)	2	U	DR	12	w	NR	NR	GE	M	GRO	BDWT	W	139		72
253	Sokol et al., 1985	Rat (Rattus norvegicus)	3	U	DR	30	d	52	d	JV	M	GRO	BDWT	W	169	508	74
254	Wolfe et al, 1996	Rat (Rattus norvegicus)	2	M	DR	4	w	99	d	JV	B	GRO	BDWT	W	171		76

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
255	Kishi et al., 1983	Rat (Rattus norvegicus)	4	U	GV	18	d	3	d	JV	M	GRO	BDWT	W	180		79
256	Wadi and Ahmad, 1999	Mouse (Mus musculus)	3	U	DR	6	w	7	w	SM	M	GRO	BDWT	W	187	373	69
257	Petrusz et al., 1979	Rat (Rattus norvegicus)	4	U	GV	18	d	2	d	JV	B	GRO	BDWT	W	200		70
258	Yagminas et al., 1990	Rat (Rattus norvegicus)	2	U	GV	91	d	NR	NR	JV	M	GRO	BDWT	W	200		79
259	Rabe et al., 1985	Rat (Rattus norvegicus)	2	U	DR	21	d	80	d	JV	F	GRO	BDWT	W	218		68
260	Mykkanen et al., 1980	Rat (Rattus norvegicus)	4	U	FD	1	w	NR	NR	LC	F	GRO	BDWT	W	230	460	77
261	Sourgens et al., 1987	Rat (Rattus norvegicus)	4	U	DR	30	d	NR	NR	JV	M	GRO	BDWT	W	285		67
262	Exon et al., 1979	Mouse (Mus musculus)	5	U	DR	10	w	NR	NR	JV	M	GRO	BDWT	W	362		67
263	Sokol, 1989	Rat (Rattus norvegicus)	2	U	DR	30	d	52	d	JV	M	GRO	BDWT	W	364		67
264	Holtzman et al., 1982	Rat (Rattus norvegicus)	4	U	GV	14	d	14	d	JV	NR	GRO	BDWT	W	400	800	85
265	Holtzman et al., 1982	Rat (Rattus norvegicus)	5	U	GV	14	d	20	d	JV	NR	GRO	BDWT	W	400	800	85
266	Gerber et al, 1978	Rat (Rattus norvegicus)	2	U	FD	14	mo	0	d	JV	NR	GRO	BDWT	W	431		70
267	Brady, et al, 1975	Rat (Rattus norvegicus)	2	U	GV	102	d	30	d	LC	F	GRO	BDWT	W	441		67
268	Stewart et al., 1998	Mouse (Mus musculus)	4	U	GV	12	d	6	d	JV	M	GRO	BDWT	W	534		79
269	Maker et al., 1973	Mouse (Mus musculus)	7	U	FD	30	d	NR	NR	LC	F	GRO	BDWT	W	632	1264	77
270	Selvin-Testa et. al. 1997	Rat (Rattus norvegicus)	2	U	DR	126	d	1	d	GE	F	GRO	BDWT	W	651		66
271	Piasek and Kostial 1991	Rat (Rattus norvegicus)	2	U	DR	20	w	10	w	GE	F	GRO	BDWT	W	750		71
272	Maker et al., 1973	Mouse (Mus musculus)	7	U	FD	28	d	NR	NR	LC	F	GRO	BDWT	W	1260	2530	77
273	Barrett and Livesey, 1983	Rat (Rattus norvegicus)	4	U	FD	18	d	NR	NR	LC	F	GRO	BDWT	W	1500		71
274	Schroeder et al, 1970	Rat (Rattus norvegicus)	2	U	DR	9	d	21	d	JV	M	GRO	BDWT	W		3.30	72
275	Kelliher, et al. 1973	Cattle (Bos taurus)	2	U	FD	283	d	7	mo	JV	M	GRO	BDWT	W		15.0	76
276	Hamilton and O'Flaherty, 1994	Rat (Rattus norvegicus)	3	U	DR	92	d	25	d	GE	F	MPH	GMPH	TB		28.7	70
277	Hamilton et al., 1994	Rat (Rattus norvegicus)	4	U	DR	7	d	25	d	GE	F	GRO	BDWT	W		29.0	66
278	Hammond and Succop, 1995	Rat (Rattus norvegicus)	2	U	DR	5	d	26	d	JV	F	GRO	BDWT	W		29.0	66
279	Hammond et al., 1993	Rat (Rattus norvegicus)	2	U	DR	26	d	22	d	JV	F	GRO	BDWT	W		29.5	70
280	Hammond et al., 1993	Rat (Rattus norvegicus)	2	U	DR	14	d	26	d	JV	F	MPH	Other	TA		29.9	69
281	Minnema and Hammond, 1994	Rat (Rattus norvegicus)	2	U	DR	10	d	26	d	JV	F	GRO	BDWT	W		30.4	67
282	Al-Omar et al, 2000	Mouse (Mus musculus)	2	M	GV	3	w	NR	NR	JV	M	GRO	BDWT	W		46.4	84
283	White, 1977	Dog (Canis familiaris)	2	U	OR	5	w	<1	yr	JV	NR	GRO	BDWT	W		50.0	84
284	Pankakoski et al., 1994	Shrew (Sorex araneus)	4	M	FD	31	d	NR	NR	JV	B	GRO	BDWT	W		61.5	76
285	Shailesh Kumar and Desiraju, 1990	Rat (Rattus norvegicus)	3	U	GV	58	d	2	d	JV	B	GRO	BDWT	W		100	79
286	Hsu et al, 1975	Pig (Sus scrofa)	2	U	FD	13	w	4	w	JV	NR	GRO	BDWT	W		173	73
287	Harry et al., 1985	Rat (Rattus norvegicus)	2	U	GV	29	d	2	d	JV	F	GRO	BDWT	W		200	79
288	Lessler and Wright, 1976	Rat (Rattus norvegicus)	2	U	FD	5	w	NR	NR	MA	NR	GRO	BDWT	W		272	72
289	Press 1975	Rat (Rattus norvegicus)	2	U	GV	6	d	1	d	JV	B	GRO	BDWT	W		328	79
290	Sokol, 1989	Rat (Rattus norvegicus)	2	U	DR	30	d	27	d	JV	M	GRO	BDWT	W		354	67
291	Ronis et al., 1996	Rat (Rattus norvegicus)	2	U	DR	50	d	24	d	JV	M	GRO	BDWT	W		371	67
292	Toews et al., 1983	Rat (Rattus norvegicus)	2	U	GV	28	d	2	d	JV	M	GRO	BDWT	W		400	79
293	Holtzman et al., 1982	Rat (Rattus norvegicus)	4	U	GV	14	d	18	d	JV	NR	GRO	BDWT	W		400	79
294	Rasile et. al. 1995	Mouse (Mus musculus)	2	U	DR	45	d	50-	d	GE	F	GRO	BDWT	W		404	67
295	Mykkanen et al., 1980	Rat (Rattus norvegicus)	4	U	FD	1	w	NR	NR	LC	F	GRO	BDWT	W		442	71
296	Piasek et al, 1988	Rat (Rattus norvegicus)	2	U	DR	6	w	14	w	LC	F	GRO	BDWT	W		638	67
297	Gulati et al, 1985	Mouse (Mus musculus)	4	M	DR	10	w	11	w	JV	F	GRO	BDWT	W		748	73
298	Barlow et al., 1977	Rat (Rattus norvegicus)	2	U	FD	21	d	NR	NR	LC	F	GRO	BDWT	W		991	72
299	Brashear et al., 1978	Rat (Rattus norvegicus)	2	U	GV	18	d	2	d	JV	B	GRO	BDWT	W		1000	79
300	Gerber et al, 1978	Rat (Rattus norvegicus)	2	U	FD	2	w	0	d	JV	NR	GRO	BDWT	W		1430	72
301	Holtzman et al., 1982	Rat (Rattus norvegicus)	4	U	GV	14	d	24	d	JV	NR	GRO	BDWT	W		1600	79
302	Holtzman et al., 1981	Rat (Rattus norvegicus)	2	U	FD	2	w	60-	d	JV	M	GRO	BDWT	W		2390	69
303	Holtzman et al., 1982	Rat (Rattus norvegicus)	3	U	GV	14	d	16	d	JV	NR	GRO	BDWT	W		2400	79
304	Holtzman et al, 1980	Rat (Rattus norvegicus)	2	U	FD	14	d	60	d	JV	M	GRO	BDWT	W		2650	77
Survival (S)																	
305	Schroeder and Mitchener, 1975	Mouse (Mus musculus)	2	U	DR	669	d	19-	d	JV	B	MOR	LFSP	W	3.50		68
306	Junaid et al., 1997	Mouse (Mus musculus)	4	U	GV	60	d	NR	NR	AD	F	MOR	MORT	W	4.00	8.00	82
307	Lynch et al., 1976	Cattle (Bos taurus)	3	U	OR	84	d	NR	NR	JV	M	MOR	SURV	W	7.79		85
308	Lorenzo et al., 1978	Rabbit (Oryctolagus	5	U	GV	30	d	1	d	JV	F	MOR	MORT	W	10.7	50.4	84
309	Azar et al., 1973	Rat (Rattus norvegicus)	5	M	FD	2	yr	NR	NR	NR	M	MOR	MORT	W	10.9	42.4	81
310	Logner et al., 1984	Cattle (Bos taurus)	4	U	FD	10	d	74	d	JV	M	MOR	MORT	W	16.0	43.0	88
311	Azar et al., 1973	Dog (Canis familiaris)	5	M	FD	2	yr	NR	NR	NR	B	MOR	MORT	W	24.7		68
312	Jessup, 1967	Rabbit (Oryctolagus	3	U	FD	10	d	NR	NR	GE	F	MOR	MORT	W	29.2		72
313	Lassen and Buck, 1979	Pig (Sus scrofa)	5	U	DR	13	w	6	w	JV	NR	MOR	MORT	W	30.2		68
314	Bankowska and Hine, 1985	Rat (Rattus norvegicus)	2	U	DR	4	w	NR	NR	JV	M	MOR	MORT	W	40.3		68
315	Al-Omar et al, 2000	Mouse (Mus musculus)	2	M	GV	5	w	NR	NR	JV	M	MOR	MORT	W	46.4		85
316	Carpenter, 1982	Hamster (Mesocricetus	2	U	DR	51	d	15	w	GE	F	MOR	MORT	W	64.8		68
317	Carpenter, 1982	Hamster (Mesocricetus	2	U	DR	14	d	11	w	GE	F	MOR	MORT	W	64.9		68
318	Jessup and Shott, 1969	Rat (Rattus norvegicus)	5	U	FD	92	w	21	d	JV	M	MOR	SURV	W	74.9		73
319	Jessup, 1969	Rat (Rattus norvegicus)	4	U	FD	8	w	NR	NR	GE	B	MOR	SURV	W	78.9		73
320	Azar et al., 1973	Rat (Rattus norvegicus)	3	M	FD	2	yr	NR	NR	NR	M	MOR	MORT	W	87.5	163	83
321	Wolfe et al, 1996	Rat (Rattus norvegicus)	5	U	DR	24	w	94	d	JV	B	MOR	MORT	W	104		77

Table 7
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Lead to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
322	Lessler and Wright, 1976	Rat (Rattus norvegicus)	2	U	FD	24	w	NR	NR	YO	M	MOR	MORT	W	170		73
323	Lessler and Wright, 1976	Rat (Rattus norvegicus)	2	U	FD	8	w	NR	NR	MA	M	MOR	MORT	W	170		66
324	Petrusz et al., 1979	Rat (Rattus norvegicus)	4	U	GV	18	d	2	d	JV	B	MOR	MORT	W	200		80
325	Ogilvie and Martin, 1981	Mouse (Mus musculus)	2	U	DR	10	mo	NR	NR	AD	M	MOR	MORT	W	379		68
326	Holtzman et al., 1982	Rat (Rattus norvegicus)	5	U	GV	14	d	20	d	JV	NR	MOR	MORT	W	400	800	86
327	Holtzman et al., 1982	Rat (Rattus norvegicus)	4	U	GV	14	d	24	d	JV	NR	MOR	MORT	W	400	800	86
328	Rasile et. al. 1995	Mouse (Mus musculus)	2	U	DR	98	d	50-	d	GE	F	MOR	MORT	W	404		68
329	Piasekand Kostial, 1987	Rat (Rattus norvegicus)	4	U	DR	18	w	NR	NR	JV	M	MOR	MORT	W	639		72
330	Holtzman et al., 1982	Rat (Rattus norvegicus)	4	U	GV	14	d	24	d	JV	NR	MOR	MORT	W	2000	2400	86
331	Holtzman et al., 1982	Rat (Rattus norvegicus)	3	U	GV	14	d	14	d	JV	NR	MOR	MORT	W	3200		80
332	Kanisawa and Schroeder, 1969	Rat (Rattus norvegicus)	2	U	DR	727	d	30	d	JV	F	MOR	LFSP	W		0.569	67
333	Zmudski et al., 1983	Cattle (Bos taurus)	4	U	DR	21	d	10	w	JV	M	MOR	MORT	W		2.70	72
334	Schroeder et al, 1963	Rat (Rattus norvegicus)	2	U	DR	6	mo	28	d	JV	B	MOR	SURV	W		2.87	67
335	Schroeder et al, 1964	Mouse (Mus musculus)	2	U	DR	21	mo	21	d	JV	M	MOR	SURV	W		3.10	73
336	Wells, et.al, 1986	Cattle (Bos taurus)	2	U	DR	8	d	3	mo	JV	M	MOR	MORT	W		20.0	72
337	Pankakoski et al., 1994	Shrew (Sorex araneus)	4	M	FD	31	d	NR	NR	JV	B	MOR	MORT	W		61.5	77
338	Press 1975	Rat (Rattus norvegicus)	2	U	GV	14	d	1	d	JV	B	MOR	MORT	W		328	80
339	Shailesh Kumar and Desiraju, 1990	Rat (Rattus norvegicus)	2	U	GV	58	d	2	d	JV	B	MOR	MORT	W		400	84
340	Holtzman et al., 1982	Rat (Rattus norvegicus)	4	U	GV	14	d	16	d	JV	NR	MOR	MORT	W		400	80
341	Eyden et al, 1978	Mouse (Mus musculus)	6	U	FD	115	d	NR	NR	AD	B	MOR	SURV	W		635	72
342	Gulati et al, 1985	Mouse (Mus musculus)	4	M	DR	18	w	11	w	JV	B	MOR	MORT	W		670	74
343	Lamb et al., 1997	Mouse (Mus musculus)	4	U	DR	105	d	6	w	JV	B	MOR	MORT	W		670	72
									geomean bounded only (R-G)=						34.9	137	

Source: USEPA Ecological Soil Screening Levels for Lead Interim Final, OSWER Directive 9285.7-70. March 2005.

