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HUMAN HEALTH RISK ASSESSMENT FOR THE SMURFIT-STONE/FRENCHTOWN MILL OPERABLE UNIT 3 SITE LOCATED IN MISSOULA COUNTY, MONTANA

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LIST OF ACRONYMS AND ABBREVIATIONS

95UCL	95% Upper Confidence Limit
ABSd	Dermal Absorption Fraction
ABS_{GI}	Fraction absorbed in gastrointestinal tract
AT	Averaging Time
BW	Body Weight
C	Concentration
CF	Conversion Factor
CFR	Clark Fork River
COPC	Contaminant of Potential Concern
CSM	Conceptual Site Model
CTE	Central Tendency Exposure
DAD	Dermal Absorbed Dose
DAevent	Absorbed dose per event
DAF	Dermal Adherence Factor
DI	Daily Intake
DI_L	Daily Intake, averaged over a lifetime
DL	Dioxin-Like
DRI	Daily Recommended Intake
EC	Exposure Concentration
ED	Exposure Duration
EF	Exposure Frequency
EPC	Exposure Point Concentration
EPD	Effective Predictive Domain
ET	Exposure Time
EU	Exposure Unit
EV	Event Frequency
FSP	Field Sampling Plan
HDPT	High Density Pulp Tank
HHRA	Human Health Risk Assessment
HI	Hazard Index
HIF	Human Intake Factor
HQ	Hazard Quotient
IR	Intake Rate
IRIS	Integrated Risk Information System
Kow	Octanol/water partition coefficient
LOAEL	Lowest Observed Adverse Effect Level
MDEQ	Montana Department of Environmental Quality
MDL	Method Detection Limit
MPDES	Montana Pollution Discharge Elimination System
MW	Molecular Weight
ND	Non-Detect
NOAEL	No Observed Adverse Effect Level
NPL	National Priorities List
OCC	Old Corrugated Container

OU	Operable Unit
PAH	Polyaromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCDD	Polychlorinated Dibenzo-p-dioxin
PCDF	Polychlorinated Dibenzo-p-furan
PEF	Particulate Emission Factor
PPRTV	Provisional Peer Reviewed Toxicity Value
PRP	Potentially Responsible Party
QAPP	Quality Assurance Project Plan
RBA	Relative Bioavailability
RBC	Risk-Based Concentration
RIWP	Remedial Investigation Work Plan
RfC	Reference Concentration
RfD	Reference Dose
RfD_{ABS}	Absorbed Reference Dose
RL	Reporting Limit
RME	Reasonable Maximum Exposure
RSL	Regional Screening Level
SA	Surface Area
SF	Slope Factor
SF_{ABS}	Absorbed Slope Factor
SI	Site Investigation
SL	Screening Level
STSC	Superfund Technical Support Center
SVOC	Semi-volatile Organic Compound
TCDD	2,3,7,8-Tetrachlorodibenzo-p-dioxin
TEF	Toxicity Equivalence Factor
TEQ	Toxicity Equivalent
TSB	Transformer Storage Building
TWA	Time Weighted Average
TWF	Time Weighting Factor
UR	Unit Risk
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
WMW	Wilcoxon-Mann-Whitney

1.0 INTRODUCTION

1.1 Purpose

This document is a human health risk assessment (HHRA) for the Smurfit-Stone/Frenchtown Mill Operable Unit 3 Site (hereafter referred to as "the OU3 Site") located in Montana. The purpose of this document is to evaluate potential risks to humans, both now and in the future, from Site-related chemicals that are present at the OU3 Site, assuming that no steps are taken to remediate the environment or to reduce human contact with contaminated environmental media.

The results of this assessment are intended to help inform risk managers and the public about current and potential future health risks to humans that may occur as a result of exposure to Site-related chemicals, and to help determine if there is a need for action to protect public health at the OU3 Site. The methods used to evaluate risks in this assessment are consistent with current guidelines for human health risk assessment provided by the U.S. Environmental Protection Agency (USEPA) for use at Superfund sites (USEPA 1989; 1991a; 1991b; 1991c; 1992a; 2002; 2014).

1.2 Organization

In addition to this introduction, this report is organized into the following sections:

Section 2	This section provides a description of the Site and a review of data that have been collected to characterize the environmental contamination at the Site.
Section 3	This section identifies human exposure scenarios of potential concern at the OU3 Site and describes the approach for identifying chemicals of potential concern (COPCs) for each exposure medium.
Section 4	This section includes the toxicity assessment and identifies potential non-cancer and cancer effects and toxicity values for the COPCs identified at the OU3 Site.
Section 5	This section summarizes estimated exposure and risk to humans from COPCs at the OU3 Site.
Section 6	This section provides full citations for USEPA guidance documents, Site-related documents, and scientific publications referenced in this report.

All tables, figures, and appendices cited in the text are provided at the end of the report.

2.0 SITE CHARACTERIZATION

A detailed description of the Smurfit-Stone/Frenchtown Mill Site and its history is provided in the Remedial Investigation Work Plan (RIWP) report for the Site (NewFields 2015). Site information is also provided on EPA's Superfund Page for the Site[1]. Pertinent information derived from these sources is summarized in the following subsections.

2.1 Site Overview

The Smurfit-Stone/Frenchtown Mill Site is in Missoula County, Montana and is located 11 miles northwest of Missoula, Montana (Figure 2-1). The entire Site consists of three operable units and encompasses approximately 3,150 acres.

Historically, a pulp and paper mill operated on site from 1957 to 2010. Wood was chipped, and the chips were washed and digested using sodium hydroxide and sodium sulfide to create a wood fiber pulp. Beginning in 1990, pulp was also created from recycling old corrugated containers at a recycled fiber plant on site. Waste bark and wood (hog fuel) generated as part of the on-site chipping of logs was conveyed to a storage yard on site and burned in a boiler. Most of the pulp was used to produce un-bleached linerboard, but a small fraction (about 6 percent) of the total pulp produced from 1960-1999 was used to create white linerboard or sold as bleached pulp.

The core industrial footprint of the Site includes the former mill, recycling plant, a wood chipping staging area, the hog fuel area, and various equipment storage areas. During the production of pulp and paper, high usage of water and energy resulted in large amounts of wastewater, solid waste (e.g., treatment sludges, boiler ash, wood processing residuals, lime kiln grits, inert materials, and general refuse) and air emissions. The paper making process at the Site was designed to recover and recycle chemicals utilized in the washing and digesting processes. Stack emissions from recovery boilers, power boilers, and lime kilns were controlled and monitored, and releases to the atmosphere were subject to permit standards. The Mill included a wastewater treatment system that included a primary clarifier and settling ponds (primary treatment), sludge dewatering plant, aeration basins (secondary treatment), polishing ponds, a color removal plant (tertiary treatment) and a series of unlined holding ponds used to store treated effluent prior to discharge. When holding ponds were at capacity, treated wastewater was moved to infiltration basins and infiltrated to groundwater. Treated wastewaters discharged to the Clark Fork River (CFR) was subject to MPDES permit standards.

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[1] Smurfit-Stone Mill Frenchtown, Missoula, MT webpage:
https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0802850

The USEPA conducted an initial site investigation (SI) in 2011 to support evaluation of the Site for possible inclusion in the National Priority List (NPL) (USEPA 2012). This investigation was focused on the former wastewater treatment and storage area, O'Keefe Creek, and the CFR. The Smurfit-Stone/Frenchtown Mill Site was proposed to be added to the National Priority List (NPL) on December 12, 2013. Although the Site has not been added to the NPL, an agreement was reached in November 2015 between the USEPA and the Respondents[2] to conduct a remedial investigation (RI). For assessment and management purposes, the USEPA has divided the Site into three operable units (OUs) based on historic use and the nature of the potential environmental concerns, as follows (Figure 2-2):

> **OU1** encompasses about 1,200 acres of the Site. This area has been and continues to be used largely for agricultural purposes, including grasslands for cattle grazing and cropland irrigated for alfafa and grain crops.
>
> **OU2** encompasses approximately 255 acres of the Site and includes the former industrial area. This area includes the former buildings and process areas for the Mill.
>
> **OU3** encompasses approximately 1,700 acres of the Site and includes areas of the Site where solid and aqueous wastes were treated and stored. This area includes the former wastewater treatment system (settling ponds, aeration basins, polishing ponds, solid waste basins, holding ponds, spoils basins, and infiltration basins), the holding ponds areas within the 100-year floodplain, and parts of the CFR where hazardous substances from historic mill operations may have come to be located.

This assessment focuses on OU3. OU3 includes the land outside of the 100-year floodplain where the former wastewater treatment system was contained. This area will be referred to herein as the "upland" area. OU3 also includes the land within the 100-year floodplain up to and including the CFR adjacent to and immediately downstream of the Site.

Within the Administrative Order on Consent (AOC) for the Remedial Investigation/Feasibility Study (RI/FS), OU3 is defined to include site-wide groundwater (USEPA 2015a). Since the USEPA is evaluating human health risks separately for each individual OU, each HHRA includes evaluation of groundwater collected from wells within the boundary for the OU being assessed. For the purposes of this assessment, groundwater data collected from wells within the OU3 land boundary were evaluated as described in further detail below. Groundwater data collected from wells within the land boundaries of the other OUs were evaluated in the respective HHRA reports.

[2] International Paper Company, WestRock CP, LLC, and M2Green LLC as defined in the Agreement and Order on Consent (AOC).

2.2 Former Wastewater Treatment and Storage

Figure 2-3 presents a schematic of the general wastewater treatment flow process for the Mill during the last 13 years of operation (1997-2010). The wastewater treatment system was designed to allow for flexibility to route treated water to multiple areas when needed. As shown in Figure 2-3, the Mill maintained four permitted outfalls to the CFR. Treated wastewater discharged to the CFR through outfalls 1 through 3 was subject to permit conditions including ambient river temperature and flow. Outfall 4 was used for discharging non-contact cooling water.

2.3 Solid Waste Basins

The Mill utilized spoils basins (SBs) and solid waste basins (SWBs) in OU3 (Figure 2-3), as follows:

- SB19 & SB20 received dredged pond material (spoils) removed from the aeration basins and settling ponds (P5 and P8).
- SWBA received general refuse (paper, plastic, metal, wood, glass, and food).
- SWB6 received hog fuel ash and lime kiln grits.
- SWBCa and SWBCb received hog fuel, lime grits, and ragger wire.
- SWBF received asbestos containing materials.
- SWBG received Class III inert materials (wood, gravel, log yard wastes, bricks).

All solid waste basins listed above were closed and capped in 1993 except for SWBG which has an open and active permit to receive Class III inert materials. After 1993, all Class II solid wastes generated by the Mill were transported offsite for disposal.

2.4 Basis for Potential Human Health Concern

Mill operations (predominantly the pulping and bleaching processes) used or produced various hazardous chemicals on site, including volatile and semi-volatile organic compounds (VOCs and SVOCs), and bleaching chemicals. The use of chlorine for the bleaching of pulp produces chlorinated organic compounds, including dioxins and furans. Treatment and storage of solid and aqueous wastes within OU3 may have resulted in contamination of surface soils and subsequent contamination of subsurface soils and groundwater, as well as possible contamination of sediments and surface water within the CFR and its tributaries that flow through the Site via fate and transport mechanisms discussed in further detail below. Previous site investigations have identified COPCs at the Site to include dioxins/furans, heavy metals, polychlorinated biphenyls (PCBs), SVOCs, and VOCs. Exposures to these types of COPCs may cause a range of non-cancer and cancer effects in humans. Humans who reside in, work at, and/or visit the OU3

Site now or in the future could be at risk of adverse health effects if excessive exposure to contaminated environmental media were to occur.

2.5 Data Overview

As described in the RIWP, numerous environmental studies and compliance monitoring events have been conducted at the Site in support of ongoing RI activities (NewFields 2015). In April 2014, the Potential Responsible Party (PRP) for the Site commissioned the collection of environmental samples to initiate the ongoing site investigation. Follow-up sampling was conducted in a series of sampling events in accordance with the USEPA approved RIWP and associated Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) as follows:

- November and December 2015 (NewFields 2015)
- June 2016 (RIWP Addendum 1; NewFields 2016a)
- August 2016 (RIWP Addendum 2; NewFields 2016b)
- March 2017 (RIWP Addendum 3; NewFields 2017a)
- June 2017 (RIWP Addendum 4; NewFields 2017b)
- October 2017 (RIWP Addendum 7; NewFields 2017c)

The environmental data collected during the site investigations described above from 2014-2017 were considered in this assessment.

The environmental data for the OU3 Site considered in this assessment includes analytical results for soil, groundwater, sediment and surface water samples collected within the boundaries of OU3 by NewFields in 2014, 2015, 2016 and 2017 (see Table 2-1). These data have been validated and are considered to be appropriate for use in this assessment. Figures 2-4 to 2-6 present the sampling locations corresponding to the surface soil and subsurface soil samples collected within OU3. Figure 2-7 presents the locations of the groundwater wells identified for inclusion in this assessment for OU3 (Atkins Monitoring Well 6 [ATMW6], NewField Monitoring Wells [NFMW] 1 through 12 and 19, Smurfit-Stone Monitoring Wells [SMW] 7 through 20, and test wells [TW] 2R and 5R). Figure 2-8 presents the sediment and surface water sampling locations within the CFR and its' tributaries.

Data considered in this HHRA that were not collected by NewFields include fish tissue data provided by the Montana Fish, Wildlife and Parks (MTFWP) (Schmetterling and Selch 2013). These data correspond to 5-fish composite skinless fillet samples of northern pike and rainbow trout collected in 2013 from backwaters, sloughs and margins of the CFR along a 10-km reach just downstream of the Site (Figure 2-9).

Appendix A briefly summarizes the available data and outlines the data reduction procedures employed in this assessment. Excel files containing the data are included as an electronic attachment to Appendix A. Summary statistics are provided in Tables 2-2 to 2-12.

Specific Data Considerations

Calculation of Toxicity Equivalents

For this assessment, data for dioxin/furan congeners were converted to a 2,3,7,8-tetrachlorodibenzodioxin (TCDD) toxicity equivalent value (TEQ)[3]. This was done because polychlorinated dibenzodioxin (PCDD) and furan (PCDF) congeners all act by the same mechanism as TCDD. TEQ values were calculated by computing the sum across congeners of the product of congener-specific concentration and relative Toxicity Equivalence Factor (TEF):

$$TEQ = \Sigma\ (Ci \times TEFi)$$

TEFs were based on USEPA (2010a). The USEPA Scribe database for the Smurfit-Stone/Frenchtown Mill Site includes three alternative TEQ values that were computed based on evaluating ND concentrations as zero, at one-half the MDL and at one-half the reporting limit (RL). Although summary statistics are provided for each of these alternatives, risk calculations included in this risk assessment were based on evaluating NDs at ½ MDL, unless otherwise noted (i.e., comparison to background concentrations as described in Section 3.3). Evaluation of NDs at ½ the MDL when calculating TEQ is consistent with evaluations conducted at other USEPA sites in the region.

Inorganic Data in Water

Groundwater and surface water samples were analyzed for both total recoverable and dissolved concentrations of inorganics. In general, filtered water data may underestimate actual exposure to humans if contaminants of concern are primarily associated with particulate matter. For risk assessment purposes, USEPA Region 8 evaluates exposures to groundwater assuming that the water is consumed without filtration. Thus, total metal concentrations were used to quantify risks in this assessment. However, at this Site, the groundwater database is more robust for dissolved metals and in some cases the highest concentrations observed were based on dissolved metals in samples where total metals were not analyzed. On this basis, the uncertainty section includes discussion of risk estimates based on the dissolved fraction.

[3] https://www.epa.gov/superfund/risk-assessment-dioxin-superfund-sites

3.0 EXPOSURE ASSESSMENT

Exposure is the process by which humans come in to contact with chemicals in the environment. In general, humans can be exposed to chemicals in a variety of environmental media (e.g., soil, sediment, water, air, food), and these exposures can occur through several routes (e.g., ingestion, dermal contact, inhalation).

3.1 Site Conceptual Model

Figure 3-1 presents a Conceptual Site Model (CSM) for OU3 that summarizes USEPA's current understanding of how chemicals that have been released to the environment within OU3 might result in exposure of human receptors. This CSM is based on the most current understanding of expected land use now and in the future. The main features of this CSM are discussed below.

3.1.1 Primary Sources of Contamination

As noted above and as described in further detail in the RIWP, Mill operations included the creation of pulp, wood chipping, recycling of OCC, burning of solid fuels in boilers, and paper making (NewFields 2015). These operations are potential sources of metals, as well as volatile and semi-volatile organic compounds (VOCs and SVOCs) including polycyclic aromatic hydrocarbons (PAHs). Chlorinated bleaching operations related to the production of linerboard produced by the mill occurred in OU2 from 1960 to 1999, and are a potential source of dioxins and furans. The historical use of OU3 for treatment and storage of wastewater and solid wastes represents the primary source of contamination of OU3 soils. Historical Mill operations consisting of boiler emissions may have also resulted in direct deposition of contaminants in OU3 surface soils.

3.1.2 Transport in the Environment

Solid wastes generated during mill operations or recovered from the aqueous waste stream were either burned for energy recovery (e.g. primary wastewater treatment plant solids) or were stored in solid waste disposal areas. Treated wastewater was stored in ponds designed to allow infiltration into soil and groundwater. Water that did not infiltrate was ultimately discharged into the CFR. Additionally, contaminants generated and/or released from historical Mill operations may migrate in the environment by several processes:

- Fine-grained soil particulates from contaminated soil and/or solid waste disposal areas may be released into air as a consequence either of wind erosion and/or human disturbances. The waste materials in the settling ponds were saturated due to precipitation and historic inundation which limited dust generation. Additionally, transport of contaminants emitted to the air from boiler emissions can result in direct deposition of chemicals in OU3 surface soils.

- Runoff (from rain or snowmelt) from surface soils and/or solid waste disposal areas may result in contamination of both surface water and sediments in the CFR and its tributaries (O'Keefe and Lavalle Creeks).

- Contaminants in soil may be dissolved by water (rain or snowmelt) and infiltrate into subsurface soils and downward into groundwater.

O'Keefe Creek enters the boundary of the Smurfit-Stone/Frenchtown Mill Site along the southern edge of OU2 as shown in Figure 2-2. O'Keefe runs through portions of OU3 to the confluence with Lavalle Creek prior to discharging to the CFR. Lavalle Creek runs up through OU1 land on the southern end of the Site prior to the confluence with O'Keefe Creek. It is possible that runoff from surface soils may result in the transport of contamination from OU3 surface soils into O'Keefe Creek and the confluence point between the two tributaries. Thus, exposures associated with O'Keefe and Lavalle Creeks were included in the OU3 CSM. However, as described in further detail below, risks to recreational visitors exposed to sediments and surface waters in these creeks were previously evaluated in the OU1 HHRA and found to be below the USEPA's unacceptable risk criteria (USEPA 2017b). No new data from these creeks have become available at the time of this assessment, so no quantitative evaluation of O'Keefe and Lavalle Creeks was performed. An addendum to this HHRA will be issued to evaluate human health exposures and risks when additional surface water and sediment data are collected from these tributaries.

3.1.3 Land Use and Potentially Exposed Populations

<u>Current Land Use</u>

Currently, the USEPA is unaware of any residential or commercial land use within OU3. However, the CFR is popular for a variety of recreational activities including hiking, camping and fishing. Thus, the CSM identifies exposures of recreational visitors (hikers, campers and fishermen) within OU3 as being of potential concern.

Hypothetical Future Land Use

OU3 is not currently zoned for a specific land use. Therefore, there are no land use restrictions currently in place to prohibit the development of the OU3 upland for residential, commercial, or industrial use. However, Missoula County does not allow new building development within the 100-year floodplain (Missoula County 2017). Given this restriction prohibiting future development in the floodplain area of OU3 for residential and commercial/industrial use, the CSM does not reflect such hypothetical future uses in the floodplain. The CSM identifies exposures of hypothetical future residents and workers as being of potential concern in the upland area of OU3 only.

Future residential and/or commercial development of land within the OU3 upland area would involve soil excavation and construction. On this basis, the CSM also includes a hypothetical future construction worker receptor who may be exposed in the upland areas of OU3.

The Respondents indicated that all areas within the 100-year floodplain of the CFR may be developed in the future into natural riparian woodlands or wet meadows with recreational features including trails, river access, golf course, and/or parks (NewFields 2015). This might increase the frequency and extent that the CFR floodplain is used by recreational visitors.

Tribal Fishers

Pursuant to the Hellgate Treaty of 1855, the Confederated Salish and Kootenai Tribes (CSKT) are a natural resources trustee of the CFR fishery and reserved themselves the right to fish within the CFR. Thus, the OU3 CSM includes tribal fishers as a population of concern.

3.2 Exposure Pathways of Chief Concern

Not all of the potential exposure pathways to these populations of receptors are likely to be of equal concern. First, in order to be of concern, an exposure pathway must be "complete". That is, there must be contact between a human receptor and a contaminated environmental medium. Exposure pathways that are not complete are indicated in Figure 3-1 by open boxes. For pathways that are complete, the relative importance of one to another is related to the amount of chemical taken into the body by each pathway. Exposure scenarios that are likely to result in the highest level of exposure are shown in Figure 3-1 by boxes containing a solid circle (●). Greatest attention is focused on quantification of exposure from these pathways in order to determine if the pathway contributes significant risk. Pathways that are complete but which are judged to contribute only minor exposures, at least in comparison to other pathways, are shown by boxes with an open circle (❍). Because of their minor contribution, these pathways are not evaluated quantitatively. Boxes with an “X” indicate exposure pathways that are likely to be complete, but for which data are insufficient to derive meaningful risk estimates.

The following sections present a more detailed description of these pathways and an analysis of their relative importance for human exposure.

3.2.1 Exposures to Soil

Exposures to Surface Soil

Incidental Ingestion of Surface Soil

Even though few people intentionally ingest soil, anyone who has direct contact with contaminated surface soil may incidentally ingest small amounts that adhere to their hands during outdoor activities. Incidental ingestion of soil is often one of the most important routes of human exposure, so ingestion of surface soil is evaluated for all receptors.

Dermal Contact with Surface Soil

Humans who come into contact with contaminated soils may get some of the material on their skin. As such, dermal exposure to surface soil is considered a complete exposure pathway and is evaluated quantitatively for all receptors.

Inhalation of Airborne Soil Particulates

Whenever contaminated soils are exposed at the surface, fine-grained particles may become suspended in air by wind and/or human activity, and humans in the area could inhale those particles. In cases where the soil is disturbed only by wind or light human activity (e.g., walking/hiking), the amount of particulate material inhaled from air is generally quite small compared to the amount that is typically assumed for incidental ingestion. Therefore, inhalation of soil particulates generated by wind erosion or walking was considered a minor pathway for all potential human receptors. Appendix B presents screening level calculations to support this designation.

When soil is disturbed by mechanical forces such as construction equipment, dust levels in air may be significant and intake of soil from inhalation of airborne dusts may become similar to or even higher than the ingestion pathway. Thus, inhalation of soil particulates generated through the use of construction equipment was evaluated quantitatively for hypothetical future construction workers.

Inhalation of Vapors Emitted from Surface Soils

Whenever contaminated soils are exposed at the surface, volatile chemicals may volatilize into the air and humans in the area could inhale those vapors. Soils in OU3 have not been analyzed for volatile organic compounds (VOCs) because no VOCs were detected in OU2 soils (where they were considered most likely to occur) (NewFields, 2016c). Volatilization of dioxins/furans expected in OU3 soils is generally not expected to be significant given the relatively low volatility of these chemicals and the absence of a continuous source. Also, the amount of vapor inhaled from air is generally quite small compared to the amount that is typically assumed for incidental ingestion. Therefore, inhalation of vapors emitted from surface soils was considered a minor pathway for all potential human receptors. Appendix B presents screening level calculations to support this designation.

Exposures to Subsurface Soil

Due to the nature of the work, construction workers may be exposed via direct contact to soils down to a depth of 10 feet. Construction workers who have direct contact with contaminated soils may get soils on their skin and incidentally ingest small amounts that adhere to their hands during construction activities. On this basis, incidental ingestion of and dermal contact with subsurface soils were considered complete exposure pathways for hypothetical future construction workers.

3.2.2 Exposures to Groundwater

Groundwater is not currently used as a drinking water source in OU3. Therefore, current exposures to groundwater are not evaluated quantitatively. However, it is possible that groundwater within the OU3 upland area could be used within future residences and/or commercial/industrial buildings. Wells identified for inclusion in the upland dataset are ATMW6, NFMW1 through NFMW12, NFMW19, NFMW20, and SMW16 through 19. As shown in Figure 2-7, groundwater wells SMW17, NFMW20, NFMW19, SMW16, NFMW8, and NFMW7 are all located on or very close to the 100-year floodplain boundary. These were included in the upland dataset due to their close proximity and the possibility that hypothetical future properties within the upland could extending into the floodplain where a well could be located. It is not clear if a well is considered a “structure” under the building restrictions within the floodplain. There are three primary pathways by which a hypothetical future resident or commercial worker may be exposed to groundwater as described below.

Ingestion of Drinking Water

Hypothetical future residents or commercial workers may ingest Site groundwater as drinking water.

Dermal Contact with Groundwater

If Site groundwater was used in residential homes in the future, dermal exposure by residents would primarily be the result of showering/bathing. If Site groundwater was used in commercial/industrial buildings in the future, dermal exposure by workers would primarily be the result of hand washing. Several VOCs were detected in groundwater from wells within the OU3 upland area. However, VOCs tend to volatilize from the skin (USEPA 2004). Metals and dioxins/furans have been detected in OU3 groundwater samples. USEPA guidance recommends against quantifying exposure and risk based on dermal contact with 2,3,7,8-TCDD in water because the molecular weight (MW) and octanol/water partition coefficient (Kow) are outside of the effective predictive domain (EPD) (USEPA 2004). Uptake of metals across the skin from contact with water is usually a minor exposure pathway due to the relatively low tendency of metals to cross the skin even when contact does occur. Furthermore, risk associated with dermal contact to metals in water is expected to be relatively small compared to the amount that is typically assumed for ingestion of drinking water. On this basis, dermal exposure to groundwater by hypothetical future residents and workers is considered a minor pathway in the CSM. Appendix B presents screening level calculations to support this designation. Thus, dermal exposure to contaminants in groundwater by hypothetical future residents and workers was considered a minor pathway and was not evaluated quantitatively in this assessment.

Inhalation of Vapors Released from Water

Volatile chemicals in water can be released to indoor air by two pathways: 1) vaporization to indoor air through standard indoor water uses, and 2) vapor intrusion in which vapors rise from the groundwater through the soil underlying a building foundation and get into the building through cracks in the foundation. Although these pathways may be complete at future residences and/or commercial/industrial buildings within the OU3 Site, the chemicals detected at a high frequency in OU3 groundwater (dioxins/furans, metals) are not considered to be of sufficient volatility to expect significant exposures via these pathways. Therefore, these pathways were not evaluated quantitatively in this assessment.

3.2.3 Exposures to Sediment

Incidental Ingestion of Sediment

People recreating along/within the CFR and its tributaries within OU3 are unlikely to intentionally ingest sediment, but as described above for surface soil, anyone who has direct contact with contaminated sediments may incidentally ingest small amounts that adhere to their hands during recreational activities. Thus, incidental ingestion of sediment is considered a complete exposure pathway for all recreational visitors/fishers in the floodplain.

Dermal Contact with Sediment

Recreational visitors who come into contact with contaminated sediments may get some of the material on their skin during recreational activities. As such, dermal exposure to sediments is considered a complete exposure pathway for all recreational visitors/fishers in the floodplain.

3.2.4 Exposures to Surface Water

Ingestion of Surface Water as Drinking Water

Although it is assumed that people recreating in the area generally bring potable drinking water and/or some form of a water filtration system, this assessment also considers exposure by a hypothetical recreational visitor who may ingest drinking water drawn from the CFR without the benefit of filtration. Of the various types of recreational visitors, it is assumed that campers would be most likely to do this. Thus, ingestion of surface water as drinking water was considered a complete exposure pathway for campers.

Incidental Ingestion of Surface Water

Other recreational visitors to the CFR may not intentionally ingest surface water, but may incidentally ingest small amounts while recreating. Therefore, this exposure pathway was considered complete for hikers and fishermen.

Dermal Contact with Surface Water

Humans visiting the CFR for recreational purposes may have occasional dermal contact with surface water. Average water temperatures for the CFR range around 68 degrees Fahrenheit in the peak summer months (USGS 2017). Given water temperature, climate, and the general nature of the river adjacent to and directly downstream of the Site as dynamic and fast flowing, it is not anticipated that a person would be dermally exposed to surface water for any significant amount of time without protective gear (e.g., waders). Thus, dermal exposure to surface water is considered a complete exposure pathway for recreational visitors during limited wading activities only.

3.2.5 Exposures to Food Items

Ingestion of Homegrown Produce Items

Hypothetical future residential use within OU3 may include residential gardens used to grow vegetables or fruit in Site-impacted soils. Area residents who ingest home-grown produce may be exposed to certain contaminants that may be taken up by the vegetables or fruit. No data are available on the levels of contaminants that may be present in vegetation within OU3. Therefore, this pathway cannot be evaluated quantitatively in this risk assessment without modeling uptake from soils into plants. Dioxins/furans and metals have been detected in OU3 soils. USEPA (1999) notes that most plants do not generally absorb dioxin. Similarly, most metals have little tendency to accumulate in plant tissue (Life Systems 1995; Weston 1997). In addition, exposure to dioxins and metals from ingestion of washed garden vegetables is likely to be a minor source of exposure compared with direct ingestion of soil. On this basis, ingestion of home grown produce by a hypothetical future resident was not evaluated quantitatively in this risk assessment. A qualitative evaluation of excluding this pathway from the risk characterization is discussed in the uncertainty assessment.

Ingestion of Fish from Impacted Streams

Fish that live in the CFR may take up contaminants from surface water, sediment, or food, leading to exposure of humans who eat locally-caught fish. The State of Montana currently has a consumption advisory in place for the portion of the CFR below the confluence with the Blackfoot River and Flint Creek to avoid eating Northern Pike over 22 inches, and limit eating rainbow trout 10-18 inches to four meals per month (State of Montana 2015). Although this advisory is likely to limit the potential exposure by fishers to contaminants in the tissues of fish caught from locations in the CFR included in this assessment, an advisory is not a regulation. As such, consumption of locally-caught fish is assumed to occur and this pathway was retained for quantitative evaluation in this assessment for both a recreational fisher and a tribal fisher.

3.2.6 Summary of Exposure Pathways for Quantitative Assessment

Table 3-1 summarizes the exposure pathways that were selected for quantitative evaluation in this risk assessment.

3.3 Selection of Chemicals of Potential Concern

COPCs are contaminants which exist in the environment at concentration levels that might be of potential health concern to humans and which are or might be derived, at least in part, from Site-related sources.

3.3.1 COPC Selection Process

The procedure used to identify COPCs for the evaluation of risks to human receptors from contaminated environmental media (soil and groundwater) is shown in Figure 3-2. It is important to note that this COPC selection procedure is intended to be conservative. That is, it is expected that some chemicals may be identified as COPCs that are actually of little or no concern, but that no chemicals of authentic concern will be overlooked.

The COPC selection procedure includes two primary steps:

(1) Comparison of Site data to risk-based concentrations,
(2) Comparison of Site data to background data.

In brief, the COPC selection procedure classifies each chemical into one of three categories:

- COPC
- Not a COPC
- Source of Uncertainty

In Step 1, the process begins by determining if the chemical has a risk-based concentration (RBC) that can be used to evaluate potential risk. An RBC is a concentration of a chemical in a medium that is believed to pose negligible health risk to a specified population of human receptors. For carcinogens, this is a concentration that corresponds to a cancer risk of 1E-06. For non-carcinogens, this is a concentration that corresponds to a Hazard Quotient (HQ) of 0.1.

If an RBC is available, the next step is to evaluate the detection frequency. If a chemical was detected in 5% or more of the Site samples, the maximum detected concentration for each chemical in each medium is compared to the RBC. If the maximum detected concentration exceeds the RBC, the chemical moves into Step 2, the background comparison. If the maximum detected concentration does not exceed the RBC, it may be concluded that the chemical does not pose a significant risk to humans and may be excluded as a COPC.

If the chemical was detected in fewer than 5% of the Site samples, or if the chemical was not detected, then the detection limit is evaluated. If the detection limit is lower than the RBC, then it is very unlikely that the chemical will pose a significant risk to human health and may be excluded as a COPC. However, if the detection limit is above the RBC, this is identified as a source of uncertainty.

If a chemical does not have an RBC, this is identified as a source of uncertainty unless the chemical is a beneficial nutrient and the expected average intake from Site media is similar to the range that is considered healthful.

In Step 2, Site data for chemicals identified as having a maximum detected concentration above an available RBC value are compared to appropriate background concentrations.

If the measured level of a chemical is not statistically (based on an alpha of 0.05, see section 3.3.4) higher than the level that would be expected for that chemical based on background levels, then it may be concluded that the Site-related contribution for that chemical is sufficiently minor and further quantitative evaluation is not needed. If the chemical is observed to be present at a level higher than would otherwise be expected, then that chemical is retained for quantitative risk evaluation.

In summary, a chemical is identified as a COPC if the maximum detected concentration exceeds an available RBC, and Site concentrations for that chemical are significantly higher than background concentrations.

3.3.2 Source of Risk-Based Screening Level Values

Risk-based screening levels (SLs or RBCs) used in this assessment were selected based on the human receptor identified in the CSM (Figure 3-1) who is expected to receive the highest exposure. In general, this is the hypothetical future resident. Therefore, RBC values for use in the COPC selection protocol were derived from USEPA's Regional Screening Level (RSL) Tables (USEPA, 2017a)[4], using values that are protective of residents. USEPA's RSL Tables include generic SLs for a resident exposed to soil or drinking water calculated assuming default exposure parameters that represent Reasonable Maximum Exposure (RME) conditions for chronic exposures via the oral, dermal and inhalation pathways.

USEPA RSL Tables do not include SLs for people consuming fish caught from contaminated water bodies. However, the USEPA RSL Calculator can be used to calculate fish SLs based on

[4] https://www.epa.gov/risk/regional-screening-levels-rsls (Tables last updated November 2017)

Site-specific fish consumption rates. Fish ingestion rates for an RME fisher were assumed to be equal to the 95^{th} percentile value of 43 g/day presented in USEPA (2011a, Table 10-5) for consuming anglers in North Dakota (the nearest state with data). Fish SLs were calculated using the USEPA RSL Calculator and this assumed fish ingestion rate.