Table 8
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Selenium to Birds
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Reproduction (REP)																	
85	Thapar et al 1969	Chicken (*Gallus domesticus*)	3	U	FD	76	w	1	d	LB	F	EGG	EGWT	EG	0.092	0.368	83
86	Stanley et al, 1996	Mallard (*Anas platyrhynchos*)	3	U	FD	122	d	1	yr	AD	B	REP	HTCH	WO	0.212	0.425	89
87	Poley and Moxon, 1937	Chicken (*Gallus domesticus*)	4	U	FD	1	w	NR	NR	LB	F	REP	RSUC	WO	0.214	0.429	85
88	Heinz et. al., 1989	Duck (*Anas platyrhynchos*)	6	U	FD	46	d	NR	NR	LB	B	REP	PROG	WO	0.219	0.438	90
89	Ort and Latshaw, 1978	Chicken (*Gallus domesticus*)	4	U	FD	28	w	32	w	LB	F	REP	HTCH	WO	0.247	0.412	85
90	Hoffman and Heinz, 1988	Mallard (*Anas platyrhynchos*)	5	U	FD	6	w	NR	NR	LB	B	REP	RSUC	WO	0.273	0.546	89
91	Moksnes and Norheim, 1982	Chicken (*Gallus domesticus*)	4	U	FD	31	w	20	w	LB	B	REP	PROG	WO	0.284		70
92	Moksnes, 1983	Chicken (*Gallus domesticus*)	6	U	FD	18	w	20	w	LB	F	EGG	EGWT	EG	0.292		79
93	Thapar et al 1969	Chicken (*Gallus domesticus*)	3	U	FD	105	w	1	d	LB	F	REP	PROG	WO	0.378		70
94	Albers et al 1996	Duck (*Anas platyrhynchos*)	5	U	FD	16	w	1	yr	AD	M	REP	TEWT	TE	0.644	1.29	81
95	Heinz et. al., 1989	Duck (*Anas platyrhynchos*)	2	U	FD	49	d	NR	NR	LB	B	REP	PROG	WO	0.890		70
96	Stoewsand, etl al, 1977	Japanese Quail (*Coturnix japonica*)	2	U	FD	10	w	2	w	LB	B	EGG	ESTH	WO	0.896		75
97	Heinz and Hoffman, 1987	Mallard (*Anas platyrhynchos*)	6	U	FD	57	w	2	yr	LB	F	REP	NDAY	WO	1.03	2.58	87
98	Santolo et al 1999	American Kestrel (*Falco sparverius*)	3	M	FD	11	w	NR	mo	LB	F	EGG	EGWT	EM	1.37		83
99	Stoewsand, etl al, 1977	Japanese Quail (*Coturnix japonica*)	2	M	FD	10	w	NR	NR	JV	B	EGG	ESTH	WO	3.64		80
100	Arnold et al, 1973	Chicken (*Gallus domesticus*)	3	U	FD	24	w	1	d	LB	F	EGG	EGWT	EG		0.0911	79
101	Kaantee and Kurkela, 1980	Chicken (*Gallus domesticus*)	3	M	FD	2	w	18	mo	LB	F	REP	PROG	WO		0.0988	85
102	Stone and Soares, 1976	Japanese Quail (*Coturnix japonica*)	2	U	FD	32	d	NR	NR	LB	F	REP	PROG	WO		0.120	79
103	Poley et al., 1937	Chicken (*Gallus domesticus*)	2	M	FD	1	w	NR	NR	LB	F	REP	HTCH	WO		0.127	79
104	Stanley et al., 1994	Mallard (*Anas platyrhynchos*)	2	M	FD	93	d	1	yr	LB	B	REP	TERA	EM		0.355	83
105	Heinz and Hoffman 1998	Mallard (*Anas platyrhynchos*)	2	M	FD	75	d	18	mo	LB	F	REP	TERA	EM		0.456	84
106	Heinz and Hoffman 1996	Mallard (*Anas platyrhynchos*)	2	M	FD	4	w	NR	mo	LB	F	REP	TERA	EM		0.524	83
107	Hoffman and Heinz, 1988	Mallard (*Anas platyrhynchos*)	2	U	FD	6	w	NR	NR	LB	B	REP	ABNM	WO		0.546	83
108	Heinz and Hoffman 1996	Mallard (*Anas platyrhynchos*)	2	M	FD	4	w	NR	mo	LB	F	REP	TERA	EM		0.580	83
109	Heinz and Hoffman 1996	Mallard (*Anas platyrhynchos*)	2	M	FD	4	w	NR	mo	LB	F	REP	TPRD	EM		0.614	77
110	Smith et al, 1988	Black-crowned night-heron (*Nycticorax nycti*	2	U	FD	92	d	NR	NR	LB	B	REP	ODVP	WO		0.675	76
111	El-Begerami et al, 1977	Japanese Quail (*Coturnix japonica*)	3	U	FD	16	w	1	d	JV	B	REP	ABNM	WO		0.702	78
112	El-Begearmi et al, 1982	Japanese Quail (*Coturnix japonica*)	2	U	FD	16	w	NR	NR	LB	F	REP	HTCH	WO		0.780	78
113	Stoewsand et al., 1978	Japanese Quail (*Coturnix japonica*)	2	U	FD	5	w	15	d	JV	F	REP	EGPN	WO		0.826	78
114	Heinz and Hoffman, 1987	Mallard (*Anas platyrhynchos*)	2	U	FD	41	d	2	yr	LB	F	REP	PROG	WO		0.898	85
115	Heinz and Fitzgerald, 1993	Mallard (*Anas platyrhynchos*)	2	M	FD	21	w	NR	NR	LB	F	REP	PROG	WO		1.19	84
116	Wiemeyer and Hoffman, 1996	Owl (*Otus asio*)	3	M	FD	3	m	3	yr	LB	B	REP	PLBR	WO		4.49	85
Growth (GRO)																	
117	Colnago et al, 1984	Chicken (*Gallus domesticus*)	3	M	FD	24	d	1	d	JV	M	GRO	BDWT	WO	0.0632		73
118	Jensen, 1986	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	0.0740	0.370	75
119	Hegazy and Adachi, 2000	Chicken (*Gallus domesticus*)	2	U	FD	15	d	1	d	JV	NR	GRO	BDWT	WO	0.0859		70
120	Thapar et al 1969	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO	0.180	0.721	81
121	Hill 1979	Chicken (*Gallus domesticus*)	4	U	FD	5	w	1	d	JV	F	GRO	BDWT	WO	0.204	0.408	77
122	Echevarria et al., 1988	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	GRO	BDWT	WO	0.213	0.426	82
123	Moksnes and Norheim, 1982	Chicken (*Gallus domesticus*)	4	U	FD	31	w	20	w	JV	B	GRO	BDWT	WO	0.284		68
124	Moksnes, 1983	Chicken (*Gallus domesticus*)	6	U	FD	18	w	20	w	SM	F	GRO	BDWT	WO	0.292		77
125	Moksnes and Norheim, 1982	Chicken (*Gallus domesticus*)	4	U	FD	6	w	1	d	JV	B	GRO	BDWT	WO	0.319		68
126	Arnold et al, 1973	Chicken (*Gallus domesticus*)	3	U	FD	104	w	1	d	JV	B	GRO	BDWT	WO	0.371		68
127	Thapar et al 1969	Chicken (*Gallus domesticus*)	3	U	FD	105	w	1	d	JV	F	GRO	BDWT	WO	0.379		68
128	Poley and Moxon, 1937	Chicken (*Gallus domesticus*)	4	U	FD	6	w	NR	NR	SM	F	GRO	BDWT	WO	0.429		68
129	Hill, 1974	Chicken (*Gallus domesticus*)	6	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO	0.429	0.859	82
130	Jensen et al., 1977	Chicken (*Gallus domesticus*)	5	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO	0.617	1.23	77
131	O'Toole and Raisbeck 1997	Mallard (*Anas platyrhynchos*)	4	U	FD	21	d	NR	NR	JV	M	GRO	BDWT	WO	0.690	1.73	79
132	Cantor et al., 1984	Chicken (*Gallus domesticus*)	4	U	DR	7	d	6	d	JV	M	GRO	BDWT	WO	0.718	1.44	78
133	Sell and Horani, 1976	Japanese Quail (*Coturnix japonica*)	2	U	FD	23	d	8	d	JV	B	GRO	BDWT	WO	0.909		69
134	Yamamoto et al, 1998	American Kestrel (*Falco sparverius*)	3	M	FD	77	d	NR	NR	MA	M	GRO	BDWT	WO	1.06		68
135	Hoffman et al, 1991	Mallard (*Anas platyrhynchos*)	3	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO	1.13	4.53	86
136	Hoffman et al, 1992	Mallard (*Anas platyrhynchos*)	3	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO	1.23	4.94	86
137	Ansari and Britton, 1974	Chicken (*Gallus domesticus*)	2	U	FD	10	d	1	d	JV	M	GRO	BDWT	WO	1.38		67
138	Howell and Hill, 1978	Chicken (*Gallus domesticus*)	2	U	FD	20	d	1	d	JV	B	GRO	BDWT	WO	1.42		67
139	Cantor et al., 1984	Chicken (*Gallus domesticus*)	4	U	DR	7	d	9	d	JV	B	GRO	BDWT	WO	1.45	2.90	78
140	Heinz et al 1988	Mallard (*Anas platyrhynchos*)	5	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	1.74	3.48	89
141	Heinz et al 1988	Mallard (*Anas platyrhynchos*)	5	U	FD	3	w	1	d	JV	NR	GRO	BDWT	WO	2.13	4.26	89
142	Heinz et al 1996	Mallard (*Anas platyrhynchos*)	2	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO	3.04		72
143	Heinz et al 1996	Mallard (*Anas platyrhynchos*)	3	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO	4.16	8.32	84
144	Heinz et al 1996	Mallard (*Anas platyrhynchos*)	3	U	FD	1	w	1	d	JV	NR	GRO	BDWT	WO	5.75	11.5	84
145	Jensen et al., 1977	Chicken (*Gallus domesticus*)	5	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO	6.34	11.9	77
146	Heinz et al 1996	Mallard (*Anas platyrhynchos*)	3	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO	7.31		72
147	El-Begearmi and Combs, 1982	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO		0.0912	77
148	Poley et al., 1937	Chicken (*Gallus domesticus*)	2	M	FD	1	w	NR	NR	SM	F	GRO	BDWT	WO		0.127	77
149	El-Begearmi and Combs, 1982	Chicken (*Gallus domesticus*)	3	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO		0.130	77
150	El-Begearmi and Combs, 1982	Chicken (*Gallus domesticus*)	4	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO		0.180	77

Table 8
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Selenium to Birds
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
151	Fairbrother and Fowles, 1990	Mallard (*Anas platyrhynchos*)	3	U	DR	9	d	9	mo	JV	M	GRO	BDWT	WO		0.275	72
152	Dafalla and Adam, 1986	Chicken (*Gallus domesticus*)	3	U	FD	2	w	7	d	JV	B	GRO	BDWT	WO		0.306	77
153	Khan et al, 1993	Chicken (*Gallus domesticus*)	2	U	GV	28	d	43	d	JV	B	GRO	BDWT	WO		0.50	84
154	Khan et al, 1993	Chicken (*Gallus domesticus*)	2	U	OR	4	w	NR	NR	JV	B	GRO	BDWT	WO		0.50	79
155	Sell and Horani, 1976	Chicken (*Gallus domesticus*)	2	U	FD	28	d	1	d	JV	M	GRO	BDWT	WO		0.629	78
156	Elzubeir and Davis, 1988	Chicken (*Gallus domesticus*)	2	U	FD	24	d	14	d	JV	M	GRO	BDWT	WO		0.788	77
157	Davis, el. al. 1996	Chicken (*Gallus domesticus*)	2	U	FD	21	d	14	d	JV	M	GRO	BDWT	WO		0.855	77
158	Hill, 1979	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO		0.859	71
159	Stoewsand, etl al, 1977	Japanese Quail (*Coturnix japonica*)	2	U	FD	10	w	2	w	JV	B	GRO	BDWT	WO		0.896	77
160	Heinz and Fitzgerald, 1993	Mallard (*Anas platyrhynchos*)	2	M	FD	21	w	NR	NR	SM	B	GRO	BDWT	WO		1.08	75
161	Hoffman et al, 1992	Duck (*Anas platyrhynchos*)	3	U	FD	4	w	1	d	JV	B	GRO	BDWT	WO		1.20	82
162	Berg and Martinson, 1972	Chicken (*Gallus domesticus*)	3	U	FD	2	w	1	d	JV	NR	GRO	BDWT	WO		1.38	77
163	Lowry and Baker, 1989	Chicken (*Gallus domesticus*)	2	U	FD	14	d	8	d	JV	M	GRO	BDWT	WO		1.55	77
164	Hill, 1979	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	GRO	BDWT	WO		1.72	71
165	Howell and Hill, 1978	Chicken (*Gallus domesticus*)	2	U	FD	21	d	1	d	JV	B	GRO	BDWT	WO		1.78	76
166	Donaldson and McGowan, 1989	Chicken (*Gallus domesticus*)	3	U	FD	20	d	1	d	JV	M	GRO	BDWT	WO		2.27	77
167	Hill, 1980	Chicken (*Gallus domesticus*)	2	U	FD	1	w	1	d	JV	F	GRO	BDWT	WO		2.76	71
168	Stoewsand, etl al, 1977	Japanese Quail (*Coturnix japonica*)	2	M	FD	10	w	NR	NR	JV	B	GRO	BDWT	WO		3.64	82