3.3.3 Evaluation of Beneficial Minerals

A number of metals are beneficial minerals, and a certain level of intake is required to maintain good health. This includes calcium, chromium (III), copper, iron, magnesium, manganese, molybdenum, potassium, selenium, sodium, and zinc. However, excess intake of these minerals may cause adverse effects. If a SL was available for such minerals in USEPA's RSL Tables, they were evaluated as described above. Because of their low toxicity (even at high doses), USEPA has not derived RBC values for some minerals, including calcium, magnesium, potassium, and sodium. These four chemicals were evaluated by calculating an effective RBC as follows:

Effective RBC (beneficial) = DRI / DI

Where:

DRI = Daily Reference Intake (mg/day), derived from the Food and Nutrition Board (FNB 2013)

DI = Daily intake of Site medium (kg/day of soil; L/day of water)

3.3.4 Background Screen

Concentrations of a chemical in the environment are characterized by distributions, whereby a comparison between Site data and background data must be based on sound statistical techniques. For the purposes of this assessment, USEPA's ProUCL Software (v 5.0) was used to compare available Site data to available background data (USEPA 2013). This was done using the Wilcoxon-Mann-Whitney (WMW) two sample hypothesis test in ProUCL for the null hypothesis Site >= background. If ProUCL concludes that the Form 2 null hypothesis cannot be rejected with 95% confidence, the WMW two sample hypothesis test is conducted for the null hypothesis Site = background at a confidence coefficient of 95%. The Gehan test was used when multiple detection limits are present as prompted by the ProUCL output based on the WMW test.

Background Data

The background data evaluated in this assessment are provided in electronic format in Appendix A. Summary statistics are provided in Tables 3-2 to 3-5.

Soil

Background soil data considered in this assessment are based on surface soil samples collected across the state of Montana by the MDEQ and analyzed for dioxins/furans and inorganics (MDEQ, 2013; 2011). MDEQ categorized soils as urban or rural. Urban soils were further categorized as residential, commercial or industrial. Site data were compared against the background data for each of these categories. Of note, MDEQ evaluated NDs using reporting limits (RLs). As such, for the purposes of comparing Site concentrations to background concentrations, ND results in the Site dataset were evaluated at ½ RL.

Groundwater

Five wells within the boundary of the Smurfit-Stone/Frenchtown Mill Site (CountyMW, SMW1, SMW5, SMW6, and WFBW) were previously identified as background groundwater locations. These wells were identified as being upgradient from any potential Site contamination during Mill operations. Groundwater samples were collected from these wells in April 2014, December 2015, May 2016, and March/June/July 2017 as part of ongoing RI activities. Samples were analyzed for dioxins/furans, PCBs (as Aroclors), total and dissolved metals, SVOCs and VOCs; although not all samples were analyzed for all of these contaminant classes.

Sediment and Surface Water

To support RI activities, NewFields previously collected sediment and surface water samples from locations within the CFR upstream of the Site (Figure 2-8). Samples were analyzed for dioxins/furans, PCBs (as Aroclors), metals, and SVOCs. Additional surface water and sediment data from locations within the CFR upstream of the Site are available from U.S. Geological Survey (USGS) monitoring stations located upstream of Missoula (Station ID 12340500), at Turah (Station ID 12334550), and near Drummond (Station ID 12331800) (Dodge et al. 2017). The USGS data are limited to select metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel and zinc).

Fish

Fish have not been collected upstream of the Site as part of the RI investigation. In the absence of tissue data for fish collected within the CFR upstream of the Site, data from a national fish tissue study conducted by the USEPA (2016a) was considered for use in the background comparison. USEPA (2016a) collected adult fish from 1,924 randomly selected urban and non-urban river and stream sites in the conterminous United States. Predator fish species (e.g., bass or trout) ranging in length from 101-683 mm were collected. Composite fillet samples were analyzed for mercury and selenium (and other contaminants that are not of interest at the OU3 Site).

Because data from USEPA (2016a) were not available for dioxins and Aroclors, the USEPA (2009a) National Study of Chemical Residues in Lake Fish Tissue was also considered as a potential background fish tissue dataset. USEPA (2009a) collected adult predator fish species (e.g., bass or trout) ranging in length from 122-840 mm. Composite skin-on fillet (scales removed and belly flap attached) samples were analyzed for mercury, PCBs as Aroclors, and dioxins/furans. Given that persistent organic pollutants like dioxins and PCBs accumulate in fat, using skin-on fillets with belly flap attached are not ideal for comparing dioxin and PCB concentrations measured in skinless fillets (MTFWP fish tissues). Additionally, there is uncertainty in the representativeness of using a background dataset based on fish collected from lakes to compare to fish collected from a river environment. Such a comparison may not account for potential influences of differing ecological variables that could influence contaminant uptake, absorption, and distribution.

The only other background information on concentrations of dioxins/furans in fish tissues that was found, comes from older studies that collected fish from areas within the CFR upstream of the Site (USEPA 1992b; TetraTech 1998). These data were limited to a point estimate based on a fillet composite sample (5 fish/composite) for brown trout collected from Warm Springs (USEPA 1992b) and a point estimate based on a whole-body composite sample (5 fish/composite) for mountain whitefish collected from the CFR just upstream of the Site (TetraTech 2998). These data are not adequate for performing statistical analyses and were not used.

3.3.5 COPC Screening Results

Tables 3-6 to 3-12 present the application of the COPC selection process to the OU3 soil, groundwater, sediment, surface water and fish data, respectively. The results are briefly summarized below.

Risk-based Screen

As seen in Tables 3-6 to 3-12, maximum detected concentrations were higher than respective RBCs in OU3 media for the following:

- TEQ, aluminum, antimony, arsenic, cadmium, chromium, cobalt, iron, manganese, mercury, thallium, and vanadium in OU3 upland soil.
- TEQ, aluminum, arsenic, barium, chromium, cobalt, iron, manganese, mercury, thallium, and vanadium in OU3 floodplain soil.
- TEQ, Aroclor-1260, aluminum, antimony, arsenic, barium, chromium, cobalt, iron, magnesium, manganese, nickel, thallium, vanadium, and chlorobenzene in groundwater.
- Arsenic, chromium, cobalt, iron, manganese and thallium in CFR bed sediments.
- Aluminum, arsenic, chromium, cobalt, copper, iron, manganese and thallium in flood fringe sediments.
- Arsenic in CFR surface water.
- TEQ, Aroclor-1254 and mercury in fish.

Background Screen

Of the chemicals listed above with maximum detected concentrations above respective RBCs, the following were identified in the background screening process as being present within OU3 above background concentrations:

- TEQ, antimony, cadmium and mercury in OU3 upland soil.
- TEQ, barium, and mercury in OU3 floodplain soil.
- TEQ, aluminum, arsenic, chromium, cobalt, iron, manganese, nickel and vanadium in groundwater.

Appendix C includes the ProUCL output for the background comparisons for these chemicals. As seen in Appendix C, concentrations of the COPCs listed above were determined to be statistically greater than background concentrations (Do not reject H0, conclude Site > background).

COPC Screens for Sediment and Surface Water

None of the COPCs in CFR sediments or surface water whose maximum detected concentration was higher than the respective RBC were identified in the background screen as being present at concentrations significantly above upstream concentrations. In addition, as described in the COPC screen presented in the OU1 HHRA, no COPCs were identified within Lavalle and O'Keefe Creeks to be both present at concentrations above respective RBCs and present at concentrations statistically elevated above background concentrations (USEPA 2017b).

No COPCs in surface water or sediment were retained as COPCs in this assessment. However, as described in Section 6, uncertainties in the robustness of the available sediment and surface water datasets within the CFR, O'Keefe Creek, and Lavalle Creek limit the confidence in these findings. To the extent that additional surface water and sediment data are collected from these water bodies during future sampling events that are relevant to refining this assessment, an addendum to this HHRA will be developed to evaluate those additional data.

COPC Screen for Fish Tissue

TEQ and Aroclor-1254 were identified as COPCs in fish tissue based on comparison of the maximum detected concentrations observed in the MTFWP fillet samples compared to the risk-based SLs. No suitable background data were located for comparing observed concentrations in fish collected from the CFR just downstream of the Site. Thus, TEQ and Aroclor-1254 were retained as COPCs in fish tissue.

Summary

In accordance with the COPC selection procedure presented in Figure 3-2, contaminants were selected as COPCs if their detection frequency was greater than or equal to 5%, the maximum detected concentration in a given medium (OU3 soil, OU3 groundwater, CFR sediments, CFR surface waters, and fish tissue) exceeded conservative RBCs, and if Site concentrations were either statistically elevated above available background concentrations or could not be evaluated relative to background concentrations. In summary, as seen in Tables 3-6 to 3-12, COPCs for OU3 retained for quantitative risk characterization are:

- TEQ, antimony, cadmium and mercury in OU3 upland soil.
- TEQ, barium, and mercury in OU3 floodplain soil.
- TEQ, aluminum, arsenic, chromium, cobalt, iron, manganese, nickel and vanadium in groundwater.
- TEQ and Aroclor-1254 in fish.

3.4 Quantification of Exposure

3.4.1 Basic Equations

Ingestion Exposures

The amount of chemical which is ingested by receptors exposed to Site media may be quantified using the following general equation:

$$DI = C \cdot (IR / BW) \cdot (EF \cdot ED / AT) \cdot RBA$$

where:

DI	=	Daily intake of chemical (mg per kg of body weight per day).
C	=	Concentration of the chemical in the contaminated environmental medium (soil/sediment, water) to which the person is exposed. The units are mg/kg for soil, µg/L for water, and mg/kg-ww for fish.
IR	=	Intake rate of the contaminated environmental medium. The units are kg/day for soil and fish, and L/day for water.
BW	=	Body weight of the exposed person (kg).
EF	=	Exposure frequency (days/year). This describes how often a person is likely to be exposed to the contaminated medium over the course of a typical year.
ED	=	Exposure duration (years). This describes how long a person is likely to be exposed to the contaminated medium during their lifetime.

AT = Averaging time (days). This term specifies the length of time over which the average dose is calculated. For a chemical which causes non-cancer effects, the averaging time is equal to the exposure duration. For a chemical that causes cancer effects, the averaging time is 70 years.

RBA = Soil relative bioavailability.

Note that the factors EF, ED, and AT combine to yield a factor between zero and one. Values near 1.0 indicate that exposure is nearly continuous over the specified averaging period, while values near zero indicate that exposure occurs only rarely.

For mathematical convenience, the general equation for calculating dose can be written as:

$$DI = C \cdot HIF \cdot RBA$$

where:

HIF = Human Intake Factor. This term describes the average amount of an environmental medium contacted by the exposed person each day. The value of HIF is typically given by:

$$HIF = (IR / BW) \cdot (EF \cdot ED / AT)$$

The units of HIF are kg/kg-day for soil and L/kg-day for water.

When the same individual may be exposed beginning as a child and extending into adulthood, exposure was calculated as the time-weighted average (TWA) lifetime exposure for evaluating non-cancer hazards and cancer risks as recommended in USEPA Guidance (USEPA 1989).

Dermal Exposures

The amount of a chemical which is absorbed across the skin is referred to as the dermally absorbed dose (DAD). Procedures for estimation of the DAD as outlined in USEPA (2004) are used in this assessment and described below. Exposure is quantified using an equation of the following general form:

$$DAD = DA_{event} \cdot EF \cdot ED \cdot EV \cdot SA / (BW \cdot AT)$$

where:

DAD = Dermal absorbed dose (mg of chemical per kg of body weight per day).

DA_{event} = Absorbed dose per event (mg of chemical per square centimeter of skin surface area per event). This is media-specific and is further described below.

EF = Exposure frequency (days/year). This describes how often a person is likely to be exposed to the contaminated medium over the course of a typical year.

ED = Exposure duration (years). This describes how long a person is likely to be exposed to the contaminated medium during their lifetime.

EV = Event frequency (events/day). This describes the number of times per day a person comes in contact with a contaminant in soil.

SA = Surface area (cm^2). This describes the amount of skin exposed to the contaminated media.

BW = Body weight of the exposed person (kg).

AT = Averaging time (days). This term specifies the length of time over which the average dose is calculated.

For contaminants in soil, DA_{event} is estimated as follows:

$$DA_{event} = C_{soil} \cdot CF_s \cdot DAF \cdot ABS_d$$

where:

C_{soil} = Chemical concentration in soil (mg of chemical per kg of soil).

CF_s = Conversion factor for soil (10^{-6} kg/mg).

DAF = Dermal adherence factor (mg of soil per square centimeter of skin surface area per event). This describes the amount of soil that adheres to the skin per unit of surface area.

ABS_d = Dermal absorption fraction (unitless). This value is chemical-specific and represents the contribution of absorption of a chemical across a person's skin from soil to the systemic dose.

For mathematical convenience, the general equation for calculating DAD can be written as:

Soil: $DAD = C_{soil} \cdot ABS_d \cdot HIF_{soil}$

where:

$HIF_{soil} = (SA \cdot DAF \cdot EF \cdot ED \cdot EV \cdot CF_s) / (BW \cdot AT)$

The units of HIF are kg/kg-day for soil.

<u>Inhalation Exposures</u>

Inhalation exposures are evaluated in accordance with the inhalation dosimetry methodology presented in USEPA (2009b).

In accordance with USEPA (2009b), the human intake equation does not include an inhalation rate (m^3/day) or body weight because the amount of the chemical that reaches the target site is not a simple function of these factors. Instead, the interaction of the inhaled contaminant with the respiratory tract is affected by factors such as species-specific relationships of exposure concentrations to deposited/delivered doses and physiochemical characteristics of the inhaled contaminant (USEPA 2009b). Therefore, the inhaled exposure concentration (EC) for chronic exposures is calculated as:

$EC = C \cdot (ET \cdot EF \cdot ED / AT)$

where:

EC = Exposure Concentration ($\mu g/m^3$). This is the time-weighted concentration based on the characteristics of the exposure scenario being evaluated.

C = Concentration of the chemical in air ($\mu g/m^3$) to which the person is exposed.

ET = Exposure time (hours/day). This describes how long a person is likely to be exposed to the contaminated medium over the course of a day.

EF = Exposure frequency (days/year). This describes how often a person is likely to be exposed to the contaminated medium over the course of a year.

ED = Exposure duration (years). This describes how long a person is likely to be exposed to the contaminated medium during their lifetime.

AT = Averaging time (hours). This term specifies the length of time over which the time-weighted average concentration is calculated.

For mathematical convenience, the general equation for exposure concentration can be written as:

$$EC = C \cdot TWF$$

where:

TWF = Time-Weighting Factor (unitless). The value of TWF is given by:

$$TWF = (ET \cdot EF \cdot ED / AT)$$

As described above, when the same individual may be exposed beginning as a child and extending into adulthood, exposure was calculated as the TWA lifetime exposure for evaluating non-cancer and cancer risks.

3.4.2 Human Exposure Parameters

For every exposure pathway of potential concern, it is expected that there will be differences between different individuals in the level of exposure at a specific location due to differences in intake rates, body weights, exposure frequencies, and exposure durations. Thus, there is normally a wide range of average daily intakes between different members of an exposed population. Because of this, all daily intake calculations must specify what part of the range of doses is being estimated. Typically, attention is focused on intakes that are “average” or are otherwise near the central portion of the range, and on intakes that are near the upper end of the range (e.g., the 95th percentile). These two exposure estimates are referred to as Central Tendency Exposure (CTE) and RME, respectively.

Tables 3-13 to 3-19 list the CTE and RME exposure parameters and resultant HIF values used in this assessment for each receptor population. Most of the values are based on USEPA default guidelines. Other values were informed by Site information or professional judgment.

3.4.3 Exposure Areas

An exposure point (also referred to as an exposure unit or exposure area) is an area where a receptor may be exposed to one or more environmental media. In general, receptors are assumed to move about at random within an exposure area.

Soil

For the purposes of this assessment, the OU3 upland area and the OU3 floodplain area were evaluated separately given the differences in historical land use, and in hypothetical future land use. In both the upland and floodplain areas, exposure units (EUs) were defined as a geographic area of an assumed size identified based on random grid assignment. In concept, this assumes that a receptor is expected to contact all locations within a grid equally over their exposure duration (26 or 70 years).

Upland

The OU3 upland area was subdivided into 20-acre grids as shown in Figure 2-4. Each 20-acre area is assumed to represent the maximum area within which a hypothetical future resident or worker may be exposed at random over their entire exposure duration. Thus, each 20-acre grid represents an individual exposure area.

Floodplain

The OU3 floodplain area was subdivided into 100-acre grids as shown in Figure 2-5. Each 100-acre area is assumed to represent the maximum area within which a recreational visitor may be exposed at random over their entire exposure duration. Thus, each 100-acre grid represents an individual exposure area.

Groundwater

When groundwater is used for drinking water, exposure evaluation is often performed on a well-by-well basis. This is because wells in different areas and screened at different depths may draw water with differing levels of contamination. Table 3-20 summarizes the groundwater samples collected per well for which identified COPC concentrations were measured. As shown in the table, there are insufficient numbers of samples (1 or 2 samples) with data to support evaluation on an individual well basis. Figure 3-3 graphs total manganese concentrations as a function of well location in the OU3 upland area. As shown, there is no apparent spatial pattern in concentration data. Thus, for the purposes of this assessment, the groundwater well data were grouped into a single exposure unit (EU) for evaluating exposures to hypothetical future residents and commercial/industrial workers ingesting groundwater as drinking water. For evaluation of combined exposure from OU3 upland surface soil and groundwater by these receptors, groundwater data were evaluated by soil grid.

3.4.4 Exposure Point Concentrations

Based on the assumption of random exposure over an exposure area, risk from a contaminant within an exposure area is related to the arithmetic mean concentration of that contaminant averaged over the entire exposure area.

<u>Soil</u>

As described above, surface soil data have been collected at this Site over the course of four years during three separate sampling events (2014, 2015 and 2017). Surface soil sampling conducted in 2014 and 2015 involved the collection of 5-point composites collected over a 1-square meter area (2014 sampling event) or over an area of 1 to 3-meter radius (2015 sampling event) following a biased sampling approach (sampling locations selected based on Site knowledge to identify areas of most concern). During the most recent sampling event in 2017, one 20-point composite surface soil sample was collected from those EUs within OU3 where data were lacking (i.e., fewer than two 5-point composite samples). The 20-point composite sample was comprised of 20 grab samples collected across the entire EU. This sampling approach is recommended by the USEPA because it is designed to provide a representative sample of the average concentration in the exposure unit (ITRC 2012). The surface soil data available for each exposure area grid (see Figures 2-4 and 2-5) falls into one of the following categories:

a) One 20-point composite sample only
b) One 20-point composite plus one or more 5-point composites
c) One or more 5-point composites

As described in USEPA (1992), the USEPA recommends that a 95% upper confidence limit (95UCL) of the arithmetic mean at each EU be used as the exposure point concentration (EPC) when calculating exposure and risk at that location. This is because the true arithmetic mean concentration cannot be calculated with certainty from a limited number of measurements.

However, OU3 soil data are available based on unequally weighted samples which limits characterization of the EPC using a 95UCL. The larger the number of grab samples used to create the composite sample, the lower the variability around the mean estimate. Additionally, the larger the area within the EU that a composite sample is based, the more representative of the mean exposure across the entire EU. Therefore, if available, a 20-point composite comprised of grabs collected across the whole of the EU provides a representative estimate of the mean. Whereas, a mean derived based on a localized 5-point composite is more uncertain, and the variability around the mean could be much greater. Thus, for this assessment, the available data for each EU will be used to represent the best estimate of the mean for each of the data categories listed above as follows:

Category a. For EUs where a single 20-point composite sample is available, this concentration was used as the EPC, since this is the only data point available.

Category b. For EUs in Category b, the EPC was based on weighting the data by the number of grab samples collected. For example, if for a given contaminant, the concentration in a 5-point composite sample collected from an EU was 5 mg/kg and the concentration in a 20-point composite sample was 3 mg/kg, the EPC would be calculated as:

$$(5 \text{ mg/kg} * 5) + (3 \text{ mg/kg} * 20) / (20 + 5) = 3.4 \text{ mg/kg}$$

This approach effectively places more confidence in the value of the 20-point composite because this sample provides an unbiased estimate of the mean concentration over the entire exposure area, while the 5-point composite samples represent only a small area of the exposure unit and may tend to be biased high. Data in some EUs include a 20-point composite and more than one 5-point composite. In this case, the concentrations of the 5-point composites were averaged prior to calculating the weighted EPC.

Category c. For EUs where two or more 5-point composite samples are available and there is no 20-point composite, the average concentration was used as the EPC. If the 5-point composites were unbiased, use of the maximum value would normally be preferred to help ensure that the EPC does not underestimate the true mean. However, since all of the 5-point composites are likely to be biased high, a simple average of the values is likely to be adequately conservative, and use of the maximum value would likely result in a substantial overestimate of the true mean.

Within the center of the OU3 upland area (i.e., grids 50-66), a 30-point composite sample was collected from within a historically defined basin/pond (e.g., aeration basin II, settling pond 8) where previously collected data were lacking. This sampling was primarily conducted to support the ecological risk assessment for the Site, but these data also fill data gaps for EUs with little to no other data. Concentrations based on 30-point composite samples were used in calculating EPCs similar to data based on 20-point composite samples.

Grab samples were also collected from boreholes at depth in the subsurface. For evaluating exposures to hypothetical future construction workers, data for both surface and subsurface soils were combined into a single dataset. The same approach outlined above was followed for calculating grid-specific EPCs, except a grid-specific weighted concentration accounted for an additional sample result based on the average across subsurface samples if available.

Tables 3-21 and 3-22 summarize the available soil data by grid for the upland and floodplain areas, respectively.

Airborne Dust from Construction Activities

No Site-specific data are available on particulate levels in air generated during mechanical disturbances with construction equipment. In the absence of measured values, the concentration of contaminants in air that would occur during hypothetical future construction activities was estimated using the following equation:

$$C(air) = C(soil) / PEF$$

where:

C(air) = concentration of contaminant in air (mg/m^3)
C(soil) = concentration of contaminant in soil (mg/kg)
PEF = particulate emission factor (m^3 of air per kg of soil) for a construction scenario

The PEF assumed for evaluating exposures related to construction activities is assumed to be 4.4E+08 m^3/kg. This value is consistent with the recommendation in USEPA (2002) that accounts for the mass of dust emitted by traffic on unpaved roads during construction activities and the mass of dust emitted by wind erosion. Because inhalation toxicity values are based on an assumed continuous exposure over a specified exposure duration, when exposure is less than continuous, the value of the exposure concentration (EC) used to quantify risk is calculated from C(air) as follows:

$$EC\ (\text{non-cancer effects}) = C(air) \cdot ET/24 \cdot EF/365$$

$$EC(\text{cancer effects}) = C(air) \cdot ET/24 \cdot EF/365 \cdot ED/70$$

where:

ET = exposure time (hrs/day)
EF = exposure frequency (days/yr)
ED = exposure duration (years)

Groundwater

The mathematical approach that is most appropriate for computing the 95UCL of a data set depends on a number of factors, including the number of data points available, the shape of the distribution of the values, and the degree of censoring (USEPA 2002). Because of the complexity of this process, the USEPA Technical Support Center has developed a software application called ProUCL v5.0 (USEPA 2013a) to assist in the estimation of 95UCL values. ProUCL calculates 95UCLs for a data set using several different strategies and recommends which 95UCL is considered preferable based on the properties of the data set.

As noted above, wells in the OU3 upland area were grouped into a single exposure unit. All measured values for each COPC were provided to ProUCL for evaluation. The EPC was based on the 95UCL recommended by ProUCL.

For evaluation of combined exposure from soil and groundwater, maximum groundwater concentrations within each soil grid were used as the EPC.

Fish

All data from the MTFWP fish fillet samples were combined for use in calculating the EPC values for fish ingestion using ProUCL to generate a 95UCL.

3.4.5 Relative Bioavailability of Dioxins and Metals in Soil

An accurate assessment of human exposure to ingested chemicals requires knowledge of the amount of chemical absorbed from the gastrointestinal tract into the body from Site media compared to the amount of absorption that occurred in the toxicity studies used to derive the toxicity factors. This ratio (amount absorbed from Site media compared to the amount absorbed in toxicity tests) is referred to as Relative Bioavailability (RBA).

The oral RBA value for dioxins in soil is assumed to be 100% in accordance with USEPA (USEPA 2010b). In the absence of data on the oral RBA values for antimony, barium cadmium, and mercury in soil, an RBA of 100% was also assumed for these COPCs. These are considered to be conservative assumptions.

3.4.6 Cooking Loss in Fish Tissue

For some contaminants, cooking can reduce exposure intake. USEPA (2000) indicates that contaminant losses from cooking can be significant for organics, such as dioxins and PCBs. Cooking loss is a function of many variables including cooking method, cooking duration, cooking temperature, preparation techniques, lipid content of fish, and fish species. Assumed cooking losses for Aroclor-1254 and TEQ were 30% and 54%, respectively. These assumptions were based on the data presented in USEPA (2000) that identified an average cooking loss for PCBs of 30%, and a median cooking loss of 54% for TCDD (ranged from 37 to 80%).

4.0 TOXICITY ASSESSMENT

4.1 Toxicity Overview

The basic objective of a toxicity assessment is to identify what adverse health effects a chemical may cause, and how the appearance of these adverse effects depends on exposure level. In addition, the toxic effects of a chemical frequently depend on the route of exposure (oral, inhalation, dermal) and the duration of exposure (subchronic, chronic, or lifetime). Thus, a full description of the toxic effects of a chemical includes a listing of what adverse health effects the chemical may cause, and how the occurrence of these effects depends upon dose, route, and duration of exposure.

The toxicity assessment process is usually divided into two parts: the first characterizes and quantifies the non-cancer effects of the chemical, while the second addresses the cancer effects of the chemical. This two-part approach is employed because there are typically major differences in the time-course of action and the shape of the dose-response curve for cancer and non-cancer effects. The relationship between the dose of the chemical administered or received and the incidence of adverse health effects in the exposed population forms the basis for a quantitative dose-response relationship. Toxicity values (e.g, reference doses and slope factors) are derived based on such dose-response relationships.

4.1.1 Non-cancer Effects

Essentially all chemicals can cause adverse health effects if given at a high enough dose. However, when the dose is sufficiently low, typically adverse non-cancer effects are not observed. Thus, in characterizing the non-cancer effects of a chemical, the key parameter is the threshold dose at which an adverse effect first becomes evident. Doses below the threshold are considered to be safe, while doses above the threshold are likely to cause an effect.

The threshold dose is typically estimated from toxicological data (derived from studies of humans and/or animals) by finding the highest dose that does not produce an observable adverse effect, and the lowest dose which does produce an effect. These are referred to as the "No-observed-adverse-effect-level" (NOAEL) and the "Lowest-observed-adverse-effect-level" (LOAEL), respectively. The threshold is presumed to lie in the interval between the NOAEL and the LOAEL. However, in order to be conservative (health protective), non-cancer risk evaluations are not based directly on the threshold exposure level, but on a value referred to as the Reference Dose (RfD) for oral exposures or Reference Concentration (RfC) for inhalation exposures. The RfD and RfC are estimates (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

The RfD and RfC values are derived from a NOAEL (or a LOAEL if a reliable NOAEL is not available) by dividing by an "uncertainty factor". If the data are from studies in humans, and if the observations are considered to be very reliable, the uncertainty factor may be as small as 1.0. However, the uncertainty factor is normally at least 10, and can be much higher if the data are limited. The effect of dividing the NOAEL or the LOAEL by an uncertainty factor is to ensure that the RfD or RfC is not higher than the threshold level for adverse effects. Thus, there is always a "margin of safety" built into an RfD and RfC values, and doses equal to or less than the RfD or RfC are nearly certain to be without any risk of adverse effect. Doses higher than the RfD or RfC may carry some risk, but because of the margin of safety, a dose above the RfD or RfC does not mean that an effect will necessarily occur.

4.1.2 Cancer Effects

For cancer effects, the toxicity assessment process has two components. The first is a qualitative evaluation of the weight of evidence (WOE) that the chemical does or does not cause cancer in humans. Previously, this evaluation was performed by the EPA using the system summarized below:

WOE	Meaning	Description
A	Known human carcinogen	Sufficient evidence of cancer in humans.
B1	Probable human carcinogen	Suggestive evidence of cancer incidence in humans.
B2	Probable human carcinogen	Sufficient evidence of cancer in animals, but lack of data or insufficient data in humans.
C	Possible human carcinogen	Suggestive evidence of carcinogenicity in animals.
D	Cannot be evaluated	No evidence or inadequate evidence of cancer in animals or humans.
E	Not carcinogenic to humans	Strong evidence that it does not cause cancer in humans.

More recently, EPA has developed a revised classification system for characterizing the weight of evidence for carcinogens (USEPA 2005a). However, this system has not yet been implemented for a number of chemicals, so the older classification scheme is retained for use in this assessment.

For chemicals which are classified in Group A, B1, B2, or C, the second part of the toxicity assessment is to describe the carcinogenic potency of the chemical. This is done by quantifying how the number of cancers observed in exposed animals or humans increases as the dose increases. Typically, it is assumed that the dose response curve for cancer has no threshold, arising from the origin and increasing linearly until high doses are reached. Thus, the most convenient descriptor of cancer potency is the slope of the dose-response curve at low doses (where the slope is still linear). This is referred to as the Slope Factor (SF), which has dimensions of risk of cancer per unit dose.

Estimating the cancer SF is often complicated by the fact that observable increases in cancer incidence usually occur only at relatively high doses, frequently in the part of the dose-response curve that is no longer linear. Thus, it is necessary to use mathematical models to extrapolate from the observed high dose data to the desired (but un-measurable) slope at low dose. In order to account for the uncertainty in this extrapolation process, USEPA typically chooses to employ the 95 percent upper confidence limit of the slope as the SF. That is, there is a 95 percent probability that the true cancer potency is lower than the value chosen for the SF. This approach ensures that there is a margin of safety in cancer as well as non-cancer risk estimates.

For inhalation exposures, cancer risk is characterized by an inhalation Unit Risk (UR) value. This value represents the upper-bound excess lifetime cancer risk estimated to result from continuous lifetime exposure to a chemical at a concentration of 1 $\mu g/m^3$ in air.

4.2 Human Toxicity Values

In 2003, USEPA's Superfund program revised its hierarchy of human health toxicity values into the following three-tiered approach:

1. USEPA's Integrated Risk Information System (IRIS)[5].

2. The Provisional Peer Reviewed Toxicity Values (PPRTVs) derived by USEPA's Superfund Health Risk Technical Support Center (STSC)[6].

3. Other toxicity values including additional USEPA and non-USEPA sources of toxicity information. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer reviewed.

Table 4-1 presents the toxicity values used for evaluating human health risks from COPCs at the OU3 Site. These toxicity values are discussed in further detail below.

[5] https://www.epa.gov/iris
[6] https://hhpprtv.ornl.gov/

Organics

Dioxin

In February 2012, USEPA released an IRIS RfD for TCDD of 0.7 pg/kg-day (7E-10 mg/kg-day). This value is based on two epidemiological studies reporting reproductive effects in populations exposed to TCDD from an industrial accident. This RfD was derived based on an adjusted LOAEL of 20 pg/kg-day and an uncertainty factor of 30 (10 for extrapolation from a LOAEL to a NOAEL and 3 for human-to-human variability). No Tier 1 cancer toxicity criteria are available for TCDD. Currently, the USEPA recommends evaluating human health risks from exposures to dioxins using the IRIS RfD (USEPA 2017c). USEPA considers the RfD to be protective of both non-cancer and cancer effects and anticipates that dioxin cleanup levels based on the RfD to be within the cancer risk range.

There is no USEPA IRIS RfC or IRIS UR for TCDD. The USEPA RSL Tables (USEPA 2017a) provide dioxin soil screening levels for the inhalation pathway based on the California EPA RfC and UR values. However, inhalation risk based on particulate emissions from soil, estimated using the California EPA RfC value, shows that the contribution of the inhalation pathway compared to the ingestion pathway is well below 1% (USEPA 2013b).

PCBs

In October 1994, USEPA published an IRIS RfD for Aroclor-1254 of 2E-5 mg/kg-day (USEPA 1994). This value is based on immune, dermal and ocular effects observed in a series of monkey studies. This RfD was derived based on a LOAEL of 0.005 mg/kg-day and an uncertainty factor of 300. PCBs are classified as probably human carcinogens under IRIS. There is no RfD value for Aroclor-1260. The cancer potency of PCB mixtures is assessed using the IRIS SF of 2 $(mg/kg\text{-}day)^{-1}$ for high risk PCBs.

Inorganics

Inorganic COPCs may exist in multiple forms or valence states within the environment. In general, inorganics exist primarily as salts within the environment. Therefore, toxicity values used in this assessment were based on the salt forms when available. The basis of the toxicity values used in this assessment for inorganic COPCs is discussed in brief below.

Antimony

Antimony concentrations in soil were reported based on total antimony. The IRIS RfD of 4.0E-04 mg/kg-day is based on a chronic drinking water study in rats using potassium antimony tartrate (USEPA 1987). This value is based on a LOAEL of 0.35 mg/kg-day for effects on longevity, blood glucose and cholesterol levels adjusted by an uncertainty factor of 1,000.

Arsenic

Arsenic concentrations in groundwater were reported based on total arsenic. The IRIS RfD of 3E-04 mg/kg-day and SF of 1.5E+00 $(mg/kg\text{-}day)^{-1}$ are based on inorganic arsenic. Long-term exposure to high levels of inorganic arsenic in drinking water has been associated with skin disorders and increased risk for diabetes, high blood pressure, and several types of cancer.

Barium

The IRIS RfD for barium is 2.0E-01 mg/kg-day (USEPA 2005b). This value is based on a 2-year drinking water study in mice that observed nephropathy following exposure to barium chloride. Dose-response data were modeled to derive a 95% lower confidence limit on the maximum likelihood estimate of the dose corresponding to a 5% extra risk ($BMDL_{05}$) of 63 mg/kg-day. This value was adjusted by an uncertainty factor of 300 to calculate the RfD.

Cadmium

The IRIS assessment for cadmium reports two RfD values, one for exposures to cadmium in water, and one for exposures to cadmium in food based on significant proteinuria observed in humans exposed orally to cadmium. The food RfD of 0.001 mg Cd/kg/day is used to evaluate oral exposures to soil.