Table 8
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Selenium to Birds
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Survival (MOR)																	
169	Arnold et al, 1973	Chicken (*Gallus domesticus*)	3	U	FD	24	w	1	d	JV	F	MOR	MORT	WO	0.093	0.371	82
170	Van Vleet et al, 1981	Duck (*Anas platyrhynchos*)	2	U	FD	15	d	1	d	JV	M	MOR	MORT	WO	0.153		77
171	El-Begearmi and Combs, 1982	Chicken (*Gallus domesticus*)	4	U	FD	2	w	1	d	JV	B	MOR	MORT	WO	0.290	0.579	84
172	Moksnes, 1983	Chicken (*Gallus domesticus*)	6	U	FD	18	w	20	w	SM	F	MOR	MORT	WO	0.292		78
173	Thapar et al 1969	Chicken (*Gallus domesticus*)	3	U	FD	76	w	1	d	JV	F	MOR	MORT	WO	0.368		78
174	Thapar et al 1969	Chicken (*Gallus domesticus*)	3	U	FD	105	w	1	d	JV	B	MOR	MORT	WO	0.378		77
175	El-Begearmi and Combs, 1982	Chicken (*Gallus domesticus*)	3	U	FD	2	w	1	d	JV	B	MOR	MORT	WO	0.412	0.823	84
176	Heinz and Fitzgerald 1993	Mallard (*Anas platyrhynchos*)	5	U	FD	13	w	NR	mo	AD	M	MOR	MORT	WO	0.563	1.13	85
177	El-Begearmi and Combs, 1982	Chicken (*Gallus domesticus*)	4	U	FD	2	w	1	d	JV	B	MOR	MORT	WO	0.572	1.14	84
178	Stoewsand et al., 1974	Japanese Quail (*Coturnix japonica*)	2	U	FD	4	w	1	d	JV	B	MOR	MORT	WO	0.610		77
179	Sell and Horani, 1976	Chicken (*Gallus domesticus*)	2	U	FD	28	d	1	d	JV	M	MOR	MORT	WO	0.629		79
180	Echevarria et al., 1988	Chicken (*Gallus domesticus*)	4	U	FD	3	w	1	d	JV	M	MOR	MORT	WO	0.64		68
181	O'Toole and Raisbeck 1997	Mallard (*Anas platyrhynchos*)	4	U	FD	50	d	NR	NR	AD	M	MOR	MORT	WO	0.699	4.19	82
182	El-Begerami et al, 1977	Japanese Quail (*Coturnix japonica*)	3	U	FD	12	w	1	d	JV	B	MOR	SURV	WO	0.702	1.40	83
183	El-Begearmi et al, 1982	Japanese Quail (*Coturnix japonica*)	2	U	FD	16	w	NR	NR	NR	B	MOR	SURV	WO	0.780		70
184	Heinz 1993	Duck (*Anas platyrhynchos*)	2	U	FD	21	w	NR	NR	AD	M	MOR	MORT	WO	0.844		70
185	Hill, 1979	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	MOR	MORT	WO	0.859		72
186	Heinz et. al., 1989	Duck (*Anas platyrhynchos*)	2	U	FD	49	d	NR	NR	SM	B	MOR	MORT	WO	0.890		76
187	Stoewsand, etl al, 1977	Japanese Quail (*Coturnix japonica*)	2	U	FD	10	w	2	w	JV	B	MOR	MORT	WO	0.896		78
188	Sell and Horani, 1976	Japanese Quail (*Coturnix japonica*)	2	U	FD	23	d	8	d	JV	B	MOR	MORT	WO	0.909		78
189	Heinz et. al., 1989	Duck (*Anas platyrhynchos*)	6	U	FD	46	w	NR	NR	SM	B	MOR	MORT	WO	0.910		79
190	Yamamoto et al, 1998	American Kestrel (*Falco sparverius*)	2	M	FD	77	d	NR	NR	MA	B	MOR	MORT	WO	0.944		75
191	Heinz and Hoffman, 1987	Mallard (*Anas platyrhynchos*)	2	U	FD	41	d	2	yr	SM	F	MOR	MORT	WO	1.01		84
192	Yamamoto et al, 1998	American Kestrel (*Falco sparverius*)	3	M	FD	77	d	NR	NR	MA	B	MOR	MORT	WO	1.06		78
193	Heinz and Fitzgerald, 1993	Mallard (*Anas platyrhynchos*)	2	M	FD	21	w	NR	NR	SM	B	MOR	MORT	WO	1.08		76
194	Hoffman et al, 1991	Mallard (*Anas platyrhynchos*)	3	U	FD	4	w	1	d	JV	B	MOR	SURV	WO	1.13	4.53	87
195	Hoffman et al, 1992	Duck (*Anas platyrhynchos*)	3	U	FD	4	w	1	d	JV	B	MOR	SURV	WO	1.20	4.80	87
196	Green and Albers, 1997	Mallard (*Anas platyrhynchos*)	5	U	FD	16	w	14	mo	AD	M	MOR	MORT	WO	1.22	2.44	83
197	Hoffman et al, 1992	Mallard (*Anas platyrhynchos*)	3	U	FD	4	w	1	d	JV	B	MOR	SURV	WO	1.23	4.94	87
198	Santolo et al 1999	American Kestrel (*Falco sparverius*)	3	M	FD	11	w	NR	mo	AD	B	MOR	MORT	WO	1.37		78
199	Ansari and Britton, 1974	Chicken (*Gallus domesticus*)	2	U	FD	10	d	1	d	JV	M	MOR	MORT	WO	1.38		77
200	Howell and Hill, 1978	Chicken (*Gallus domesticus*)	2	U	FD	20	d	1	d	JV	B	MOR	MORT	WO	1.42		77
214	Hill, 1979	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	MOR	MORT	WO	1.72		72
201	Hoffman et al, 1991	Mallard (*Anas platyrhynchos*)	7	U	FD	14	w	2	yr	AD	M	MOR	SURV	WO	1.87		78
202	Smith et al, 1988	Black-crowned night-heron (*Nycticorax nycti*	3	U	FD	92	d	NR	NR	AD	B	MOR	MORT	WO	2.03		78
203	Albers et al 1996	Duck (*Anas platyrhynchos*)	5	U	FD	16	w	1	yr	AD	M	MOR	MORT	WO	2.38	4.75	80
204	Heinz et al 1996	Mallard (*Anas platyrhynchos*)	2	U	FD	2	w	1	d	JV	NR	MOR	SURV	WO	3.04		73
205	Donaldson and McGowan, 1989	Chicken (*Gallus domesticus*)	3	U	FD	18	d	1	d	JV	M	MOR	MORT	WO	3.04	6.08	84
206	Jensen et al., 1977	Chicken (*Gallus domesticus*)	5	U	FD	2	w	1	d	JV	B	MOR	MORT	WO	3.07	6.14	78
207	Heinz and Hoffman, 1987	Mallard (*Anas platyrhynchos*)	6	U	FD	57	d	2	yr	SM	B	MOR	MORT	WO	3.08	12.3	84
208	Heinz et al 1996	Mallard (*Anas platyrhynchos*)	3	U	FD	1	w	1	d	JV	NR	MOR	SURV	WO	3.49	6.99	85
209	Stoewsand, etl al, 1977	Japanese Quail (*Coturnix japonica*)	2	M	FD	10	w	2	w	JV	B	MOR	MORT	WO	3.64		83
210	Heinz et al 1996	Mallard (*Anas platyrhynchos*)	3	U	FD	2	w	1	d	JV	NR	MOR	SURV	WO	3.72		79
211	Heinz et al 1988	Mallard (*Anas platyrhynchos*)	5	U	FD	3	w	1	d	JV	NR	MOR	MORT	WO	3.99	7.98	90
212	Heinz et al 1988	Mallard (*Anas platyrhynchos*)	5	U	FD	2	w	1	d	JV	NR	MOR	MORT	WO	5.84	11.7	90
213	Heinz et al 1996	Mallard (*Anas platyrhynchos*)	3	U	FD	2	w	1	d	JV	NR	MOR	SURV	WO	7.31		66
215	Jensen et al., 1977	Chicken (*Gallus domesticus*)	5	U	FD	2	w	1	d	JV	B	MOR	MORT	WO	28.2	29.0	78
216	Khan et al, 1993	Chicken (*Gallus domesticus*)	2	U	GV	28	d	43	d	JV	F	MOR	MORT	WO		0.50	78
217	Howell and Hill, 1978	Chicken (*Gallus domesticus*)	2	U	FD	21	d	1	d	JV	B	MOR	MORT	WO		1.78	77
218	Hill, 1974	Chicken (*Gallus domesticus*)	2	U	FD	2	w	1	d	JV	B	MOR	MORT	WO		3.44	77
219	Heinz 1993	Duck (*Anas platyrhynchos*)	2	U	FD	5	w	NR	NR	AD	M	MOR	MORT	WO		5.75	71
									geomean bounded only (R-G)=						0.593	1.39	

Source: USEPA Ecological Soil Screening Levels for Selenium Interim Final, OSWER Directive 9285.7-72. July 2007.

Table 9
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Selenium to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
Reproduction (REP)																	
231	Nobunaga et al., 1979	Mouse (*Mus musculus*)	3	U	DR	56	d	60	d	GE	F	REP	PRWT	WO	0.072	0.145	81
232	Fredriksson et al., 1993	Rat (*Rattus norvegicus*)	2	M	FD	14	w	NR	NR	GE	F	REP	ODVP	WO	0.108		74
233	Gunter et al, 2003	Cattle (*Bos taurus*)	2	U	FD	42	w	NR	NR	GE	F	REP	PRWT	WO	0.173		70
234	Nebbia et al., 1987	Rat (*Rattus norvegicus*)	4	U	DR	240	d	NR	NR	JV	M	REP	TEWT	TE	0.384	0.768	80
235	Kezhou et al., 1987	Rat (*Rattus norvegicus*)	4	U	FD	5	w	NR	NR	JV	M	REP	SPCL	GO	0.388	0.776	86
236	Abdo, 1994	Rat (*Rattus norvegicus*)	6	UX	DR	13	w	6	w	JV	F	REP	GREP	WO	0.393	0.763	95
237	Halverson, 1974	Rat (*Rattus norvegicus*)	5	U	FD	42	d	90	d	GE	F	REP	PROG	WO	0.456		71
238	Abdo, 1994	Mouse (*Mus musculus*)	6	UX	DR	13	w	6	w	JV	M	REP	GREP	WO	0.735	1.51	92
239	Panter et al., 1995	Sheep (*Ovis aries*)	2	M	FD	88	d	NR	mo	GE	F	REP	PRWT	WO	0.780		77
240	Panter et al., 1995	Sheep (*Ovis aries*)	2	M	FD	88	d	NR	NR	GE	F	REP	PRWT	WO	0.945		69
241	Hau et al., 1987	Mouse (*Mus musculus*)	4	U	DR	29	d	8	w	GE	F	REP	PRWT	WO	1.21	6.03	78
242	Piccirillo et al 1983	Mouse (*Mus musculus*)	2	U	GV	8	d	64	d	GE	F	REP	PRWT	WO	1.60		86
243	Abdo, 1994	Mouse (*Mus musculus*)	6	UX	DR	13	w	6	w	JV	B	REP	SPCL	TE	2.28		85
244	Webster, 1979	Mouse (*Mus musculus*)	5	U	FD	19	d	4	mo	GE	F	REP	PRWT	WO	2.54	25.4	78
245	Hardin et al., 1987	Mouse (*Mus musculus*)	5	U	GV	8	d	6-8	w	GE	F	REP	PRWT	WO	3.20	6.39	87
246	Plasterer et al., 1985	Mouse (*Mus musculus*)	2	U	GV	8	d	61-71	d	GE	F	REP	PRWT	WO	3.20		86
247	Booth et al. 1983	Mouse (*Mus musculus*)	2	U	GV	8	d	NR	NR	GE	F	REP	PROG	WO	7.0		90
248	Kaur and Parshad, 1994	Rat (*Rattus norvegicus*)	3	U	FD	5	w	NR	NR	JV	M	REP	SPCV	TE		0.089	79
249	Abdo, 1994	Rat (*Rattus norvegicus*)	6	UX	DR	13	w	6	w	JV	F	REP	GREP	WO		0.130	89
250	Wahlstrom and Olson, 1959	Pig (*Sus scrofa*)	2	U	FD	239	d	8	w	GE	F	REP	PRWT	WO		0.296	79
251	Schroeder and Mitchener, 1971	Mouse (*Mus musculus*)	2	U	DR	6	mo	21	d	JV	F	REP	DEYO	WO		0.434	73
252	Thorlacius-Ussing, 1990	Rat (*Rattus norvegicus*)	3	U	DR	21	d	NR	NR	LC	F	REP	PRWT	WO		0.504	73
253	Parshad and Sud, 1989	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	M	REP	TEWT	TE		0.550	79
254	Thorlacius-Ussing et al., 1987	Rat (*Rattus norvegicus*)	2	U	DR	21	d	NR	mo	LC	F	REP	PRWT	WO		0.749	73
255	Chermoff and Kavlock, 1982	Mouse (*Mus musculus*)	2	U	GV	5	d	60	d	GE	F	REP	PROG	WO		4.18	86
256	Gray and Kavlock, 1984	Mouse (*Mus musculus*)	2	U	OR	5	d	90	d	GE	F	REP	PROG	WO		4.57	81
257	Seidenberg et al 1986	Mouse (*Mus musculus*)	2	U	GV	4	d	NR	NR	GE	F	REP	PROG	WO		5.01	86
Growth (GRO)																	
258	Shull and Checke, 1973	Rat (*Rattus norvegicus*)	3	U	FD	8	w	NR	NR	JV	M	GRO	BDWT	WO	0.053	0.265	82
259	Meyer et al 1982	Rat (*Rattus norvegicus*)	2	U	FD	30	d	NR	NR	JV	M	GRO	BDWT	WO	0.0642		78
260	Palmer et al., 1982	Rat (*Rattus norvegicus*)	3	M	FD	4	w	NR	NR	JV	N	GRO	BDWT	WO	0.0838	0.763	86
261	Chen et al., 1990	Rat (*Rattus norvegicus*)	2	U	FD	2	w	NR	NR	JV	M	GRO	BDWT	WO	0.0869		77
262	Glattre et al, 1995	Rat (*Rattus norvegicus*)	2	U	DR	4	w	NR	NR	JV	M	GRO	BDWT	WO	0.090		67
263	Debski et al., 1992	Rat (*Rattus norvegicus*)	2	U	FD	2	w	NR	NR	JV	M	GRO	BDWT	WO	0.110		81
264	Kim and Mahan, 2001	Pig (*Sus scrofa*)	6	U	FD	12	w	NR	NR	JV	B	GRO	BDWT	WO	0.112	0.157	84
265	Kim and Mahan, 2001	Pig (*Sus scrofa*)	4	U	FD	12	w	8	w	JV	B	GRO	BDWT	WO	0.137	0.273	84
266	Mahan and Moxon, 1984	Pig (*Sus scrofa*)	7	U	FD	37	d	4	w	JV	B	GRO	BDWT	WO	0.143	0.215	84
267	Goehring et. al. 1983	Pig (*Sus scrofa*)	6	M	FD	5	w	NR	NR	JV	B	GRO	BDWT	WO	0.146	0.273	89
268	Liu et al., 1994	Rat (*Rattus norvegicus*)	4	M	FD	2	w	45	d	JV	F	GRO	BDWT	WO	0.151	0.304	89
269	Liu and Milner, 1992	Rat (*Rattus norvegicus*)	2	M	FD	2	w	41	d	JV	F	GRO	BDWT	WO	0.153		76
270	Kim and Mahan, 2001	Pig (*Sus scrofa*)	2	UX	FD	14	w	NR	NR	JV	F	GRO	BDWT	WO	0.155	0.221	89
271	Behne et al., 1992	Rat (*Rattus norvegicus*)	2	U	FD	110	d	30	d	JV	M	GRO	BDWT	WO	0.163		77
272	Jenkins and Hidiroglou, 1986	Cattle (*Bos taurus*)	5	U	FD	6	w	3	d	JV	M	GRO	BDWT	WO	0.165	0.330	83
273	Mahan and Magee, 1991	Pig (*Sus scrofa*)	3	UX	FD	35	d	23	d	JV	B	GRO	BDWT	WO	0.170	0.510	89
274	Gunter et al, 2003	Cattle (*Bos taurus*)	2	U	FD	42	w	NR	NR	GE	F	GRO	BDWT	WO	0.173		68
275	Nehru et al., 1997	Rat (*Rattus norvegicus*)	2	U	GV	8	w	NR	NR	JV	F	GRO	BDWT	WO	0.175		79
276	Palmer and Olson, 1974	Rat (*Rattus norvegicus*)	3	M	DR	42	d	21	d	JV	M	GRO	BDWT	WO	0.181		76
277	Mahan and Magee, 1991	Pig (*Sus scrofa*)	3	UX	FD	35	d	23	d	JV	B	GRO	BDWT	WO	0.183	0.548	89
278	Mandisodza et al., 1979	Pig (*Sus scrofa*)	3	M	FD	61	d	5-7	w	JV	B	GRO	BDWT	WO	0.189		74
279	Palmer and Olson, 1974	Rat (*Rattus norvegicus*)	3	M	DR	42	d	21	d	JV	M	GRO	BDWT	WO	0.191		78
280	Coudray, et. al. 1996	Rat (*Rattus norvegicus*)	2	U	FD	8	w	NR	NR	JV	M	GRO	BDWT	WO	0.198		77
281	Mandisodza et al., 1979	Pig (*Sus scrofa*)	3	M	FD	61	d	5-7	w	JV		GRO	BDWT	WO	0.202		68
282	Salbe and Levander, 1990	Rat (*Rattus norvegicus*)	3	UX	FD	6	w	NR	NR	JV	M	GRO	BDWT	WO	0.214		82
283	McAdam and Levander, 1987	Rat (*Rattus norvegicus*)	4	U	FD	6	w	21	d	JV	M	GRO	BDWT	WO	0.217	0.435	82
284	Goehring et al., 1984	Rat (*Rattus norvegicus*)	4	M	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO	0.217	0.470	88
285	Salbe and Levander, 1990	Rat (*Rattus norvegicus*)	3	UX	FD	6	w	NR	NR	JV	M	GRO	BDWT	WO	0.217		82
286	Moxon and Mahan, 1982	Pig (*Sus scrofa*)	8	UX	FD	37	d	NR	NR	JV	N	GRO	BDWT	WO	0.227	0.340	89
287	Kim and Mahan, 2001	Pig (*Sus scrofa*)	4	UX	FD	14	w	NR	NR	JV	F	GRO	BDWT	WO	0.236		74
288	Tsunoda et al, 2000	Mouse (*Mus musculus*)	4	U	DR	14	d	7-8	w	JV	M	GRO	BDWT	WO	0.240	0.580	79
289	Lane et al., 1984	Mouse (*Mus musculus*)	2	U	FD	26	w	4	w	JV	F	GRO	BDWT	WO	0.254		77
290	LeBoeuf et al., 1985	Rat (*Rattus norvegicus*)	3	U	FD	6	w	NR	NR	JV	M	GRO	BDWT	WO	0.261	0.521	82
291	Goehring et al., 1984	Pig (*Sus scrofa*)	4	M	FD	6	w	NR	NR	JV	B	GRO	BDWT	WO	0.265		74
292	Palmer and Olson, 1974	Rat (*Rattus norvegicus*)	4	M	DR	7	d	21	d	JV	M	GRO	BDWT	WO	0.274	0.540	84
293	Turan et al., 1997	Rabbit (*Oryctolagus cuniculus*)	2	U	FD	12	w	NR	NR	JV	B	GRO	BDWT	WO	0.277		73
294	Wahlstrom and Olson, 1959	Pig (*Sus scrofa*)	2	U	FD	239	d	8	w	GE	F	GRO	BDWT	WO	0.296		68
295	Bioulac-Sage et al., 1992	Rat (*Rattus norvegicus*)	3	U	FD	2	mo	NR	NR	JV	M	GRO	BDWT	WO	0.318		70
296	Julius et al, 1983	Hamster (*Mesocricetus auratus*)	3	U	FD	21	d	4	w	JV	B	GRO	BDWT	WO	0.356	0.712	84