Chromium

Chromium concentrations in groundwater were reported based on total chromium. There is no oral RfD for total chromium. However, there are IRIS RfDs for trivalent chromium (Cr(III)) and hexavalent chromium (Cr(VI)) (USEPA 1998a,b). The IRIS RfD for Cr(III) of 1.5E+00 mg/kg-day is based on an adjusted NOAEL of 1,468 mg/kg-day observed in a chronic rat feeding study that found no treatment-related adverse effects at the highest dose tested. Cr(III) potentiates the action of insulin in peripheral tissue and is essential for humans (USEPA 1998a). The IRIS RfD for Cr(VI) of 3.0E-03 mg/kg-day is based on a NOAEL of 25 mg/L observed in a 1-year drinking water study in rats that found no treatment-related adverse effects at the highest concentration tested (USEPA 1998b). The valence state of chromium in OU3 groundwater is not known. Chromium exists in the environment mainly in the trivalent form (ATSDR 2000). On this basis, the oral RfDs for Cr(III) and Cr(VI) were used to calculate an adjusted RfD based on an assumed ratio Cr(III) to Cr(VI) of 6:1 (USEPA 2017a). The adjusted oral RfD of 1.3E+00 mg/kg-day was used to evaluate groundwater exposures in this assessment.

There are no IRIS SFs for Cr(III) or Cr(VI). USEPA (1998a,b) designates both Cr(III) and Cr(VI) as Group D carcinogens (not classified as to its human carcinogenicity) by the oral route. The current IRIS assessment for Cr(VI) states "No data were located in the available literature that suggested that Cr(VI) is carcinogenic by the oral route of exposure." The USEPA RSL tables include an oral slope factor for Cr(VI) based on the Tier III California EPA oral cancer SF. However, there is uncertainty associated with this SF. Cr(VI) is currently under review by the IRIS program. External review comments received on the 2010 draft update of the Toxicological Review of Hexavalent Chromium reference data to suggest that Cr(VI) administered by the oral route may exert toxicity as a threshold carcinogen (USEPA 2011b). In this case, following the hierarchy outlined above, the IRIS RfD is selected as the Tier I toxicity value for assessing risks to chromium exposure in the interim while an updated IRIS carcinogenicity assessment is being developed. For this reason, chromium is not evaluated as an oral carcinogen.

Cobalt

There is no IRIS RfD for cobalt. However, there is a PPRTV RfD for cobalt of 3E-04 mg/kg-day (USEPA 2008). This value is based on effects on the thyroid in humans observed at a LOAEL of 1 mg/kg-day following exposure for 22 days. The PPRTV RfD was derived by adjusting this LOAEL by an uncertainty factor of 3,000.

Iron

There is no IRIS RfD for iron. However, there is a PPRTV RfD for iron of 7.0E-01 mg/kg-day (USEPA 2006). This value is based on adverse gastrointestinal effects in humans observed at a LOAEL of 60 mg/day following dietary exposures. The PPRTV RfD was based on an adjusted LOAEL calculated by adding the LOAEL for gastrointestinal effects to the estimated mean dietary intake of 11 mg/day and dividing by a reference body weight of 70 kg. This resulted in an adjusted LOAEL of 1 mg/kg-day which was used to derive the PPRTV RfD by applying an uncertainty factor of 1.5.

Manganese

Two oral RfD values are available for manganese (food, nonfood). The IRIS RfD (1.4E-01 mg/kg-day) includes manganese from all sources, including diet (USEPA 1995). This RfD is derived to be protective against central nervous system effects in humans following oral exposure, and is based on the upper range of total dietary intake (10 mg/day) as recommended in the 1989 Food and Nutrition Board National Research Council report. USEPA (1995) notes that intakes above the RfD derived from the upper range of total dietary intake are not necessarily associated with toxicity. IRIS recommends using a modifying factor of 3 when calculating risks associated with non-food sources due to a number of uncertainties, leading to an RfD of 4.7E-02 mg/kg-day. This RfD based on non-food sources was used in this assessment for groundwater.

Mercury

Mercury concentrations in soil were reported based on total mercury. There is no oral RfD for total mercury. Mercury exists primarily in salt forms within the environment. There is an IRIS RfD for mercuric chloride (and other mercury salts) of 3.0E-04 mg/kg-day. This RfD was used to evaluate soil exposures in this assessment. There is no RfC available for mercuric chloride.

The predominant form of mercury that accumulates in fish tissue is methylmercury (ATSDR 1999). Methylmercury is the most toxic form of mercury. The IRIS oral RfD of 1.0E-04 mg/kg-day was used to evaluate exposures to mercury in fish tissues.

Vanadium

The oral RfD for vanadium of 5.0E-03 mg/kg-day used in this assessment for evaluating exposures to groundwater is derived from the IRIS oral RfD for vanadium pentoxide by factoring out the molecular weight of the oxide ion (USEPA 2015b). The IRIS RfD for vanadium pentoxide of 9E-03 mg/kg-day is based on decreased hair cysteine levels in rats.

5.0 RISK CHARACTERIZATION

As outlined above, dioxins/furans, Aroclor-1254, and select inorganics were identified as COPCs at the OU3 Site. As noted in the toxicity assessment, human health risks evaluated in this assessment are those associated with non-cancer effects caused by exposures to TCDD, antimony, barium and mercury in soils, TCDD, chromium, cobalt, iron, manganese and vanadium in groundwater, and TCDD, Aroclor-1254 and mercury in fish tissues. Human health risks associated with cancer effects evaluated in this assessment are those caused by exposures to the PCBs (Aroclor-1254).

Non-cancer Effects

The potential for non-cancer effects is evaluated by comparing the estimated exposure concentration for a receptor over a specified time period to a reference threshold that represents the exposure below which it is unlikely for even sensitive populations to experience adverse health effects (USEPA 1989). This ratio of exposure to toxicity is called a Hazard Quotient (HQ). When a receptor is exposed to a COPC by more than one route, or is exposed to more than one COPC, these values may be summed to yield a hazard Index (HI). If the HQ or HI value is equal to or less than one, it is believed that there is no appreciable risk that non-cancer health effects will occur. If an HQ or HI exceeds one, there is some possibility that non-cancer effects may occur, although an HQ or HI above one does not indicate an effect will definitely occur. This is because of the margin of safety inherent in the derivation of all toxicity values (see Section 4). However, the larger the HQ or HI value, the more likely it is that an adverse effect may occur.

Ingestion Exposures

For most chemicals, the potential for non-cancer effects is evaluated by comparing the estimated daily intake of the chemical over a specific time period with the RfD for that chemical derived for a similar exposure period, as follows (USEPA 1989):

$$HQ = DI / RfD$$

where:

DI	=	Daily Intake (mg/kg-day)
RfD	=	Reference Dose (mg/kg-day)

Ingestion of contaminants in fish tissue also considers contaminant losses due to cooking. This is accounted for using the following equation:

$$HQ = DI \cdot 1/CL / RfD$$

where:

CL = cooking loss (as a fraction)

Dermal Exposures

For most chemicals, the potential for non-cancer effects following dermal exposure is evaluated by comparing the estimated absorbed dose of the chemical over a specific time period with the absorbed RfD for that chemical derived for a similar exposure period, as follows (USEPA 1989):

$$HQ = DAD / RfD_{ABS}$$

where:

DAD = Dermal absorbed dose (mg/kg-day)
RfD_{ABS}= Absorbed Reference Dose (mg/kg-day)
$RfD_{ABS} = RfD \cdot ABS_{GI}$

The ABS_{GI} term is unitless, chemical-specific and is applied to the available oral toxicity value to account for the absorption efficiency of an administered dose across the gastrointestinal tract and into the bloodstream.

Inhalation Exposures

As per the CSM (Figure 3-1), inhalation exposures were only evaluated for hypothetical future construction workers exposed to OU3 upland soils down to a depth of 10 feet during construction activities. As described above, there is no RfC available for evaluating non-cancer effects from inhalation exposures to antimony and mercury (evaluated as mercuric chloride). For TEQ, there is no Tier I RfC available, and exposures to dioxins in soils via the inhalation pathway are considered minor by comparison to the ingestion pathway (USEPA 2013b). Thus, non-cancer hazards associated with inhalation exposures of soil particulates by construction workers were not quantified.

Cancer Effects

The excess risk of cancer from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer because of that exposure. Excess cancer risks are summed across all carcinogenic chemicals and all exposure pathways that contribute to exposure of an individual in a given population. The level of total cancer risk that is of concern is a matter of personal, community, and regulatory judgment. In general, the USEPA considers excess cancer risks that are below 1E-06 to be so small as to be negligible, and risks above 1E-04 to be sufficiently large that some sort of remediation is desirable[7]. Excess cancer risks that range between 1E-04 and 1E-06 are generally considered to be within USEPA health guidelines (USEPA 1991b), although this is evaluated on a case by case basis, and USEPA may determine that risks lower than 1E-04 are not sufficiently protective and warrant remedial action. Furthermore, the MDEQ allowable cancer risk level is 1E-05, which will be considered as part of the risk management decisions associated with this Site. Cancer risks for each chemical are calculated as described below.

Aside from 2,3,7,8-TCDD, the COPCs identified in OU3 soils are considered non-carcinogenic. As described in the toxicity assessment, use of the RfD for 2,3,7,8-TCDD to evaluate non-cancer hazards associated with exposures to dioxins/furans is considered protective of cancer risks. Thus, none of the COPCs identified in OU3 soils or groundwater were evaluated for cancer effects. Therefore, cancer risks were only evaluated for the ingestion of Aroclor-1254 in fish tissue.

Ingestion Exposures

The excess risk of cancer from ingestion exposure to a chemical is calculated as follows (USEPA 1989):

$$\text{Excess Cancer Risk} = 1 - \exp(-DI_L \cdot SF)$$

where:

DI_L = Daily Intake, averaged over a lifetime (mg/kg-day)
SF = Slope Factor $(\text{mg/kg-day})^{-1}$

[7] Note that excess cancer risk can be expressed in several formats. A cancer risk expressed in a scientific notation format as 1E-06 is equivalent to 1 in 1,000,000 or 10^{-6}. Similarly, a cancer risk of 1E-04 is equivalent to 1 in 10,000or 10^{-4}. For the purposes of this document, all cancer risks are presented in a scientific notation format (*i.e.,* 1E-06).

In most cases (except when the product of $DI_L \cdot SF$ is larger than about 0.01), this equation may be approximated by the following:

$$\text{Excess Cancer Risk} = DI_L \cdot SF$$

When calculating cancer risks from ingesting fish, cooking loss is accounted for as:

$$\text{Excess Cancer Risk} = DI_L \cdot 1/CL \cdot SF$$

5.1 Risks from Exposures to COPCs in OU3 Soils

Detailed calculations of exposure and risk are presented in Appendix D. Risk estimates associated with exposures to COPCs in OU3 soils are summarized in Tables 5-1 and 5-2. Non-cancer hazards that exceed the USEPA guidelines of HQ ≤1E+00 are shaded pink. Inspection of Tables 5-1 and 5-2 reveal the following main conclusions.

Residents

Non-cancer hazards and cancer risks to hypothetical future residents within the OU3 upland area from incidental ingestion of and dermal contact with soil appear to be within usual USEPA guidelines for all EUs except grid 74. The non-cancer HI for an RME resident exposed to surface soil within grid 74 is slightly elevated above the USEPA level of concern (HQ>1) at 2E+00. This elevated risk is due to incidental ingestion of TEQ (see Table 5-3).

Workers

Non-cancer hazards and cancer risks to hypothetical future commercial/industrial workers and hypothetical future construction workers within the OU3 upland area from incidental ingestion of and dermal contact with upland soils appear to be within usual USEPA guidelines for all EUs.

Recreational Visitors

Non-cancer hazards and cancer risks to current and hypothetical future recreational visitors from incidental ingestion of and dermal contact with surface soil appear to be within usual USEPA guidelines for all EUs, for both the upland and floodplain areas.

5.2 Risks from Exposures to COPCs in OU3 Groundwater Wells

Detailed calculations of exposure and risk are presented in Appendix D. Risk estimates associated with exposures to COPCs in groundwater wells within the OU3 upland area are summarized in Table 5-4. Non-cancer hazards that exceed the USEPA guidelines of HQ ≤1E+00 and cancer risk ≤ 1E-04 are shaded. Inspection of Table 5-4 reveals the following main conclusions.

Residents

Non-cancer hazards for hypothetical future residents within the OU3 upland area from ingestion of COPCs in groundwater are elevated above a level of concern for both the CTE and RME receptors (5E+00 and 1E+01, respectively). This elevated risk is primarily due to manganese and cobalt, with some additional contribution from arsenic. Cancer risk for the hypothetical future resident based on arsenic in groundwater is 4E-05 and 2E-04 for the CTE and RME receptors, respectively.

To further support risk management decisions, Figure 5-1 presents a map of non-cancer HQs for manganese in individual groundwater wells. Similarly, Figure 5-2 presents a map of cancer risks for arsenic in individual wells. These HQs and cancer risks are calculated based on exposure by an RME resident assuming the max detected concentrations as the EPCs in each well. Thus, these non-cancer hazard and cancer risk estimates likely overestimate actual risks. As seen, HQ values based on manganese exposure exceed 1E+00 in 22 wells. Cancer risks based on exposure to arsenic exceed 1E-04 in nine wells. These calculations are included in Appendix D.

Workers

Non-cancer hazards for hypothetical future commercial/industrial workers within the OU3 upland area from ingestion of COPCs in groundwater are elevated above a level of concern for both the CTE and RME receptors (2E+00 and 4E+00, respectively). This elevated risk is primarily due to manganese, with some additional contribution from cobalt. Cancer risk for the hypothetical future commercial/industrial workers within the OU3 upland area are within usual USEPA guidelines.

5.3 Combined Risks from Exposures to Soil and Groundwater

In general, exposures by hypothetical future residents and workers to COPCs in OU3 upland soils are below a level of concern except within one EU (grid 74). If groundwater were used for drinking, non-cancer hazards from exposure to manganese would be substantial. Combined non-cancer hazards associated with exposures to COPCs in OU3 upland surface soil and manganese in groundwater are summarized in Table 5-5. As shown, the additional exposure to hypothetical future residents from incidental ingestion of and dermal contact with surface soil does not appreciably increase the total risk when combined with exposure to manganese in groundwater. Non-cancer HIs that exceed USEPA guideline (HQ≤1E+00) are due to consumption of manganese in groundwater.

5.4 Risks from Fish Ingestion

Recreational Fishers

As shown in Table 5-6, non-cancer hazards and cancer risks to recreational fishers ingesting TEQ and Aroclor-1254 in fish caught from the CFR just downstream of the Site appear to be within usual USEPA guidelines (HQ≤1E+00, cancer risk ≤ 1E-04).

Tribal Fishers

As shown in Table 5-7, non-cancer hazards to tribal fishers ingesting TEQ and Aroclor-1254 in fish caught from the CFR just downstream of the Site are above a level of concern for the RME receptor (3E+00). The primary risk driver is Aroclore-1254. Non-cancer hazards to the CTE tribal fisher and cancer risks to both CTE and RME tribal fishers ingesting Aroclor-1254 in fish appear to be within usual USEPA guidelines (HQ≤1E+00, cancer risk ≤ 1E-04).

6.0 UNCERTAINTY ASSESSMENT

Quantitative evaluation of the risks to humans from environmental contamination is frequently limited by uncertainty regarding a number of key data items, including concentration levels in the environment, the true level of human contact with contaminated media, and the true dose-response curves for non-cancer and cancer effects in humans. This uncertainty is usually addressed by making assumptions or estimates for uncertain parameters based on whatever limited data are available. Because of these assumptions and estimates, the results of risk calculations are themselves uncertain, and it is important for risk managers and the public to keep this in mind when interpreting the results of a risk assessment.

The main sources of uncertainty in the exposure assessment and risk characterization presented in this assessment include uncertainties from exposure pathways not evaluated, as well as uncertainties in the exposure parameters and toxicity values used to derive screening levels as described in further detail below.

6.1 Uncertainties in Exposure Assessment

6.1.1 Uncertainties in Data

Surface Water and Sediment

Sediment and surface water samples collected from within O’Keefe Creek are limited to two bed sediment samples and one surface water sample, although the surface water sample and one of the sediment samples were collected from a location within O’Keefe Creek upstream of the Site near Interstate-90. Sediment and surface water samples collected from Lavalle Creek are limited to three bed sediment samples and one surface water sample. Sediment and surface water samples collected from within the CFR are limited to six bed sediment samples adjacent to (n=3) and downstream (n=3) of the Site, three flood fringe sediment samples downstream of the Site, and three surface water samples adjacent to (n=1) and downstream (n=3) of the Site. Additional sediment and surface water data were collected from upstream locations as shown in Figure 2-8. The limited nature of the sediment and surface water data collected in the Creeks, and collected from the CFR adjacent to and downstream of the Site presents some uncertainty in the risk estimates, although the magnitude of this uncertainty is not known. Additionally, all of these samples were collected at a single time point. Because sediment and surface water concentrations may vary over time, samples collected at a single time point may not provide a clear understanding of the range of concentrations that may occur over time. This HHRA will be amended in the future to include the evaluation of any additional sediment and surface water data collected from Lavalle and O’Keefe Creeks and the CFR as part of ongoing RI activities.

Fish

The MTFWP fish tissue data do not appear to have undergone third-party validation consistent with data quality specifications in the project QAPP (NewFields 2015). However, based on initial review of the raw data files, it is not likely that such a validation effort would deem these data inadequate for use in this risk assessment. It is possible that such validation may result in some results being qualified differently, but it is not anticipated to result in significant impact on risk estimates.

Additionally, the MTFWP are limited to fish caught during one sampling event at locations just downstream of the Site. The limited nature of these data presents some uncertainty in the risk estimates, although the magnitude of this uncertainty is not known. This HHRA will be amended in the future to include the evaluation of any additional and relevant fish data that may become available.

6.1.2 Uncertainties in Exposure Pathways Not Evaluated

Omission of exposure pathways believed to be minor compared to one or more other pathways that were evaluated may result in a small underestimation of exposure and risk, but the magnitude of this underestimation is not expected to be significant.

With regard to exposure by hypothetical future residents from ingestion of home-grown fruits and vegetables, OU3 soil data indicate concentrations of dioxins/furans and metals in upland soils are generally comparable to background and/or present at levels below the USEPA's unacceptable risk criteria. Data on dioxin and metal uptake by plants (USEPA 1999; Life Systems 1995) and risk evaluations of exposures to metals in plants (Life Systems 1995, Weston 1997) all indicate that this is a minor exposure pathway by comparison to ingestion of soil. Based on this, it is concluded that omission of the home grown produce pathway is not likely to result in a significant underestimation of exposure and risk from dioxin/furan and metal contaminants in soil.

6.1.3 Uncertainties from Chemicals Not Evaluated

As discussed above, quantitative risk estimates are derived only for COPCs. Contaminants that were measured in Site samples but excluded as a COPC may contribute a small amount of added risk, but the contribution is expected to be so small that this is not a source of significant uncertainty. The same is expected of contaminants that could not be evaluated as COPCs due to the lack of a risk-based screening level (no toxicity value), or contaminants qualified as not detected but whose MDL is greater than the available RBC. Although these contaminants are flagged as sources of uncertainty in the COPC screens, their relative contribution to the total risk is expected to be minor.

In addition, due to the nature of past sampling at the Site, there are more data on dissolved inorganic concentrations than there are data on total recoverable inorganic concentrations (i.e., groundwater samples collected in 2015 and 2016 were analyzed for dissolved inorganic concentrations, but not for total inorganic concentrations). For some inorganics, the maximum detected concentration observed in groundwater within the OU3 upland based on the dissolved fraction in a sample that was not analyzed for the total recoverable fraction is higher than the maximum detected concentration based on the total recoverable fraction used in the COPC screen. On this basis, the uncertainty associated with the lack of total recoverable data for these samples is evaluated using the available dissolved concentrations. If the COPC screen presented in Section 3 is reconstructed based on using the groundwater data for the dissolved inorganic concentrations, the same COPCs are identified. Non-cancer hazards for hypothetical future residents are 5E+00 and 1E+01 for the CTE and RME receptors, respectively. This elevated risk is primarily due to manganese and arsenic. Cancer risk for a hypothetical future resident ingesting arsenic in groundwater is 3E-04. Non-cancer HI for a RME hypothetical future commercial/industrial worker is 3E+00. In this case, the primary risk driver is manganese. Cancer risk for a hypothetical future commercial/industrial worker ingesting arsenic in groundwater is 1E-04.

<u>Uncertainties in Exposure Point Concentrations</u>

In all exposure calculations, the desired input parameter is the true mean concentration of a contaminant within a medium, averaged over the area where random exposure occurs. However, because the true mean cannot be calculated based on a limited set of measurements, the USEPA (1989, 1992) recommends that the exposure estimate be based on the 95UCL. The groundwater EPCs were based on 95UCLs where appropriate. When data are plentiful and inter-sample variability is not large, the UCL may be only slightly higher than the mean of the data. However, when data are sparse or are highly variable, the 95UCL may be substantially greater than the mean of the available data.

95UCL values were not calculated for soil due to the mix of sample types and limited sample sizes. In cases where a 20-point composite or 30-point composite was collected over the entire exposure area, variability around the mean is characterized better than within a 5-point composite. Without additional data it is uncertain if the use of a single 20-point composite may overestimate or underestimate the true mean. In cases where additional data from localized samples (5-point composites collected over a small area, or grab samples) collected through biased sampling at areas identified as being of environmental concern, the weighted EPC is likely biased slightly high.

Uncertainties in Human Exposure Parameters

Accurate calculation of exposures requires accurate estimates of the level of human exposure that is occurring. However, many of the required exposure parameters are not known with certainty and must be estimated from limited data or knowledge. In general, when exposure data were limited or absent, the exposure parameters were chosen in a way that was intended to be conservative. Because of this, the values selected are thought to be more likely to overestimate than underestimate actual exposure and risk.

The risk estimates presented in Table 5-7 for a tribal fisher are based on the fish consumption rates from the Shoshone-Bannock Tribe (USEPA 2016b). The USEPA considers these consumption rates to best represent inland tribes with limited access to abundant fisheries as expected within the stretch of the CFR included in OU3. However, in the absence of tribe-specific fish consumption data, it is uncertain how representative the Shoshone-Bannock fish consumption rates are for the CSKT. If similar fish consumption rates based on the Nez Perce Tribe (USEPA 2016c) were used instead (mean of 98.4 g/day and 95th percentile of 345 g/day), non-cancer hazards from consuming fish caught in the CFR exceed 1 for both the CTE and RME tribal fisher (3E+00 and 1E+01, respectively), and the cancer risk for the CTE and RME tribal fishers are 2E-05 and 1E-04.

Uncertainties in Chemical Absorption (RBA)

The risk from an ingested chemical depends on how much of the ingested chemical is absorbed from the gastrointestinal tract into the body. Currently available information suggests that RBA of dioxin in soils can be expected to be less than 100%, but available estimates of soil dioxin RBA are not adequate to derive an alternative to assuming an RBA of 1.0. Use of this default assumption is likely to overestimate the true risk with the magnitude of the error depending on the true RBA value.

6.2 Uncertainties in Toxicity Assessment

Uncertainties in Toxicity Values

Toxicity information for many chemicals is often limited. Consequently, there are varying degrees of uncertainty associated with toxicity values (i.e., oral SF, RfD, RfC, inhalation UR). For example, uncertainties can arise from the following sources:

- Extrapolation from animal studies to humans
- Extrapolation from high dose to low dose
- Extrapolation from continuous exposure to intermittent exposure
- Limited or inconsistent toxicity studies

In general, uncertainty in toxicity factors is one of the largest sources of uncertainty in risk estimates at a site. Because of the conservative methods USEPA uses in dealing with these uncertainties, it is much more likely that the uncertainty will result in an overestimation rather than an underestimation of risk.

For manganese, toxicity data in humans generally agree that occupational exposures to manganese dust in the air results in central nervous system pathology. However, data on the neurotoxicity of orally ingested manganese at relatively low doses are less consistent, albeit suggestive. Additionally, many variables including environmental factors and biological factors can influence manganese absorption. The IRIS oral RfD for manganese in water is particularly uncertain as it is based on an upper dietary intake rate of 10 mg/day, instead of quantitative information to indicate toxic levels of manganese in the diet of humans. A modifying factor of 3 is applied for evaluating exposures from drinking water adding to the conservativeness of the overall non-diet RfD. Because of the conservativeness of the oral RfD for manganese, it is likely that uncertainty associated with this toxicity value will result in an overestimation rather than an underestimation of risk.

6.3 Uncertainties in Risk Characterization

Because risk estimates for a chemical are derived by combining uncertain estimates of exposure and toxicity (see above), the risk estimates for each chemical are more uncertain than either the exposure estimate or the toxicity estimate alone.

For non-carcinogens, summing HQ values across different COPCs is properly applied only to compounds that induce the same effect by the same mechanism of action. Consequently, summation of HQ values for COPCs that are not expected to include the same type of effects or that do not act by the same mechanisms could overestimate the potential for effects. Thus, all of the HI values in this report, are likely to overestimate the true level of human health non-cancer hazard.

<u>Groundwater</u>

Non-cancer hazards associated with manganese and arsenic exposures in groundwater are not associated with similar hazards from exposures to Site soils. As described above, releases of Site-related contaminants are expected to have occurred primarily by deposition into surface soils, but levels of manganese and arsenic in OU3 upland surface soils do not appear to be elevated above background.

<u>Fish</u>

No background data for fish collected from the CFR upstream of the Site are available, and no adequate data on concentrations of TEQ or Aroclors in fish collected from unimpacted waters were available for conducting a background comparison. However, concentrations of dioxins/furans and Aroclors in available sediment and surface water data suggest similar concentrations between upstream reaches and the CFR adjacent to and just downstream of the Site. Given the limitations in the existing database however, it is not clear if the observed non-cancer hazards and cancer risks estimated in this assessment are related to Site contamination.

7.0 REFERENCES

ATSDR. 1999. Toxicological Profile for Mercury. Agency for Toxic Substances and Disease Registry. March.

Dodge, K.A., Hornberger, M.I., and Turner, M.A. 2017. Water-quality, bed-sediment, and biological data (October 2014 through September 2015) and statistical summaries of data for streams in the Clark Fork Basin, Montana: U.S. Geological Survey Open-File Report 2016–1201, 122 p.

FNB. 2013. Dietary Reference Intakes (DRIs): Estimated Average Requirements. Food and Nutrition Board, Institute of Medicine, National Academies of Science.

ITRC. 2012. Incremental Sampling Methodology. February. Available online at: https://www.itrcweb.org/ism-1/.

Life Systems. 1995. Uptake of Lead and Arsenic by Garden Vegetables. Study Report for the Kennecott Site, Salt Lake County, Utah. February.

MDEQ. 2011. Montana Dioxin Background Investigation Report. Montana Department of Environmental Quality. April 2011.

MDEQ. 2013. Background Concentrations of Inorganic Constituents in Montana Surface Soils. Montana Department of Environmental Quality. September 2013.

Missoula County. 2017. Missoula County Floodplain Regulations. Section 5.02(d)(1).

MTFWP. 2013. News Release. Agencies Advise Limited Consumption of Some Fish Species Below Mill Site on Clark Fork River. October. Available online at: http://fwp.mt.gov/news/newsReleases/fishing/nr_0797.html.

NewFields. 2015. Remedial Investigation Work Plan. Smurfit Stone/Frenchtown Mill Missoula County, Montana. November.

NewFields. 2016a. Addendum No 1 to the Remedial Investigation Work Plan. 2016 Seasonally High Groundwater Sampling, Smurfit Stone/Frenchtown Mill, Missoula, County Montana. Memorandum dated May 25, 2016.

NewFields. 2016b. Addendum No. 2 to the Remedial Investigation Work Plan, Additional Soil Sampling for PCBs at the High Density Pulp Tank Foundation and Transformer Storage Building Foundation Areas, Smurfit Stone/Frenchtown Mill, Missoula, County Montana. Memorandum dated August 15, 2016.

NewFields. 2016c. Preliminary Data Summary Report. Smurfit Stone/Frenchtown Mill, Missoula County, Montana. June.

NewFields. 2017a. Addendum No. 3 (Version 3) to the Remedial Investigation Work Plan – Deep Groundwater Sampling, Former Frenchtown Mill Site, Missoula, County Montana. Memorandum dated February 27, 2017.

NewFields. 2017b. Addendum 4 to the Remedial Investigation Work Plan, 2017 Groundwater Monitoring, Former Frenchtown Mill Site, Missoula, County Montana. May.

NewFields. 2017c. Addendum No. 7 to Remedial Investigation Work Plan. Supplemental Soil Sampling in OU2 and OU3. Former Frenchtown Mill, Missoula, County Montana. October.

Schmetterling and Selch 2013. Preliminary Investigations into the Toxicity of Game Fish in the Clark Fork River downstream from the Smurfit Stone Container Mill. Montana Fish, Wildlife and Parks. July.

State of Montana. 2015. Montana Sport Fish Consumption Guidelines. Montana Fish, Wildlife and Parks, Montana Department of Environmental Quality, and Montana Department of Public Health and Human Services.

TetraTech. 1998. MPDES Compliance Monitoring for Dioxins and Furans in Alluvial Sediment and Fish near the Stone Container Corporation Plant at Missoula, Montana. January.

USEPA. 1987. Integrated Risk Information System Chemical Assessment Summary for Antimony; CASRN 7440-36-0. Last revised January 31, 1987.

USEPA. 1989. Risk Assessment Guidance for Superfund (RAGS). Volume I. Human Health Evaluation Manual (Part A).

USEPA. 1991a. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." Washington, DC. OSWER Directive 9285.6-03.

USEPA. 1991b. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Washington, DC. OSWER Directive 9355.0-30.

USEPA. 1991c. Risk Assessment Guidance for Superfund (RAGS). Volume I. Human Health Evaluation Manual (Part B, Development of Risk-based Preliminary Remediation Goals). Washington, DC. OSWER Directive 9285.7-01B.

USEPA. 1992a. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response. Supplemental Guidance to RAGS: Calculating the Concentration Term. Publication 9285.7-081.

USEPA. 1992b. The National Study of Chemical Residues in Fish. EPA-823-R-92-008a. September.

USEPA. 1994. Polychlorinated Biphenyls (PCBs) IRIS Summary. Noncancer Assessment Reference Dose; last updated August 1994.

USEPA. 1995. Manganese IRIS Summary. Noncancer Assessment Reference Dose; last updated November 1995.

USEPA. 1998a. Chromium (III), insoluble salts IRIS Summary. Last updated September.

USEPA. 1998b. Chromium (VI) IRIS Summary. Last updated September.

USEPA. 1999. Facts About Dioxin. U.S. Environmental Protection Agency, Region 8. November.

USEPA. 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 2. Risk Assessment and Fish Consumption Limits. Third Edition. EPA 823-B-00-008. November.

USEPA. 2002. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10. December.

USEPA. 2003. Human Health Toxicity Values in Superfund Risk Assessments. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation. OSWER Directive 9285.7-53. December 2003.

USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). Final. EPA/540/R/99/005. OSWER 9285.7-02EP. PB99-963312. July.

USEPA. 2005a. Guidelines for Carcinogen Risk Assessment. EPA/630/P-03/001B. March.

USEPA. 2005b. Barium IRIS Summary. Last updated July.

USEPA. 2006. Provisional Peer Reviewed Toxicity Values for Iron and Compounds. September.

USEPA. 2008. Provisional Peer Reviewed Toxicity Values for Cobalt. August.

USEPA. 2009a. The National Study of Chemical Residues in Lake Fish Tissue. EPA-823-R-09-006. September.

USEPA. 2009b. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. EPA-540-R-070-002. OSWER 9285.7-82. January.

USEPA. 2010a. Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds. EPA/100/R-10/005. December.

USEPA. 2010b. Final Report. Bioavailability of Dioxins and Dioxin-Like Compounds in Soil. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation, Environmental Response Team. December.

USEPA. 2011a. Exposure Factors Handbook 2011 Edition (Final Report). EPA/600/R-09/052F. September.

USEPA. 2011b. Peer Review Workshop for EPA's Draft Toxicological Review of Hexavalent Chromium. Reviewer Post-Meeting Comments. July.

USEPA. 2012. Analytical Results Report for a Combined Site Inspection and Removal Assessment. Smurfit-Stone Mill, near Missoula, Missoula County, MT.

USEPA. 2013a. ProUCL Version 5.0.00 User Guide. Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. U.S. Environmental Protection Agency, Office of Research and Development. EPA/600/R-07/041. September.

USEPA. 2013b. Use of Dioxin TEFs in Calculating Dioxin TEQs at CERCLA and RCRA Sites. May.

USEPA. 2014. Human Health Evaluation Manual, Supplemental Guidance: "Update of Standard Default Exposure Factors." OSWER Directive 9200.1-120.

USEPA. 2015a. Administrative Settlement Agreement and Order on Consent for Remedial Investigation/Feasibility Study. U.S. Environmental Protection Agency, Region 8. November.

USEPA. 2015b. Status of the Reassessment of Vanadium Pentoxide. December.

USEPA. 2016a. National Rivers and Streams Assessment 2008-2009: A Collaborative Survey. EPA/841/R-16/007. March.

USEPA. 2016b. Fish Consumption Survey of the Shoshone-Bannock Tribes. December.

USEPA. 2016c. Fish Consumption Survey of the Nez Perce Tribe. December.

USEPA. 2017a. Regional Screening Levels. U.S. Environmental Protection Agency. Last updated November 2017. Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls.

USEPA. 2017b. Human Health Risk Assessment for the Smurfit-Stone/Frenchtown Mill Operable Unit 1 Site. Located in Missoula County, Montana. February.

USEPA. 2017c. USEPA Risk Assessment for Dioxin at Superfund Sites Web Page. Available online at: https://www.epa.gov/superfund/risk-assessment-dioxin-superfund-sites. Last accessed December 2017.

USGS. 2017. National Water Information System: Web Interface. U.S. Geological Survey. Last updated October.

Weston. 1997. Baseline Human Health Risk Assessment for the Murray Smelter Superfund Site - Site-wide Evaluation. Prepared for USEPA. May.