Table 9
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Selenium to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
297	Kim and Mahan, 2001	Pig (*Sus scrofa*)	4	U	FD	12	w	8	w	JV	B	GRO	BDWT	WO	0.367	0.489	79
298	Yeh et al, 1997	Rat (*Rattus norvegicus*)	4	U	FD	8	w	NR	NR	JV	B	GRO	BDWT	WO	0.367		77
299	Abdo, 1994	Rat (*Rattus norvegicus*)	6	U	DR	13	w	6	w	JV	F	GRO	BDWT	WO	0.368	0.564	93
300	Kiremidjian-Schumacher et al., 1	Mouse (*Mus musculus*)	2	U	FD	8	w	6	w	JV	M	GRO	BDWT	WO	0.371		69
301	Julius et al, 1983	Hamster (*Mesocricetus auratus*)	3	U	FD	21	d	4	w	JV	M	GRO	BDWT	WO	0.374	0.747	84
302	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	2	U	FD	5	w	NR	NR	JV	M	GRO	BDWT	WO	0.375		76
303	Spallholz et al., 1973	Mouse (*Mus musculus*)	10	U	FD	5	w	NR	NR	JV	B	GRO	BDWT	WO	0.384	0.523	83
304	Nebbia et al., 1987	Rat (*Rattus norvegicus*)	4	U	DR	240	d	NR	NR	JV	M	GRO	BDWT	WO	0.384	0.768	78
305	Kezhou et al., 1987	Rat (*Rattus norvegicus*)	4	U	FD	5	w	NR	NR	JV	M	GRO	BDWT	WO	0.388	0.776	84
306	Abdo, 1994	Rat (*Rattus norvegicus*)	6	U	DR	13	w	6	w	JV	F	GRO	BDWT	WO	0.393	0.763	93
307	Schroeder and Mitchener, 1972	Mouse (*Mus musculus*)	2	U	DR	360	d	NR	lf	JV	M	GRO	BDWT	WO	0.407		68
308	Halverson et al 1966	Rat (*Rattus norvegicus*)	8	U	FD	6	w	NR	NR	JV	M	GRO	BDWT	WO	0.425	0.567	77
309	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	2	U	FD	5	w	NR	NR	JV	M	GRO	BDWT	WO	0.426		74
310	Halverson et al 1966	Rat (*Rattus norvegicus*)	7	U	FD	6	w	NR	NR	JV	M	GRO	BDWT	WO	0.432	0.577	83
311	McAdam and Levander, 1987	Rat (*Rattus norvegicus*)	4	U	FD	6	w	21	d	JV	M	GRO	BDWT	WO	0.435	0.869	82
312	McAdam and Levander, 1987	Rat (*Rattus norvegicus*)	4	U	FD	6	w	21	d	JV	M	GRO	BDWT	WO	0.435	0.869	82
313	McAdam and Levander, 1987	Rat (*Rattus norvegicus*)	4	U	FD	6	w	21	d	JV	M	GRO	BDWT	WO	0.435	0.869	82
314	Johnson, et al., 2000	Mouse (*Mus musculus*)	4	U	DR	14	d	6-7	w	JV	M	GRO	BDWT	WO	0.438	1.31	78
315	Jacobs and Forst 1981	Rat (*Rattus norvegicus*)	6	U	DR	35	d	5, 12	w	JV	B	GRO	BDWT	WO	0.452	0.904	77
316	Goehring et al., 1984	Pig (*Sus scrofa*)	4	M	FD	17	w	NR	NR	JV	B	GRO	BDWT	WO	0.464		74
317	Whanger and Butler, 1988	Rat (*Rattus norvegicus*)	4	U	FD	9	w	NR	NR	JV	M	GRO	BDWT	WO	0.490		78
318	Whanger and Butler, 1988	Rat (*Rattus norvegicus*)	4	U	FD	9	w	NR	NR	JV	M	GRO	BDWT	WO	0.500		78
319	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	5	U	FD	5	w	NR	NR	JV	M	GRO	BDWT	WO	0.515	1.54	77
320	Beems and van Beek, 1985	Hamster (*Mesocricetus auratus*)	5	M	FD	42	d	NR	NR	JV	M	GRO	BDWT	WO	0.610	1.21	92
321	Turan et al 1997	Rabbit (*Oryctolagus cuniculus*)	2	U	FD	14	w	NR	NR	JV	B	GRO	BDWT	WO	0.652		68
322	Hadjimarkos, 1970	Hamster (*Mesocricetus auratus*)	4	U	DR	4	w	NR	NR	JV	M	GRO	BDWT	WO	0.680	0.88	82
323	Abdo, 1994	Mouse (*Mus musculus*)	6	U	DR	13	w	6	w	JV	M	GRO	BDWT	WO	0.735	1.51	90
324	Panter et al., 1995	Sheep (*Ovis aries*)	2	M	FD	88	d	NR	NR	GE	F	GRO	BDWT	WO	0.780		73
325	Abdo, 1994	Mouse (*Mus musculus*)	6	U	DR	13	w	6	w	JV	B	GRO	BDWT	WO	0.781	1.23	93
326	Jacobs and Forst, 1981	Mouse (*Mus musculus*)	4	U	DR	47	w	6	w	JV	F	GRO	BDWT	WO	0.784	1.21	78
327	Julius et al, 1983	Hamster (*Mesocricetus auratus*)	5	U	FD	21	d	4	w	JV	B	GRO	BDWT	WO	0.810	1.62	84
328	Panter et al., 1995	Sheep (*Ovis aries*)	2	M	FD	88	d	NR	NR	GE	F	GRO	BDWT	WO	0.945		67
329	Hermann, et.al. 1991	Rat (*Rattus norvegicus*)	3	U	FD	8	w	NR	NR	JV	F	GRO	BDWT	WO	0.996	1.59	82
330	Hermann, et.al. 1991	Rat (*Rattus norvegicus*)	3	U	FD	8	w	NR	NR	JV	F	GRO	BDWT	WO	0.996	1.59	82
331	Ishikawa et al, 1992	Mouse (*Mus musculus*)	5	U	DR	12	w	5	w	JV	M	GRO	BDWT	WO	1.09		72
332	Jacobs and Forst, 1981	Mouse (*Mus musculus*)	7	U	DR	46	d	7	w	JV	M	GRO	BDWT	WO	1.14	2.27	77
333	Beems and van Beek, 1985	Hamster (*Mesocricetus auratus*)	5	M	FD	42	d	NR	NR	JV	F	GRO	BDWT	WO	1.26		77
334	Piccirillo et al 1983	Mouse (*Mus musculus*)	2	U	GV	8	d	64	d	GE	F	GRO	BDWT	WO	1.60		84
335	Tsunoda et al, 2000	Mouse (*Mus musculus*)	4	U	DR	14	d	7-8	w	JV	M	GRO	BDWT	WO	1.96		71
336	Hardin et al., 1987	Mouse (*Mus musculus*)	5	U	GV	8	d	6-8	w	JV	F	GRO	BDWT	WO	3.20	6.39	85
337	Plasterer et al., 1985	Mouse (*Mus musculus*)	2	U	GV	8	d	61-71	d	GE	F	GRO	BDWT	WO	3.20		84
338	Piccirillo et al 1983	Mouse (*Mus musculus*)	6	U	GV	8	d	64	d	JV	F	GRO	BDWT	WO	4.57		84
339	Plasterer et al., 1985	Mouse (*Mus musculus*)	4	U	GV	8	d	61-71	d	JV	F	GRO	BDWT	WO	4.57		84
340	Booth et al. 1983	Mouse (*Mus musculus*)	4	U	GV	8	d	68-81	d	JV	F	GRO	BDWT	WO	10.0		90
341	Sayato et al 1993	Mouse (*Mus musculus*)	5	U	GV	30	d	5	w	JV	M	GRO	BDWT	WO	10.0	20.0	85
342	Kaur and Parshad, 1994	Rat (*Rattus norvegicus*)	3	U	FD	1	w	NR	NR	JV	M	GRO	BDWT	WO		0.0908	77
343	Spallholz et al., 1973	Mouse (*Mus musculus*)	3	U	FD	5	w	NR	NR	JV	B	GRO	BDWT	WO		0.0968	77
344	Boylan et al, 1990	Mouse (*Mus musculus*)	2	M	FD	6	mo	NR	NR	JV	F	GRO	BDWT	WO		0.156	82
345	Wahlstrom et al, 1956	Pig (*Sus scrofa*)	2	U	FD	108	d	NR	NR	JV	N	GRO	BDWT	WO		0.163	78
346	Behne et al., 1992	Rat (*Rattus norvegicus*)	2	U	FD	110	d	30	d	JV	M	GRO	BDWT	WO		0.166	77
347	Baker et al., 1989	Pig (*Sus scrofa*)	2	M	FD	9	w	8-14	w	JV	B	GRO	BDWT	WO		0.205	81
348	Rhian and Moxon, 1943	Dog (*Canis familiaris*)	2	U	FD	8	w	150	d	JV	F	GRO	BDWT	WO		0.209	77
349	Goehring et al., 1984	Rat (*Rattus norvegicus*)	4	M	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO		0.215	82
350	Chen et al., 1985	Rat (*Rattus norvegicus*)	4	U	DR	32	d	NR	NR	JV	M	GRO	BDWT	WO		0.232	72
351	Miller, 1938	Pig (*Sus scrofa*)	5	U	FD	63	d	4	mo	JV	B	GRO	BDWT	WO		0.235	78
352	Wahlstrom et al, 1956	Pig (*Sus scrofa*)	2	U	FD	3	mo	NR	NR	JV	N	GRO	BDWT	WO		0.254	78
353	Schroeder, 1967	Rat (*Rattus norvegicus*)	2	U	DR	30	d	21	d	JV	B	GRO	BDWT	WO		0.267	72
354	Schroeder, 1967	Mouse (*Mus musculus*)	2	U	DR	99	d	21	d	JV	F	GRO	BDWT	WO		0.274	72
355	Schroeder, 1967	Rat (*Rattus norvegicus*)	2	U	DR	30	d	21	d	JV	B	GRO	BDWT	WO		0.276	72
356	Mercado and Bibby 1973	Rat (*Rattus norvegicus*)	2	U	DR	50	d	23	d	JV	M	GRO	BDWT	WO		0.282	71
357	Wahlstrom et al., 1984	Pig (*Sus scrofa*)	2	U	FD	6	w	5-6	w	JV	M	GRO	BDWT	WO		0.303	82
358	Baker et al., 1989	Pig (*Sus scrofa*)	2	M	FD	9	w	8-14	w	JV	B	GRO	BDWT	WO		0.307	81
359	Wahlstrom et al, 1956	Pig (*Sus scrofa*)	2	U	FD	98	d	NR	NR	JV	N	GRO	BDWT	WO		0.323	78
360	Birt et al., 1983	Hamster (*Mesocricetus auratus*)	3	U	FD	25	w	4	w	JV	F	GRO	BDWT	WO		0.345	82
361	Baker et al., 1989	Pig (*Sus scrofa*)	2	M	FD	9	w	8-14	w	JV	B	GRO	BDWT	WO		0.352	81
362	Thorlacius-Ussing et al., 1988	Rat (*Rattus norvegicus*)	2	U	DR	21	d	25	d	JV	F	GRO	BDWT	WO		0.378	72
363	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	3	U	FD	3	w	NR	NR	JV	M	GRO	BDWT	WO		0.390	76
364	Thorlacius-Ussing et al., 1988	Rat (*Rattus norvegicus*)	2	U	DR	21	d	21	d	JV	M	GRO	BDWT	WO		0.411	72