TABLES

Table 2-1. Smurfit-Stone/Frenchtown Mill OU3 Data Summary

Media	Sample Date	Sample Description	Analysis
Upland Surface Soil	April 2014	Surface (0-2.4 inches) soil samples were collected from 7 locations (n=7). Surface (0-6 inches) soil samples were collected from 13 locations (n=13). Samples were 5-point composites collected over a square meter area.	Aroclors (n=19), TAL metals (n=19), dioxins and furans (n=20).
	December 2015	Two surface (0-2 inches and 5-7 inches) soil samples were collected at 8 locations (n=16). Samples were 5-point composites collected over an area of 1 to 3-meter radius.	TAL metals and dioxins and furans.
	October 2017	Composite surface (0-6 inches) soil samples were collected from 24 areas (n=24). Samples were 20-point composites collected over a 20-acre grid. 30-point composites were collected over the area of a historically defined basin/pond.	TAL metals, dioxins and furans and TOC.
Upland Subsurface Soil	April/May 2014	Subsurface soil samples were collected from 11 locations at varying depths from 1 to 10 feet (n=12). Samples were discrete samples.	Aroclors (n=10), TAL metals (n=10), dioxins and furans (n=12).
	December 2015	Subsurface soil samples were collected from 26 locations at varying depths from 0 to 12 feet (n=26). Samples were a vertical composite.	Aroclors (n=4), TAL metals (n=26), and dioxins and furans (n=26).
	October 2017	Composite subsurface (24-30 inches) soil samples were collected from 14 area (n=14). Samples were discrete samples.	Dioxins and furans, TAL metals, and TOC.
Floodplain Surface Soil	April 2014	Surface (0-2.4 inches and 0-6 inches) soil samples were collected from 2 locations (n=2). Samples were 5-point composites collected over a square meter area.	Aroclors, TAL metals, dioxins and furans.
	December 2015	Surface (0-2 inches) soil samples were collected at 17 locations (n=17). Samples were 5-point composites collected over an area of 1 to 3-meter radius.	TAL metals, dioxins and furans and TOC.
	October 2017	Composite surface (0-6 inches) soil samples were collected from 5 areas (n=5). Samples were 20-point composites collected over a 100-acre grid.	TAL metals, dioxins and furans and TOC.
Floodplain Subsurface Soil	April/May 2014	Subsurface soil samples were collected from 1 to 1.5 feet at 1 location and from 5.5 to 6 feet at 1 location (n=2). Samples were discrete samples. Samples were discrete samples.	Aroclors, TAL metals, and dioxins and furans.
	October 2017	Composite subsurface (24-30 inches) soil samples were collected from 6 areas (n=6). Samples were discrete samples. Samples were discrete samples.	Dioxins and furans, TAL metals, and TOC.
Shallow Groundwater	April 2014	Twenty shallow wells sampled (n=20).	Aroclors(n=11), total and dissolved TAL metals (n=11), dioxins and furans (n=11) and miscellaneous parameters (e.g. DO, temperature, etc.; n=20).
	December 2015	Twenty-six shallow wells sampled (n=26). Eighteen of the wells sampled in 2014 were also sampled during this event.	Aroclors (n=2), total and dissolved TAL metals (n=26), dioxins and furans (n=26), SVOCs (n=8), VOCs (n=8), and miscellaneous parameters (e.g. DO, temperature, etc.; n=26).
	June 2016	Twenty-three wells sampled (n=23). All of the wells were previoulsy sampled in 2015.	Aroclors (n=5), dissolved TAL metals (n=23), dioxins and furans (n=22), and miscellaneous parameters (e.g. DO, temperature, etc.; n=23).
	March/June/July 2017	Twenty-six shallow wells sampled (n=29). All of the wells were previously sampled at least once before in 2015 and 2016.	Aroclors (n=12), total and dissolved TAL metals (n=29), dioxins and furans (n=29), SVOCs (n=12), VOCs (n=12), and miscellaneous parameters (e.g. DO, temperature, etc.; n=29).
Deep Groundwater	March/June/July 2017	Three deep wells sampled (n=6).	Aroclors, total and dissolved TAL metals, dioxins and furans, SVOCs, VOCs, and miscellaneous parameters (e.g. DO, temperature, etc.)
Bed Sediment	November 2015	Bed sediment samples were collected from 3 locations within the site boundary and 3 locations downstream of the site (n=6).	Aroclors (n=2), TAL metals (n=6), dioxins and furans (n=6), SVOCs (n=2) and TOC (n=6).
Flood Fringe Sediment	December 2015	Flood fringe sediment samples were collected from 1 location within the site boundary and 2 locations downstream of the site (n=3).	TAL metals, dioxins and furans, and TOC.
Surface Water	November 2015	Surface water was collected from 1 location within the site boundary and 2 locations downstream of the site (n=3).	Aroclors (n=2), total and dissolved TAL metals (n=3), dioxins and furans (n=3), and SVOCs (n=2).
Fish	May 2013	Composite predator fish fillet tissue samples were collected at 7 locations downstream of the site (n=7)	Aroclors, dioxins and furans, mercury, and selenium.

Table 2-2. OU3 Upland Surface Soil (0-6 inches) Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	52	52	100	3.09E-05	1.08E-04	7.56E-04	--
	TEQ - Dioxins/Furans (ND=1/2RL)	52	52	100	3.10E-05	1.08E-04	7.56E-04	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	52	52	100	3.09E-05	1.08E-04	7.56E-04	--
PCBs	Aroclor-1016	19	0	0	8.46E-03	4.10E-03	--	1.69E-02
	Aroclor-1221	19	0	0	5.30E-03	1.43E-03	--	1.06E-02
	Aroclor-1232	19	0	0	9.51E-03	2.96E-03	--	1.90E-02
	Aroclor-1242	19	0	0	8.42E-03	3.19E-03	--	1.68E-02
	Aroclor-1248	19	0	0	5.01E-03	1.42E-03	--	1.00E-02
	Aroclor-1254	19	0	0	7.33E-03	1.94E-03	--	1.47E-02
	Aroclor-1260	19	0	0	7.07E-03	4.99E-03	--	1.41E-02
	Aroclor-1262	19	0	0	7.94E-03	2.82E-03	--	1.59E-02
	Aroclor-1268	19	0	0	4.83E-03	1.17E-03	--	9.66E-03
Total Metals	Aluminum	51	51	100	9.81E+03	4.65E+03	1.89E+04	5.06E+00
	Antimony	43	32	74	8.02E-01	9.09E-01	3.90E+00	1.69E-01
	Arsenic	51	51	100	6.43E+00	8.04E+00	4.07E+01	2.81E-01
	Barium	51	51	100	4.33E+02	2.69E+02	1.12E+03	2.93E-01
	Beryllium	43	34	79	3.50E-01	2.40E-01	1.10E+00	9.33E-02
	Cadmium	51	50	98	1.78E+00	2.29E+00	8.30E+00	4.54E-02
	Calcium	43	43	100	9.09E+04	1.25E+05	4.98E+05	8.78E+01
	Chromium	51	51	100	1.82E+01	1.15E+01	5.82E+01	2.00E-01
	Cobalt	51	50	98	3.19E+00	1.57E+00	8.50E+00	2.43E-01
	Copper	51	51	100	2.92E+01	1.97E+01	8.94E+01	6.70E-01
	Iron	51	51	100	8.24E+03	4.49E+03	2.08E+04	2.83E+01
	Lead	51	51	100	1.54E+01	1.93E+01	1.04E+02	3.70E-02
	Magnesium	43	43	100	6.77E+03	5.04E+03	2.93E+04	1.34E+01
	Manganese	51	51	100	7.48E+02	7.78E+02	2.70E+03	3.57E-01
	Mercury	51	44	86	5.28E-01	1.01E+00	4.30E+00	1.27E-02
	Nickel	51	51	100	1.20E+01	6.86E+00	3.79E+01	2.78E-01
	Potassium	43	39	91	1.81E+03	1.77E+03	9.21E+03	5.18E+01
	Selenium	43	19	44	4.99E-01	4.61E-01	1.60E+00	3.36E-01
	Silver	51	27	53	4.83E-01	5.06E-01	1.70E+00	2.60E-01
	Sodium	43	42	98	1.66E+03	2.37E+03	8.89E+03	6.48E+01
	Thallium	51	50	98	1.70E-01	1.55E-01	7.90E-01	3.35E-02
	Vanadium	51	51	100	2.16E+01	2.16E+01	1.19E+02	3.08E-01
	Zinc	51	51	100	1.57E+02	1.62E+02	6.86E+02	1.92E+00

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of mg/kg.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-3. OU3 Upland Subsurface Soil (10 feet) Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	46	46	100	5.49E-06	9.97E-06	4.30E-05	--
	TEQ - Dioxins/Furans (ND=1/2RL)	46	46	100	5.78E-06	9.84E-06	4.30E-05	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	46	46	100	5.52E-06	9.95E-06	4.30E-05	--
PCBs	Aroclor-1016	14	0	0	7.31E-03	3.82E-03	--	1.46E-02
	Aroclor-1221	14	0	0	6.98E-03	5.43E-03	--	1.40E-02
	Aroclor-1232	14	0	0	7.03E-03	2.34E-03	--	1.41E-02
	Aroclor-1242	14	0	0	9.06E-03	5.87E-03	--	1.81E-02
	Aroclor-1248	14	0	0	6.03E-03	3.68E-03	--	1.21E-02
	Aroclor-1254	14	1	7	1.32E-02	2.99E-02	1.17E-01	1.05E-02
	Aroclor-1260	14	1	7	1.28E-02	2.55E-02	1.00E-01	1.22E-02
	Aroclor-1262	14	0	0	5.81E-03	2.12E-03	--	1.16E-02
	Aroclor-1268	14	0	0	3.82E-03	1.11E-03	--	7.64E-03
Total Metals	Aluminum	44	44	100	6.62E+03	4.16E+03	2.10E+04	6.27E+00
	Antimony	18	3	17	1.04E-01	9.81E-02	3.80E-01	1.37E-01
	Arsenic	44	44	100	3.82E+00	6.26E+00	4.28E+01	1.83E-01
	Barium	44	44	100	2.18E+02	1.84E+02	5.90E+02	1.33E-01
	Beryllium	18	12	67	3.46E-01	3.38E-01	1.20E+00	8.23E-02
	Cadmium	44	33	75	7.61E-01	1.24E+00	6.40E+00	3.95E-02
	Calcium	18	18	100	2.19E+04	8.17E+04	3.49E+05	2.24E+01
	Chromium	44	44	100	1.22E+01	7.15E+00	3.07E+01	2.44E-01
	Cobalt	44	44	100	3.21E+00	2.09E+00	1.10E+01	2.88E-01
	Copper	44	44	100	2.26E+01	1.47E+01	6.64E+01	5.00E-01
	Iron	44	44	100	7.93E+03	4.62E+03	2.03E+04	3.29E+01
	Lead	44	44	100	1.09E+01	1.58E+01	1.02E+02	4.64E-02
	Magnesium	18	18	100	3.96E+03	2.68E+03	9.54E+03	6.78E+00
	Manganese	44	44	100	4.81E+02	5.76E+02	1.85E+03	5.15E-01
	Mercury	44	35	80	1.81E-01	2.52E-01	9.40E-01	9.55E-03
	Nickel	44	44	100	1.09E+01	9.90E+00	5.87E+01	2.35E-01
	Potassium	18	18	100	1.31E+03	9.44E+02	3.38E+03	1.82E+01
	Selenium	18	4	22	2.92E-01	3.37E-01	1.20E+00	2.94E-01
	Silver	44	17	39	3.32E-01	4.42E-01	1.50E+00	1.97E-01
	Sodium	18	16	89	8.50E+02	2.06E+03	8.90E+03	1.69E+01
	Thallium	44	31	70	1.04E-01	1.47E-01	9.60E-01	4.45E-02
	Vanadium	44	44	100	1.01E+01	5.36E+00	2.42E+01	4.03E-01
	Zinc	44	44	100	8.17E+01	1.02E+02	5.49E+02	1.96E+00

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of mg/kg.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-4. OU3 Floodplain Surface Soil Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	23	23	100	2.44E-05	2.85E-05	1.02E-04	--
	TEQ - Dioxins/Furans (ND=1/2RL)	23	23	100	2.44E-05	2.84E-05	1.02E-04	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	23	23	100	2.44E-05	2.84E-05	1.02E-04	--
PCBs	Aroclor-1016	2	0	0	5.40E-03	5.66E-04	--	1.08E-02
	Aroclor-1221	2	0	0	5.40E-03	5.66E-04	--	1.08E-02
	Aroclor-1232	2	0	0	1.01E-02	1.10E-03	--	2.03E-02
	Aroclor-1242	2	0	0	9.43E-03	1.03E-03	--	1.89E-02
	Aroclor-1248	2	0	0	4.05E-03	4.24E-04	--	8.10E-03
	Aroclor-1254	2	0	0	7.43E-03	8.13E-04	--	1.49E-02
	Aroclor-1260	2	0	0	3.38E-03	3.89E-04	--	6.75E-03
	Aroclor-1262	2	0	0	8.78E-03	9.55E-04	--	1.76E-02
	Aroclor-1268	2	0	0	4.73E-03	5.30E-04	--	9.45E-03
Total Metals	Aluminum	24	24	100	1.18E+04	4.17E+03	2.15E+04	4.62E+00
	Antimony	7	5	71	3.07E-01	1.66E-01	4.70E-01	1.73E-01
	Arsenic	24	24	100	6.05E+00	3.65E+00	1.49E+01	1.75E-01
	Barium	24	24	100	7.02E+02	6.22E+02	2.84E+03	4.72E-01
	Beryllium	7	7	100	5.39E-01	2.10E-01	9.50E-01	8.26E-02
	Cadmium	24	24	100	1.33E+00	1.32E+00	5.10E+00	3.61E-02
	Calcium	7	7	100	1.10E+04	8.98E+03	2.48E+04	1.90E+01
	Chromium	24	24	100	1.99E+01	9.71E+00	4.52E+01	2.15E-01
	Cobalt	24	24	100	3.83E+00	1.39E+00	7.10E+00	2.68E-01
	Copper	24	24	100	6.08E+01	4.19E+01	2.08E+02	3.88E-01
	Iron	24	24	100	1.09E+04	3.89E+03	2.29E+04	2.87E+01
	Lead	24	24	100	1.73E+01	8.18E+00	3.53E+01	4.88E-02
	Magnesium	7	7	100	4.87E+03	1.85E+03	8.63E+03	4.67E+00
	Manganese	24	24	100	5.53E+02	5.34E+02	1.80E+03	4.43E-01
	Mercury	24	24	100	9.44E-01	1.45E+00	5.30E+00	2.32E-02
	Nickel	24	24	100	9.55E+00	3.01E+00	1.45E+01	1.87E-01
	Potassium	7	7	100	2.14E+03	9.14E+02	4.11E+03	1.95E+01
	Selenium	7	2	29	1.99E-01	8.72E-02	3.40E-01	2.97E-01
	Silver	24	20	83	4.42E-01	4.11E-01	1.80E+00	1.71E-01
	Sodium	7	7	100	7.63E+02	7.83E+02	1.84E+03	1.58E+01
	Thallium	24	23	96	1.47E-01	5.28E-02	2.20E-01	4.80E-02
	Vanadium	24	24	100	2.14E+01	1.09E+01	4.62E+01	3.52E-01
	Zinc	24	24	100	1.70E+02	1.00E+02	4.13E+02	1.63E+00

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of mg/kg.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-5. OU3 Floodplain Subsurface Soil (10 feet) Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	46	46	100	5.49E-06	9.97E-06	4.30E-05	--
	TEQ - Dioxins/Furans (ND=1/2RL)	46	46	100	5.78E-06	9.84E-06	4.30E-05	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	46	46	100	5.52E-06	9.95E-06	4.30E-05	--
PCBs	Aroclor-1016	14	0	0	7.31E-03	3.82E-03	--	1.46E-02
	Aroclor-1221	14	0	0	6.98E-03	5.43E-03	--	1.40E-02
	Aroclor-1232	14	0	0	7.03E-03	2.34E-03	--	1.41E-02
	Aroclor-1242	14	0	0	9.06E-03	5.87E-03	--	1.81E-02
	Aroclor-1248	14	0	0	6.03E-03	3.68E-03	--	1.21E-02
	Aroclor-1254	14	1	7	1.32E-02	2.99E-02	1.17E-01	1.05E-02
	Aroclor-1260	14	1	7	1.28E-02	2.55E-02	1.00E-01	1.22E-02
	Aroclor-1262	14	0	0	5.81E-03	2.12E-03	--	1.16E-02
	Aroclor-1268	14	0	0	3.82E-03	1.11E-03	--	7.64E-03
Total Metals	Aluminum	44	44	100	6.62E+03	4.16E+03	2.10E+04	6.27E+00
	Antimony	18	3	17	1.04E-01	9.81E-02	3.80E-01	1.37E-01
	Arsenic	44	44	100	3.82E+00	6.26E+00	4.28E+01	1.83E-01
	Barium	44	44	100	2.18E+02	1.84E+02	5.90E+02	1.33E-01
	Beryllium	18	12	67	3.46E-01	3.38E-01	1.20E+00	8.23E-02
	Cadmium	44	33	75	7.61E-01	1.24E+00	6.40E+00	3.95E-02
	Calcium	18	18	100	2.19E+04	8.17E+04	3.49E+05	2.24E+01
	Chromium	44	44	100	1.22E+01	7.15E+00	3.07E+01	2.44E-01
	Cobalt	44	44	100	3.21E+00	2.09E+00	1.10E+01	2.88E-01
	Copper	44	44	100	2.26E+01	1.47E+01	6.64E+01	5.00E-01
	Iron	44	44	100	7.93E+03	4.62E+03	2.03E+04	3.29E+01
	Lead	44	44	100	1.09E+01	1.58E+01	1.02E+02	4.64E-02
	Magnesium	18	18	100	3.96E+03	2.68E+03	9.54E+03	6.78E+00
	Manganese	44	44	100	4.81E+02	5.76E+02	1.85E+03	5.15E-01
	Mercury	44	35	80	1.81E-01	2.52E-01	9.40E-01	9.55E-03
	Nickel	44	44	100	1.09E+01	9.90E+00	5.87E+01	2.35E-01
	Potassium	18	18	100	1.31E+03	9.44E+02	3.38E+03	1.82E+01
	Selenium	18	4	22	2.92E-01	3.37E-01	1.20E+00	2.94E-01
	Silver	44	17	39	3.32E-01	4.42E-01	1.50E+00	1.97E-01
	Sodium	18	16	89	8.50E+02	2.06E+03	8.90E+03	1.69E+01
	Thallium	44	31	70	1.04E-01	1.47E-01	9.60E-01	4.45E-02
	Vanadium	44	44	100	1.01E+01	5.36E+00	2.42E+01	4.03E-01
	Zinc	44	44	100	8.17E+01	1.02E+02	5.49E+02	1.96E+00

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of mg/kg.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-6. OU3 Upland Shallow Groundwater Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	65	54	83	4.70E-07	1.30E-06	6.49E-06	--
	TEQ - Dioxins/Furans (ND=1/2RL)	65	54	83	2.30E-06	1.75E-06	1.15E-05	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	65	54	83	8.41E-07	1.27E-06	6.81E-06	--
PCBs	Aroclor-1016	28	0	0	1.85E-02	2.09E-03	--	3.69E-02
	Aroclor-1221	28	0	0	1.87E-02	3.21E-03	--	3.75E-02
	Aroclor-1232	28	0	0	1.86E-02	4.24E-03	--	3.72E-02
	Aroclor-1242	28	0	0	2.47E-02	2.79E-03	--	4.93E-02
	Aroclor-1248	28	0	0	1.70E-02	3.28E-03	--	3.39E-02
	Aroclor-1254	28	0	0	2.11E-02	3.66E-03	--	4.21E-02
	Aroclor-1260	28	5	18	3.63E-02	6.01E-02	3.10E-01	3.15E-02
	Aroclor-1262	28	0	0	1.90E-02	4.82E-03	--	3.79E-02
	Aroclor-1268	28	0	0	2.12E-02	5.79E-03	--	4.24E-02
Total Metals	Aluminum	28	28	100	6.50E+02	2.40E+03	1.28E+04	1.85E+00
	Antimony	28	15	54	3.63E-01	5.24E-01	2.50E+00	1.40E-01
	Arsenic	28	28	100	9.10E+00	1.10E+01	5.43E+01	1.93E-01
	Barium	28	28	100	2.60E+02	2.48E+02	9.60E+02	6.60E-01
	Beryllium	9	3	33	6.48E-02	4.56E-02	1.00E-01	6.60E-02
	Cadmium	28	8	29	6.39E-02	1.73E-01	9.10E-01	2.59E-02
	Calcium	28	28	100	9.78E+04	7.31E+04	3.31E+05	9.71E+01
	Chromium	28	27	96	3.30E+00	3.58E+00	1.56E+01	1.61E-01
	Cobalt	28	23	82	4.52E+00	1.85E+01	9.84E+01	1.50E-01
	Copper	28	25	89	2.61E+00	3.72E+00	1.46E+01	2.56E-01
	Iron	28	28	100	5.56E+03	9.73E+03	4.49E+04	1.93E+01
	Lead	28	25	89	5.33E-01	8.86E-01	3.50E+00	3.64E-02
	Magnesium	28	28	100	4.79E+04	4.47E+04	1.50E+05	8.21E+01
	Manganese	28	28	100	5.51E+03	9.34E+03	5.15E+04	3.20E+00
	Mercury	28	1	4	3.90E-02	7.12E-02	4.00E-01	5.04E-02
	Nickel	28	27	96	7.99E+00	1.69E+01	9.06E+01	1.50E-01
	Potassium	28	28	100	2.65E+04	2.42E+04	1.26E+05	4.87E+02
	Selenium	28	11	39	2.25E-01	2.80E-01	1.50E+00	1.86E-01
	Silver	28	4	14	4.94E-02	3.23E-02	3.10E-02	9.32E-02
	Sodium	28	28	100	3.88E+05	3.11E+05	9.85E+05	7.00E+02
	Thallium	28	3	11	1.89E-02	3.96E-02	2.20E-01	2.52E-02
	Vanadium	28	26	93	1.70E+01	2.62E+01	1.20E+02	2.04E-01
	Zinc	28	27	96	1.09E+01	2.77E+01	1.36E+02	1.35E+00
Dissolved Metals	Aluminum	66	66	100	1.79E+02	3.09E+02	1.62E+03	3.13E+00
	Antimony	31	24	77	7.41E-01	1.49E+00	8.20E+00	1.40E-01
	Arsenic	66	66	100	1.14E+01	1.30E+01	6.07E+01	1.88E-01
	Barium	66	66	100	2.65E+02	2.46E+02	9.90E+02	3.00E-01
	Beryllium	9	1	11	3.79E-02	1.47E-02	7.70E-02	6.60E-02
	Cadmium	66	13	20	2.81E-02	4.56E-02	2.40E-01	2.34E-02
	Calcium	66	66	100	9.49E+04	7.48E+04	3.42E+05	1.61E+02
	Chromium	66	65	98	4.11E+00	4.09E+00	1.76E+01	2.25E-01
	Cobalt	66	63	95	2.64E+00	1.20E+01	9.79E+01	1.20E-01
	Copper	66	38	58	1.80E+00	3.37E+00	1.74E+01	4.72E-01
	Iron	66	66	100	4.20E+03	7.54E+03	4.79E+04	3.02E+01
	Lead	66	49	74	4.19E-01	9.82E-01	5.20E+00	3.10E-02
	Magnesium	66	65	98	4.21E+04	3.75E+04	1.51E+05	1.46E+02
	Manganese	66	66	100	4.95E+03	6.97E+03	5.22E+04	4.09E+00
	Mercury	66	3	5	2.23E-02	2.64E-02	2.20E-01	3.67E-02
	Nickel	66	65	98	6.26E+00	1.15E+01	8.95E+01	1.87E-01
	Potassium	66	64	97	2.29E+04	1.60E+04	9.93E+04	7.73E+02
	Selenium	31	15	48	2.39E-01	2.36E-01	1.00E+00	2.16E-01
	Silver	66	8	12	4.74E-02	3.34E-02	6.50E-02	8.89E-02
	Sodium	66	66	100	3.98E+05	2.95E+05	1.04E+06	3.43E+02
	Thallium	66	5	8	8.92E-03	4.41E-03	1.70E-02	1.68E-02
	Vanadium	66	62	94	1.77E+01	2.42E+01	1.30E+02	2.35E-01
	Zinc	66	54	82	7.54E+00	1.80E+01	1.27E+02	1.87E+00

Table 2-6. OU3 Upland Shallow Groundwater Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
Miscellaneous Parameters	Chloride	57	57	100	3.48E+04	3.36E+04	1.78E+05	2.31E+00
	Fluoride	57	51	89	2.30E+02	1.23E+02	9.10E+02	9.68E+01
	Nitrogen, NO2 plus NO3	57	50	88	2.24E+02	1.05E+03	7.90E+03	6.01E-03
	Phosphorus (as P)	57	57	100	1.11E+03	9.24E+02	3.00E+03	1.81E+01
	Sulfate	57	57	100	3.77E+05	5.77E+05	2.68E+06	2.63E+00
Semivolatiles	1,2,4-Trichlorobenzene	20	0	0	4.58E+00	7.08E+00	--	9.16E+00
	1,2-Dichlorobenzene	20	0	0	3.99E+00	5.85E+00	--	7.97E+00
	1,2-Diphenylhydrazine	20	0	0	1.89E+00	1.95E+00	--	3.78E+00
	1,3-Dichlorobenzene	20	0	0	4.53E+00	6.97E+00	--	9.05E+00
	1,4-Dichlorobenzene	20	0	0	3.89E+00	5.66E+00	--	7.77E+00
	1-Methylnaphthalene	20	0	0	2.61E+00	3.36E+00	--	5.21E+00
	2,4,5-Trichlorophenol	20	0	0	1.67E+00	1.64E+00	--	3.34E+00
	2,4,6-Trichlorophenol	20	0	0	1.66E+00	1.64E+00	--	3.32E+00
	2,4-Dichlorophenol	20	0	0	2.13E+00	2.42E+00	--	4.25E+00
	2,4-Dimethylphenol	20	0	0	6.04E+00	4.96E+00	--	1.20E+01
	2,4-Dinitrophenol	20	0	0	3.08E+00	3.93E+00	--	6.15E+00
	2,4-Dinitrotoluene	20	0	0	1.84E+00	2.07E+00	--	3.67E+00
	2,6-Dinitrotoluene	20	0	0	1.22E+00	9.05E-01	--	2.43E+00
	2-Chloronaphthalene	20	0	0	2.78E+00	3.57E+00	--	5.54E+00
	2-Chlorophenol	20	0	0	1.72E+00	1.68E+00	--	3.44E+00
	2-Methylnaphthalene	20	0	0	3.00E+00	4.08E+00	--	5.99E+00
	2-Nitroaniline	20	0	0	2.23E+00	2.31E+00	--	4.45E+00
	2-Nitrophenol	20	0	0	2.26E+00	2.62E+00	--	4.50E+00
	3,3`-Dichlorobenzidine	20	0	0	2.41E+00	1.72E+00	--	4.81E+00
	3-Nitroaniline	20	0	0	2.57E+00	1.67E+00	--	5.11E+00
	4,6-Dinitro-o-cresol	20	0	0	2.30E+00	2.30E+00	--	4.58E+00
	4-Bromophenyl phenyl ether	20	0	0	2.81E+00	3.74E+00	--	5.60E+00
	4-Chloro-3-methylphenol	20	0	0	1.92E+00	2.36E+00	--	3.84E+00
	4-Chlorophenyl phenyl ether	20	0	0	1.88E+00	2.46E+00	--	3.76E+00
	4-Nitroaniline	20	0	0	3.11E+00	3.06E+00	--	6.21E+00
	4-Nitrophenol	20	0	0	3.36E+00	4.06E+00	--	6.71E+00
	Acenaphthene	20	0	0	2.28E+00	3.04E+00	--	4.55E+00
	Acenaphthylene	20	0	0	2.26E+00	2.65E+00	--	4.52E+00
	Anthracene	20	0	0	1.94E+00	1.92E+00	--	3.88E+00
	Benzo(a)anthracene	20	0	0	2.39E+00	1.89E+00	--	4.77E+00
	Benzo(a)pyrene	20	0	0	2.31E+00	2.68E+00	--	4.62E+00
	Benzo(b)fluoranthene	20	0	0	2.27E+00	2.72E+00	--	4.54E+00
	Benzo(g,h,i)perylene	20	0	0	2.66E+00	3.34E+00	--	5.31E+00
	Benzo(k)fluoranthene	20	0	0	2.38E+00	2.75E+00	--	4.75E+00
	bis(2-chloroethoxy)methane	20	0	0	1.79E+00	2.12E+00	--	3.58E+00
	bis(2-chloroethyl)ether	20	0	0	1.75E+00	1.67E+00	--	3.49E+00
	Bis(2-chloroisopropyl)ether	20	0	0	1.95E+00	2.07E+00	--	3.90E+00
	Bis(2-ethylhexyl)phthalate	20	0	0	5.00E+00	7.71E+00	--	1.00E+01
	Butyl benzyl phthalate	20	0	0	2.25E+00	2.83E+00	--	4.50E+00
	Carbazole	20	0	0	1.75E+00	1.62E+00	--	3.50E+00
	Chrysene	20	0	0	2.27E+00	2.76E+00	--	4.52E+00
	Dibenzo(a,h)anthracene	20	0	0	2.55E+00	3.53E+00	--	5.10E+00
	Dibenzofuran	20	0	0	2.16E+00	2.51E+00	--	4.32E+00
	Dibutyl phthalate	20	0	0	1.96E+00	2.05E+00	--	3.90E+00
	Diethyl phthalate	20	0	0	2.00E+00	2.16E+00	--	3.99E+00
	Dimethyl phthalate	20	0	0	1.83E+00	1.91E+00	--	3.66E+00
	Di-n-octyl phthalate	20	0	0	2.48E+00	3.32E+00	--	4.95E+00
	Fluoranthene	20	0	0	2.07E+00	2.27E+00	--	4.14E+00
	Fluorene	20	0	0	1.99E+00	2.23E+00	--	3.97E+00
	Hexachlorobenzene	20	0	0	2.73E+00	3.45E+00	--	5.45E+00
	Hexachlorobutadiene	20	0	0	3.59E+00	5.30E+00	--	7.17E+00
	Hexachloroethane	20	0	0	3.83E+00	5.71E+00	--	7.64E+00
	Indeno(1,2,3-cd)pyrene	20	0	0	2.42E+00	3.28E+00	--	4.83E+00
	Isophorone	20	0	0	1.61E+00	1.79E+00	--	3.21E+00
	m & p-cresols	20	0	0	1.73E+00	1.49E+00	--	3.46E+00

Table 2-6. OU3 Upland Shallow Groundwater Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
	Naphthalene	20	0	0	2.87E+00	3.86E+00	--	5.73E+00
Semivolatiles	Nitrobenzene	20	0	0	1.92E+00	1.93E+00	--	3.84E+00
	N-Nitrosodimethylamine	20	0	0	1.64E+00	1.50E+00	--	3.28E+00
	N-Nitrosodi-n-propylamine	20	0	0	1.63E+00	1.47E+00	--	3.25E+00
	N-Nitrosodiphenylamine	20	0	0	2.14E+00	1.51E+00	--	4.27E+00
	o-Cresol	20	0	0	2.59E+00	2.98E+00	--	5.17E+00
	p-Chloroaniline	20	0	0	3.17E+00	2.83E+00	--	6.34E+00
	Pentachlorophenol	20	1	5	3.51E+00	4.66E+00	1.11E+01	6.03E+00
	Phenanthrene	20	0	0	1.60E+00	1.44E+00	--	3.19E+00
	Phenol	20	0	0	1.73E+00	1.74E+00	--	3.45E+00
	Pyrene	20	0	0	2.06E+00	2.30E+00	--	4.12E+00
Volatile Organics	1,1,1,2-Tetrachloroethane	20	0	0	5.92E-02	3.42E-02	--	1.18E-01
	1,1,1-Trichloroethane	20	0	0	5.71E-02	3.59E-02	--	1.14E-01
	1,1,2,2-Tetrachloroethane	20	0	0	6.05E-02	4.15E-02	--	1.21E-01
	1,1,2-Trichloroethane	20	0	0	6.72E-02	4.42E-02	--	1.34E-01
	1,1-Dichloroethane	20	0	0	6.05E-02	4.15E-02	--	1.21E-01
	1,1-Dichloroethene	20	0	0	6.47E-02	3.79E-02	--	1.29E-01
	1,1-Dichloropropene	20	0	0	5.66E-02	1.96E-02	--	1.13E-01
	1,2,3-Trichlorobenzene	20	0	0	9.70E-02	1.51E-02	--	1.94E-01
	1,2,3-Trichloropropane	20	0	0	1.57E-01	7.79E-02	--	3.14E-01
	1,2,4-Trichlorobenzene	20	0	0	8.60E-02	2.01E-02	--	1.72E-01
	1,2,4-Trimethylbenzene	20	2	10	1.10E-01	1.82E-01	7.30E-01	1.05E-01
	1,2-Dibromo-3-chloropropane	20	0	0	3.20E-01	2.51E-02	--	6.40E-01
	1,2-Dibromoethane	20	0	0	7.36E-02	3.47E-02	--	1.47E-01
	1,2-Dichlorobenzene	20	0	0	6.74E-02	3.57E-02	--	1.35E-01
	1,2-Dichloroethane	20	0	0	5.56E-02	2.46E-02	--	1.11E-01
	1,2-Dichloropropane	20	0	0	1.04E-01	8.90E-02	--	2.08E-01
	1,3,5-Trimethylbenzene	20	0	0	5.26E-02	3.97E-02	--	1.05E-01
	1,3-Dichlorobenzene	20	0	0	6.75E-02	3.14E-02	--	1.35E-01
	1,3-Dichloropropane	20	0	0	6.57E-02	4.55E-02	--	1.31E-01
	1,4-Dichlorobenzene	20	1	5	7.23E-02	7.05E-02	3.60E-01	1.13E-01
	2,2-Dichloropropane	20	0	0	1.01E-01	6.63E-02	--	2.02E-01
	Acetone	20	9	45	6.26E+00	6.76E+00	2.46E+01	3.22E+00
	Allyl chloride	20	0	0	1.91E-01	8.29E-02	--	3.82E-01
	Benzene	20	2	10	7.08E-02	6.63E-02	2.40E-01	1.09E-01
	Bromobenzene	20	0	0	7.61E-02	4.10E-02	--	1.52E-01
	Bromochloromethane	20	0	0	9.26E-02	6.48E-02	--	1.85E-01
	Bromoform	20	0	0	1.15E-01	7.54E-02	--	2.30E-01
	Bromomethane	20	0	0	1.32E-01	4.02E-02	--	2.64E-01
	Carbon tetrachloride	20	0	0	9.37E-02	6.81E-02	--	1.87E-01
	Chlorobenzene	20	2	10	2.25E+00	7.03E+00	2.82E+01	1.32E-01
	Chloroethane	20	0	0	1.04E-01	5.53E-02	--	2.08E-01
	Chloroform	20	0	0	1.17E-01	1.51E-02	--	2.34E-01
	Chloromethane	20	0	0	1.52E-01	1.41E-01	--	3.04E-01
	cis-1,2-Dichloroethylene	20	0	0	8.60E-02	3.27E-02	--	1.72E-01
	cis-1,3-Dichloropropylene	20	0	0	6.27E-02	3.54E-02	--	1.25E-01
	Cumene	20	4	20	2.09E-01	3.77E-01	1.20E+00	1.06E-01
	Dibromochloromethane	20	0	0	4.64E-02	2.81E-02	--	9.28E-02
	Dichlorobromomethane	20	0	0	5.64E-02	2.81E-02	--	1.13E-01
	Dichlorodifluoromethane	20	0	0	1.21E-01	1.04E-01	--	2.41E-01
	Dichlorofluoromethane	20	0	0	6.02E-02	4.17E-02	--	1.20E-01
	Ethyl ether	20	1	5	1.09E-01	7.30E-02	1.70E-01	2.06E-01
	Ethylbenzene	20	0	0	6.85E-02	3.90E-02	--	1.37E-01
	Hexachlorobutadiene	20	0	0	1.35E-01	8.80E-02	--	2.70E-01
	m & p-Xylenes	20	7	35	4.64E-01	5.89E-01	1.50E+00	2.30E-01
	Methylcyclohexane	20	0	0	8.30E-01	3.52E-01	--	1.66E+00
	Methyl ethyl ketone	20	0	0	7.20E-01	4.02E-01	--	1.44E+00
	Methyl isobutyl ketone	20	0	0	1.04E-01	4.27E-02	--	2.08E-01
	Methylene bromide	20	0	0	1.41E-01	1.16E-01	--	2.82E-01
	Methylene chloride	20	0	0	5.41E-02	3.85E-02	--	1.08E-01