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Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
365	Liu and Boylan, 1994	Rat (*Rattus norvegicus*)	2	M	FD	8	w	NR	NR	JV	M	GRO	BDWT	WO		0.420	82
366	Schroeder and Mitchener, 1972	Mouse (*Mus musculus*)	2	U	DR	90	d	NR	lf	JV	M	GRO	BDWT	WO		0.425	72
367	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	3	U	FD	5	w	NR	NR	JV	M	GRO	BDWT	WO		0.441	76
368	Carmichael and Fowler, 1980	Rat (*Rattus norvegicus*)	2	U	DR	22	w	NR	NR	JV	M	GRO	BDWT	WO		0.454	73
369	Birt et al., 1986	Hamster (*Mesocricetus auratus*)	2	U	FD	10	w	4	w	JV	M	GRO	BDWT	WO		0.490	77
370	Raisbeck et al., 1996	Pronghorn (*Antilocapra americana*)	2	M	FD	164	d	6-96	mo	JV	M	GRO	BDWT	WO		0.493	81
371	Salbe et al., 1990	Rat (*Rattus norvegicus*)	3	U	DR	21	d	21	d	JV	B	GRO	BDWT	WO		0.498	72
372	LeBoeuf and Hoekstra, 1983	Rat (*Rattus norvegicus*)	2	U	FD	6	w	NR	NR	JV	M	GRO	BDWT	WO		0.521	76
373	Thorlacius-Ussing, 1990	Rat (*Rattus norvegicus*)	2	U	DR	21	d	21	d	JV	B	GRO	BDWT	WO		0.543	71
374	Parshad and Sud, 1989	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO		0.550	77
375	Gronbaek et al., 1995	Rat (*Rattus norvegicus*)	2	U	DR	14	d	3-4	w	JV	M	GRO	BDWT	WO		0.570	73
376	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	4	U	FD	3	w	NR	NR	JV	M	GRO	BDWT	WO		0.589	76
377	Kezhou et al., 1987	Rat (*Rattus norvegicus*)	4	U	FD	5	w	NR	NR	JV	M	GRO	BDWT	WO		0.653	78
378	Hadjimarkos, 1967	Rat (*Rattus norvegicus*)	2	U	DR	21	d	NR	NR	JV	M	GRO	BDWT	WO		0.667	73
379	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO		0.704	76
380	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	M	GRO	BDWT	WO		0.754	77
381	Palmer and Olson, 1974	Rat (*Rattus norvegicus*)	4	M	DR	7	d	21	d	JV	M	GRO	BDWT	WO		0.767	78
382	Cabe, et al., 1979	Rat (*Rattus norvegicus*)	2	U	DR	13	w	50	d	JV	M	GRO	BDWT	WO		0.769	72
383	Panter et al., 1996	Pig (*Sus scrofa*)	2	U	FD	6	w	8-10	w	JV	B	GRO	BDWT	WO		0.794	70
384	Panter et al., 1996	Pig (*Sus scrofa*)	2	U	FD	6	w	8-10	w	JV	B	GRO	BDWT	WO		0.794	76
385	Palmer et al., 1982	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	N	GRO	BDWT	WO		0.794	82
386	Panter et al., 1996	Pig (*Sus scrofa*)	2	U	FD	6	w	8-10	w	JV	B	GRO	BDWT	WO		0.794	76
387	Palmer et al., 1982	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	N	GRO	BDWT	WO		0.809	82
388	Palmer et al., 1982	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	N	GRO	BDWT	WO		0.817	82
389	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	U	FD	8	w	NR	NR	JV	M	GRO	BDWT	WO		0.823	77
390	Obermeyer et al, 1971	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	N	GRO	BDWT	WO		0.903	77
391	Halverson and Monty, 1960	Rat (*Rattus norvegicus*)	2	U	FD	28	d	NR	NR	JV	M	GRO	BDWT	WO		0.968	77
392	Halverson et al., 1962	Rat (*Rattus norvegicus*)	2	U	FD	18	d	NR	NR	NR	M	GRO	BDWT	WO		0.984	77
393	Halverson and Monty, 1960	Rat (*Rattus norvegicus*)	2	U	FD	28	d	NR	NR	JV	M	GRO	BDWT	WO		0.988	77
394	Halverson et al., 1962	Rat (*Rattus norvegicus*)	2	U	FD	18	d	NR	NR	NR	M	GRO	BDWT	WO		1.02	77
395	Cutler, 1974	Rat (*Rattus norvegicus*)	2	U	DR	5	mo	NR	NR	JV	M	GRO	BDWT	WO		1.11	72
396	Hermann, et.al. 1991	Rat (*Rattus norvegicus*)	2	U	FD	8	w	NR	NR	JV	F	GRO	BDWT	WO		1.59	76
397	Rastogi et al., 1976	Rat (*Rattus norvegicus*)	2	U	DR	1	w	1	mo	JV	B	GRO	BDWT	WO		1.59	73
398	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	65	d	28	d	JV	B	GRO	BDWT	WO		1.79	81
399	Halverson et al., 1962	Rat (*Rattus norvegicus*)	2	M	FD	18	d	NR	NR	NR	M	GRO	BDWT	WO		1.94	71
400	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	5	d	28	d	JV	M	GRO	BDWT	WO		3.54	81
401	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	5	d	28	d	JV	B	GRO	BDWT	WO		3.74	78
402	Chermoff and Kavlock, 1982	Mouse (*Mus musculus*)	2	U	GV	5	d	60	d	GE	F	GRO	BDWT	WO		4.18	84
Survival (MOR)																	
403	Spallholz et al., 1973	Mouse (*Mus musculus*)	3	U	FD	5	w	NR	NR	JV	B	MOR	SURV	WO	0.0961	0.385	82
404	Spallholz et al., 1973	Mouse (*Mus musculus*)	10	U	FD	5	w	NR	NR	JV	B	MOR	SURV	WO	0.101	0.168	84
405	Palmer and Olson, 1974	Rat (*Rattus norvegicus*)	3	M	DR	42	d	21	d	JV	M	MOR	MORT	WO	0.181		79
406	Palmer and Olson, 1974	Rat (*Rattus norvegicus*)	3	M	DR	42	d	21	d	JV	M	MOR	MORT	WO	0.186		79
407	McAdam and Levander, 1987	Rat (*Rattus norvegicus*)	4	U	FD	6	w	21	d	JV	M	MOR	MORT	WO	0.217	0.435	83
408	McAdam and Levander, 1987	Rat (*Rattus norvegicus*)	4	U	FD	6	w	21	d	JV	M	MOR	MORT	WO	0.217	0.435	83
409	Schroeder, 1967	Rat (*Rattus norvegicus*)	2	U	DR	180	d	21	d	JV	B	MOR	MORT	WO	0.221		73
410	Gronbaek and Thorlacius-Ussing	Rat (*Rattus norvegicus*)	4	U	DR	2	w	NR	NR	NR	M	MOR	SURV	WO	0.239		68
411	Palmer and Olson, 1974	Rat (*Rattus norvegicus*)	4	M	DR	21	d	21	d	JV	M	MOR	MORT	WO	0.274	0.540	85
412	Jenkins and Hidiroglou, 1986	Cattle (*Bos taurus*)	5	U	FD	6	w	3	d	JV	M	MOR	MORT	WO	0.334		78
413	Birt et al., 1983	Hamster (*Mesocricetus auratus*)	2	U	FD	25	w	4	w	JV	B	MOR	MORT	WO	0.350		79
414	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	2	U	FD	3	w	NR	NR	JV	M	MOR	SURV	WO	0.375		77
415	Abdo, 1994	Rat (*Rattus norvegicus*)	6	UX	DR	13	w	6	w	JV	F	MOR	MORT	WO	0.393	0.763	94
416	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	4	U	FD	3	w	NR	NR	JV	M	MOR	MORT	WO	0.426	1.28	83
417	McAdam and Levander, 1987	Rat (*Rattus norvegicus*)	4	U	FD	6	w	21	d	JV	M	MOR	MORT	WO	0.435	0.869	83
418	McAdam and Levander, 1987	Rat (*Rattus norvegicus*)	4	U	FD	6	w	21	d	JV	M	MOR	MORT	WO	0.435	0.869	83
419	Moxon and Mahan, 1982	Pig (*Sus scrofa*)	8	UX	FD	37	d	NR	NR	JV	N	MOR	MORT	WO	0.474	0.632	90
420	Abdo, 1994	Rat (*Rattus norvegicus*)	6	UX	DR	13	w	6	w	JV	F	MOR	MORT	WO	0.564	0.769	94
421	Halverson et al 1966	Rat (*Rattus norvegicus*)	8	U	FD	4	w	NR	NR	JV	M	MOR	MORT	WO	0.576	0.720	78
422	Halverson et al 1966	Rat (*Rattus norvegicus*)	7	U	FD	4	w	NR	NR	JV	M	MOR	MORT	WO	0.587	0.733	84
423	Palmer and Olson, 1974	Rat (*Rattus norvegicus*)	4	M	DR	21	d	21	d	JV	M	MOR	MORT	WO	0.595	0.892	85
424	Wilson et al 1988	Pig (*Sus scrofa*)	4	U	OR	9	d	6	w	JV	M	MOR	MORT	WO	0.639	1.19	91
425	Birt et al., 1983	Hamster (*Mesocricetus auratus*)	3	U	FD	25	w	4	w	JV	B	MOR	MORT	WO	0.652		72
426	Turan et al 1997	Rabbit (*Oryctolagus cuniculus*)	2	U	FD	14	w	NR	NR	JV	B	MOR	MORT	WO	0.652		78
427	Kezhou et al., 1987	Rat (*Rattus norvegicus*)	4	U	FD	22	d	NR	NR	JV	M	MOR	MORT	WO	0.653	0.980	85
428	Chen et al., 1982	Rat (*Rattus norvegicus*)	3	U	FD	4	w	NR	NR	JV	M	MOR	MORT	WO	0.680		78
429	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	M	MOR	MORT	WO	0.704		77
430	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	U	FD	4	w	NR	NR	JV	M	MOR	MORT	WO	0.754		78
431	Cabe, et al., 1979	Rat (*Rattus norvegicus*)	2	U	DR	18	w	50	d	JV	M	MOR	MORT	WO	0.769		73

Table 9
NOAEL and LOAELs for Reproduction, Growth and Survival Effects of Selenium to Mammals
USS Lead Superfund Site - OU2
East Chicago, Indiana

Result #	Reference	Test Organism	# of Conc/ Doses	Method of Analyses	Route of Exposure	Exposure Duration	Duration Units	Age	Age Units	Lifestage	Sex	Effect Type	Effect Measure	Response Site	NOAEL Dose (mg/kg bw/day)	LOAEL Dose (mg/kg bw/day)	Data Evaluation Score
432	Palmer et al., 1982	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	N	MOR	MORT	WO	0.794		83
433	Palmer et al., 1982	Rat (*Rattus norvegicus*)	3	M	FD	4	w	NR	NR	JV	N	MOR	MORT	WO	0.820		83
434	Kezhou et al., 1987	Rat (*Rattus norvegicus*)	4	U	FD	22	d	NR	NR	JV	M	MOR	MORT	WO	0.857	1.71	85
435	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	3	U	FD	3	w	NR	NR	JV	M	MOR	SURV	WO	0.881		77
436	Jacobs and Forst 1981	Rat (*Rattus norvegicus*)	6	U	DR	35	d	5, 12	w	JV	B	MOR	SURV	WO	0.904	1.81	78
437	Rastogi et al., 1976	Rat (*Rattus norvegicus*)	2	U	DR	8	w	1	mo	JV	B	MOR	MORT	WO	0.953		74
438	Piccirillo et al 1983	Mouse (*Mus musculus*)	6	U	GV	8	d	64	d	JV	F	MOR	MORT	WO	1.14	2.28	91
439	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	3	U	FD	3	w	NR	NR	JV	M	MOR	MORT	WO	1.17		77
440	Hadjimarkos, 1970	Hamster (*Mesocricetus auratus*)	4	U	DR	4	w	NR	NR	JV	M	MOR	MORT	WO	1.17		77
441	Jacobs and Forst, 1981	Mouse (*Mus musculus*)	4	U	DR	47	w	6	w	JV	F	MOR	MORT	WO	1.21		73
442	Beems and van Beek, 1985	Hamster (*Mesocricetus auratus*)	5	M	FD	42	d	NR	NR	JV	M	MOR	MORT	WO	1.21		87
443	Beems and van Beek, 1985	Hamster (*Mesocricetus auratus*)	5	M	FD	42	d	NR	NR	JV	F	MOR	MORT	WO	1.26		87
444	Miller, 1938	Pig (*Sus scrofa*)	5	U	FD	63	d	4	mo	JV	B	MOR	MORT	WO	1.49	5.96	83
445	Abdo, 1994	Mouse (*Mus musculus*)	6	UX	DR	13	w	6	w	JV	M	MOR	MORT	WO	1.51		85
446	Piccirillo et al 1983	Mouse (*Mus musculus*)	2	U	GV	8	d	64	d	GE	F	MOR	MORT	WO	1.60		85
447	Jacobs and Forst, 1981	Mouse (*Mus musculus*)	7	U	DR	46	d	7	w	JV	B	MOR	MORT	WO	2.27	4.55	78
448	Abdo, 1994	Mouse (*Mus musculus*)	6	UX	DR	13	w	6	w	JV	B	MOR	MORT	WO	2.28		88
449	Plasterer et al., 1985	Mouse (*Mus musculus*)	6	U	GV	8	d	61-71	d	JV	F	MOR	MORT	WO	2.28	4.57	91
450	Pathak and Datta 1984	Goat (*Capra hircus*)	4	U	OR	17	d	6	mo	MA	N	MOR	MORT	WO	3.0	6.0	87
451	Julius et al, 1983	Hamster (*Mesocricetus auratus*)	5	U	FD	21	d	4	w	JV	B	MOR	MORT	WO	3.18	6.36	85
452	Hardin et al., 1987	Mouse (*Mus musculus*)	5	U	GV	8	d	6-8	w	GE	F	MOR	MORT	WO	3.20	6.39	86
453	Plasterer et al., 1985	Mouse (*Mus musculus*)	2	U	GV	8	d	61-71	d	GE	F	MOR	SURV	WO	3.20		85
454	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	4	U	FD	3	w	NR	NR	JV	M	MOR	SURV	WO	3.53		77
455	Chermoff and Kavlock, 1982	Mouse (*Mus musculus*)	2	U	GV	5	d	60	d	GE	F	MOR	MORT	WO	4.18		85
456	Booth et al. 1983	Mouse (*Mus musculus*)	6	U	GV	8	d	68-81	d	JV	F	MOR	MORT	WO	10.0	20	97
457	Dausch and Fullerton, 1993	Rat (*Rattus norvegicus*)	5	U	FD	3	w	NR	NR	JV	M	MOR	SURV	WO	15.4		78
458	Schroeder, 1967	Rat (*Rattus norvegicus*)	2	U	DR	16	d	21	d	JV	B	MOR	MORT	WO		0.275	73
459	Jacobs and Forst 1981	Rat (*Rattus norvegicus*)	2	U	DR	10	w	5	w	JV	M	MOR	SURV	WO		0.440	73
460	Palmer et al., 1982	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	N	MOR	MORT	WO		0.809	83
461	Palmer et al., 1982	Rat (*Rattus norvegicus*)	2	M	FD	4	w	NR	NR	JV	N	MOR	MORT	WO		0.817	83
462	Palmer et al 1983	Rat (*Rattus norvegicus*)	2	U	FD	8	w	NR	NR	JV	M	MOR	SURV	WO		0.823	72
463	Halverson et al., 1962	Rat (*Rattus norvegicus*)	2	U	FD	18	d	NR	NR	NR	M	MOR	MORT	WO		0.975	78
464	Halverson et al., 1962	Rat (*Rattus norvegicus*)	2	U	FD	18	d	NR	NR	NR	M	MOR	MORT	WO		0.984	78
465	Cutler, 1974	Rat (*Rattus norvegicus*)	2	U	DR	5	mo	NR	NR	JV	M	MOR	MORT	WO		1.11	73
466	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	M	MOR	MORT	WO		1.79	82
467	Halverson et al., 1962	Rat (*Rattus norvegicus*)	2	M	FD	18	d	NR	NR	NR	M	MOR	MORT	WO		1.94	72
468	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	B	MOR	MORT	WO		3.54	82
469	Franke and Moxon 1937	Rat (*Rattus norvegicus*)	2	U	FD	100	d	28	d	JV	B	MOR	MORT	WO		3.74	79
470	Davidson-York et al, 1999	Pig (*Sus scrofa*)	2	M	FD	19	d	NR	NR	NR	B	MOR	MORT	WO		4.17	76
471	Seidenberg et al 1986	Mouse (*Mus musculus*)	2	U	GV	4	d	NR	NR	GE	F	MOR	MORT	WO		5.01	85
									geomean bounded only (R-G)=						0.404	0.843	