Table 2-6. OU3 Upland Shallow Groundwater Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
Volatile Organics	MTBE (Methyl tert-butyl ether)	20	1	5	9.17E-02	2.05E-01	9.60E-01	9.44E-02
	Naphthalene	20	0	0	6.46E-02	1.94E-02	--	1.29E-01
	n-Butyl benzene	20	1	5	9.10E-02	1.69E-01	7.90E-01	1.13E-01
	n-Propyl benzene	20	0	0	6.92E-02	3.42E-02	--	1.38E-01
	o-Chlorotoluene	20	2	10	6.04E-02	5.02E-02	2.10E-01	1.02E-01
	o-Xylene	20	0	0	6.24E-02	4.83E-02	--	1.25E-01
	p-Chlorotoluene	20	0	0	5.12E-02	2.41E-02	--	1.02E-01
	p-Isopropyltoluene	20	1	5	8.77E-02	1.29E-01	6.30E-01	1.20E-01
	sec-Butyl benzene	20	0	0	3.88E-02	1.36E-02	--	7.76E-02
	Styrene	20	0	0	5.13E-02	3.24E-02	--	1.03E-01
	tert-Amyl methyl ether	20	0	0	7.70E-02	1.51E-02	--	1.54E-01
	tert-Butyl benzene	20	0	0	1.25E+00	6.28E-01	--	2.50E+00
	Tetrachloroethylene	20	6	30	2.29E-01	6.57E-01	3.00E+00	8.74E-02
	Tetrahydrofuran	20	0	0	8.70E-02	1.51E-02	--	1.74E-01
	Toluene	20	0	0	5.72E-02	4.42E-02	--	1.14E-01
	trans-1,2-Dichloroethylene	20	0	0	4.12E-02	2.41E-02	--	8.24E-02
	trans-1,3-Dichloropropylene	20	0	0	5.25E-02	3.14E-02	--	1.05E-01
	Trichloroethylene	20	0	0	1.23E-01	7.29E-02	--	2.46E-01
	Trichlorofluoromethane	20	0	0	4.56E-02	4.27E-03	--	9.12E-02
	Trichlorotrifluoroethane	20	6	30	4.75E-01	5.82E-01	1.50E+00	3.30E-01
	Vinyl chloride	2	0	0	1.80E-01	0.00E+00	--	3.60E-01
	Xylenes (total)	2	0	0	8.00E-02	0.00E+00	--	1.60E-01

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of µg/L.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-7. OU3 Floodplain Shallow Groundwater Summary Statistics

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	34	29	85	1.10E-07	2.41E-07	1.24E-06	--
	TEQ - Dioxins/Furans (ND=1/2RL)	34	29	85	2.16E-06	9.78E-07	5.06E-06	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	34	29	85	5.03E-07	2.35E-07	1.57E-06	--
PCBs	Aroclor-1016	3	0	0	1.97E-02	2.89E-04	--	3.93E-02
	Aroclor-1221	3	0	0	1.60E-02	0.00E+00	--	3.20E-02
	Aroclor-1232	3	0	0	2.42E-02	2.89E-04	--	4.83E-02
	Aroclor-1242	3	0	0	2.52E-02	2.89E-04	--	5.03E-02
	Aroclor-1248	3	0	0	1.57E-02	2.89E-04	--	3.13E-02
	Aroclor-1254	3	0	0	2.27E-02	2.89E-04	--	4.53E-02
	Aroclor-1260	3	0	0	1.37E-02	2.89E-04	--	2.73E-02
	Aroclor-1262	3	0	0	1.42E-02	2.89E-04	--	2.83E-02
	Aroclor-1268	3	0	0	1.60E-02	0.00E+00	--	3.20E-02
Total Metals	Aluminum	14	14	100	2.11E+02	4.48E+02	1.72E+03	1.78E+00
	Antimony	14	13	93	3.83E-01	1.89E-01	6.40E-01	8.50E-02
	Arsenic	14	14	100	8.59E+00	9.51E+00	3.34E+01	1.34E-01
	Barium	14	14	100	8.44E+01	5.53E+01	2.00E+02	5.36E-02
	Beryllium	3	1	33	6.22E-01	1.02E+00	1.80E+00	6.60E-02
	Cadmium	14	11	79	5.84E-01	1.64E+00	6.10E+00	1.84E-02
	Calcium	14	14	100	1.11E+05	9.27E+04	3.31E+05	7.30E+01
	Chromium	14	13	93	9.53E-01	9.74E-01	3.40E+00	1.56E-01
	Cobalt	14	12	86	2.48E+01	7.13E+01	2.64E+02	7.93E-02
	Copper	14	14	100	1.22E+01	2.52E+01	9.72E+01	3.47E-01
	Iron	14	12	86	3.85E+03	5.44E+03	2.08E+04	1.54E+01
	Lead	14	14	100	4.49E-01	5.26E-01	1.90E+00	2.04E-02
	Magnesium	14	14	100	3.79E+04	3.36E+04	1.26E+05	5.56E+01
	Manganese	14	14	100	4.42E+03	5.78E+03	1.81E+04	2.59E+00
	Mercury	14	1	7	4.26E-02	5.43E-02	2.30E-01	5.43E-02
	Nickel	14	14	100	2.63E+01	6.97E+01	2.60E+02	1.29E-01
	Potassium	14	14	100	2.61E+04	1.82E+04	6.46E+04	3.67E+02
	Selenium	14	10	71	3.05E-01	2.34E-01	7.10E-01	1.59E-01
	Silver	14	3	21	2.68E-02	3.44E-02	1.10E-01	3.07E-02
	Sodium	14	14	100	3.97E+05	2.37E+05	7.63E+05	6.34E+02
	Thallium	14	4	29	2.21E-02	3.98E-02	1.50E-01	1.25E-02
	Vanadium	14	14	100	5.57E+00	5.47E+00	1.55E+01	1.25E-01
	Zinc	14	12	86	4.82E+01	1.33E+02	4.92E+02	2.26E+00
Dissolved Metals	Aluminum	34	33	97	1.20E+02	2.08E+02	1.18E+03	2.66E+00
	Antimony	14	14	100	5.49E-01	1.80E-01	8.50E-01	8.50E-02
	Arsenic	34	34	100	1.31E+01	1.38E+01	5.19E+01	1.15E-01
	Barium	34	34	100	9.74E+01	5.86E+01	2.63E+02	5.33E-02
	Beryllium	3	1	33	5.89E-01	9.62E-01	1.70E+00	6.60E-02
	Cadmium	34	18	53	3.52E-01	1.14E+00	6.20E+00	1.88E-02
	Calcium	34	34	100	1.09E+05	9.44E+04	4.14E+05	1.86E+02
	Chromium	34	33	97	1.75E+00	1.64E+00	5.40E+00	1.89E-01
	Cobalt	34	34	100	2.31E+01	7.84E+01	3.78E+02	8.55E-02
	Copper	34	33	97	6.18E+00	1.57E+01	9.19E+01	3.17E-01
	Iron	34	30	88	3.94E+03	8.20E+03	4.12E+04	3.48E+01
	Lead	34	33	97	2.83E-01	2.82E-01	9.70E-01	2.65E-02
	Magnesium	34	34	100	3.67E+04	3.75E+04	1.62E+05	1.32E+02
	Manganese	34	34	100	4.24E+03	5.54E+03	2.45E+04	4.03E+00
	Mercury	34	1	3	2.19E-02	1.63E-02	5.10E-02	4.14E-02
	Nickel	34	34	100	2.12E+01	6.23E+01	2.64E+02	1.31E-01
	Potassium	34	34	100	2.50E+04	1.74E+04	7.14E+04	5.71E+02
	Selenium	14	9	64	2.75E-01	2.11E-01	6.00E-01	1.59E-01
	Silver	34	6	18	3.54E-02	3.36E-02	8.50E-02	6.36E-02
	Sodium	34	34	100	4.10E+05	2.09E+05	7.60E+05	3.07E+02
	Thallium	34	10	29	1.90E-02	3.57E-02	1.50E-01	1.19E-02
	Vanadium	34	34	100	8.41E+00	7.81E+00	2.66E+01	1.84E-01
	Zinc	34	28	82	3.00E+01	9.55E+01	4.96E+02	1.92E+00

Table 2-7. OU3 Floodplain Shallow Groundwater Summary Statistics

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
Miscellaneous Parameters	Chloride	31	31	100	3.41E+04	2.21E+04	7.68E+04	2.34E+00
	Fluoride	31	27	87	2.93E+02	4.07E+02	2.40E+03	2.01E+02
	Nitrogen, NO2 plus NO3	31	29	94	3.61E+02	7.07E+02	2.60E+03	9.85E-03
	Phosphorus (as P)	31	31	100	4.38E+02	3.75E+02	1.20E+03	8.30E+00
	Sulfate	31	31	100	8.67E+05	6.88E+05	2.65E+06	5.00E+00

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of µg/L.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-8. OU3 Deep Groundwater Summary Statistics

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	6	4	67	3.10E-08	3.32E-08	7.54E-08	--
	TEQ - Dioxins/Furans (ND=1/2RL)	6	4	67	1.86E-06	5.42E-07	2.73E-06	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	6	4	67	4.38E-07	3.71E-08	5.03E-07	--
PCBs	Aroclor-1016	6	0	0	1.71E-02	2.04E-04	--	3.42E-02
	Aroclor-1221	5	0	0	2.10E-02	0.00E+00	--	4.22E-02
	Aroclor-1232	6	0	0	1.56E-02	2.04E-04	--	3.12E-02
	Aroclor-1242	6	0	0	2.56E-02	2.04E-04	--	5.12E-02
	Aroclor-1248	6	0	0	1.88E-02	4.08E-04	--	3.77E-02
	Aroclor-1254	6	0	0	2.16E-02	2.04E-04	--	4.32E-02
	Aroclor-1260	6	0	0	1.78E-02	2.74E-04	--	3.55E-02
	Aroclor-1262	6	0	0	1.83E-02	4.08E-04	--	3.67E-02
	Aroclor-1268	6	0	0	2.78E-02	4.08E-04	--	5.57E-02
Total Metals	Aluminum	3	3	100	2.54E+01	1.36E+01	4.00E+01	1.90E+00
	Antimony	3	3	100	1.65E-01	7.92E-02	2.20E-01	3.20E-02
	Arsenic	3	3	100	3.00E+00	1.25E+00	4.30E+00	9.10E-02
	Barium	3	3	100	5.03E+01	1.14E+01	6.24E+01	1.90E-02
	Cadmium	3	3	100	7.47E-02	4.55E-02	1.20E-01	1.30E-02
	Calcium	3	3	100	2.88E+04	3.88E+03	3.31E+04	2.47E+01
	Chromium	3	3	100	3.57E-01	9.07E-02	4.60E-01	1.40E-01
	Cobalt	3	3	100	7.03E-01	4.30E-01	1.20E+00	2.10E-02
	Copper	3	3	100	7.97E+00	1.13E+01	2.10E+01	4.00E-01
	Iron	3	2	67	2.94E+01	2.29E+01	5.43E+01	1.85E+01
	Lead	3	3	100	5.60E-01	4.36E-01	9.80E-01	1.20E-02
	Magnesium	3	3	100	1.11E+04	1.43E+03	1.27E+04	2.60E+00
	Manganese	3	3	100	6.62E+02	2.53E+02	8.27E+02	3.00E-01
	Mercury	3	1	33	5.17E-02	3.58E-02	9.30E-02	6.20E-02
	Nickel	3	3	100	1.86E+00	1.10E+00	3.10E+00	9.90E-02
	Potassium	3	3	100	2.47E+03	3.55E+02	2.88E+03	1.26E+02
	Selenium	3	0	0	6.50E-02	9.31E-10	--	1.30E-01
	Silver	3	1	33	6.97E-02	1.13E-01	2.00E-01	9.20E-03
	Sodium	3	3	100	1.54E+05	1.79E+04	1.75E+05	4.46E+01
	Thallium	3	1	33	6.40E-03	4.85E-03	1.20E-02	7.20E-03
	Vanadium	3	3	100	4.47E+00	3.61E+00	8.40E+00	8.50E-02
	Zinc	3	3	100	9.90E+00	2.98E+00	1.31E+01	7.80E-01
Dissolved Metals	Aluminum	6	6	100	1.31E+01	8.59E+00	2.51E+01	1.90E+00
	Antimony	6	6	100	3.27E-01	1.39E-01	5.20E-01	3.20E-02
	Arsenic	6	6	100	3.03E+00	1.43E+00	5.10E+00	9.10E-02
	Barium	6	6	100	5.14E+01	1.15E+01	6.93E+01	1.90E-02
	Cadmium	6	6	100	6.27E-02	2.77E-02	1.10E-01	1.30E-02
	Calcium	6	6	100	2.90E+04	4.72E+03	3.62E+04	2.03E+01
	Chromium	6	4	67	2.22E-01	1.37E-01	4.00E-01	1.40E-01
	Cobalt	6	6	100	9.35E-01	6.07E-01	2.00E+00	2.10E-02
	Copper	6	6	100	8.15E+00	1.06E+01	2.44E+01	4.00E-01
	Iron	6	2	33	1.56E+01	9.98E+00	3.08E+01	1.85E+01
	Lead	6	6	100	4.11E-01	3.72E-01	8.70E-01	1.20E-02
	Magnesium	6	6	100	1.11E+04	1.76E+03	1.37E+04	5.00E+00
	Manganese	6	6	100	6.46E+02	2.01E+02	8.62E+02	5.25E-01
	Mercury	6	4	67	5.38E-02	3.57E-02	1.20E-01	4.65E-02
	Nickel	6	6	100	1.95E+00	9.75E-01	3.30E+00	9.90E-02
	Potassium	6	6	100	2.34E+03	2.73E+02	2.75E+03	7.61E+01
	Selenium	6	3	50	1.24E-01	6.61E-02	2.00E-01	1.30E-01
	Silver	6	4	67	5.40E-02	6.72E-02	1.50E-01	9.20E-03
	Sodium	6	6	100	1.51E+05	1.14E+04	1.67E+05	2.83E+01
	Thallium	6	2	33	5.90E-03	3.58E-03	1.10E-02	7.20E-03
	Vanadium	6	6	100	4.82E+00	4.67E+00	1.29E+01	8.50E-02
	Zinc	6	6	100	1.67E+01	1.96E+01	5.36E+01	7.80E-01

Table 2-8. OU3 Deep Groundwater Summary Statistics

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
Miscellaneous Parameters	Chloride	6	6	100	2.50E+04	4.16E+03	3.24E+04	2.32E+00
	Fluoride	6	6	100	2.63E+02	6.35E+01	3.70E+02	4.53E+01
	Nitrogen, NO2 plus NO3	6	1	17	5.29E+00	9.17E+00	2.40E+01	3.10E-03
	Phosphorus (as P)	6	6	100	4.43E+01	2.29E+01	7.50E+01	2.68E+00
	Sulfate	6	6	100	1.05E+05	1.09E+04	1.16E+05	1.13E+00
Semivolatiles	1,2,4-Trichlorobenzene	6	0	0	1.69E+00	6.85E-01	--	3.38E+00
	1,2-Dichlorobenzene	6	0	0	1.68E+00	3.03E-01	--	3.35E+00
	1,2-Diphenylhydrazine	6	0	0	8.42E-01	1.56E-01	--	1.68E+00
	1,3-Dichlorobenzene	6	0	0	1.86E+00	4.84E-01	--	3.72E+00
	1,4-Dichlorobenzene	6	0	0	1.70E+00	2.21E-01	--	3.38E+00
	1-Methylnaphthalene	6	0	0	1.10E+00	6.32E-02	--	2.18E+00
	2,4,5-Trichlorophenol	6	0	0	8.50E-01	2.76E-01	--	1.68E+00
	2,4,6-Trichlorophenol	6	0	0	8.00E-01	2.21E-01	--	1.58E+00
	2,4-Dichlorophenol	6	0	0	9.42E-01	1.02E-01	--	1.88E+00
	2,4-Dimethylphenol	6	0	0	7.20E+00	6.18E+00	--	1.44E+01
	2,4-Dinitrophenol	6	0	0	1.18E+00	1.94E-01	--	2.33E+00
	2,4-Dinitrotoluene	6	0	0	7.58E-01	2.04E-02	--	1.52E+00
	2,6-Dinitrotoluene	6	0	0	5.85E-01	2.54E-01	--	1.17E+00
	2-Chloronaphthalene	6	0	0	1.22E+00	4.08E-02	--	2.43E+00
	2-Chlorophenol	6	0	0	9.17E-01	3.30E-01	--	1.83E+00
	2-Methylnaphthalene	6	0	0	1.23E+00	1.94E-01	--	2.43E+00
	2-Nitroaniline	6	0	0	1.03E+00	2.02E-01	--	2.07E+00
	2-Nitrophenol	6	0	0	1.07E+00	1.66E-01	--	2.13E+00
	3,3`-Dichlorobenzidine	6	0	0	1.06E+00	4.31E-01	--	2.12E+00
	3-Nitroaniline	6	0	0	1.54E+00	9.60E-01	--	3.08E+00
	4,6-Dinitro-o-cresol	6	0	0	7.58E-01	1.02E-01	--	1.50E+00
	4-Bromophenyl phenyl ether	6	0	0	9.25E-01	3.75E-01	--	1.85E+00
	4-Chloro-3-methylphenol	6	0	0	9.83E-01	1.86E-01	--	1.95E+00
	4-Chlorophenyl phenyl ether	6	0	0	8.33E-01	2.58E-02	--	1.65E+00
	4-Nitroaniline	6	0	0	1.38E+00	2.48E-01	--	2.73E+00
	4-Nitrophenol	6	0	0	1.36E+00	7.36E-02	--	2.70E+00
	Acenaphthene	6	0	0	1.00E+00	6.32E-02	--	1.98E+00
	Acenaphthylene	6	0	0	1.07E+00	1.29E-01	--	2.13E+00
	Anthracene	6	0	0	1.00E+00	3.30E-01	--	2.00E+00
	Benzo(a)anthracene	6	0	0	7.25E-01	2.74E-02	--	1.45E+00
	Benzo(a)pyrene	6	0	0	1.05E+00	1.14E-01	--	2.08E+00
	Benzo(b)fluoranthene	6	0	0	7.83E-01	1.83E-01	--	1.57E+00
	Benzo(g,h,i)perylene	6	0	0	9.83E-01	1.83E-01	--	1.97E+00
	Benzo(k)fluoranthene	6	0	0	8.50E-01	1.30E-01	--	1.70E+00
	bis(2-chloroethoxy)methane	6	0	0	9.75E-01	2.48E-01	--	1.93E+00
	bis(2-chloroethyl)ether	6	0	0	9.17E-01	3.30E-01	--	1.83E+00
	Bis(2-chloroisopropyl)ether	6	0	0	9.83E-01	2.56E-01	--	1.97E+00
	Bis(2-ethylhexyl)phthalate	6	1	17	1.86E+00	8.44E-01	2.00E+00	3.32E+00
	Butyl benzyl phthalate	6	0	0	1.00E+00	3.16E-02	--	1.98E+00
	Carbazole	6	0	0	7.92E-01	2.11E-01	--	1.58E+00
	Chrysene	6	0	0	8.50E-01	1.30E-01	--	1.70E+00
	Dibenzo(a,h)anthracene	6	0	0	9.67E-01	2.56E-01	--	1.93E+00
	Dibenzofuran	6	0	0	9.08E-01	2.04E-02	--	1.82E+00
	Dibutyl phthalate	6	0	0	8.75E-01	1.41E-01	--	1.73E+00
	Diethyl phthalate	6	0	0	8.42E-01	8.61E-02	--	1.68E+00
	Dimethyl phthalate	6	0	0	8.00E-01	1.14E-01	--	1.58E+00
	Di-n-octyl phthalate	6	0	0	1.11E+00	4.92E-02	--	2.22E+00
	Fluoranthene	6	0	0	8.50E-01	4.47E-02	--	1.70E+00
	Fluorene	6	0	0	7.75E-01	2.74E-02	--	1.55E+00
	Hexachlorobenzene	6	0	0	1.01E+00	2.11E-01	--	2.02E+00
	Hexachlorobutadiene	6	0	0	1.49E+00	3.02E-01	--	2.98E+00
	Hexachloroethane	6	0	0	1.63E+00	3.03E-01	--	3.25E+00
	Indeno(1,2,3-cd)pyrene	6	0	0	9.17E-01	2.21E-01	--	1.82E+00
	Isophorone	6	0	0	9.08E-01	2.84E-01	--	1.82E+00
	m & p-cresols	6	0	0	1.21E+00	7.04E-01	--	2.42E+00

Table 2-8. OU3 Deep Groundwater Summary Statistics

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
Semivolatiles	Naphthalene	6	0	0	1.22E+00	1.13E-01	--	2.43E+00
	Nitrobenzene	6	0	0	9.08E-01	2.29E-01	--	1.82E+00
	N-Nitrosodimethylamine	6	0	0	8.58E-01	3.22E-01	--	1.72E+00
	N-Nitrosodi-n-propylamine	6	0	0	8.75E-01	3.57E-01	--	1.73E+00
	N-Nitrosodiphenylamine	6	0	0	1.23E+00	6.95E-01	--	2.45E+00
	o-Cresol	6	0	0	1.72E+00	7.32E-01	--	3.43E+00
	p-Chloroaniline	6	0	0	2.50E+00	1.59E+00	--	4.98E+00
	Pentachlorophenol	6	0	0	9.10E-01	5.92E-01	--	1.82E+00
	Phenanthrene	6	0	0	7.08E-01	1.74E-01	--	1.42E+00
	Phenol	6	0	0	8.33E-01	2.02E-01	--	1.67E+00
	Pyrene	6	0	0	8.25E-01	2.74E-02	--	1.65E+00
	1,1,1,2-Tetrachloroethane	6	0	0	3.20E-02	--	--	6.40E-02
	1,1,1-Trichloroethane	6	0	0	2.85E-02	4.17E-10	--	5.70E-02
Volatile Organics	1,1,2,2-Tetrachloroethane	6	0	0	2.75E-02	--	--	5.50E-02
	1,1,2-Trichloroethane	6	0	0	3.20E-02	--	--	6.40E-02
	1,1-Dichloroethane	6	0	0	2.75E-02	--	--	5.50E-02
	1,1-Dichloroethene	6	0	0	3.45E-02	--	--	6.90E-02
	1,1-Dichloropropene	6	0	0	4.10E-02	--	--	8.20E-02
	1,2,3-Trichlorobenzene	6	0	0	8.50E-02	1.18E-09	--	1.70E-01
	1,2,3-Trichloropropane	6	0	0	9.50E-02	--	--	1.90E-01
	1,2,4-Trichlorobenzene	6	0	0	7.00E-02	--	--	1.40E-01
	1,2,4-Trimethylbenzene	6	0	0	3.40E-02	--	--	6.80E-02
	1,2-Dibromo-3-chloropropane	6	0	0	3.00E-01	--	--	6.00E-01
	1,2-Dibromoethane	6	0	0	4.60E-02	5.89E-10	--	9.20E-02
	1,2-Dichlorobenzene	6	0	0	3.90E-02	--	--	7.80E-02
	1,2-Dichloroethane	6	0	0	3.60E-02	4.17E-10	--	7.20E-02
	1,2-Dichloropropane	6	0	0	3.30E-02	--	--	6.60E-02
	1,3,5-Trimethylbenzene	6	0	0	2.10E-02	--	--	4.20E-02
	1,3-Dichlorobenzene	6	0	0	4.25E-02	5.89E-10	--	8.50E-02
	1,3-Dichloropropane	6	0	0	2.95E-02	--	--	5.90E-02
	1,4-Dichlorobenzene	6	0	0	4.05E-02	--	--	8.10E-02
	2,2-Dichloropropane	6	0	0	4.80E-02	8.33E-10	--	9.60E-02
	Acetone	6	1	17	5.63E+00	1.30E+01	3.22E+01	6.40E-01
	Allyl chloride	6	0	0	1.25E-01	--	--	2.50E-01
	Benzene	6	0	0	2.10E-02	--	--	4.20E-02
	Bromobenzene	6	0	0	4.35E-02	8.33E-10	--	8.70E-02
	Bromochloromethane	6	0	0	4.10E-02	--	--	8.20E-02
	Bromoform	6	0	0	5.50E-02	--	--	1.10E-01
	Bromomethane	6	0	0	1.00E-01	1.67E-09	--	2.00E-01
	Carbon tetrachloride	6	0	0	3.95E-02	--	--	7.90E-02
	Chlorobenzene	6	0	0	3.30E-02	--	--	6.60E-02
	Chloroethane	6	0	0	6.00E-02	--	--	1.20E-01
	Chloroform	6	0	0	1.05E-01	--	--	2.10E-01
	Chloromethane	6	0	0	4.00E-02	--	--	8.00E-02
	cis-1,2-Dichloroethylene	6	0	0	6.00E-02	--	--	1.20E-01
	cis-1,3-Dichloropropylene	6	0	0	3.45E-02	--	--	6.90E-02
	Cumene	6	0	0	3.20E-02	--	--	6.40E-02
	Dibromochloromethane	6	0	0	2.40E-02	4.17E-10	--	4.80E-02
	Dichlorobromomethane	6	0	0	3.40E-02	--	--	6.80E-02
	Dichlorodifluoromethane	6	0	0	3.75E-02	--	--	7.50E-02
	Dichlorofluoromethane	6	0	0	2.70E-02	--	--	5.40E-02
	Ethyl ether	6	0	0	4.50E-02	5.89E-10	--	9.00E-02
	Ethylbenzene	6	0	0	3.75E-02	--	--	7.50E-02
	Hexachlorobutadiene	6	0	0	6.50E-02	--	--	1.30E-01
	m & p-Xylenes	6	0	0	5.50E-02	--	--	1.10E-01
	Methyl ethyl ketone	6	0	0	5.50E-01	9.42E-09	--	1.10E+00
	Methyl isobutyl ketone	6	0	0	4.00E-01	6.66E-09	--	8.00E-01
	Methylene bromide	6	0	0	7.00E-02	--	--	1.40E-01
	Methylene chloride	6	0	0	4.85E-02	5.89E-10	--	9.70E-02
	MTBE (Methyl tert-butyl ether)	6	0	0	2.35E-02	2.95E-10	--	4.70E-02

Table 2-8. OU3 Deep Groundwater Summary Statistics

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
Volatile Organics	Naphthalene	6	0	0	3.20E-02	--	--	6.40E-02
	n-Butyl benzene	6	0	0	8.00E-02	--	--	1.60E-01
	n-Propyl benzene	6	0	0	2.45E-02	5.10E-10	--	4.90E-02
	o-Chlorotoluene	6	0	0	4.20E-02	--	--	8.40E-02
	o-Xylene	6	0	0	2.20E-02	4.17E-10	--	4.40E-02
	p-Chlorotoluene	6	0	0	2.40E-02	4.17E-10	--	4.80E-02
	p-Isopropyltoluene	6	0	0	3.20E-02	--	--	6.40E-02
	sec-Butyl benzene	6	0	0	4.70E-02	5.89E-10	--	9.40E-02
	Styrene	6	0	0	2.80E-02	--	--	5.60E-02
	tert-Butyl benzene	6	0	0	2.55E-02	--	--	5.10E-02
	Tetrachloroethylene	6	0	0	6.50E-02	--	--	1.30E-01
	Tetrahydrofuran	6	0	0	7.50E-01	--	--	1.50E+00
	Toluene	6	5	83	6.20E-01	7.10E-01	2.00E+00	5.90E-02
	trans-1,2-Dichloroethylene	6	0	0	7.50E-02	--	--	1.50E-01
	trans-1,3-Dichloropropylene	6	0	0	2.20E-02	4.17E-10	--	4.40E-02
	Trichloroethylene	6	0	0	2.20E-02	4.17E-10	--	4.40E-02
	Trichlorofluoromethane	6	0	0	2.75E-02	--	--	5.50E-02
	Trichlorotrifluoroethane	6	0	0	6.50E-02	--	--	1.30E-01
	Vinyl chloride	6	0	0	4.90E-02	1.02E-09	--	9.80E-02
	Xylenes (total)	6	0	0	7.50E-02	--	--	1.50E-01

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of µg/L.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-9. CFR Bed Sediment Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	6	6	100	2.67E-07	2.01E-07	5.53E-07	--
	TEQ - Dioxins/Furans (ND=1/2RL)	6	6	100	6.31E-07	1.83E-07	8.56E-07	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	6	6	100	3.02E-07	1.97E-07	5.79E-07	--
PCBs	Aroclor-1016	2	0	0	5.63E-03	5.30E-04	--	1.13E-02
	Aroclor-1221	2	0	0	1.31E-02	1.24E-03	--	2.62E-02
	Aroclor-1232	2	0	0	5.83E-03	5.30E-04	--	1.17E-02
	Aroclor-1242	2	0	0	1.50E-02	1.41E-03	--	2.99E-02
	Aroclor-1248	2	0	0	9.65E-03	9.19E-04	--	1.93E-02
	Aroclor-1254	2	0	0	3.63E-03	3.18E-04	--	7.25E-03
	Aroclor-1260	2	0	0	3.70E-03	3.54E-04	--	7.40E-03
	Aroclor-1262	2	0	0	4.93E-03	4.60E-04	--	9.85E-03
	Aroclor-1268	2	0	0	3.38E-03	3.18E-04	--	6.75E-03
Total Metals	Aluminum	6	6	100	4.33E+03	1.17E+03	6.04E+03	8.60E+00
	Arsenic	6	6	100	6.17E+00	1.34E+00	7.70E+00	2.53E-01
	Barium	6	6	100	1.20E+02	2.19E+01	1.50E+02	1.65E-01
	Cadmium	6	6	100	4.63E-01	2.35E-01	7.60E-01	5.62E-02
	Chromium	6	6	100	5.28E+00	1.23E+00	7.10E+00	3.93E-01
	Cobalt	6	6	100	2.68E+00	4.31E-01	3.30E+00	5.10E-01
	Copper	6	6	100	5.31E+01	2.47E+01	8.33E+01	6.70E-01
	Iron	6	6	100	6.86E+03	1.06E+03	8.24E+03	5.14E+01
	Lead	6	6	100	1.42E+01	5.30E+00	2.13E+01	9.05E-02
	Manganese	6	6	100	4.12E+02	2.78E+02	8.32E+02	4.23E-01
	Mercury	6	6	100	1.59E-01	9.36E-02	3.00E-01	1.65E-02
	Nickel	6	6	100	4.37E+00	7.63E-01	5.40E+00	3.15E-01
	Silver	6	4	67	3.28E-01	1.93E-01	6.20E-01	2.43E-01
	Thallium	6	4	67	1.09E-01	5.28E-02	1.80E-01	9.05E-02
	Vanadium	6	6	100	9.37E+00	1.74E+00	1.20E+01	5.63E-01
	Zinc	6	6	100	1.43E+02	3.82E+01	1.92E+02	2.77E+00
Semivolatiles	1,2,4-Trichlorobenzene	2	0	0	1.65E-01	1.64E-01	--	3.31E-01
	1,2-Dichlorobenzene	2	0	0	6.46E-02	6.42E-02	--	1.29E-01
	1,2-Diphenylhydrazine	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	1,3-Dichlorobenzene	2	0	0	6.32E-02	6.27E-02	--	1.26E-01
	1,4-Dichlorobenzene	2	0	0	6.70E-02	6.65E-02	--	1.34E-01
	1-Methylnaphthalene	2	0	0	1.73E-01	1.72E-01	--	3.46E-01
	2,4,5-Trichlorophenol	2	0	0	1.20E-01	1.19E-01	--	2.40E-01
	2,4,6-Trichlorophenol	2	0	0	1.29E-01	1.28E-01	--	2.58E-01
	2,4-Dichlorophenol	2	0	0	1.89E-01	1.88E-01	--	3.78E-01
	2,4-Dimethylphenol	2	0	0	1.88E-01	1.87E-01	--	3.76E-01
	2,4-Dinitrophenol	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	2,4-Dinitrotoluene	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	2,6-Dinitrotoluene	2	0	0	8.58E-02	8.52E-02	--	1.72E-01
	2-Chloronaphthalene	2	0	0	1.57E-01	1.56E-01	--	3.14E-01
	2-Chlorophenol	2	0	0	2.34E-01	2.33E-01	--	4.68E-01
	2-Methylnaphthalene	2	0	0	1.80E-01	1.78E-01	--	3.59E-01
	2-Nitroaniline	2	0	0	1.09E-01	1.08E-01	--	2.17E-01
	2-Nitrophenol	2	0	0	1.72E-01	1.70E-01	--	3.43E-01
	3,3`-Dichlorobenzidine	2	0	0	1.40E-01	1.39E-01	--	2.80E-01
	3-Nitroaniline	2	0	0	1.03E-01	1.02E-01	--	2.05E-01
	4,6-Dinitro-o-cresol	2	0	0	2.00E-01	1.98E-01	--	3.99E-01
	4-Bromophenyl phenyl ether	2	0	0	1.07E-01	1.06E-01	--	2.13E-01
	4-Chloro-3-methylphenol	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	4-Chlorophenyl phenyl ether	2	0	0	1.15E-01	1.15E-01	--	2.31E-01
	4-Nitroaniline	2	0	0	8.78E-02	8.72E-02	--	1.76E-01
	4-Nitrophenol	2	0	0	1.05E-01	1.04E-01	--	2.10E-01
	Acenaphthene	2	0	0	1.16E-01	1.15E-01	--	2.31E-01
	Acenaphthylene	2	0	0	1.31E-01	1.30E-01	--	2.63E-01
	Anthracene	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Benzo(a)anthracene	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Benzo(a)pyrene	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Benzo(b)fluoranthene	2	0	0	1.27E-01	1.26E-01	--	2.54E-01
	Benzo(g,h,i)perylene	2	0	0	1.22E-01	1.21E-01	--	2.44E-01