Source: USEPA Ecological Soil Screening Levels for Selenium Interim Final, OSWER Directive 9285.7-72. July 2007.

ATTACHMENT D BULK SEDIMENT, EXTRACTION DATA, AND BIOAVAILABILITY ESTIMATES

Table 1

Summary of Bulk Sediment and SEM Extraction Results: Antimony

USS Lead Superfund Site - OU2

East Chicago, Indiana

Decision Unit	Replicate	Sample Name	Total_Antimony value	Total_Antimony units	SEM_Antimony value	SEM_Antimony units	SEM_Antimony value	SEM_Antimony units	Bioavailability SEM_Sb/Total Sb value	Bioavailability SEM_Sb/Total Sb %
DU1	1/A	DU1-SE1-0-6-112818	47	mg/kg	0.00022	mmol/g	26.79	mg/kg	0.57	57%
	2/B	DU1-SE2-0-6-112818	49	mg/kg	0.000019	mmol/g	2.31	mg/kg	0.05	5%
	3/C	DU1-SE3-0-6-112818	51	mg/kg	0.00015	mmol/g	18.26	mg/kg	0.36	36%
DU2	1/A	DU2-SE1-0-6-112918	39	mg/kg	0.0000095	mmol/g	1.16	mg/kg	0.03	3%
	2/B	DU2-SE2-0-6-112918	20	mg/kg	0.000013	mmol/g	1.58	mg/kg	0.08	8%
	3/C	DU2-SE3-0-6-112918	27	mg/kg	0.000047	mmol/g	5.72	mg/kg	0.21	21%
DU3	1/A	DU3-SE1-0-6-120518	11	mg/kg	0.0000044	mmol/g	0.54	mg/kg	0.05	5%
	2/B	DU3-SE2-0-6-120518	15	mg/kg	0.0000014	mmol/g	0.17	mg/kg	0.01	1%
	3/C	DU3-SE3-0-6-120518	12	mg/kg	0.0000049	mmol/g	0.60	mg/kg	0.05	5%
DU4	1/A	DU4-SE1-0-6-120618	15	mg/kg	0.0000053	mmol/g	0.65	mg/kg	0.04	4%
	2/B	DU4-SE2-0-6-120618	11	mg/kg	0.0000014	mmol/g	0.17	mg/kg	0.02	2%
	3/C	DU4-SE3-0-6-120618	16	mg/kg	0.000070	mmol/g	8.52	mg/kg	0.53	53%
DU5	1/A	DU5-SE1-0-6-120718	34	mg/kg	0.000022	mmol/g	2.68	mg/kg	0.08	8%
	2/B	DU5-SE2-0-6-120718	36	mg/kg	0.000016	mmol/g	1.95	mg/kg	0.05	5%
	3/C	DU5-SE3-0-6-120718	33	mg/kg	0.0000032	mmol/g	0.39	mg/kg	0.01	1%
DU6	1/A	DU6-SE1-0-6-120418	26	mg/kg	0.0000019	mmol/g	0.23	mg/kg	0.01	1%
	2/B	DU6-SE2-0-6-120418	28	mg/kg	0.0000090	mmol/g	1.10	mg/kg	0.04	4%
	3/C	DU6-SE3-0-6-120418	30	mg/kg	0.000034	mmol/g	4.14	mg/kg	0.14	14%
DU7	1/A	DU7-SE1-0-6-120318	16	mg/kg	0.0000012	mmol/g	0.15	mg/kg	0.01	1%
	2/B	DU7-SE2-0-6-120318	12	mg/kg	0.0000042	mmol/g	0.51	mg/kg	0.04	4%
	3/C	DU7-SE3-0-6-120318	15	mg/kg	0.000011	mmol/g	1.34	mg/kg	0.09	9%
DU8	1/A	DU8-SE1-0-6-113018	46	mg/kg	0.0000027	mmol/g	0.33	mg/kg	0.01	1%
	2/B	DU8-SE2-0-6-113018	44	mg/kg	0.00025	mmol/g	30.44	mg/kg	0.69	69%
	3/C	DU8-SE3-0-6-113018	48	mg/kg	0.0000098	mmol/g	1.19	mg/kg	0.02	2%
								Arithemetic Mean =		13%
								Geometric Mean =		5%

MW_Sb =	121.7600

Notes:
Total metal (mg/kg) and SEM metal (mmol/g) are from laboratory analysis.
SEM metal (mg/kg) was calculated as follows:

$$SEM\ Metal\ \left(\frac{mg}{kg}\right) = SEM\ Metal\ \left(\frac{mmol}{g}\right) \times Conversion\ Factor\left(\frac{1000\ mg - mol}{kg - mmol}\right) \times Molecular\ Weigt\ \left(\frac{g}{mol}\right)$$

$$Conversion\ Factor = \frac{1000\ g}{kg} \times \frac{1\ mol}{1000\ mmol} \times \frac{1000\ mg}{g}$$

$$Molecular\ Weight\ (Antimony) = 121.76\frac{g}{mol}$$

SEM = simultaneously extracted metals
mmol/g = millimoles per gram
mg/kg = milligrams per kilogram

Table 2

Summary of Bulk Sediment and SEM Extraction Results: Arsenic

USS Lead Superfund Site - OU2

East Chicago, Indiana

			Total_Arsenic		*SEM_Arsenic*				**Bioavailability** *SEM_As/Total As*	
			value	*units*	*value*	*units*	*value*	*units*	*value*	*%*
DU1	*1/A*	DU1-SE1-0-6-112818	320	*mg/kg*	0.0032	*mmol/g*	239.75	*mg/kg*	*0.75*	75%
	2/B	DU1-SE2-0-6-112818	390	*mg/kg*	0.00024	*mmol/g*	17.98	*mg/kg*	*0.05*	5%
	3/C	DU1-SE3-0-6-112818	390	*mg/kg*	0.0021	*mmol/g*	157.34	*mg/kg*	*0.40*	40%
DU2	*1/A*	DU2-SE1-0-6-112918	410	*mg/kg*	0.0006	*mmol/g*	44.95	*mg/kg*	*0.11*	11%
	2/B	DU2-SE2-0-6-112918	270	*mg/kg*	0.00091	*mmol/g*	68.18	*mg/kg*	*0.25*	25%
	3/C	DU2-SE3-0-6-112918	290	*mg/kg*	0.0011	*mmol/g*	82.41	*mg/kg*	*0.28*	28%
DU3	*1/A*	DU3-SE1-0-6-120518	240	*mg/kg*	0.0017	*mmol/g*	127.37	*mg/kg*	*0.53*	53%
	2/B	DU3-SE2-0-6-120518	290	*mg/kg*	0.00046	*mmol/g*	34.46	*mg/kg*	*0.12*	12%
	3/C	DU3-SE3-0-6-120518	260	*mg/kg*	0.00018	*mmol/g*	13.49	*mg/kg*	*0.05*	5%
DU4	*1/A*	DU4-SE1-0-6-120618	230	*mg/kg*	0.00024	*mmol/g*	17.98	*mg/kg*	*0.08*	8%
	2/B	DU4-SE2-0-6-120618	200	*mg/kg*	0.00028	*mmol/g*	20.98	*mg/kg*	*0.10*	10%
	3/C	DU4-SE3-0-6-120618	270	*mg/kg*	0.0015	*mmol/g*	112.38	*mg/kg*	*0.42*	42%
DU5	*1/A*	DU5-SE1-0-6-120718	550	*mg/kg*	0.001	*mmol/g*	74.92	*mg/kg*	*0.14*	14%
	2/B	DU5-SE2-0-6-120718	590	*mg/kg*	0.0005	*mmol/g*	37.46	*mg/kg*	*0.06*	6%
	3/C	DU5-SE3-0-6-120718	570	*mg/kg*	0.00075	*mmol/g*	56.19	*mg/kg*	*0.10*	10%
DU6	*1/A*	DU6-SE1-0-6-120418	320	*mg/kg*	0.00037	*mmol/g*	27.72	*mg/kg*	*0.09*	9%
	2/B	DU6-SE2-0-6-120418	320	*mg/kg*	0.00089	*mmol/g*	66.68	*mg/kg*	*0.21*	21%
	3/C	DU6-SE3-0-6-120418	380	*mg/kg*	0.0016	*mmol/g*	119.87	*mg/kg*	*0.32*	32%
DU7	*1/A*	DU7-SE1-0-6-120318	200	*mg/kg*	0.000071	*mmol/g*	5.32	*mg/kg*	*0.03*	3%
	2/B	DU7-SE2-0-6-120318	180	*mg/kg*	0.00018	*mmol/g*	13.49	*mg/kg*	*0.07*	7%
	3/C	DU7-SE3-0-6-120318	180	*mg/kg*	0.00047	*mmol/g*	35.21	*mg/kg*	*0.20*	20%
DU8	*1/A*	DU8-SE1-0-6-113018	310	*mg/kg*	0.000093	*mmol/g*	6.97	*mg/kg*	*0.02*	2%
	2/B	DU8-SE2-0-6-113018	300	*mg/kg*	0.0015	*mmol/g*	112.38	*mg/kg*	*0.37*	37%
	3/C	DU8-SE3-0-6-113018	280	*mg/kg*	0.00057	*mmol/g*	42.71	*mg/kg*	*0.15*	15%
									Arithemetic Mean =	20%
									Geometric Mean =	14%

MW_As =	74.9216

Notes:

0.1395508

Total metal (mg/kg) and SEM metal (mmol/g) are from laboratory analysis.

SEM metal (mg/kg) was calculated as follows:

$$SEM\ Metal\left(\frac{mg}{kg}\right) = SEM\ Metal\left(\frac{mmol}{g}\right) \times Conversion\ Factor\left(\frac{1000\ mg-mol}{kg-mmol}\right) \times Molecular\ Weigt\ \left(\frac{g}{mol}\right)$$

$$Conversion\ Factor = \frac{1000\ g}{kg} \times \frac{1\ mol}{1000\ mmol} \times \frac{1000\ mg}{g}$$

$$Molecular\ Weight\ (Arsenic) = 74.9216\frac{g}{mol}$$

SEM = simultaneously extracted metals

mmol/g = millimoles per gram

mg/kg = milligrams per kilogram

Table 3

Summary of Bulk Sediment and SEM Extraction Results: Cadmium

USS Lead Superfund Site - OU2

East Chicago, Indiana

			Total_Cadmium		SEM_Cadmium				Bioavailability SEM_Cd/Total_Cd	
			value	units	value	units	value	units	value	%
DU1	1/A	DU1-SE1-0-6-112818	12	mg/kg	0.00014	mmol/g	15.74	mg/kg	1.31	131%
	2/B	DU1-SE2-0-6-112818	14	mg/kg	0.0000071	mmol/g	0.80	mg/kg	0.06	6%
	3/C	DU1-SE3-0-6-112818	13	mg/kg	0.00016	mmol/g	17.99	mg/kg	1.38	138%
DU2	1/A	DU2-SE1-0-6-112918	6	mg/kg	0.000018	mmol/g	2.02	mg/kg	0.34	34%
	2/B	DU2-SE2-0-6-112918	4	mg/kg	0.000028	mmol/g	3.15	mg/kg	0.79	79%
	3/C	DU2-SE3-0-6-112918	4.6	mg/kg	0.000023	mmol/g	2.59	mg/kg	0.56	56%
DU3	1/A	DU3-SE1-0-6-120518	5.4	mg/kg	0.00001	mmol/g	1.12	mg/kg	0.21	21%
	2/B	DU3-SE2-0-6-120518	7.4	mg/kg	0.000033	mmol/g	3.71	mg/kg	0.50	50%
	3/C	DU3-SE3-0-6-120518	7	mg/kg	0.0000046	mmol/g	0.52	mg/kg	0.07	7%
DU4	1/A	DU4-SE1-0-6-120618	7.3	mg/kg	0.000013	mmol/g	1.46	mg/kg	0.20	20%
	2/B	DU4-SE2-0-6-120618	7.3	mg/kg	0.000052	mmol/g	5.85	mg/kg	0.80	80%
	3/C	DU4-SE3-0-6-120618	7.9	mg/kg	0.000079	mmol/g	8.88	mg/kg	1.12	112%
DU5	1/A	DU5-SE1-0-6-120718	21	mg/kg	0.00009	mmol/g	10.12	mg/kg	0.48	48%
	2/B	DU5-SE2-0-6-120718	19	mg/kg	0.000046	mmol/g	5.17	mg/kg	0.27	27%
	3/C	DU5-SE3-0-6-120718	15	mg/kg	0.00046	mmol/g	51.71	mg/kg	3.45	345%
DU6	1/A	DU6-SE1-0-6-120418	56	mg/kg	0.00025	mmol/g	28.10	mg/kg	0.50	50%
	2/B	DU6-SE2-0-6-120418	57	mg/kg	0.00015	mmol/g	16.86	mg/kg	0.30	30%
	3/C	DU6-SE3-0-6-120418	65	mg/kg	0.00037	mmol/g	41.59	mg/kg	0.64	64%
DU7	1/A	DU7-SE1-0-6-120318	33	mg/kg	0.000027	mmol/g	3.04	mg/kg	0.09	9%
	2/B	DU7-SE2-0-6-120318	29	mg/kg	0.00079	mmol/g	88.80	mg/kg	3.06	306%
	3/C	DU7-SE3-0-6-120318	33	mg/kg	0.00012	mmol/g	13.49	mg/kg	0.41	41%
DU8	1/A	DU8-SE1-0-6-113018	64	mg/kg	0.00034	mmol/g	38.22	mg/kg	0.60	60%
	2/B	DU8-SE2-0-6-113018	56	mg/kg	0.00045	mmol/g	50.58	mg/kg	0.90	90%
	3/C	DU8-SE3-0-6-113018	58	mg/kg	0.00032	mmol/g	35.97	mg/kg	0.62	62%
									Arithemetic Mean =	78%
									Geometric Mean =	49%

MW_Cd	112.4110

Notes:

Total metal (mg/kg) and SEM metal (mmol/g) are from laboratory analysis.