Table 2-9. CFR Bed Sediment Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
Semivolatiles	Benzo(k)fluoranthene	2	0	0	1.28E-01	1.27E-01	--	2.57E-01
	bis(2-chloroethoxy)methane	2	0	0	1.96E-01	1.94E-01	--	3.92E-01
	bis(2-chloroethyl)ether	2	0	0	6.99E-02	6.94E-02	--	1.40E-01
	Bis(2-chloroisopropyl)ether	2	0	0	2.32E-01	2.30E-01	--	4.64E-01
	Bis(2-ethylhexyl)phthalate	2	0	0	1.72E-01	1.70E-01	--	3.43E-01
	Butyl benzyl phthalate	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Carbazole	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Chrysene	2	0	0	1.35E-01	1.34E-01	--	2.69E-01
	Dibenzo(a,h)anthracene	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Dibenzofuran	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Dibutyl phthalate	2	0	0	1.39E-01	1.38E-01	--	2.78E-01
	Diethyl phthalate	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Dimethyl phthalate	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Di-n-octyl phthalate	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Fluoranthene	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Fluorene	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Hexachlorobenzene	2	0	0	1.32E-01	1.31E-01	--	2.64E-01
	Hexachlorobutadiene	2	0	0	8.46E-02	8.40E-02	--	1.69E-01
	Hexachloroethane	2	0	0	6.38E-02	6.33E-02	--	1.28E-01
	Indeno(1,2,3-cd)pyrene	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Isophorone	2	0	0	1.60E-01	1.59E-01	--	3.20E-01
	m & p-cresols	2	0	0	2.01E-01	1.99E-01	--	4.01E-01
	Naphthalene	2	0	0	1.88E-01	1.87E-01	--	3.76E-01
	Nitrobenzene	2	0	0	2.03E-01	2.01E-01	--	4.06E-01
	N-Nitrosodimethylamine	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	N-Nitrosodi-n-propylamine	2	0	0	1.37E-01	1.36E-01	--	2.73E-01
	N-Nitrosodiphenylamine	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	o-Cresol	2	0	0	2.17E-01	2.16E-01	--	4.34E-01
	p-Chloroaniline	2	0	0	1.54E-01	1.53E-01	--	3.08E-01
	Pentachlorophenol	2	0	0	5.02E-01	4.99E-01	--	1.00E+00
	Phenanthrene	2	0	0	1.43E-01	1.42E-01	--	2.87E-01
	Phenol	2	0	0	2.19E-01	2.18E-01	--	4.38E-01
	Pyrene	2	0	0	1.26E-01	1.25E-01	--	2.53E-01

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of mg/kg.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-10. CFR Flood Fringe Sediment Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	3	3	100	3.40E-07	1.26E-07	4.22E-07	--
	TEQ - Dioxins/Furans (ND=1/2RL)	3	3	100	7.92E-07	6.83E-08	8.71E-07	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	3	3	100	3.75E-07	1.24E-07	4.55E-07	--
Total Metals	Aluminum	3	3	100	1.14E+04	1.78E+03	1.32E+04	4.90E+00
	Arsenic	3	3	100	1.76E+01	8.29E+00	2.72E+01	1.43E-01
	Barium	3	3	100	2.44E+02	1.55E+01	2.59E+02	9.40E-02
	Cadmium	3	3	100	1.63E+00	3.51E-01	2.00E+00	3.20E-02
	Chromium	3	3	100	1.29E+01	1.75E+00	1.47E+01	2.23E-01
	Cobalt	3	3	100	6.93E+00	7.51E-01	7.70E+00	2.90E-01
	Copper	3	3	100	2.07E+02	9.45E+01	3.13E+02	3.87E-01
	Iron	3	3	100	1.59E+04	2.15E+03	1.80E+04	2.92E+01
	Lead	3	3	100	4.36E+01	9.70E+00	5.32E+01	5.13E-02
	Manganese	3	3	100	6.41E+02	1.70E+02	7.68E+02	5.93E-01
	Mercury	3	3	100	2.33E-01	1.40E-01	3.90E-01	9.67E-03
	Nickel	3	3	100	1.20E+01	1.45E+00	1.34E+01	1.80E-01
	Silver	3	3	100	8.73E-01	3.20E-01	1.20E+00	1.40E-01
	Thallium	3	3	100	2.07E-01	2.52E-02	2.30E-01	5.13E-02
	Vanadium	3	3	100	1.86E+01	1.85E+00	2.04E+01	3.27E-01
	Zinc	3	3	100	4.01E+02	4.77E+01	4.56E+02	1.60E+00

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of mg/kg.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-11. CFR Surface Water Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	3	3	100	2.24E-09	4.84E-10	2.64E-09	--
	TEQ - Dioxins/Furans (ND=1/2RL)	3	3	100	1.59E-06	1.62E-07	1.71E-06	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	3	3	100	3.30E-07	4.84E-10	3.30E-07	--
PCBs	Aroclor-1016	2	0	0	2.25E-02	--	--	4.50E-02
	Aroclor-1221	2	0	0	9.75E-03	3.54E-04	--	1.95E-02
	Aroclor-1232	2	0	0	1.83E-02	3.54E-04	--	3.65E-02
	Aroclor-1242	2	0	0	1.40E-02	--	--	2.80E-02
	Aroclor-1248	2	0	0	6.00E-03	--	--	1.20E-02
	Aroclor-1254	2	0	0	7.75E-03	3.54E-04	--	1.55E-02
	Aroclor-1260	2	0	0	7.50E-03	--	--	1.50E-02
	Aroclor-1262	2	0	0	2.10E-02	--	--	4.20E-02
	Aroclor-1268	2	0	0	1.15E-02	--	--	2.30E-02
Total Metals	Aluminum	3	3	100	2.78E+01	2.79E+00	3.03E+01	3.00E+00
	Arsenic	3	3	100	2.17E+00	5.77E-02	2.20E+00	1.10E-01
	Barium	3	3	100	9.65E+01	2.89E+00	9.82E+01	8.10E-02
	Cadmium	3	0	0	1.20E-02	--	--	2.40E-02
	Chromium	3	0	0	8.50E-02	1.32E-09	--	1.70E-01
	Cobalt	3	0	0	6.50E-02	9.31E-10	--	1.30E-01
	Copper	3	3	100	1.63E+00	3.21E-01	2.00E+00	2.10E-01
	Iron	3	3	100	5.56E+01	6.70E+00	6.33E+01	1.37E+01
	Lead	3	3	100	1.37E-01	1.15E-02	1.50E-01	4.60E-02
	Manganese	3	3	100	1.29E+01	1.91E+00	1.51E+01	2.40E-01
	Mercury	3	0	0	1.10E-02	--	--	2.20E-02
	Nickel	3	2	67	1.50E-01	6.24E-02	2.00E-01	1.60E-01
	Silver	3	0	0	7.50E-02	1.32E-09	--	1.50E-01
	Thallium	3	0	0	7.50E-03	1.16E-10	--	1.50E-02
	Vanadium	3	3	100	6.33E-01	3.21E-02	6.70E-01	2.80E-01
	Zinc	3	3	100	2.87E+00	5.51E-01	3.50E+00	2.40E+00
Dissolved Metals	Aluminum	3	1	33	3.70E+00	3.81E+00	8.10E+00	3.00E+00
	Arsenic	3	3	100	2.10E+00	3.46E-01	2.50E+00	1.10E-01
	Barium	3	3	100	9.84E+01	1.27E+01	1.13E+02	8.10E-02
	Cadmium	3	0	0	1.20E-02	--	--	2.40E-02
	Calcium	3	3	100	3.15E+04	1.53E+02	3.17E+04	6.70E+01
	Chromium	3	3	100	2.80E-01	8.89E-02	3.80E-01	1.70E-01
	Cobalt	3	3	100	5.60E-01	1.66E-01	6.80E-01	1.30E-01
	Copper	3	3	100	9.07E-01	8.14E-02	1.00E+00	2.10E-01
	Iron	3	1	33	9.70E+00	4.94E+00	1.54E+01	1.37E+01
	Lead	3	2	67	1.14E-01	1.28E-01	2.60E-01	4.60E-02
	Magnesium	3	3	100	8.61E+03	3.06E+01	8.64E+03	2.00E+01
	Manganese	3	3	100	9.87E+00	2.11E+00	1.23E+01	2.40E-01
	Nickel	3	3	100	2.20E-01	6.93E-02	3.00E-01	1.60E-01
	Potassium	3	3	100	1.94E+03	5.57E+01	2.00E+03	1.26E+02
	Silver	3	0	0	7.50E-02	1.32E-09	--	1.50E-01
	Sodium	3	3	100	7.64E+03	1.96E+02	7.82E+03	3.33E+01
	Thallium	3	0	0	7.50E-03	1.16E-10	--	1.50E-02
	Vanadium	3	3	100	5.30E-01	1.73E-02	5.50E-01	2.80E-01
	Zinc	3	1	33	1.67E+00	8.08E-01	2.60E+00	2.40E+00
Miscellaneous Parameters	Chloride	3	3	100	3.80E+03	--	3.80E+03	7.80E+01
	Fluoride	3	3	100	1.80E+02	1.00E+01	1.90E+02	3.90E+01
	Nitrogen, NO2 plus NO3	3	3	100	8.10E+01	1.21E+01	9.20E+01	4.50E+00
	Phosphorus (as P)	3	3	100	2.00E+01	--	2.00E+01	1.00E+00
	Sulfate	3	3	100	2.14E+04	7.55E+02	2.22E+04	1.00E+02

Table 2-11. CFR Surface Water Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average MDL
Semivolatiles	1,2,4-Trichlorobenzene	2	0	0	9.50E-01	--	--	1.90E+00
	1,2-Dichlorobenzene	2	0	0	9.50E-01	--	--	1.90E+00
	1,2-Diphenylhydrazine	2	0	0	1.25E+00	--	--	2.50E+00
	1,3-Dichlorobenzene	2	0	0	8.00E-01	--	--	1.60E+00
	1,4-Dichlorobenzene	2	0	0	9.50E-01	--	--	1.90E+00
	1-Methylnaphthalene	2	0	0	1.05E+00	--	--	2.10E+00
	2,4,5-Trichlorophenol	2	0	0	1.10E+00	--	--	2.20E+00
	2,4,6-Trichlorophenol	2	0	0	1.10E+00	--	--	2.20E+00
	2,4-Dichlorophenol	2	0	0	1.15E+00	--	--	2.30E+00
	2,4-Dimethylphenol	2	0	0	3.40E+00	--	--	6.80E+00
	2,4-Dinitrophenol	2	0	0	1.40E+00	--	--	2.80E+00
	2,4-Dinitrotoluene	2	0	0	1.05E+00	--	--	2.10E+00
	2,6-Dinitrotoluene	2	0	0	1.15E+00	--	--	2.30E+00
	2-Chloronaphthalene	2	0	0	1.10E+00	--	--	2.20E+00
	2-Chlorophenol	2	0	0	1.10E+00	--	--	2.20E+00
	2-Methylnaphthalene	2	0	0	1.05E+00	--	--	2.10E+00
	2-Nitroaniline	2	0	0	1.40E+00	--	--	2.80E+00
	2-Nitrophenol	2	0	0	1.10E+00	--	--	2.20E+00
	3,3`-Dichlorobenzidine	2	0	0	2.45E+00	--	--	4.90E+00
	3-Nitroaniline	2	0	0	2.50E+00	--	--	5.00E+00
	4,6-Dinitro-o-cresol	2	0	0	1.75E+00	--	--	3.50E+00
	4-Bromophenyl phenyl ether	2	0	0	1.20E+00	--	--	2.40E+00
	4-Chloro-3-methylphenol	2	0	0	8.00E-01	--	--	1.60E+00
	4-Chlorophenyl phenyl ether	2	0	0	7.00E-01	--	--	1.40E+00
	4-Nitroaniline	2	0	0	2.20E+00	--	--	4.40E+00
	4-Nitrophenol	2	0	0	1.70E+00	--	--	3.40E+00
	Acenaphthene	2	0	0	8.00E-01	--	--	1.60E+00
	Acenaphthylene	2	0	0	1.10E+00	--	--	2.20E+00
	Anthracene	2	0	0	1.25E+00	--	--	2.50E+00
	Benzo(a)anthracene	2	0	0	2.55E+00	--	--	5.10E+00
	Benzo(a)pyrene	2	0	0	1.20E+00	--	--	2.40E+00
	Benzo(b)fluoranthene	2	0	0	1.25E+00	--	--	2.50E+00
	Benzo(g,h,i)perylene	2	0	0	1.25E+00	--	--	2.50E+00
	Benzo(k)fluoranthene	2	0	0	1.40E+00	--	--	2.80E+00
	bis(2-chloroethoxy)methane	2	0	0	7.50E-01	--	--	1.50E+00
	bis(2-chloroethyl)ether	2	0	0	1.15E+00	--	--	2.30E+00
	Bis(2-chloroisopropyl)ether	2	0	0	1.15E+00	--	--	2.30E+00
	Bis(2-ethylhexyl)phthalate	2	0	0	1.20E+00	--	--	2.40E+00
	Butyl benzyl phthalate	2	0	0	9.50E-01	--	--	1.90E+00
	Carbazole	2	0	0	1.35E+00	--	--	2.70E+00
	Chrysene	2	0	0	1.15E+00	--	--	2.30E+00
	Dibenzo(a,h)anthracene	2	0	0	9.00E-01	--	--	1.80E+00
	Dibenzofuran	2	0	0	1.15E+00	--	--	2.30E+00
	Dibutyl phthalate	2	0	0	1.20E+00	--	--	2.40E+00
	Diethyl phthalate	2	0	0	1.25E+00	--	--	2.50E+00
	Dimethyl phthalate	2	0	0	1.15E+00	--	--	2.30E+00
	Di-n-octyl phthalate	2	0	0	8.50E-01	--	--	1.70E+00
	Fluoranthene	2	0	0	1.25E+00	--	--	2.50E+00
	Fluorene	2	0	0	1.20E+00	--	--	2.40E+00
	Hexachlorobenzene	2	0	0	1.30E+00	--	--	2.60E+00
	Hexachlorobutadiene	2	0	0	8.50E-01	--	--	1.70E+00
	Hexachloroethane	2	0	0	8.50E-01	--	--	1.70E+00
	Indeno(1,2,3-cd)pyrene	2	0	0	9.00E-01	--	--	1.80E+00
	Isophorone	2	0	0	8.00E-01	--	--	1.60E+00
	m & p-cresols	2	0	0	1.15E+00	--	--	2.30E+00
	Naphthalene	2	0	0	1.00E+00	--	--	2.00E+00
	Nitrobenzene	2	0	0	1.25E+00	--	--	2.50E+00
	N-Nitrosodimethylamine	2	0	0	1.15E+00	--	--	2.30E+00
	N-Nitrosodi-n-propylamine	2	0	0	1.15E+00	--	--	2.30E+00
	N-Nitrosodiphenylamine	2	0	0	1.95E+00	--	--	3.90E+00
	o-Cresol	2	0	0	1.00E+00	--	--	2.00E+00
	p-Chloroaniline	2	0	0	1.80E+00	--	--	3.60E+00
	Pentachlorophenol	2	0	0	1.10E+00	--	--	2.20E+00
	Phenanthrene	2	0	0	1.25E+00	--	--	2.50E+00
	Phenol	2	0	0	1.10E+00	--	--	2.20E+00
	Pyrene	2	0	0	1.25E+00	--	--	2.50E+00

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]All concentrations reported in units of µg/L.

[b]Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 2-12. Fish Tissue Summary Statistics[a]

Analysis	Contaminant	N	N Detect	DF (%)	Average Concentration[b]	Standard Deviation[b]	Maximum Detected Concentration	Average DL
TEQ	TEQ (ND=0)	7	7	100%	7.5E-08	5.9E-08	1.8E-07	--
	TEQ (ND=1/2 DL)	7	7	100%	1.6E-07	5.1E-08	2.4E-07	--
PCBs	Aroclor 1016	7	0	0%	1.6E-02	9.3E-04	0.0E+00	3.3E-02
	Aroclor 1221	7	0	0%	1.6E-02	9.3E-04	0.0E+00	3.3E-02
	Aroclor 1232	7	0	0%	1.6E-02	9.3E-04	0.0E+00	3.3E-02
	Aroclor 1242	7	0	0%	1.6E-02	9.3E-04	0.0E+00	3.3E-02
	Aroclor 1248	7	0	0%	1.6E-02	9.3E-04	0.0E+00	3.3E-02
	Aroclor 1254	7	2	29%	2.4E-02	1.8E-02	6.7E-02	3.3E-02
	Aroclor 1260	7	0	0%	1.6E-02	9.3E-04	0.0E+00	3.3E-02
	Aroclor 1262	7	0	0%	1.6E-02	9.3E-04	0.0E+00	3.3E-02
	Aroclor 1268	7	0	0%	1.6E-02	9.3E-04	0.0E+00	3.3E-02
Metals	Mercury	7	7	100%	1.1E-01	9.0E-02	2.5E-01	1.3E-02
	Selenium	7	6	86%	1.2E-01	2.9E-02	1.4E-01	9.3E-02

TEQ = toxicity equivalent; ND = non-detect; DL = detection imit; PCB = polychlorinated biphenyl; DF = detection frequency

[a]Tissue data from Schmetterling and Selch (2013). Concentrations are reported in units of mg/kg-wet weight.

[b]Non-detects were evaluated at 1/2 the DL. The Estimated Detection Limit (EDL) was used as the DL if available. For Aroclors and metals, the Reporting Limit (RL) was used as the DL when an EDL value was not available.

Table 3-1. Summary of Exposure Pathways Selected for Quantitative Evaluation

Exposed Population	Exposure Pathways
Hypothetical future residents (adults and children age 0-6 years)	• Incidental ingestion of surface soil • Dermal contact with surface soil • Ingestion of groundwater as drinking water
Current/Hypothetical future commercial/industrial workers	• Incidental ingestion of surface soil • Dermal contact with surface soil • Ingestion of groundwater as drinking water
Hypothetical future construction workers	• Incidental ingestion of surface and subsurface soil • Dermal contact with surface and subsurface soil • Inhalation of soil particulates created by mechanical disturbances of surface soils
Current/Hypothetical future hikers (adults and older children age 6-16 years)	• Incidental ingestion of surface soil and sediment • Incidental ingestion of surface water • Dermal contact with surface soil, sediment and surface water
Current/Hypothetical future campers (adults and older children age 6-16 years)	• Incidental ingestion of surface soil and sediment • Ingestion of surface water as drinking water • Dermal contact with surface soil, sediment and surface water
Current/Hypothetical future fishers (adults and older children age 6-16 years)	• Incidental ingestion of surface soil and sediment • Incidental ingestion of surface water • Ingestion of fish • Dermal contact with surface soil, sediment and surface water

Table 3-2. MDEQ Background Surface Soil Summary Statistics[a,b]

Analysis	Contaminant	N	N Detect	Detection Frequency (%)	Average Concentration[c]	Standard Deviation[c]	Maximum Detected Concentration	Average RL
TEQ	Rural, TEQ (ND=1/2RL)	58	52	90	7.17E-07	4.77E-07	1.85E-06	4.46E-07
	Urban, TEQ (ND=1/2RL)	59	58	98	1.59E-06	1.64E-06	9.34E-06	1.24E-07
Metals	Aluminum	112	112	100	1.55E+04	5.76E+03	3.37E+04	--
	Antimony	112	89	79	1.95E-01	1.88E-01	1.20E+00	1.00E-01
	Arsenic	112	112	100	1.14E+01	1.16E+01	8.19E+01	--
	Barium	112	112	100	1.96E+02	1.06E+02	5.75E+02	--
	Beryllium	112	112	100	6.85E-01	2.46E-01	1.40E+00	--
	Cadmium	112	97	87	2.89E-01	2.03E-01	1.10E+00	1.00E-01
	Chromium	112	112	100	1.96E+01	1.22E+01	1.30E+02	--
	Cobalt	112	112	100	7.33E+00	2.76E+00	1.64E+01	--
	Copper	112	112	100	1.76E+01	1.01E+01	7.07E+01	--
	Iron	112	112	100	1.82E+04	6.78E+03	5.92E+04	--
	Lead	112	112	100	1.53E+01	6.37E+00	3.69E+01	--
	Manganese	112	112	100	5.08E+02	3.69E+02	2.92E+03	--
	Mercury	112	1	1	2.54E-02	4.06E-03	6.80E-02	5.00E-02
	Nickel	112	112	100	1.66E+01	9.50E+00	8.15E+01	--
	Selenium	112	88	79	3.83E-01	2.43E-01	1.60E+00	2.00E-01
	Silver	112	30	27	1.12E-01	8.09E-02	5.00E-01	1.74E-01
	Thallium	112	112	100	2.48E-01	1.12E-01	8.40E-01	--
	Vanadium	112	112	100	3.09E+01	1.35E+01	9.22E+01	--
	Zinc	112	112	100	6.05E+01	2.33E+01	1.47E+02	--

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit

[a] Data summarized in MDEQ (2011; 2013); USEPA received raw data files from personal correspondence with MDEQ.

[b] All concentrations reported in units of mg/kg.

[c] Non-detects evaluated at 1/2 the RL when calculating average and standard deviation.

Table 3-3. Background Groundwater Summary Statistics[a,b]

Analysis	Contaminant	N	N Detect	Detection Frequency (%)	Average Concentration[c]	Standard Deviation[c]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	12	1	8	1.52E-08	5.28E-08	1.83E-07	--
	TEQ - Dioxins/Furans (ND=1/2RL)	12	1	8	1.87E-06	7.00E-07	9.96E-07	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	12	1	8	4.26E-07	1.21E-07	4.96E-07	--
PCBs	Aroclor-1016	6	0	0	1.83E-02	2.84E-03	--	3.63E-02
	Aroclor-1221	6	0	0	1.79E-02	4.28E-03	--	3.58E-02
	Aroclor-1232	6	0	0	1.72E-02	3.72E-03	--	3.42E-02
	Aroclor-1242	6	0	0	2.30E-02	4.22E-03	--	4.58E-02
	Aroclor-1248	6	0	0	1.59E-02	4.78E-03	--	3.18E-02
	Aroclor-1254	6	0	0	1.90E-02	5.45E-03	--	3.80E-02
	Aroclor-1260	6	0	0	1.50E-02	4.00E-03	--	3.00E-02
	Aroclor-1262	6	0	0	1.93E-02	4.08E-03	--	3.83E-02
	Aroclor-1268	6	0	0	2.11E-02	7.10E-03	--	4.22E-02
Total Metals	Aluminum	6	5	83	1.08E+01	1.22E+01	3.46E+01	1.85E+00
	Antimony	6	4	67	1.43E-01	5.27E-02	2.20E-01	8.30E-02
	Arsenic	6	6	100	2.36E+00	1.82E+00	5.10E+00	1.37E-01
	Barium	6	6	100	2.33E+02	7.57E+01	3.59E+02	5.93E-02
	Beryllium	1	0	0	3.30E-02	#DIV/0!	--	6.60E-02
	Cadmium	6	0	0	9.42E-03	4.59E-03	--	1.88E-02
	Calcium	6	6	100	5.37E+04	8.92E+03	6.35E+04	6.23E+01
	Chromium	6	5	83	3.07E-01	1.46E-01	5.20E-01	1.52E-01
	Cobalt	6	3	50	5.43E-02	4.10E-02	5.00E-02	8.07E-02
	Copper	6	6	100	2.60E+00	2.01E+00	6.60E+00	3.37E-01
	Iron	6	2	33	2.49E+01	3.52E+01	9.57E+01	1.48E+01
	Lead	6	3	50	9.75E-02	1.98E-01	5.00E-01	2.03E-02
	Magnesium	6	6	100	1.96E+04	3.35E+03	2.37E+04	4.38E+01
	Manganese	6	5	83	1.05E+00	1.18E+00	2.80E+00	1.26E-01
	Mercury	6	0	0	2.80E-02	7.35E-03	--	5.60E-02
	Nickel	6	2	33	2.53E-01	3.25E-01	8.00E-01	1.24E-01
	Potassium	6	6	100	2.77E+03	6.55E+02	3.52E+03	3.13E+02
	Selenium	6	3	50	2.09E-01	1.47E-01	4.50E-01	1.57E-01
	Silver	6	1	17	2.30E-02	3.17E-02	1.10E-02	4.38E-02
	Sodium	6	6	100	1.69E+04	5.38E+03	2.33E+04	1.21E+02
	Thallium	6	0	0	6.82E-03	5.01E-03	--	1.36E-02
	Vanadium	6	6	100	1.12E+00	4.54E-01	1.60E+00	1.37E-01
	Zinc	6	4	67	1.14E+01	2.51E+01	6.27E+01	1.07E+00
Volatile Organics	Chlorobenzene	4	0	0	5.35E-02	4.10E-02	--	1.07E-01

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection imit; DL = dioxin-like; PCB = polychlorinated biphenyl

[a] Data collected from the County well, SMW1, SMW5, SMW6 and deep well WFBW.

[b] All concentrations reported in units of µg/L.

[c] Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 3-4. Background Sediment Summary Statistics[a,b]

Panel A: Bed Sediments

Analysis	Contaminant	N	N Detect	Detection Frequency (%)	Average Concentration[c]	Standard Deviation[c]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	11	11	100	4.3E-07	4.5E-07	1.2E-06	--
	TEQ - Dioxins/Furans (ND=1/2RL)	11	11	100	7.4E-07	4.0E-07	1.5E-06	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	11	11	100	4.6E-07	4.4E-07	1.3E-06	--
Metals	Aluminum	11	11	100	6.7E+03	2.7E+03	1.2E+04	7.1E+00
	Arsenic	37	37	100	1.9E+01	1.2E+01	6.0E+01	2.1E-01
	Barium	11	11	100	1.7E+02	7.9E+01	2.8E+02	1.4E-01
	Cadmium	37	36	97	1.5E+00	1.0E+00	5.3E+00	4.6E-02
	Chromium	37	37	100	1.4E+01	4.9E+00	2.2E+01	3.2E-01
	Cobalt	11	11	100	4.3E+00	1.5E+00	6.4E+00	4.2E-01
	Copper	37	37	100	2.2E+02	1.6E+02	6.7E+02	5.6E-01
	Iron	37	37	100	1.7E+04	1.0E+04	5.8E+04	4.2E+01
	Lead	37	37	100	3.9E+01	2.5E+01	1.3E+02	7.4E-02
	Manganese	37	37	100	7.9E+02	6.1E+02	2.5E+03	2.4E-01
	Mercury	11	10	91	2.0E-01	1.7E-01	4.6E-01	1.4E-02
	Nickel	37	37	100	9.4E+00	3.2E+00	1.6E+01	2.6E-01
	Silver	11	9	82	4.5E-01	3.4E-01	1.1E+00	2.0E-01
	Thallium	11	10	91	1.3E-01	6.3E-02	2.4E-01	7.4E-02
	Vanadium	11	11	100	1.5E+01	4.7E+00	2.1E+01	4.7E-01
	Zinc	37	37	100	4.3E+02	2.3E+02	1.1E+03	3.6E+00

Panel B: Flood Fringe Sediments

Analysis	Contaminant	N	N Detect	Detection Frequency (%)	Average Concentration[c]	Standard Deviation[c]	Maximum Detected Concentration	Average MDL
TEQ	TEQ - Dioxins/Furans (ND=0)	8	8	100	6.2E-07	8.8E-07	2.3E-06	--
	TEQ - Dioxins/Furans (ND=1/2RL)	8	8	100	1.0E-06	7.2E-07	2.4E-06	--
	TEQ - Dioxins/Furans (ND=1/2MDL)	8	8	100	6.5E-07	8.7E-07	2.3E-06	--
Metals	Aluminum	8	8	100	7.2E+03	1.7E+03	9.3E+03	4.6E+00
	Arsenic	8	8	100	1.9E+01	1.4E+01	4.7E+01	1.4E-01
	Barium	8	8	100	2.1E+02	5.7E+01	2.7E+02	8.9E-02
	Cadmium	8	8	100	1.4E+00	8.4E-01	3.1E+00	3.0E-02
	Chromium	8	8	100	8.7E+00	2.0E+00	1.1E+01	2.1E-01
	Cobalt	8	8	100	5.0E+00	1.4E+00	6.8E+00	2.7E-01
	Copper	8	8	100	2.1E+02	1.1E+02	3.9E+02	3.6E-01
	Iron	8	8	100	1.1E+04	2.5E+03	1.4E+04	2.7E+01
	Lead	8	8	100	4.4E+01	2.3E+01	8.5E+01	4.8E-02
	Manganese	8	8	100	3.9E+02	1.9E+02	7.3E+02	2.2E-01
	Mercury	8	8	100	2.7E-01	1.5E-01	5.3E-01	8.9E-03
	Nickel	8	8	100	8.5E+00	2.4E+00	1.1E+01	1.7E-01
	Silver	8	7	88	8.7E-01	4.5E-01	1.4E+00	1.3E-01
	Thallium	8	8	100	1.6E-01	4.6E-02	2.3E-01	4.8E-02
	Vanadium	8	8	100	1.4E+01	3.9E+00	2.0E+01	3.1E-01
	Zinc	8	8	100	4.2E+02	2.1E+02	7.6E+02	3.7E+00

TEQ = toxicity equivalent; ND = non-detect; RL = reporting limit; MDL = method detection limit

[a] Data collected from upstream locations within the CFR.

[b] All concentrations reported in units of mg/kg.

[c] Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 3-5. Background Surface Water Summary Statistics[a,b]

Analysis	Contaminant	N	N Detect	Detection Frequency (%)	Average Concentration[c]	Standard Deviation[c]	Maximum Detected Concentration	Average MDL
Total Metals	Aluminum	5	4	80	2.7E+01	1.6E+01	4.2E+01	3.0E+00
	Arsenic	74	74	100	8.8E+00	1.0E+01	7.9E+01	1.4E-01
	Barium	5	5	100	1.3E+02	7.4E+01	2.5E+02	8.1E-02
	Cadmium	74	58	78	1.5E-01	3.3E-01	2.2E+00	3.0E-02
	Chromium	5	0	0	8.5E-02	0.0E+00	--	1.7E-01
	Cobalt	5	0	0	6.5E-02	0.0E+00	--	1.3E-01
	Copper	74	74	100	2.4E+01	5.0E+01	3.3E+02	5.4E-01
	Iron	74	73	99	8.0E+02	2.1E+03	1.4E+04	6.4E+00
	Lead	74	72	97	4.3E+00	1.1E+01	7.8E+01	3.3E-02
	Manganese	74	74	100	8.7E+01	1.8E+02	1.2E+03	3.9E-01
	Mercury	5	3	60	2.2E-02	1.0E-02	3.0E-02	2.2E-02
	Nickel	5	3	60	1.5E-01	6.6E-02	2.3E-01	1.6E-01
	Silver	5	0	0	7.5E-02	0.0E+00	--	1.5E-01
	Thallium	5	0	0	7.5E-03	0.0E+00	--	1.5E-02
	Vanadium	5	5	100	5.8E-01	1.7E-01	7.4E-01	2.8E-01
	Zinc	74	72	97	3.5E+01	8.6E+01	5.8E+02	2.0E+00

MDL = method detection imit

[a] Data collected from upstream locations within the CFR.

[b] All concentrations reported in units of µg/L.

[c] Non-detects evaluated at 1/2 the MDL when calculating average and standard deviation.

Table 3-6. OU3 Upland Soil COPC Screen[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]	COPC SELECTION STEPS: Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]: Is MDL > RBC?	Background[d]: Are site concentrations > background?	OU3 UPLAND SOIL COPCs: COPC	Not a COPC	Source of Uncertainty
TEQ	**TEQ - Dioxins/Furans (ND=1/2MDL)**	100	7.56E-04	--	5.1E-06 NC	yes	yes	yes		yes	X		
PCBs	Aroclor-1016	0	--	1.59E-02	4.1E-01 NC	yes	no		no			X	
	Aroclor-1221	0	--	1.20E-02	2.0E-01 C	yes	no		no			X	
	Aroclor-1232	0	--	1.69E-02	1.7E-01 C	yes	no		no			X	
	Aroclor-1242	0	--	1.74E-02	2.3E-01 C	yes	no		no			X	
	Aroclor-1248	0	--	1.09E-02	2.3E-01 C	yes	no		no			X	
	Aroclor-1254	3	1.17E-01	1.29E-02	1.2E-01 NC	yes	no		no			X	
	Aroclor-1260	3	1.00E-01	1.33E-02	2.4E-01 C	yes	no		no			X	
	Aroclor-1262	0	--	1.41E-02		no							X
	Aroclor-1268	0	--	8.80E-03		no							X
Total Metals	**Aluminum**	100	2.10E+04	5.67E+00	7.7E+03 NC	yes	yes	yes		no		X	
	Antimony	57	3.90E+00	1.60E-01	3.1E+00 NC	yes	yes	yes		yes	X		
	Arsenic	100	4.28E+01	2.37E-01	6.8E-01 C	yes	yes	yes		no		X	
	Barium	100	1.45E+03	2.24E-01	1.5E+03 NC	yes	yes	no				X	
	Beryllium	75	1.20E+00	9.01E-02	1.6E+01 NC	yes	yes	no				X	
	Cadmium	87	8.30E+00	4.30E-02	7.1E+00 NC	yes	yes	yes		yes	X		
	Calcium	100	4.98E+05	6.85E+01	3.6E+06 EN	yes	yes	no				X	
	Chromium	100	5.82E+01	2.23E-01	3.0E-01 C	yes	yes	yes		no		X	
	Cobalt	99	1.10E+01	2.67E-01	2.3E+00 NC	yes	yes	yes		no		X	
	Copper	100	8.94E+01	5.96E-01	3.1E+02 NC	yes	yes	no				X	
	Iron	100	2.08E+04	3.08E+01	5.5E+03 NC	yes	yes	yes		no		X	
	Lead	100	1.04E+02	4.19E-02	4.0E+02 NC	yes	yes	no				X	
	Magnesium	100	2.93E+04	1.14E+01	4.6E+05 EN	yes	yes	no				X	
	Manganese	100	2.70E+03	4.32E-01	1.8E+02 NC	yes	yes	yes		no		X	
	Mercury	83	8.00E+00	1.19E-02	2.3E+00 NC	yes	yes	yes		yes	X		
	Nickel	100	5.87E+01	2.60E-01	1.5E+02 NC	yes	yes	no				X	
	Potassium	93	9.21E+03	4.19E+01	1.4E+07 EN	yes	yes	no				X	
	Selenium	38	1.60E+00	3.24E-01	3.9E+01 NC	yes	yes	no				X	
	Silver	46	1.70E+00	2.32E-01	3.9E+01 NC	yes	yes	no				X	
	Sodium	95	8.90E+03	5.06E+01	4.7E+06 EN	yes	yes	no				X	
	Thallium	85	9.60E-01	3.92E-02	7.8E-02 NC	yes	yes	yes		no		X	
	Vanadium	100	1.19E+02	3.56E-01	3.9E+01 NC	yes	yes	yes		no		X	
	Zinc	100	6.86E+02	1.95E+00	2.3E+03 NC	yes	yes	no				X	

DF = Detection Frequency; TEQ = Toxicity Equivalence; PCBs = Polychlorinated Biphenyls; ND = non-detect; MDL = method detection limit; EN = essential nutrient.