SEM metal (mg/kg) was calculated as follows:

$$SEM\ Metal\left(\frac{mg}{kg}\right) = SEM\ Metal\left(\frac{mmol}{g}\right) \times Conversion\ Factor\left(\frac{1000\ mg - mol}{kg - mmol}\right) \times Molecular\ Weigt\ \left(\frac{g}{mol}\right)$$

$$Conversion\ Factor = \frac{1000\ g}{kg} \times \frac{1\ mol}{1000\ mmol} \times \frac{1000\ mg}{g}$$

$$Molecular\ Weight\ (Cadmium) = 112.411\frac{g}{mol}$$

SEM = simultaneously extracted metals

mmol/g = millimoles per gram

mg/kg = milligrams per kilogram

Table 4

Summary of Bulk Sediment and SEM Extraction Results: Lead

USS Lead Superfund Site - OU2

East Chicago, Indiana

			Total_Lead		SEM_Lead				Bioavailability SEM_Pb/Total_Pb	
			value	units	value	units	value	units	value	%
DU1	1/A	DU1-SE1-0-6-112818	980	mg/kg	0.0081	mmol/g	1678.40	mg/kg	1.71	171%
	2/B	DU1-SE2-0-6-112818	1100	mg/kg	0.00056	mmol/g	116.04	mg/kg	0.11	11%
	3/C	DU1-SE3-0-6-112818	1100	mg/kg	0.0063	mmol/g	1305.42	mg/kg	1.19	119%
DU2	1/A	DU2-SE1-0-6-112918	710	mg/kg	0.00058	mmol/g	120.18	mg/kg	0.17	17%
	2/B	DU2-SE2-0-6-112918	390	mg/kg	0.00026	mmol/g	53.87	mg/kg	0.14	14%
	3/C	DU2-SE3-0-6-112918	450	mg/kg	0.00076	mmol/g	157.48	mg/kg	0.35	35%
DU3	1/A	DU3-SE1-0-6-120518	260	mg/kg	0.0002	mmol/g	41.44	mg/kg	0.16	16%
	2/B	DU3-SE2-0-6-120518	340	mg/kg	0.00014	mmol/g	29.01	mg/kg	0.09	9%
	3/C	DU3-SE3-0-6-120518	400	mg/kg	0.00016	mmol/g	33.15	mg/kg	0.08	8%
DU4	1/A	DU4-SE1-0-6-120618	350	mg/kg	0.00059	mmol/g	122.25	mg/kg	0.35	35%
	2/B	DU4-SE2-0-6-120618	290	mg/kg	0.00053	mmol/g	109.82	mg/kg	0.38	38%
	3/C	DU4-SE3-0-6-120618	420	mg/kg	0.0017	mmol/g	352.26	mg/kg	0.84	84%
DU5	1/A	DU5-SE1-0-6-120718	660	mg/kg	0.0015	mmol/g	310.82	mg/kg	0.47	47%
	2/B	DU5-SE2-0-6-120718	800	mg/kg	0.0016	mmol/g	331.54	mg/kg	0.41	41%
	3/C	DU5-SE3-0-6-120718	640	mg/kg	0.0018	mmol/g	372.98	mg/kg	0.58	58%
DU6	1/A	DU6-SE1-0-6-120418	680	mg/kg	0.00034	mmol/g	70.45	mg/kg	0.10	10%
	2/B	DU6-SE2-0-6-120418	890	mg/kg	0.00043	mmol/g	89.10	mg/kg	0.10	10%
	3/C	DU6-SE3-0-6-120418	950	mg/kg	0.0012	mmol/g	248.65	mg/kg	0.26	26%
DU7	1/A	DU7-SE1-0-6-120318	640	mg/kg	0.00013	mmol/g	26.94	mg/kg	0.04	4%
	2/B	DU7-SE2-0-6-120318	590	mg/kg	0.0018	mmol/g	372.98	mg/kg	0.63	63%
	3/C	DU7-SE3-0-6-120318	690	mg/kg	0.00087	mmol/g	180.27	mg/kg	0.26	26%
DU8	1/A	DU8-SE1-0-6-113018	1800	mg/kg	0.00092	mmol/g	190.63	mg/kg	0.11	11%
	2/B	DU8-SE2-0-6-113018	1500	mg/kg	0.01	mmol/g	2072.10	mg/kg	1.38	138%
	3/C	DU8-SE3-0-6-113018	1500	mg/kg	0.004	mmol/g	828.84	mg/kg	0.55	55%
									Arithemetic Mean =	44%
									Geometric Mean =	28%

MW_Pb	207.2100

Notes:

Total metal (mg/kg) and SEM metal (mmol/g) are from laboratory analysis.

SEM metal (mg/kg) was calculated as follows:

$$SEM\ Metal\left(\frac{mg}{kg}\right) = SEM\ Metal\left(\frac{mmol}{g}\right) \times Conversion\ Factor\left(\frac{1000\ mg-mol}{kg-mmol}\right) \times Molecular\ Weigt\ \left(\frac{g}{mol}\right)$$

$$Conversion\ Factor = \frac{1000\ g}{kg} \times \frac{1\ mol}{1000\ mmol} \times \frac{1000\ mg}{g}$$

$$Molecular\ Weight\ (Lead) = 207.21\frac{g}{mol}$$

SEM = simultaneously extracted metals

mmol/g = millimoles per gram

mg/kg = milligrams per kilogram

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APPENDIX O DATA DISTRUBUTION ANALYSIS

Legend

Antimony Soil:

- 0 - 470 mg/kg
- 470 - 940 mg/kg
- 940 - 1,410 mg/kg
- 1,410 0 1,880 mg/kg
- > 1,880 mg/kg

- USS Lead Facility Boundary
- Approximate CAMU Boundary

Antimony RSL 470 mg/kg

Figure O-1

Antimony Soil Sample Location Map

Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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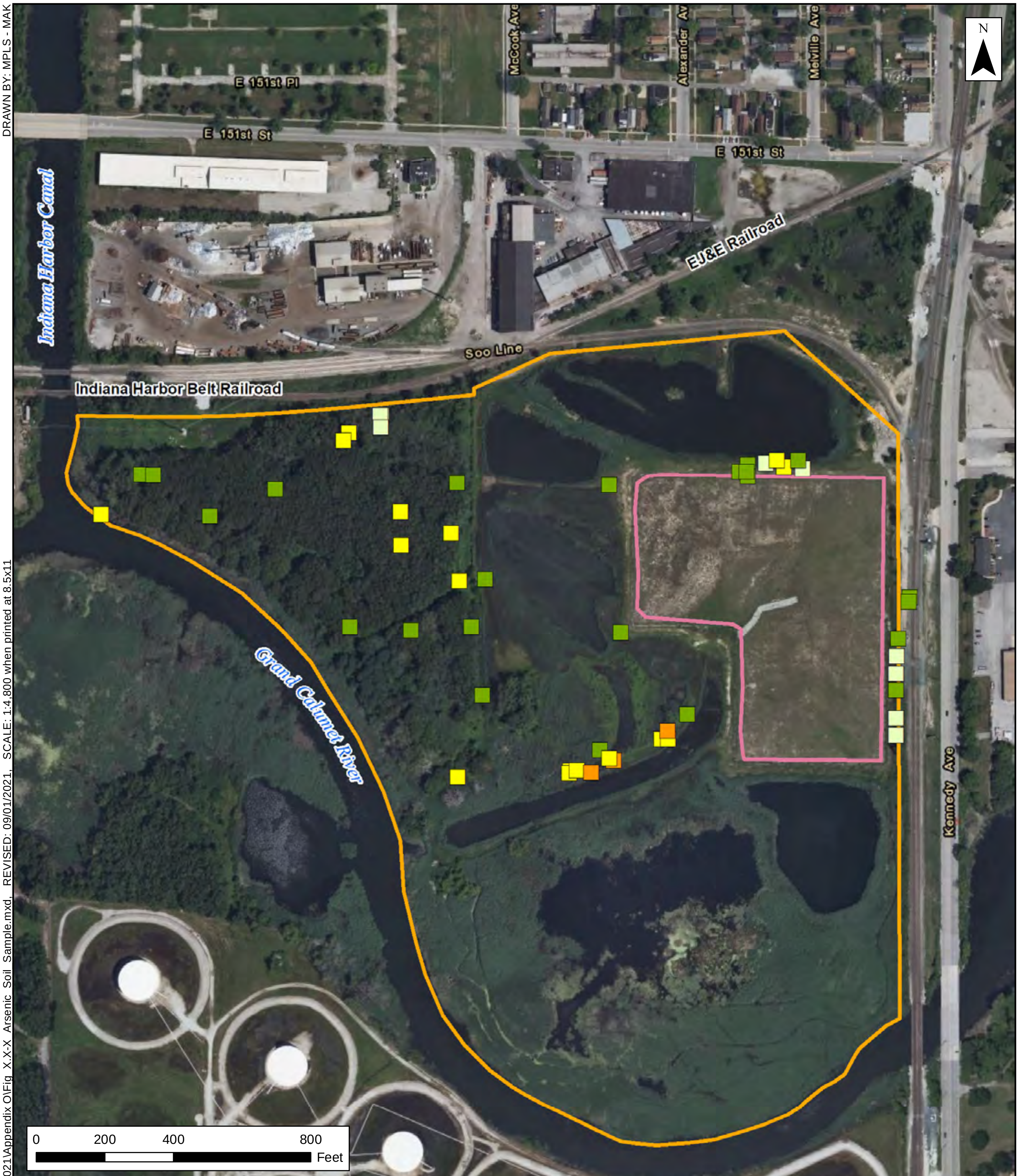
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

DRAWN BY: MPLS - MAK

J:\Projects\USS Lead_MXD\2021\RI_2021\Appendix O\Fig_X.X-X_Arsenic_Soil_Sample.mxd, REVISED: 09/01/2021, SCALE: 1:4,800 when printed at 8.5x11



Legend

Arsenic Soil:

- 0- 3 mg/kg
- 3 - 30 mg/kg
- 30 - 300 mg/kg
- 300 - 3,000 mg/kg
- > 3,000 mg/kg

- USS Lead Facility Boundary
- Approximate CAMU Boundary

Arsenic RSL 3 mg/kg

Figure O-2

Arsenic Soil Sample Location Map

Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

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J:\Projects\USS Lead_MXD\2021\RI_2021\Appendix O\Fig_X.X-X_Cadmium_Soil_Sample.mxd, REVISED: 09/01/2021, SCALE: 1:4,800 when printed at 8.5x11

Legend

Cadmium Soil:

- 0 - 980 mg/kg
- 980 - 1,960 mg/kg
- 1,960 - 2,940 mg/kg
- 2,940 - 3,920 mg/kg
- > 3,920 mg/kg

USS Lead Facility Boundary

Approximate CAMU Boundary

Cadmium RSL 980 mg/kg

Figure O-3

Cadmium Soil Sample Location Map

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

Environmental Resources Management
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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

Legend

Lead Soil:

- 0 - 800 mg/kg
- 800 - 1,600 mg/kg
- 1,600 - 2,400 mg/kg
- 2,400 - 3,200 mg/kg
- > 3,200 mg/kg

USS Lead Facility Boundary

Approximate CAMU Boundary

Lead RSL 800 mg/kg

Figure O-4
Lead Soil Sample Location Map
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

J:\Projects\USS Lead\ MXD\2021\RI 2021\Appendix O\Fig X.X-X Lead Soil Sample.mxd, REVISED: 09/01/2021, SCALE: 1:4,800 when printed at 8.5x11

DRAWN BY: MPLS - MAK

Legend

Selenium Soil:

- 0 - 5,800 mg/kg
- 5,800 - 11,600 mg/kg
- 11,600 - 17,400 mg/kg
- 17,400 - 23,200 mg/kg
- > 23,200 mg/kg

USS Lead Facility Boundary

Approximate CAMU Boundary

Selenium RSL 5,800 mg/kg

Figure O-5

Selenium Soil Sample Location Map

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

DRAWN BY: MPLS - MAK

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DRAWN BY: S. Vickery

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Legend

Antiomny Sediment:

- 0 - 470 mg/kg
- 470 - 940 mg/kg
- 940 - 1,410 mg/kg
- 1,410 - 1,880 mg/kg
- > 1,880 mg/kg

USS Lead Facility Boundary

Approximate CAMU Boundary

Antimony RSL 470 mg/kg

Figure O-6

Antimony Sediment Sample Locations

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

Legend

Arsenic Sediment:

- 0 - 3 mg/kg
- 3 - 30 mg/kg
- 30 - 300 mg/kg
- 300 - 3,000 mg/kg
- > 3,000 mg/kg

USS Lead Facility Boundary

Approximate CAMU Boundary

Arsenic RLS 3 mg/kg

Figure O-7

Arsenic Sediment Sample Locations

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

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Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

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Legend

Cadmium Sediment:

- 0 - 980 mg/kg
- 980 - 1,960 mg/kg
- 1,960 - 2,940 mg/kg
- 2,940 - 3,920 mg/kg
- > 3,920 mg/kg

USS Lead Facility Boundary

Approximate CAMU Boundary

Cadmium RSL 980 mg/kg

Figure O-8

Cadmium Sediment Sample Locations

Remedial Investigation Report - OU2

USS Lead Superfund Site

East Chicago, Indiana

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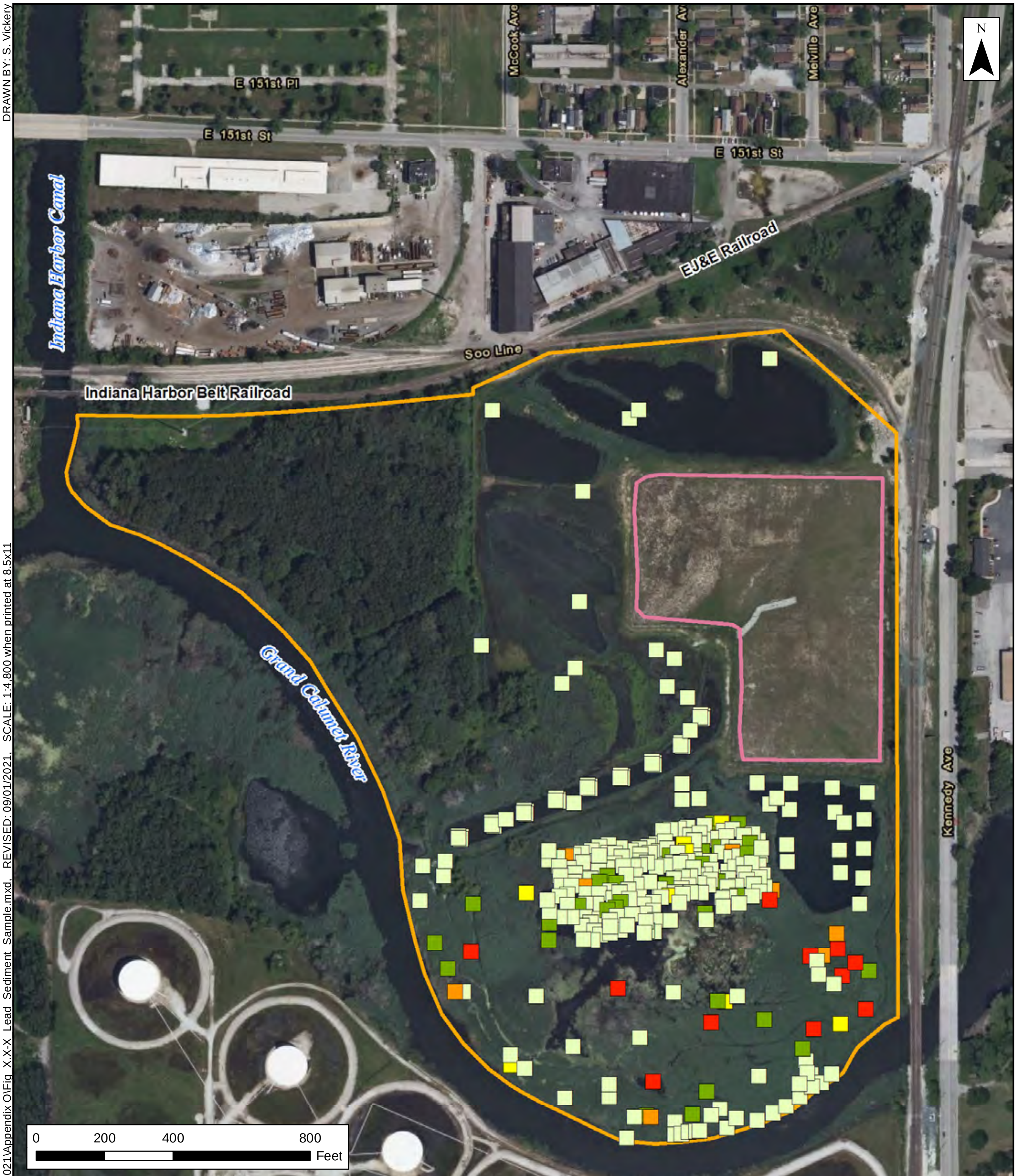
Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

J:\Projects\USS Lead_MXD\2021\RI_2021\Appendix O\Fig_X.X-X_Cadmium_Sediment_Sample.mxd, REVISED: 09/01/2021, SCALE: 1:4,800 when printed at 8.5x11 DRAWN BY: S. Vickery



Legend

Lead Soil:

- 0 - 800 mg/kg
- 800 - 1,600 mg/kg
- 1,600 - 2,400 mg/kg
- 2,400 - 3,200 mg/kg
- > 3,200 mg/kg

- USS Lead Facility Boundary
- Approximate CAMU Boundary

Lead RSL 800 mg/kg

Figure O-9
Lead Sediment Sample Locations
Remedial Investigation Report - OU2
USS Lead Superfund Site
East Chicago, Indiana

Environmental Resources Management
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Source: Esri - World Topoogpraphic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

DRAWN BY: S. Vickery

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Legend

Selenium Sediment:

- 0 - 5,800 mg/kg
- 5,800 - 11,600 mg/kg
- 11,600 - 17,400 mg/kg
- 17,400 - 23,200 mg/kg
- > 23,200 mg/kg

- USS Lead Facility Boundary
- Approximate CAMU Boundary

Selenium RSL 5,800 mg/kg

Figure O-10
Selenium Sediment Sample Locations
Remedial Investigation Report - OU2 USS
Lead Superfund Site
East Chicago, Indiana

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J:\Projects\USS Lead\ MXD\2021\RI 2021\Appendix O\Fig X.X-X Selenium Sediment Sample.mxd, REVISED: 08/26/2021, SCALE: 1:4,800 when printed at 8.5x11 DRAWN BY: S. Vickery

Source: Esri - World Topoographic Map; NAD 1983 StatePlane Indiana West FIPS 1302 Feet

APPENDIX P CITY OF EAST CHICAGO ORDINANCE PROHIBITING GROUNDWATER USE

Sponsor: Councilman Terence Hill

ORDINANCE NO. 20-0013

AN ORDINANCE PROHIBITING THE USE OF GROUNDWATER AS A POTABLE WATER SUPPLY BY THE INSTALLATION OR USE OF POTABLE WATER SUPPLY WELLS OR BY ANY OTHER MEANS

WHEREAS, certain properties in the City have been used over a period of time for commercial and/or industrial purposes; and

WHEREAS, because of such use, concentrations of certain chemical constituents in the groundwater beneath the City may exceed groundwater quality standards for potable resource groundwater prescribed by the Indiana State Department of Health and the Indiana Department of Environmental Management.

WHEREAS, the City desires to limit potential threats to human health from groundwater contamination while facilitating the redevelopment and productive use of properties that are the source of said chemical constituents; and

WHEREAS, public drinking water is readily available throughout the City through the City's Department of Water Works water distribution system.

NOW, THEREFORE, BE IT ORDAINED by the Common Council of the City of East Chicago:

The following shall be added as Section 52.03 of the East Chicago Municipal Code:

Section One: Use of groundwater as a potable water supply prohibited.

Except for such uses or methods in existence before the effective date of this ordinance, the use or attempted use as a potable water supply of groundwater from within the corporate limits of the City by the installation or drilling of wells or by any other method is hereby prohibited.

Section Two: Penalties

Any person violating the provisions of this ordinance shall be subject the penalties described in section § 10.99 of the Municipal Code.

Section Three: Definitions

"Person" is any individual, partnership, co-partnership, firm, company, limited liability company, corporation, association, joint stock company, trust, estate, political subdivision, or any other legal entity, or their legal representatives, agents or assigns.

"Potable water" for purposes of this Chapter is any water used for human or domestic consumption, including, but not limited to, water used for drinking, bathing, swimming, washing dishes, or preparing foods.

Section Four: Repealer

All ordinances or parts of ordinances in conflict with this ordinance are hereby repealed insofar as they are in conflict with this ordinance.

PASSED and ADOPTED by the Common Council of the City of East Chicago, Lake County, Indiana, on this the 24 day of August, 2020.

ROBERT GARCIA
PRESIDENT, EAST CHICAGO COMMON COUNCIL

Attest:

ADRIAN A. SANTOS, CITY CLERK

PRESENTED by me to the Mayor for his approval and signature on this 26 day of August, 2020.

ADRIAN A. SANTOS, CITY CLERK

APPROVED and SIGNED by me on this 27th day of August, 2020.

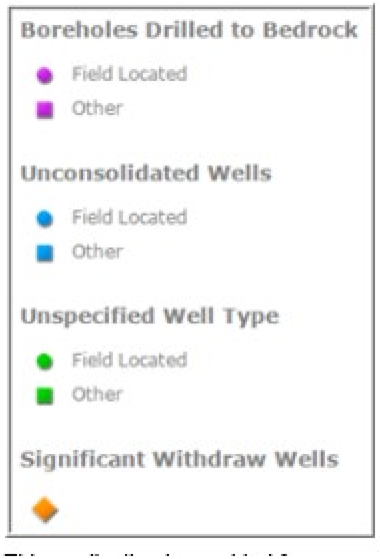
ANTHONY COPELAND, MAYOR

FILED IN CLERK'S OFFICE

AUG 27 2020

Clerk, East Chicago Common Council

APPENDIX Q WATER WELL SEARCH



Well Screened in Shallow Groundwater <30ft-bgs

APPENDIX R MEMO ON FUTURE LAND USE

Memorandum

USS Lead Refining Inc.

4780 Caterpillar Road, Unit C
Redding, CA 96003

To:	Stephanie Linebaugh Remedial Project Manager Environmental Protection Agency, Region 5
From:	Norman Johnson Vice-President U.S. Smelter and Lead Refinery, Inc.
Date:	September 30, 2021
Subject:	Current and Future Uses of the Former USS Lead Facility East Chicago, Indiana

The Respondent has prepared this Memorandum as required by Section 3.4 of the Remedial Investigation Scope of Work from the Administrative Settlement Agreement and Order on Consent (ASAOC) for Remedial Investigation/Feasibility Study of Operable Unit 2 of the U.S. Smelter and Lead Refinery, Inc. Superfund Site. The Memorandum evaluates the current and reasonably anticipated future land uses of the Former USS Lead Facility in East Chicago, Indiana. The required 11 elements are described below.

1. *Past Uses of the Former USS Lead Facility Including Title and Lien Information*

Between 1906 and 1985, the USS lead Facility processed and refined significant quantities of lead and other metals and chemicals including arsenic.

The Lake County, Indiana Assessor's website identifies the owner of the Former USS Lead Facility as "USS Lead Refining, Inc." with a mailing address of 4780 Caterpillar Road, Unit C, Redding, CA 96003. The total acreage is listed as 79.003. No tax liens were identified.

2. *Current Uses and Neighboring Areas*

The Former USS Lead Facility is bordered by industrial properties but residential areas are nearby as indicated below:

- North: Indiana Harbor Belt Railroad, vacant land (Universal Services, Formerly Howard Industries) then EJ&E Railroad, then industrial properties, the Former Anaconda Lead Products and International Lead Refining Company (ILRC) Facility and Former East Chicago Housing Authority (ECHA) which was demolished (OU1 Zone 1), and residential neighborhoods (OU1 Zones 2 & 3);

- East: Kennedy Avenue then the Former DuPont Facility;
- South: Grand Calumet River then petroleum aboveground storage tank (AST) farm; and
- West: Grand Calumet River; wetland and industrial property.

3. *Respondent's Plans for the Former USS Lead Facility Following Cleanup and any Prospective Purchasers*

The respondent plans to keep the Former USS Lead Facility secured with a perimeter chain link fence and conduct continued maintenance and monitoring of the Former USS Lead Facility as required by the Post-Closure Permit for the Corrective Action Management Unit (CAMU). No prospective purchasers have been identified nor are contemplated.

4. *Applicable Zoning Laws and Ordinance*

The City of East Chicago zoning ordinance Title 17.04 is applicable to the Former USS Lead Facility.

5. *Current Zoning*

The Lake County, Indiana Assessor's website identifies the USS Lead Refining Inc. property located at 5300 Kennedy Avenue as tax parcel 45-03-33-300-002.000-024. The property is zoned industrial.

6. *Applicable Local Area Land Use Plans, Master Plans and how they affect the Former USS Lead Facility*

The City of East Chicago, Indiana has a Comprehensive Plan.[1] The area south of 151st Street including the Former USS Lead Facility is shown as industrial land use.

7. *Existing Local Restrictions on Property*

On December 14, 2007, Indiana Department of Environmental Management (IDEM) issued a Post-Closure Permit for the CAMU, which

---

[1] https://www.eastchicago.com/DocumentCenter/View/314/Comprehensive-Plan-PDF

required Respondent to establish a trust fund for continued maintenance of and monitoring at the Former USS Lead Facility in perpetuity.

On June 6, 2005, as part of a closure plan developed with and approved by the IDEM, Respondent executed an environmental restrictive covenant which implemented institutional controls at the Former USS Lead Facility. Those institutional controls prohibit, inter alia, any activity that will impact, damage or threaten the integrity of the CAMU, the subsurface slurry wall, or the monitoring wells installed around the CAMU.

8. Property Boundaries

The Former USS Lead Facility is identified by tax parcel 45-03-33-300-002.000-024. The total acreage is listed as 79.003. The property is adjoined by the Grand Calumet River (south and west), Kennedy Avenue (east), Indiana Harbor Belt Railroad, Universal Services vacant property and EJ&E railroad (north).

9. Groundwater Use Determinations, Wellhead Protection Areas, Recharge Areas and Other Areas Identified in the State's Comprehensive Ground Water Protection Program

On August 24, 2020, the City of East Chicago passed and adopted Ordinance No. 20-0013, which prohibits the use of groundwater as a potable water supply by the installation or use of potable water supply wells or by other means. The ordinance applies to the City of East Chicago, which includes the Former USS Lead Facility property.

The Indiana Department of Environmental Management (IDEM) Source Water Proximity Determination Tool on the internet reported that the Former USS Lead Facility property located at 5300 Kennedy Avenue is not within a wellhead protection area, but it is within a source water area.

10. Flood Plains, Wetland, or Endangered or Threatened Species

The Lake Indiana GIS Portal indicates the south approximately half and west edge of the property are located within the Flood Insurance Rate Map floodplain of the Grand Calumet River. The area was identified as FIRM Zone AE, areas subject to inundation by the 1 percent annual chance flood event.

The Lake Indiana GIS Portal indicates the entire property, with the exception of the CAMU, is mapped as a wetland. The wetland classification was palustrine unconsolidated bottom, intermittently exposed (PUBG).

There is no record of sighting of federal or State endangered or threatened species at the Former USS Lead Facility. A pair of nesting bald eagles has been sighted at the USS Lead Facility. Bald eagles were delisted as endangered or threatened species but retain special protection under federal laws.

11. Utility Rights of Way

City of East Chicago sewer maps reviewed by ERM indicate that a sanitary sewer force main is present along the northern edge of the Former USS Lead Facility property. The sanitary sewer force main runs east-west and parallels the northwestern property boundary and adjoining railroad tracks.

Two public utility rights of way are located on the former USS Lead Facility property: (1) an overhead high voltage transmission line is located at the northwest corner of the property; and (2) an underground pipeline that runs southwest to north adjacent to the Dune & Swale Complex area of the property.

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ERM's Rolling Meadows Office
1701 Golf Road, Suite 1-700
Rolling Meadows, IL 60008

T: +1 847 258 8900
F: +1 847 258 8901

www.erm.com

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