Bolded contaminants are those where the maximum detected concentration exceeds the respective RBC.

[a]Concentrations in units of mg/kg.

[b]Risk-based concentrations are based on USEPA's generic residential soil RSL values (November 2017) using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value).

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

Table 3-7. OU3 Floodplain Soil COPC Screen[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]	COPC SELECTION STEPS					OU3 FLOODPLAIN SOIL COPCs		
						Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]: Is MDL > RBC?	Background[d]: Are site concentrations > background?	COPC	Not a COPC	Source of Uncertainty
TEQ	**TEQ - Dioxins/Furans (ND=1/2MDL)**	100	1.02E-04	--	5.1E-06 NC	yes	yes	yes		yes	X		
PCBs	Aroclor-1016	0	--	1.18E-02	4.1E-01 NC	yes	no		no			X	
	Aroclor-1221	0	--	9.13E-03	2.0E-01 C	yes	no		no			X	
	Aroclor-1232	0	--	1.67E-02	1.7E-01 C	yes	no		no			X	
	Aroclor-1242	0	--	1.52E-02	2.3E-01 C	yes	no		no			X	
	Aroclor-1248	0	--	7.70E-03	2.3E-01 C	yes	no		no			X	
	Aroclor-1254	0	--	1.26E-02	1.2E-01 NC	yes	no		no			X	
	Aroclor-1260	0	--	8.85E-03	2.4E-01 C	yes	no		no			X	
	Aroclor-1262	0	--	1.43E-02		no							X
	Aroclor-1268	0	--	8.15E-03		no							X
Total Metals	**Aluminum**	100	2.15E+04	4.30E+00	7.7E+03 NC	yes	yes	yes		no		X	
	Antimony	33	4.70E-01	1.67E-01	3.1E+00 NC	yes	yes	no				X	
	Arsenic	100	1.49E+01	1.90E-01	6.8E-01 C	yes	yes	yes		no		X	
	Barium	100	2.84E+03	3.84E-01	1.5E+03 NC	yes	yes	yes		yes	X		
	Beryllium	100	9.50E-01	7.85E-02	1.6E+01 NC	yes	yes	no				X	
	Cadmium	84	5.10E+00	3.63E-02	7.1E+00 NC	yes	yes	no				X	
	Calcium	100	2.48E+04	1.85E+01	3.6E+06 EN	yes	yes	no				X	
	Chromium	100	4.52E+01	1.98E-01	3.0E-01 C	yes	yes	yes		no		X	
	Cobalt	100	7.10E+00	2.40E-01	2.3E+00 NC	yes	yes	yes		no		X	
	Copper	100	2.08E+02	3.68E-01	3.1E+02 NC	yes	yes	no				X	
	Iron	100	2.29E+04	2.69E+01	5.5E+03 NC	yes	yes	yes		no		X	
	Lead	100	3.53E+01	4.49E-02	4.0E+02 NC	yes	yes	no				X	
	Magnesium	100	8.63E+03	4.53E+00	4.6E+05 EN	yes	yes	no				X	
	Manganese	100	1.80E+03	3.58E-01	1.8E+02 NC	yes	yes	yes		no		X	
	Mercury	91	5.30E+00	1.96E-02	2.3E+00 NC	yes	yes	yes		yes	X		
	Nickel	100	1.45E+01	1.83E-01	1.5E+02 NC	yes	yes	no				X	
	Potassium	100	4.11E+03	1.88E+01	1.4E+07 EN	yes	yes	no				X	
	Selenium	20	7.30E-01	2.83E-01	3.9E+01 NC	yes	yes	no				X	
	Silver	63	1.80E+00	1.80E-01	3.9E+01 NC	yes	yes	no				X	
	Sodium	100	1.84E+03	1.54E+01	4.7E+06 EN	yes	yes	no				X	
	Thallium	91	2.20E-01	4.36E-02	7.8E-02 NC	yes	yes	yes		no		X	
	Vanadium	100	4.62E+01	3.53E-01	3.9E+01 NC	yes	yes	yes		no		X	
	Zinc	100	4.13E+02	1.57E+00	2.3E+03 NC	yes	yes	no				X	

DF = Detection Frequency; TEQ = Toxicity Equivalence; PCBs = Polychlorinated Biphenyls; ND = non-detect; MDL = method detection limit; EN = essential nutrient.

Bolded contaminants are those where the maximum detected concentration exceeds the respective RBC.

[a]Concentrations in units of mg/kg.

[b]Risk-based concentrations are based on USEPA's generic residential soil RSL values (November 2017) using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value).

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency ≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

Table 3-8. OU3 Groundwater COPC Screening[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]		COPC SELECTION STEPS: Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]: Is MDL > RBC?	Background[d]: Are site concentrations > background?	OU3 GROUNDWATER COPCs: COPC	Not a COPC	Source of Uncertainty
TEQ	**TEQ (ND = 1/2 MDL)**	84	6.81E-06	--	1.2E-06	NC	yes	yes	yes		yes	X		
PCBs	Aroclor-1016	0	--	3.69E-02	1.4E-01	NC	yes	no		no			X	
	Aroclor-1221	0	--	3.75E-02	4.7E-03	C	yes	no		yes			X	
	Aroclor-1232	0	--	3.73E-02	4.7E-03	C	yes	no		yes			X	
	Aroclor-1242	0	--	4.94E-02	7.8E-03	C	yes	no		yes			X	
	Aroclor-1248	0	--	3.39E-02	7.8E-03	C	yes	no		yes			X	
	Aroclor-1254	0	--	4.21E-02	7.8E-03	C	yes	no		yes			X	
	Aroclor-1260	15	3.10E-01	3.38E-02	7.8E-03	C	yes	yes	yes		no		X	
	Aroclor-1262	0	--	3.73E-02			no							X
	Aroclor-1268	0	--	4.31E-02			no							X
Total Metals	**Aluminum**	100	1.28E+04	1.85E+00	2.0E+03	NC	yes	yes	yes		yes	X		
	Antimony	58	2.50E+00	8.56E-02	7.8E-01	NC	yes	yes	yes		no		X	
	Arsenic	100	5.43E+01	1.83E-01	5.2E-02	C	yes	yes	yes		yes	X		
	Barium	100	9.60E+02	5.98E-01	3.8E+02	NC	yes	yes	yes		no		X	
	Beryllium	33	1.00E-01	6.60E-02	2.5E+00	NC	yes	yes	no				X	
	Cadmium	35	9.10E-01	1.89E-02	9.2E-01	NC	yes	yes	no				X	
	Calcium	100	3.31E+05	9.01E+01	1.0E+06	EN	yes	yes	no				X	
	Chromium	97	1.56E+01	1.57E-01	3.5E-02	C	yes	yes	yes		yes	X		
	Cobalt	84	9.84E+01	1.23E-01	6.0E-01	NC	yes	yes	yes		yes	X		
	Copper	90	2.10E+01	2.69E-01	8.0E+01	NC	yes	yes	no				X	
	Iron	97	4.49E+04	1.92E+01	1.4E+03	NC	yes	yes	yes		yes	X		
	Lead	90	3.50E+00	3.34E-02	1.5E+01	NC	yes	yes	no				X	
	Magnesium	100	1.50E+05	7.44E+01	1.3E+05	EN	yes	yes	yes		no		X	
	Manganese	100	5.15E+04	2.92E+00	4.3E+01	NC	yes	yes	yes		yes	X		
	Mercury	6	4.00E-01	4.40E-02	5.7E-01	NC	yes	yes	no				X	
	Nickel	97	9.06E+01	1.42E-01	3.9E+01	NC	yes	yes	yes		yes	X		
	Potassium	100	1.26E+05	4.52E+02	4.0E+06	EN	yes	yes	no				X	
	Selenium	35	1.50E+00	1.55E-01	1.0E+01	NC	yes	yes	no				X	
	Silver	16	2.00E-01	9.20E-03	9.4E+00	NC	yes	yes	no				X	
	Sodium	100	9.85E+05	6.36E+02	1.3E+06	EN	yes	yes	no				X	
	Thallium	13	2.20E-01	3.54E-02	2.0E-02	NC	yes	yes	yes		no		X	
	Vanadium	94	1.20E+02	1.88E-01	8.6E+00	NC	yes	yes	yes		yes	X		
	Zinc	97	1.36E+02	1.31E+00	6.0E+02	NC	yes	yes	no				X	

Table 3-8. OU3 Groundwater COPC Screening[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]		COPC SELECTION STEPS					OU3 GROUNDWATER COPCs		
							Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]	Background[d]			
										Is MDL > RBC?	Are site concentrations > background?	COPC	Not a COPC	Source of Uncertainty
Miscellaneous Parameters	Chloride	100	1.78E+05	2.31E+00	6.7E+05	EN	yes	yes	no				X	
	Fluoride	90	9.10E+02	7.54E+01	3.5E+05	EN	yes	yes	no				X	
	Nitrogen, NO2 plus NO3	81	7.90E+03	6.15E-03	1.0E+04	C	yes	yes	no				X	
	Phosphorus (as P)	100	3.00E+03	1.67E+01	2.1E+08	EN	yes	yes	no				X	
	Sulfate	100	2.68E+06	2.49E+00			no							X
Semivolatiles	1,2,4-Trichlorobenzene	0	--	7.83E+00	4.0E-01	NC	yes	no		yes			X	
	1,2-Dichlorobenzene	0	--	6.90E+00	3.0E+01	NC	yes	no		no			X	
	1,2-Diphenylhydrazine	0	--	3.29E+00	7.8E-02	C	yes	no		yes			X	
	1,3-Dichlorobenzene	0	--	7.82E+00			no							X
	1,4-Dichlorobenzene	0	--	6.75E+00	4.8E-01	C	yes	no		yes			X	
	1-Methylnaphthalene	0	--	4.51E+00	1.1E+00	C	yes	no		yes			X	
	2,4,5-Trichlorophenol	0	--	2.96E+00	1.2E+02	NC	yes	no		no			X	
	2,4,6-Trichlorophenol	0	--	2.92E+00	1.2E+00	NC	yes	no		yes			X	
	2,4-Dichlorophenol	0	--	3.70E+00	4.6E+00	NC	yes	no		no			X	
	2,4-Dimethylphenol	0	--	1.26E+01	3.6E+01	NC	yes	no		no			X	
	2,4-Dinitrophenol	0	--	5.27E+00	3.9E+00	NC	yes	no		yes			X	
	2,4-Dinitrotoluene	0	--	3.17E+00	2.4E-01	C	yes	no		yes			X	
	2,6-Dinitrotoluene	0	--	2.14E+00	4.9E-02	C	yes	no		yes			X	
	2-Chloronaphthalene	0	--	4.82E+00	7.5E+01	NC	yes	no		no			X	
	2-Chlorophenol	0	--	3.07E+00	9.1E+00	NC	yes	no		no			X	
	2-Methylnaphthalene	0	--	5.17E+00	3.6E+00	NC	yes	no		yes			X	
	2-Nitroaniline	0	--	3.90E+00	1.9E+01	NC	yes	no		no			X	
	2-Nitrophenol	0	--	3.95E+00			no							X
	3,3`-Dichlorobenzidine	0	--	4.19E+00	1.3E-01	C	yes	no		yes			X	
	3-Nitroaniline	0	--	4.64E+00			no							X
	4,6-Dinitro-o-cresol	0	--	3.87E+00	1.5E-01	NC	yes	no		yes			X	
	4-Bromophenyl phenyl ether	0	--	4.73E+00			no							X
	4-Chloro-3-methylphenol	0	--	3.40E+00	1.4E+02	NC	yes	no		no			X	
	4-Chlorophenyl phenyl ether	0	--	3.27E+00			no							X
	4-Nitroaniline	0	--	5.41E+00	3.8E+00	C	yes	no		yes			X	
	4-Nitrophenol	0	--	5.78E+00			no							X
	Acenaphthene	0	--	3.95E+00	5.3E+01	NC	yes	no		no			X	
	Acenaphthylene	0	--	3.97E+00			no							X
	Anthracene	0	--	3.45E+00	1.8E+02	NC	yes	no		no			X	
	Benzo(a)anthracene	0	--	4.00E+00	3.0E-02	C	yes	no		yes			X	
	Benzo(a)pyrene	0	--	4.03E+00	2.5E-02	C	yes	no		yes			X	
	Benzo(b)fluoranthene	0	--	3.85E+00	2.5E-01	C	yes	no		yes			X	
	Benzo(g,h,i)perylene	0	--	4.54E+00			no							X
	Benzo(k)fluoranthene	0	--	4.05E+00	2.5E+00	C	yes	no		yes			X	
	bis(2-chloroethoxy)methane	0	--	3.20E+00	5.9E+00	NC	yes	no		no			X	
	bis(2-chloroethyl)ether	0	--	3.11E+00	1.4E-02	C	yes	no		yes			X	
	Bis(2-chloroisopropyl)ether	0	--	3.45E+00	7.1E+01	NC	yes	no		no			X	
	Bis(2-ethylhexyl)phthalate	4	2.00E+00	8.46E+00	5.6E+00	C	yes	no		yes			X	

Table 3-8. OU3 Groundwater COPC Screening[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]		COPC SELECTION STEPS					OU3 GROUNDWATER COPCs		
							Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]: Is MDL > RBC?	Background[d]: Are site concentrations > background?	COPC	Not a COPC	Source of Uncertainty
Semivolatiles	Butyl benzyl phthalate	0	--	3.92E+00	1.6E+01	C	yes	no		no			X	
	Carbazole	0	--	3.05E+00			no							X
	Chrysene	0	--	3.87E+00	2.5E+01	C	yes	no		no			X	
	Dibenzo(a,h)anthracene	0	--	4.37E+00	2.5E-02	C	yes	no		yes			X	
	Dibenzofuran	0	--	3.74E+00	7.9E-01	NC	yes	no		yes			X	
	Dibutyl phthalate	0	--	3.40E+00	9.0E+01	NC	yes	no		no			X	
	Diethyl phthalate	0	--	3.45E+00	1.5E+03	NC	yes	no		no			X	
	Dimethyl phthalate	0	--	3.18E+00			no							X
	Di-n-octyl phthalate	0	--	4.32E+00	2.0E+01	NC	yes	no		no			X	
	Fluoranthene	0	--	3.57E+00	8.0E+01	NC	yes	no		no			X	
	Fluorene	0	--	3.41E+00	2.9E+01	NC	yes	no		no			X	
	Hexachlorobenzene	0	--	4.66E+00	9.8E-03	C	yes	no		yes			X	
	Hexachlorobutadiene	0	--	6.20E+00	1.4E-01	C	yes	no		yes			X	
	Hexachloroethane	0	--	6.63E+00	3.3E-01	C	yes	no		yes			X	
	Indeno(1,2,3-cd)pyrene	0	--	4.13E+00	2.5E-01	C	yes	no		yes			X	
	Isophorone	0	--	2.89E+00	7.8E+01	C	yes	no		no			X	
	m & p-cresols	0	--	3.22E+00	9.3E+01	NC	yes	no		no			X	
	Naphthalene	0	--	4.97E+00	1.7E-01	C	yes	no		yes			X	
	Nitrobenzene	0	--	3.37E+00	1.4E-01	C	yes	no		yes			X	
	N-Nitrosodimethylamine	0	--	2.92E+00	1.1E-04	C	yes	no		yes			X	
	N-Nitrosodi-n-propylamine	0	--	2.90E+00	1.1E-02	C	yes	no		yes			X	
	N-Nitrosodiphenylamine	0	--	3.85E+00	1.2E+01	C	yes	no		no			X	
	o-Cresol	0	--	4.77E+00	9.3E+01	NC	yes	no		no			X	
	p-Chloroaniline	0	--	6.02E+00	3.7E-01	C	yes	no		yes			X	
	Pentachlorophenol	4	1.11E+01	5.06E+00	4.1E-02	C	yes	no		yes			X	
	Phenanthrene	0	--	2.78E+00			no							X
	Phenol	0	--	3.03E+00	5.8E+02	NC	yes	no		no			X	
	Pyrene	0	--	3.55E+00	1.2E+01	NC	yes	no		no			X	
Volatile Organics	1,1,1,2-Tetrachloroethane	0	--	1.09E-01	5.7E-01	C	yes	no		no			X	
	1,1,1-Trichloroethane	0	--	1.05E-01	8.0E+02	NC	yes	no		no			X	
	1,1,2,2-Tetrachloroethane	0	--	1.10E-01	7.6E-02	C	yes	no		yes			X	
	1,1,2-Trichloroethane	0	--	1.23E-01	4.1E-02	NC	yes	no		yes			X	
	1,1-Dichloroethane	0	--	1.10E-01	2.8E+00	C	yes	no		no			X	
	1,1-Dichloroethene	0	--	1.19E-01	2.8E+01	NC	yes	no		no			X	
	1,1-Dichloropropene	0	--	1.08E-01			no							X
	1,2,3-Trichlorobenzene	0	--	1.90E-01	7.0E-01	NC	yes	no		no			X	
	1,2,3-Trichloropropane	0	--	2.93E-01	7.5E-04	C	yes	no		yes			X	
	1,2,4-Trichlorobenzene	0	--	1.67E-01	4.0E-01	NC	yes	no		no			X	
	1,2,4-Trimethylbenzene	8	7.30E-01	1.14E-01	5.6E+00	NC	yes	yes	no				X	
	1,2-Dibromo-3-chloropropane	0	--	6.33E-01	3.3E-04	C	yes	no		yes			X	
	1,2-Dibromoethane	0	--	1.38E-01	7.5E-03	C	yes	no		yes			X	
	1,2-Dichlorobenzene	0	--	1.25E-01	3.0E+01	NC	yes	no		no			X	
	1,2-Dichloroethane	0	--	1.05E-01	1.7E-01	C	yes	no		no			X	
	1,2-Dichloropropane	0	--	1.84E-01	8.2E-01	NC	yes	no		no			X	

Table 3-8. OU3 Groundwater COPC Screening[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]		COPC SELECTION STEPS: Does chemical have an RBC?	COPC SELECTION STEPS: Is chemical detected ≥5%?	COPC SELECTION STEPS: Is Max Detect > RBC?	COPC SELECTION STEPS: Detection Limit[c] Is MDL > RBC?	COPC SELECTION STEPS: Background[d] Are site concentrations > background?	OU3 GROUNDWATER COPCs: COPC	OU3 GROUNDWATER COPCs: Not a COPC	OU3 GROUNDWATER COPCs: Source of Uncertainty
Volatile Organics	1,3,5-Trimethylbenzene	0	--	9.47E-02	6.0E+00	NC	yes	no		no			X	
	1,3-Dichlorobenzene	0	--	1.27E-01			no							X
	1,3-Dichloropropane	0	--	1.19E-01	3.7E+01	NC	yes	no		no			X	
	1,4-Dichlorobenzene	4	3.60E-01	8.10E-02	4.8E-01	C	yes	no		no			X	
	2,2-Dichloropropane	0	--	1.84E-01			no							X
	Acetone	38	3.22E+01	1.29E+00	1.4E+03	NC	yes	yes	no				X	
	Allyl chloride	0	--	3.60E-01	2.1E-01	NC	yes	no		yes			X	
	Benzene	8	2.40E-01	1.26E-01	4.6E-01	C	yes	yes	no				X	
	Bromobenzene	0	--	1.41E-01	6.2E+00	NC	yes	no		no			X	
	Bromochloromethane	0	--	1.68E-01	8.3E+00	NC	yes	no		no			X	
	Bromoform	0	--	2.10E-01	3.3E+00	C	yes	no		no			X	
	Bromomethane	0	--	2.53E-01	7.5E-01	NC	yes	no		no			X	
	Carbon tetrachloride	0	--	1.69E-01	4.6E-01	C	yes	no		no			X	
	Chlorobenzene	8	2.82E+01	1.48E-01	7.8E+00	NC	yes	yes	yes		no		X	
	Chloroethane	0	--	1.93E-01	2.1E+03	NC	yes	no		no			X	
	Chloroform	0	--	2.30E-01	2.2E-01	C	yes	no		yes			X	
	Chloromethane	0	--	2.67E-01	1.9E+01	NC	yes	no		no			X	
	cis-1,2-Dichloroethylene	0	--	1.63E-01	3.6E+00	NC	yes	no		no			X	
	cis-1,3-Dichloropropylene	0	--	1.16E-01			no							X
	Cumene	15	1.20E+00	1.44E-01	4.5E+01	NC	yes	yes	no				X	
	Dibromochloromethane	0	--	8.53E-02	8.7E-01	C	yes	no		no			X	
	Dichlorobromomethane	0	--	1.05E-01	1.3E-01	C	yes	no		no			X	
	Dichlorodifluoromethane	0	--	2.13E-01	2.0E+01	NC	yes	no		no			X	
	Dichlorofluoromethane	0	--	1.09E-01			no							X
	Ethyl ether	4	1.70E-01	9.00E-02	3.9E+02	NC	yes	no		no			X	
	Ethylbenzene	0	--	1.27E-01	1.5E+00	C	yes	no		no			X	
	Hexachlorobutadiene	0	--	2.47E-01	1.4E-01	C	yes	no		yes			X	
	m & p-Xylenes	27	1.50E+00	3.67E-01			no							X
	Methylcyclohexane	0	--	3.60E-01			no							X
	Methyl ethyl ketone	0	--	1.57E+00	5.6E+02	NC	yes	no		no			X	
	Methyl isobutyl ketone	0	--	1.33E+00	6.3E+02	NC	yes	no		no			X	
	Methylene bromide	0	--	1.97E-01	8.3E-01	NC	yes	no		no			X	
	Methylene chloride	0	--	2.51E-01	1.1E+01	NC	yes	no		no			X	
	MTBE (Methyl tert-butyl ether)	0	--	9.80E-02	1.4E+01	C	yes	no		no			X	
	Naphthalene	4	9.60E-01	1.40E-01	1.7E-01	C	yes	no		no			X	
	n-Butyl benzene	0	--	1.34E-01	1.0E+02	NC	yes	no		no			X	
	n-Propyl benzene	4	7.90E-01	2.10E-01	6.6E+01	NC	yes	no		no			X	
	o-Chlorotoluene	0	--	1.29E-01	2.4E+01	NC	yes	no		no			X	
	o-Xylene	8	2.10E-01	1.17E-01	1.9E+01	NC	yes	yes	no				X	
	p-Chlorotoluene	0	--	1.12E-01	2.5E+01	NC	yes	no		no			X	
	p-Isopropyltoluene	0	--	9.60E-02			no							X
	sec-Butyl benzene	4	6.30E-01	1.60E-01	2.0E+02	NC	yes	no		no			X	
	Styrene	0	--	7.40E-02	1.2E+02	NC	yes	no		no			X	

Table 3-8. OU3 Groundwater COPC Screening[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]		COPC SELECTION STEPS: Does chemical have an RBC?	COPC SELECTION STEPS: Is chemical detected ≥5%?	COPC SELECTION STEPS: Is Max Detect > RBC?	COPC SELECTION STEPS: Detection Limit[c]: Is MDL > RBC?	COPC SELECTION STEPS: Background[d]: Are site concentrations > background?	OU3 GROUNDWATER COPCs: COPC	OU3 GROUNDWATER COPCs: Not a COPC	OU3 GROUNDWATER COPCs: Source of Uncertainty
Volatile Organics	tert-Amyl methyl ether	0	--	1.60E-01			no							X
	tert-Butyl benzene	0	--	9.40E-02	6.9E+01	NC	yes	no		no			X	
	Tetrachloroethylene	0	--	1.50E-01	4.1E+00	NC	yes	no		no			X	
	Tetrahydrofuran	0	--	2.33E+00	3.4E+02	NC	yes	no		no			X	
	Toluene	42	3.00E+00	6.55E-02	1.1E+02	NC	yes	yes	no				X	
	trans-1,2-Dichloroethylene	0	--	1.70E-01	3.6E+01	NC	yes	no		no			X	
	trans-1,3-Dichloropropylene	0	--	1.03E-01			no							X
	Trichloroethylene	0	--	7.60E-02	2.8E-01	NC	yes	no		no			X	
	Trichlorofluoromethane	0	--	9.67E-02	5.2E+02	NC	yes	no		no			X	
	Trichlorotrifluoroethane	0	--	2.27E-01	1.0E+03	NC	yes	no		no			X	
	Vinyl chloride	0	--	9.23E-02	1.9E-02	C	yes	no		yes			X	
	Xylenes (total)	23	1.50E+00	6.00E-01	1.9E+01	NC	yes	yes	no				X	

DF = Detection Frequency; TEQ = Toxicity Equivalence; PCBs = Polychlorinated Biphenyls; ND = non-detect; MDL = method detection limit; EN = essential nutrient; MCL = maximum contaminant level

Bolded contaminants are those where the maximum detected concentration exceeds the respective RBC.

[a]Concentrations in units of µg/L.

[b]Risk-based concentrations are based on USEPA generic residential tapwater RSL values (November 2017) using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value).

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency ≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

Table 3-9. OU3 CFR Bed Sediments COPC Screen[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]	COPC SELECTION STEPS			Detection Limit[c]	Background[d]	OU3 BED SEDIMENT COPCs		
						Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Is MDL > RBC?	Are site concentrations > background?	COPC	Not a COPC	Source of Uncertainty
TEQ	TEQ - Dioxins/Furans (ND=1/2MDL)	100	5.79E-07	--	5.1E-06 NC	yes	yes	no				X	
PCBs	Aroclor-1016	0	--	1.13E-02	4.1E-01 NC	yes	no		no			X	
	Aroclor-1221	0	--	2.62E-02	2.0E-01 C	yes	no		no			X	
	Aroclor-1232	0	--	1.17E-02	1.7E-01 C	yes	no		no			X	
	Aroclor-1242	0	--	2.99E-02	2.3E-01 C	yes	no		no			X	
	Aroclor-1248	0	--	1.93E-02	2.3E-01 C	yes	no		no			X	
	Aroclor-1254	0	--	7.25E-03	1.2E-01 NC	yes	no		no			X	
	Aroclor-1260	0	--	7.40E-03	2.4E-01 C	yes	no		no			X	
	Aroclor-1262	0	--	9.85E-03		no							X
	Aroclor-1268	0	--	6.75E-03		no							X
Total Metals	Aluminum	100	6.04E+03	8.60E+00	7.7E+03 NC	yes	yes	no				X	
	Arsenic	100	7.70E+00	2.53E-01	6.8E-01 C	yes	yes	yes		no		X	
	Barium	100	1.50E+02	1.65E-01	1.5E+03 NC	yes	yes	no				X	
	Cadmium	100	7.60E-01	5.62E-02	7.1E+00 NC	yes	yes	no				X	
	Chromium	100	7.10E+00	3.93E-01	3.0E-01 C	yes	yes	yes		no		X	
	Cobalt	100	3.30E+00	5.10E-01	2.3E+00 NC	yes	yes	yes		no		X	
	Copper	100	8.33E+01	6.70E-01	3.1E+02 NC	yes	yes	no				X	
	Iron	100	8.24E+03	5.14E+01	5.5E+03 NC	yes	yes	yes		no		X	
	Lead	100	2.13E+01	9.05E-02	4.0E+02 NC	yes	yes	no				X	
	Manganese	100	8.32E+02	4.23E-01	1.8E+02 NC	yes	yes	yes		no		X	
	Mercury	100	3.00E-01	1.65E-02	2.3E+00 NC	yes	yes	no				X	
	Nickel	100	5.40E+00	3.15E-01	1.5E+02 NC	yes	yes	no				X	
	Silver	67	6.20E-01	2.43E-01	3.9E+01 NC	yes	yes	no				X	
	Thallium	67	1.80E-01	9.05E-02	7.8E-02 NC	yes	yes	yes		no		X	
	Vanadium	100	1.20E+01	5.63E-01	3.9E+01 NC	yes	yes	no				X	
	Zinc	100	1.92E+02	2.77E+00	2.3E+03 NC	yes	yes	no				X	
Semivolatiles	1,2,4-Trichlorobenzene	0	--	3.31E-01	5.8E+00 NC	yes	no		no			X	
	1,2-Dichlorobenzene	0	--	1.29E-01	1.8E+02 NC	yes	no		no			X	
	1,2-Diphenylhydrazine	0	--	1.00E+00	6.8E-01 C	yes	no		yes				X
	1,3-Dichlorobenzene	0	--	1.26E-01		no							X
	1,4-Dichlorobenzene	0	--	1.34E-01	2.6E+00 C	yes	no		no			X	
	1-Methylnaphthalene	0	--	3.46E-01	1.8E+01 C	yes	no		no			X	
	2,4,5-Trichlorophenol	0	--	2.40E-01	6.3E+02 NC	yes	no		no			X	
	2,4,6-Trichlorophenol	0	--	2.58E-01	6.3E+00 NC	yes	no		no			X	
	2,4-Dichlorophenol	0	--	3.78E-01	1.9E+01 NC	yes	no		no			X	
	2,4-Dimethylphenol	0	--	3.76E-01	1.3E+02 NC	yes	no		no			X	
	2,4-Dinitrophenol	0	--	1.00E+00	1.3E+01 NC	yes	no		no			X	
	2,4-Dinitrotoluene	0	--	1.00E+00	1.7E+00 C	yes	no		no			X	
	2,6-Dinitrotoluene	0	--	1.72E-01	3.6E-01 C	yes	no		no			X	
	2-Chloronaphthalene	0	--	3.14E-01	4.8E+02 NC	yes	no		no			X	
	2-Chlorophenol	0	--	4.68E-01	3.9E+01 NC	yes	no		no			X	
	2-Methylnaphthalene	0	--	3.59E-01	2.4E+01 NC	yes	no		no			X	
	2-Nitroaniline	0	--	2.17E-01	6.3E+01 NC	yes	no		no			X	
	2-Nitrophenol	0	--	3.43E-01		no							X
	3,3`-Dichlorobenzidine	0	--	2.80E-01	1.2E+00 C	yes	no		no			X	
	3-Nitroaniline	0	--	2.05E-01		no							X

Table 3-9. OU3 CFR Bed Sediments COPC Screen[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]	COPC SELECTION STEPS: Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]: Is MDL > RBC?	Background[d]: Are site concentrations > background?	OU3 BED SEDIMENT COPCs: COPC	Not a COPC	Source of Uncertainty
Semivolatiles	4,6-Dinitro-o-cresol	0	--	3.99E-01	5.1E-01 NC	yes	no		no			X	
	4-Bromophenyl phenyl ether	0	--	2.13E-01		no							X
	4-Chloro-3-methylphenol	0	--	1.00E+00	6.3E+02 NC	yes	no		no			X	
	4-Chlorophenyl phenyl ether	0	--	2.31E-01		no							X
	4-Nitroaniline	0	--	1.76E-01	2.5E+01 NC	yes	no		no			X	
	4-Nitrophenol	0	--	2.10E-01		no							X
	Acenaphthene	0	--	2.31E-01	3.6E+02 NC	yes	no		no			X	
	Acenaphthylene	0	--	2.63E-01		no							X
	Anthracene	0	--	1.00E+00	1.8E+03 NC	yes	no		no			X	
	Benzo(a)anthracene	0	--	1.00E+00	1.1E+00 C	yes	no		no			X	
	Benzo(a)pyrene	0	--	1.00E+00	1.1E-01 C	yes	no		yes				X
	Benzo(b)fluoranthene	0	--	2.54E-01	1.1E+00 C	yes	no		no			X	
	Benzo(g,h,i)perylene	0	--	2.44E-01		no							X
	Benzo(k)fluoranthene	0	--	2.57E-01	1.1E+01 C	yes	no		no			X	
	bis(2-chloroethoxy)methane	0	--	3.92E-01	1.9E+01 NC	yes	no		no			X	
	bis(2-chloroethyl)ether	0	--	1.40E-01	2.3E-01 C	yes	no		no			X	
	Bis(2-chloroisopropyl)ether	0	--	4.64E-01	3.1E+02 NC	yes	no		no			X	
	Bis(2-ethylhexyl)phthalate	0	--	3.43E-01	3.9E+01 C	yes	no		no			X	
	Butyl benzyl phthalate	0	--	1.00E+00	2.9E+02 C	yes	no		no			X	
	Carbazole	0	--	1.00E+00		no							X
	Chrysene	0	--	2.69E-01	1.1E+02 C	yes	no		no			X	
	Dibenzo(a,h)anthracene	0	--	1.00E+00	1.1E-01 C	yes	no		yes				X
	Dibenzofuran	0	--	1.00E+00	7.3E+00 NC	yes	no		no			X	
	Dibutyl phthalate	0	--	2.78E-01	6.3E+02 NC	yes	no		no			X	
	Diethyl phthalate	0	--	1.00E+00	5.1E+03 NC	yes	no		no			X	
	Dimethyl phthalate	0	--	1.00E+00		no							X
	Di-n-octyl phthalate	0	--	1.00E+00	6.3E+01 NC	yes	no		no			X	
	Fluoranthene	0	--	1.00E+00	2.4E+02 NC	yes	no		no			X	
	Fluorene	0	--	1.00E+00	2.4E+02 NC	yes	no		no			X	
	Hexachlorobenzene	0	--	2.64E-01	2.1E-01 C	yes	no		yes				X
	Hexachlorobutadiene	0	--	1.69E-01	1.2E+00 C	yes	no		no			X	
	Hexachloroethane	0	--	1.28E-01	1.8E+00 C	yes	no		no			X	
	Indeno(1,2,3-cd)pyrene	0	--	1.00E+00	1.1E+00 C	yes	no		no			X	
	Isophorone	0	--	3.20E-01	5.7E+02 C	yes	no		no			X	
	m & p-cresols	0	--	4.01E-01	3.2E+02 NC	yes	no		no			X	
	Naphthalene	0	--	3.76E-01	3.8E+00 C	yes	no		no			X	
	Nitrobenzene	0	--	4.06E-01	5.1E+00 C	yes	no		no			X	
	N-Nitrosodimethylamine	0	--	1.00E+00	2.0E-03 C	yes	no		yes				X
	N-Nitrosodi-n-propylamine	0	--	2.73E-01	7.8E-02 C	yes	no		yes				X
	N-Nitrosodiphenylamine	0	--	1.00E+00	1.1E+02 C	yes	no		no			X	
	o-Cresol	0	--	4.34E-01	3.2E+02 NC	yes	no		no			X	
	p-Chloroaniline	0	--	3.08E-01	2.7E+00 C	yes	no		no			X	
	Pentachlorophenol	0	--	1.00E+00	1.0E+00 C	yes	no		yes				X
	Phenanthrene	0	--	2.87E-01		no							X
	Phenol	0	--	4.38E-01	1.9E+03 NC	yes	no		no			X	
	Pyrene	0	--	2.53E-01	1.8E+02 NC	yes	no		no			X	

DF = Detection Frequency; TEQ = Toxicity Equivalence; PCBs = Polychlorinated Biphenyls; ND = non-detect; MDL = method detection limit; EN = essential nutrient.

Bolded contaminants are those where the maximum detected concentration exceeds the respective RBC.

[a]Concentrations in units of mg/kg.

[b]Risk-based concentrations are based on USEPA's generic residential soil RSL values (November 2017) using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value).

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency ≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

Table 3-10. OU3 Flood Fringe Sediment COPC Screen[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]	COPC SELECTION STEPS: Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]: Is MDL > RBC?	Background[d]: Are site concentrations > background?	OU3 BED SEDIMENT COPCs: COPC	Not a COPC	Source of Uncertainty
TEQ	TEQ - Dioxins/Furans (ND=1/2MDL)	100	4.55E-07	--	5.1E-06 NC	yes	yes	no					X
Total Metals	**Aluminum**	100	1.32E+04	4.90E+00	7.7E+03 NC	yes	yes	yes		no		X	
	Arsenic	100	2.72E+01	1.43E-01	6.8E-01 C	yes	yes	yes		no		X	
	Barium	100	2.59E+02	9.40E-02	1.5E+03 NC	yes	yes	no				X	
	Cadmium	100	2.00E+00	3.20E-02	7.1E+00 NC	yes	yes	no				X	
	Chromium	100	1.47E+01	2.23E-01	3.0E-01 C	yes	yes	yes		no		X	
	Cobalt	100	7.70E+00	2.90E-01	2.3E+00 NC	yes	yes	yes		no		X	
	Copper	100	3.13E+02	3.87E-01	3.1E+02 NC	yes	yes	yes		no		X	
	Iron	100	1.80E+04	2.92E+01	5.5E+03 NC	yes	yes	yes		no		X	
	Lead	100	5.32E+01	5.13E-02	4.0E+02 NC	yes	yes	no				X	
	Manganese	100	7.68E+02	5.93E-01	1.8E+02 NC	yes	yes	yes		no		X	
	Mercury	100	3.90E-01	9.67E-03	2.3E+00 NC	yes	yes	no				X	
	Nickel	100	1.34E+01	1.80E-01	1.5E+02 NC	yes	yes	no				X	
	Silver	100	1.20E+00	1.40E-01	3.9E+01 NC	yes	yes	no				X	
	Thallium	100	2.30E-01	5.13E-02	7.8E-02 NC	yes	yes	yes		no		X	
	Vanadium	100	2.04E+01	3.27E-01	3.9E+01 NC	yes	yes	no				X	
	Zinc	100	4.56E+02	1.60E+00	2.3E+03 NC	yes	yes	no				X	

DF = Detection Frequency; TEQ = Toxicity Equivalence; PCBs = Polychlorinated Biphenyls; ND = non-detect; MDL = method detection limit; EN = essential nutrient.

Bolded contaminants are those where the maximum detected concentration exceeds the respective RBC.

[a]Concentrations in units of mg/kg.

[b]Risk-based concentrations are based on USEPA's generic residential soil RSL values (November 2017) using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value).

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency ≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

Table 3-11. OU3 CFR Surface Water COPC Screen[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]	COPC SELECTION STEPS: Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Detection Limit[c]: Is MDL > RBC?	Background[d]: Are site concentrations > background?	OU3 CFR SURFACE WATER COPCs: COPC	Not a COPC	Source of Uncertainty
TEQ	TEQ - Dioxins/Furans (ND=1/2MDL)	100	3.30E-07	--	1.2E-06 NC	yes	yes	no					X
PCBs	Aroclor-1016	0	--	4.50E-02	1.4E-01 NC	yes	no		no			X	
	Aroclor-1221	0	--	1.95E-02	4.7E-03 C	yes	no		yes				X
	Aroclor-1232	0	--	3.65E-02	4.7E-03 C	yes	no		yes				X
	Aroclor-1242	0	--	2.80E-02	7.8E-03 C	yes	no		yes				X
	Aroclor-1248	0	--	1.20E-02	7.8E-03 C	yes	no		yes				X
	Aroclor-1254	0	--	1.55E-02	7.8E-03 C	yes	no		yes				X
	Aroclor-1260	0	--	1.50E-02	7.8E-03 C	yes	no		yes				X
	Aroclor-1262	0	--	4.20E-02		no							X
	Aroclor-1268	0	--	2.30E-02		no							X
Total Metals	Aluminum	100	3.03E+01	3.00E+00	2.0E+03 NC	yes	yes	no				X	
	Arsenic	100	2.20E+00	1.10E-01	5.2E-02 C	yes	yes	yes		no			X
	Barium	100	9.82E+01	8.10E-02	3.8E+02 NC	yes	yes	no				X	
	Cadmium	0	--	2.40E-02	9.2E-01 NC	yes	no		no			X	
	Chromium	0	--	1.70E-01	3.5E-02 C	yes	no		yes				X
	Cobalt	0	--	1.30E-01	6.0E-01 NC	yes	no		no			X	
	Copper	100	2.00E+00	2.10E-01	8.0E+01 NC	yes	yes	no				X	
	Iron	100	6.33E+01	1.37E+01	1.4E+03 NC	yes	yes	no				X	
	Lead	100	1.50E-01	4.60E-02	1.5E+01 NC	yes	yes	no				X	
	Manganese	100	1.51E+01	2.40E-01	4.3E+01 NC	yes	yes	no				X	
	Mercury	0	--	2.20E-02	5.7E-01 NC	yes	no		no			X	
	Nickel	67	2.00E-01	1.60E-01	3.9E+01 NC	yes	yes	no				X	
	Silver	0	--	1.50E-01	9.4E+00 NC	yes	no		no			X	
	Thallium	0	--	1.50E-02	2.0E-02 NC	yes	no		no			X	
	Vanadium	100	6.70E-01	2.80E-01	8.6E+00 NC	yes	yes	no				X	
	Zinc	100	3.50E+00	2.40E+00	6.0E+02 NC	yes	yes	no				X	
Miscellaneous Parameters	Chloride	100	3.80E+03	7.80E+01	6.7E+05 EN	yes	yes	no				X	
	Fluoride	100	1.90E+02	3.90E+01	3.5E+05 EN	yes	yes	no				X	
	Nitrogen, NO2 plus NO3	100	9.20E+01	4.50E+00	1.0E+04 C	yes	yes	no				X	
	Phosphorus (as P)	100	2.00E+01	1.00E+00	2.1E+08 EN	yes	yes	no				X	
	Sulfate	100	2.22E+04	1.00E+02		no							X
Semivolatiles	1,2,4-Trichlorobenzene	0	--	1.90E+00	4.0E-01 NC	yes	no		yes				X
	1,2-Dichlorobenzene	0	--	1.90E+00	3.0E+01 NC	yes	no		no			X	
	1,2-Diphenylhydrazine	0	--	2.50E+00	7.8E-02 C	yes	no		yes				X
	1,3-Dichlorobenzene	0	--	1.60E+00		no							X
	1,4-Dichlorobenzene	0	--	1.90E+00	4.8E-01 C	yes	no		yes				X
	1-Methylnaphthalene	0	--	2.10E+00	1.1E+00 C	yes	no		yes				X
	2,4,5-Trichlorophenol	0	--	2.20E+00	1.2E+02 NC	yes	no		no			X	
	2,4,6-Trichlorophenol	0	--	2.20E+00	1.2E+00 NC	yes	no		yes				X
	2,4-Dichlorophenol	0	--	2.30E+00	4.6E+00 NC	yes	no		no			X	
	2,4-Dimethylphenol	0	--	6.80E+00	3.6E+01 NC	yes	no		no			X	
	2,4-Dinitrophenol	0	--	2.80E+00	3.9E+00 NC	yes	no		no			X	
	2,4-Dinitrotoluene	0	--	2.10E+00	2.4E-01 C	yes	no		yes				X
	2,6-Dinitrotoluene	0	--	2.30E+00	4.9E-02 C	yes	no		yes				X
	2-Chloronaphthalene	0	--	2.20E+00	7.5E+01 NC	yes	no		no			X	
	2-Chlorophenol	0	--	2.20E+00	9.1E+00 NC	yes	no		no			X	
	2-Methylnaphthalene	0	--	2.10E+00	3.6E+00 NC	yes	no		no			X	
	2-Nitroaniline	0	--	2.80E+00	1.9E+01 NC	yes	no		no			X	
	2-Nitrophenol	0	--	2.20E+00		no							X
	3,3`-Dichlorobenzidine	0	--	4.90E+00	1.3E-01 C	yes	no		yes				X
	3-Nitroaniline	0	--	5.00E+00		no							X
	4,6-Dinitro-o-cresol	0	--	3.50E+00	1.5E-01 NC	yes	no		yes				X
	4-Bromophenyl phenyl ether	0	--	2.40E+00		no							X
	4-Chloro-3-methylphenol	0	--	1.60E+00	1.4E+02 NC	yes	no		no			X	
	4-Chlorophenyl phenyl ether	0	--	1.40E+00		no							X
	4-Nitroaniline	0	--	4.40E+00	3.8E+00 C	yes	no		yes				X
	4-Nitrophenol	0	--	3.40E+00		no							X
	Acenaphthene	0	--	1.60E+00	5.3E+01 NC	yes	no		no			X	
	Acenaphthylene	0	--	2.20E+00		no							X
	Anthracene	0	--	2.50E+00	1.8E+02 NC	yes	no		no			X	
	Benzo(a)anthracene	0	--	5.10E+00	3.0E-02 C	yes	no		yes				X
	Benzo(a)pyrene	0	--	2.40E+00	2.5E-02 C	yes	no		yes				X
	Benzo(b)fluoranthene	0	--	2.50E+00	2.5E-01 C	yes	no		yes				X
	Benzo(g,h,i)perylene	0	--	2.50E+00		no							X
	Benzo(k)fluoranthene	0	--	2.80E+00	2.5E+00 C	yes	no		yes				X
	bis(2-chloroethoxy)methane	0	--	1.50E+00	5.9E+00 NC	yes	no		no			X	
	bis(2-chloroethyl)ether	0	--	2.30E+00	1.4E-02 C	yes	no		yes				X
	Bis(2-chloroisopropyl)ether	0	--	2.30E+00	7.1E+01 NC	yes	no		no			X	
	Bis(2-ethylhexyl)phthalate	0	--	2.40E+00	5.6E+00 C	yes	no		no			X	
	Butyl benzyl phthalate	0	--	1.90E+00	1.6E+01 C	yes	no		no			X	
	Carbazole	0	--	2.70E+00		no							X

Table 3-11. OU3 CFR Surface Water COPC Screen[a]

Analysis	Contaminant	DF (%)	Maximum Detected Concentration	Average MDL	RBC[b]	COPC SELECTION STEPS			Detection Limit[c]	Background[d]	OU3 CFR SURFACE WATER COPCs		
						Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Is MDL > RBC?	Are site concentrations > background?	COPC	Not a COPC	Source of Uncertainty
Semivolatiles	Chrysene	0	--	2.30E+00	2.5E+01 C	yes	no		no			X	
	Dibenzo(a,h)anthracene	0	--	1.80E+00	2.5E-02 C	yes	no		yes				X
	Dibenzofuran	0	--	2.30E+00	7.9E-01 NC	yes	no		yes				X
	Dibutyl phthalate	0	--	2.40E+00	9.0E+01 NC	yes	no		no			X	
	Diethyl phthalate	0	--	2.50E+00	1.5E+03 NC	yes	no		no			X	
	Dimethyl phthalate	0	--	2.30E+00		no							X
	Di-n-octyl phthalate	0	--	1.70E+00	2.0E+01 NC	yes	no		no			X	
	Fluoranthene	0	--	2.50E+00	8.0E+01 NC	yes	no		no			X	
	Fluorene	0	--	2.40E+00	2.9E+01 NC	yes	no		no			X	
	Hexachlorobenzene	0	--	2.60E+00	9.8E-03 C	yes	no		yes				X
	Hexachlorobutadiene	0	--	1.70E+00	1.4E-01 C	yes	no		yes				X
	Hexachloroethane	0	--	1.70E+00	3.3E-01 C	yes	no		yes				X
	Indeno(1,2,3-cd)pyrene	0	--	1.80E+00	2.5E-01 C	yes	no		yes				X
	Isophorone	0	--	1.60E+00	7.8E+01 C	yes	no		no			X	
	m & p-cresols	0	--	2.30E+00	9.3E+01 NC	yes	no		no			X	
	Naphthalene	0	--	2.00E+00	1.7E-01 C	yes	no		yes				X
	Nitrobenzene	0	--	2.50E+00	1.4E-01 C	yes	no		yes				X
	N-Nitrosodimethylamine	0	--	2.30E+00	1.1E-04 C	yes	no		yes				X
	N-Nitrosodi-n-propylamine	0	--	2.30E+00	1.1E-02 C	yes	no		yes				X
	N-Nitrosodiphenylamine	0	--	3.90E+00	1.2E+01 C	yes	no		no			X	
	o-Cresol	0	--	2.00E+00	9.3E+01 NC	yes	no		no			X	
	p-Chloroaniline	0	--	3.60E+00	3.7E-01 C	yes	no		yes				X
	Pentachlorophenol	0	--	2.20E+00	4.1E-02 C	yes	no		yes				X
	Phenanthrene	0	--	2.50E+00		no							X
	Phenol	0	--	2.20E+00	5.8E+02 NC	yes	no		no			X	
	Pyrene	0	--	2.50E+00	1.2E+01 NC	yes	no		no			X	

DF = Detection Frequency; TEQ = Toxicity Equivalence; PCBs = Polychlorinated Biphenyls; ND = non-detect; MDL = method detection limit; EN = essential nutrient; MCL = maximum contaminant level

Bolded contaminants are those where the maximum detected concentration exceeds the respective RBC.

[a]Concentrations in units of µg/L.

[b]Risk-based concentrations are based on USEPA generic residential tapwater RSL values (November 2017) using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value).

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency ≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

Table 3-12. OU3 CFR Fish Tissue COPC Screen

Analysis	Contaminant	DF	Maximum Detected Concentration (mg/kg ww)	Average DL (mg/kg ww)[a]	RBC (mg/kg)	COPC SELECTION STEPS			Detection Limit[c]	Background[d]	CFR FISH COPCs		
						Does chemical have an RBC?	Is chemical detected ≥5%?	Is Max Detect > RBC?	Is MDL > RBC?	Are site concentrations > background?	COPC	Not a COPC	Source of Uncertainty
TEQ	TEQ, ND=0	100%	1.8E-07	--	1.36E-07 NC	yes	yes	yes		NA	X	X	
	TEQ, ND=1/2 DL	100%	2.4E-07	--	1.36E-07 NC	yes	yes	yes		NA	X		X
PCBs	Aroclor 1016	0%	--	3.3E-02	1.4E-02 NC	yes	no		yes			X	
	Aroclor 1221	0%	--	3.3E-02	2.3E-03 C	yes	no		yes			X	
	Aroclor 1232	0%	--	3.3E-02	2.3E-03 C	yes	no		yes			X	
	Aroclor 1242	0%	--	3.3E-02	2.3E-03 C	yes	no		yes			X	
	Aroclor 1248	0%	--	3.3E-02	2.3E-03 C	yes	no		yes			X	
	Aroclor 1254	29%	6.7E-02	3.3E-02	2.3E-03 C	yes	yes	yes		NA	X		
	Aroclor 1260	0%	--	3.3E-02	2.3E-03 C	yes	no		yes			X	
	Aroclor 1262	0%	--	3.3E-02		no							X
	Aroclor 1268	0%	--	3.3E-02		no							X
Metals	Mercury	100%	2.5E-01	1.3E-02	1.9E-02 NC	yes	yes	yes		no		X	
	Selenium	86%	1.4E-01	9.3E-02	9.7E-01 NC	yes	yes	no				X	

DF = Detection Frequency; TEQ = Toxicity Equivalence; PCBs = Polychlorinated Biphenyls; ND = non-detect; MDL = method detection limit; EN = essential nutrient.

Bolded contaminants are those where the maximum detected concentration exceeds the respective RBC.

[a]The Estimated Detection Limit (EDL) was used as the DL if available. For Aroclors and metals, the Reporting Limit (RL) was used as the DL when an EDL was not available.

[b]Risk-based concentrations are based on using USEPA's RSL Calculator assuming a fish ingestion rate of 43 g/day and using a target cancer risk of 1E-06 ("C" = cancer based value) or a target HQ of 0.1 ("NC" = non-cancer based value).

[c]Detection limts were evaluated for those chemicals with a detection frequency <5%.

[d]Only those chemicals identified as having a detection frequency ≥5% and a maximum detected concentration > RBC were evaluated for comparison to background.

Table 3-13. Exposure Parameters for a Hypothetical Future Resident

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body Weight - adult	kg	80	[1]	80	[1]
	Body Weight - child	kg	15	[1]	15	[1]
	Exposure frequency	days/yr	256	[4, a]	350	[1]
	Exposure duration - adult	yr	9	[4, b]	20	[1]
	Exposure duration - child	yr	3	[4, b]	6	[1]
	Exposure duration (total)	yr	12	[4, b]	26	[1]
	Averaging Time, Cancer	yr	70	[2]	70	[2]
Incidental Ingestion of Soil	Ingestion rate - adult	mg/day	50	[3, c]	100	[1]
	Ingestion rate - child	mg/day	100	[3, c]	200	[1]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**1.50E-06**		**3.87E-06**	
	HIF (cancer)	**kg/kg-day**	**2.57E-07**		**1.44E-06**	
Ingestion of Groundwater	Ingestion rate - adult	L/day	1.2	[4, d]	2.5	[1]
	Ingestion rate - child	L/day	0.45	[4, d]	0.78	[1]
	HIF (noncancer)	**L/kg-d**	**1.32E-02**		**3.46E-02**	
	HIF (cancer)	**L/kg-d**	**2.25E-03**		**1.28E-02**	
Dermal Exposure to Soil	Exposed Surface Area - adult	cm^2/event	6,032	[1]	6,032	[1]
	Exposed Surface Area - child	cm^2/event	2,373	[1]	2,373	[1]
	Adherence Factor - adult	mg/cm^2	0.01	[5]	0.07	[1]
	Adherence Factor - child	mg/cm^2	0.04	[5]	0.2	[1]
	Dermal Absorption Fraction (ABSd)	unitless	CS	[5]	CS	[5]
	Event Frequency	events/day	1	[5]	1	[5]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**1.51E-06**		**1.09E-05**	
	HIF (cancer)	**kg/kg-day**	**2.58E-07**		**4.05E-06**	

RME = Reasonable Maximum Exposure; CTE = Central Tendency Exposure; CS = chemical-specific

Sources:

[1] USEPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002. December.

[3] USEPA 1993. Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

[4] USEPA 2011. Exposure Factors Handbook.

[5] USEPA 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E). Office of Solid Waste and Emergency Response. July.

[6] MDEQ 2016. Development of Montana-Specific Default Soil Exposure Frequencies. June.

[7] Professional judgment.

Notes:

[a] Estimated frequency based on the average percent of time spent at home (70%, see Table 16-16) and multiplying by 365 days/year.

[b] Average residential occupancy period =12 years (Table 16-5); delegation of years between adult and child based on professional judgment and consistent with other Regional risk assessments.

[c] CTE ingestion rate assumed to be half that of the RME receptor.

[d] Weighted mean of consumer-only ingestion of drinking water (Table 3-1).

Table 3-14. Exposure Parameters for a Hypothetical Future Commercial/Industrial Worker

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body Weight	kg	80	[1]	80	[1]
	Exposure frequency	days/yr	219	[3]	250	[1]
	Exposure duration	yr	9	[3]	25	[1]
	Averaging Time, Noncancer	days	3,285	[2]	9,125	[2]
	Averaging Time, Cancer	days	25,550	[2]	25,550	[2]
Incidental Ingestion of Soil	Ingestion rate - soil	mg/day	50	[5, c]	100	[1]
	Conversion factor - soil	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**3.75E-07**		**8.56E-07**	
	HIF (cancer)	**kg/kg-day**	**4.82E-08**		**3.06E-07**	
Ingestion of Groundwater	Ingestion rate - water	L/day	0.63	[5, c]	1.25	[4, a]
	HIF (noncancer)	**L/kg-d**	**4.69E-03**		**1.07E-02**	
	HIF (cancer)	**L/kg-d**	**6.03E-04**		**3.82E-03**	
Dermal Exposure to Soil	Exposed Surface Area (SA)	cm^2/event	3,527	[1]	3,527	[1]
	Adherence Factor (AF)	mg/cm^2	0.07	[1,3 b]	0.12	[1]
	Dermal Absorption Fraction (ABSd)	unitless	CS	[3]	CS	[3]
	Event Frequency (EV)	events/day	1	[3]	1	[3]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**1.85E-06**		**3.62E-06**	
	HIF (cancer)	**kg/kg-day**	**2.38E-07**		**1.29E-06**	

RME = Reasonable Maximum Exposure; CTE = Central Tendency Exposure; CS = chemical-specific

Sources:

[1] USEPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002. December.

[3] USEPA 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E). Office of Solid Waste and Emergency Response. July.

[4] USEPA 1991. OSWER Directive 9285.6-03.

[5] Professional judgment.

Notes:

[a] USEPA 1991 states that half of an individual's daily water intake is assumed to occur at work. Thus, the RME value is based on half of the default daily water intake is 2.5 L/day. This is consistent with the FAQs for OSWER Directive 9200.1-120.

[b] The CTE adherence factor is based on adherence factor for an RME adult resident (derived using the 50th percentile weighted AF for a high-end activity [gardening]).

[c] CTE ingestion rate assumed to be half that of the RME receptor.

Table 3-15. Exposure Parameters for a Hypothetical Future Construction Worker

Exposure Pathway	Exposure Input Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body Weight	kg	80	[1]	80	[1]
	Exposure frequency	days/yr	62	[6, a]	124	[5]
	Exposure duration	yr	0.5	[6, a]	1	[4]
	Averaging Time, Noncancer	days	183	[2]	365	[2]
	Averaging Time, Cancer	days	25,550	[2]	25,550	[2]
Incidental Ingestion of Soil	Ingestion rate	mg/day	165	[6, a]	330	[4, b]
	Conversion factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**3.50E-07**		**1.40E-06**	
	HIF (cancer)	**kg/kg-day**	**2.50E-09**		**2.00E-08**	
Inhalation of Particulates	Exposure time	hr/day	8	[4, c]	8	[4, c]
	Particulate Emission Factor (PEF)	m^3/kg	4.40E+08	[4, d]	4.40E+08	[4, d]
	TWF (noncancer)	**unitless**	**5.66E-02**		**1.13E-01**	
	TWF (cancer)	**unitless**	**4.04E-04**		**1.62E-03**	
Dermal Exposure to Soil	Exposed Surface Area (SA)	cm^2/event	3,527	[1, e]	3,527	[1, e]
	Adherence Factor (AF)	mg/cm^2	0.1	[3, f]	0.3	[3, f]
	Dermal Absorption Fraction (ABSd)	unitless	CS	[3]	CS	[3]
	Event Frequency (EV)	events/day	1	[3]	1	[3]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**7.49E-07**		**4.49E-06**	
	HIF (cancer)	**kg/kg-day**	**5.35E-09**		**6.42E-08**	

RME = Reasonable Maximum Exposure; CTE = Central Tendency Exposure; CS = chemical-specific

Sources:

[1] USEPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

[2] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington, D.C. EPA/540/1-89/002. December.

[3] USEPA 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E). Office of Solid Waste and Emergency Response. July.

[4] USEPA 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

[5] MDEQ 2016. Development of Montana-Specific Default Soil Exposure Frequencies. June.

[6] Professional judgment.

Notes:

[a] CTE value assumed to be half that of the RME receptor.

[b] RME value is based on the default value for construction scenario (Exhibit 5-1) is based on the 95th percentile value for adult soil intake rates reported in a soil ingestion mass-balance study.

[c] Assumes the entire 8-hour workday is outdoors.

[d] Particle emission factor is based on the value recommended for off-site residents of a construction site. This value normalizese the mass of fugitive dust over 30 years but accounts for the mass of dust emited by traffic on unpaved roads during construction and the mass of dust emitted by wind erosion.

[e] Construction workers are assumed to wear a short-sleeved shirt, long pants, and shoes. Assumes that the exposed surface area is equal to the USEPA default for a worker based on assumed exposure to the head, hands and forearms.

[f] Exhibit 3-3; based on the 95th percentile value (0.3) AF for the RME receptor and the geometric mean value (0.1) AF for the CTE receptor.

Table 3-16.Exposure Parameters for a Hiker

Exposure Pathway	Exposure Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body weight as adult	kg	80	[1, a]	80	[1, a]
	Body weight as older child	kg	44	[2]	44	[2]
	Exposure frequency	days/yr	32	[4, b]	64	[4, b]
	Exposure duration as adult	yr	9	[4]	20	[2,4, d]
	Exposure duration as older child	yr	6	[4]	10	[4, c]
	Exposure duration (total)	yr	15	[4, b]	30	[1]
	Averaging Time, Cancer	yr	70	[3]	70	[3]
Incidental Ingestion soil	Ingestion rate - adult	mg/day	50	[4, e]	100	[2,4, d]
	Ingestion rate - older child	mg/day	50	[4, e]	100	[2,4, d]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**7.27E-08**		**2.79E-07**	
	HIF (cancer)	**kg/kg-day**	**1.56E-08**		**1.20E-07**	
Dermal Exposure to Soil	Exposed Surface Area as adult - soil	cm^2/event	6,032	[2, h]	6,032	[2, h]
	Exposed Surface Area as older child -soil	cm^2/event	3,749	[1, i]	3,749	[1, i]
	Adherence Factor - adult	mg/cm^2	0.01	[5]	0.07	[5]
	Adherence Factor - older child	mg/cm^2	0.01	[5]	0.07	[5]
	Dermal Absorption Fraction (ABSd)	unitless	CS	[5]	CS	[5]
	Event Frequency	events/day	1	[5]	1	[5]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**6.95E-08**		**9.66E-07**	
	HIF (cancer)	**kg/kg-day**	**1.49E-08**		**4.14E-07**	

RME = Reasonable Maximum Exposure; CTE = Central Tendency Exposure; CS = chemical-specific

Sources:

[1] USEPA 2011. Exposure Factors Handbook.

[2] USEPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

[3] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.

[4] Professional judgement

[5] USEPA 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E). Office of Solid Waste and Emergency Response. July.

Notes:

[a] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.

[b] Assumes exposure occurs over the course of 16 weeks (roughly Memorial Day to Labor Day) at a frequency of 2 day/week for a CTE receptor and 4 days/week for an RME receptor.

[c] Accounts for an older child exposed from 6 to 16 years of age.

[d] Assumes a value similar to that of an adult resident.

[e] CTE value is assumed to be half that of the RME receptor.

[f] Assumes half the soil value.

[g] Based on mean ingestion rate for wading/splashing of 3.7 mL/hr (Table 3-93) assuming exposure for 1 hr/day for a RME receptor and 0.5 hr/day for a CTE receptor.

[h] Assumes same surface area as a resident (head, hands, forearms, and lower legs for an adult; head, hands, forearms, lower legs, and feet for an older child).

[i] Weighted average surface area for an older child aged 6-16 years (Tables 7-1 and 7-2) assuming exposure to head, hands, forearms, and lower legs (similar to a resident).

[j] Weighted average surface areas calculated (Tables 7-1 and 7-2) assuming exposure to head, hands, forearms, lower legs and feet.

Table 3-17. Exposure Parameters for a Camper

Exposure Pathway	Exposure Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body weight as adult	kg	80	[1]	80	[1]
	Body weight as child	kg	15	[1]	15	[1]
	Exposure frequency	days/yr	32	[4, a]	48	[4, a]
	Exposure duration as adult	yr	9	[4, b]	20	[1,4, b]
	Exposure duration as child	yr	3	[4, b]	6	[1,4, b]
	Exposure duration (total)	yr	12		26	
	Averaging Time, Cancer	yr	70	[3]	70	[3]
Incidental Ingestion of Soil	Ingestion rate as adult - soil	mg/day	50	[4, c]	100	[1,4, b]
	Ingestion rate as child - soil	mg/day	100	[4, c]	200	[1,4, b]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**1.87E-07**		**5.31E-07**	
	HIF (cancer)	**kg/kg-day**	**3.21E-08**		**1.97E-07**	
Dermal Exposure to Soil	Exposed Surface Area as adult - soil	cm^2/event	6,032	[1, b,f]	6,032	[1, b,f]
	Exposed Surface Area as child - soil	cm^2/event	2,373	[1, b,f]	2,373	[1, b,f]
	Adherence Factor as adult	mg/cm^2	0.01	[5]	0.07	[5]
	Adherence Factor as child	mg/cm^2	0.04	[5]	0.2	[5]
	Dermal Absorption Fraction (ABSd)	unitless	CS	[5]	CS	[5]
	Event Frequency	events/day	1	[5]	1	[5]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**1.88E-07**		**1.49E-06**	
	HIF (cancer)	**kg/kg-day**	**3.23E-08**		**5.55E-07**	

RME = Reasonable Maximum Exposure; CTE = Central Tendency Exposure; CS = chemical-specific

Sources:

[1] USEPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

[2] USEPA 2011. Exposure Factors Handbook.

[3] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.

[4] Professional judgement

[5] USEPA 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E). Office of Solid Waste and Emergency Response. July.

Notes:

[a] Assumes exposure occurs over the course of 16 weeks (roughly Memorial Day to Labor Day) at a frequency of 2 day/week for a CTE visitor and 3 days/week for an RME visitor.

[b] Assumes a value similar to that of a resident.

[c] CTE value is assumed to be half that of the RME receptor.

[d] Assumes half the soil value.

[e] Weighted mean of consumer-only ingestion of drinking water (Table 3-1).

[f] For soil, surface area value for an adult assumes exposure to head, hands, forearms, and lower legs as an adult; also to feet for sediment. For soil and sediment, surface area value for a child assumes exposure to head, hands, forearms, lower legs and feet.

[g] Assumes full body exposure to surface water during swimming.

Table 3-18. Exposure Parameters for a Recreational Fisher

Exposure Pathway	Exposure Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body weight as adult	kg	80	[2]	80	[2]
	Body weight as older child	kg	44	[1, a]	44	[1, a]
	Exposure frequency	days/yr	48	[4, b]	96	[4, b]
	Exposure duration as adult	yr	9	[4]	20	[2,4, d]
	Exposure duration as older child	yr	6	[4]	10	[4, c]
	Exposure duration (total)	yr	15		30	
	Averaging Time, Cancer	yr	70	[3]	70	[3]
Incidental Ingestion of soil	Ingestion rate - adult	mg/day	50	[4, e]	100	[2,4, d]
	Ingestion rate - older child	mg/day	50		100	
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**1.09E-07**		**4.18E-07**	
	HIF (cancer)	**kg/kg-day**	**2.34E-08**		**1.79E-07**	
Ingestion of Fish	Ingestion rate - adult	g/day	12	[1, f]	43	[1, f]
	Ingestion rate - older child	g/day	12	[1, f]	43	[1, f]
	Exposure frequency	days/yr	365	[3]	365	[3]
	Conversion Factor	kg/g	1.00E-03		1.00E-03	
	HIF (noncancer)	**kg/kg-day**	**1.99E-04**		**6.84E-04**	
	HIF (cancer)	**kg/kg-day**	**4.27E-05**		**2.93E-04**	
Dermal Exposure to Soil	Exposed Surface Area as adult	cm^2/event	6,032	[2, g]	6,032	[2, g]
	Exposed Surface Area as older child	cm^2/event	3,749	[1, g]	3,749	[1, g]
	Adherence Factor - adult	mg/cm^2	0.01	[5]	0.07	[5]
	Adherence Factor - older child	mg/cm^2	0.01	[5]	0.07	[5]
	Dermal Absorption Fraction (ABSd)	unitless	CS	[5]	CS	[5]
	Event Frequency	events/day	1	[5]	1	[5]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**1.04E-07**		**1.45E-06**	
	HIF (cancer)	**kg/kg-day**	**2.24E-08**		**6.21E-07**	

RME = Reasonable Maximum Exposure; CTE = Central Tendency Exposure; CS = chemical-specific

Sources:

[1] USEPA 2011. Exposure Factors Handbook.

[2] USEPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

[3] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.

[4] Professional judgement

[5] USEPA 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E). Office of Solid Waste and Emergency Response. July.

[6] USEPA 2016. A Fish Consumption Survey of the Shoshone-Bannock Tribes. December.

Notes:

[a] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.

[b] Assumes exposure occurs over the course of 24 weeks (roughly April - September) at a frequency of 2 day/week for a CTE receptor and 4 days/week for an RME receptor.

[c] Accounts for an older child exposed from 6 to 16 years of age.

[d] Assumes a value similar to that of an adult resident.

[e] CTE value is assumed to be half that of the RME receptor.

[f] Based on long-term average mean and 95th percentile ingestion rates presented in EFH Table 10-5 for freshwater recreational fish intake by consuming anglers in North Dakota (nearest state to Montana with data).

[g] Weighted average surface areas (Tables 7-1 and 7-2) calculated assuming exposure to head, hands, forearms, lower legs, and feet (similar to that of a resident).

Table 3-19. Exposure Parameters for a Tribal Fisher

Exposure Pathway	Exposure Parameter	Units	CTE		RME	
			Value	Source	Value	Source
General	Body weight as adult	kg	80	[2]	80	[2]
	Body weight as older child	kg	44	[1, a]	44	[1, a]
	Exposure frequency (excluding fish consumption)	days/yr	48	[4, b]	96	[4, b]
	Exposure duration as adult	yr	9	[4]	20	[2,4, d]
	Exposure duration as older child	yr	6	[4]	10	[4, c]
	Exposure duration (total)	yr	15		30	
	Averaging Time, Cancer	yr	70	[3]	70	[3]
Incidental Ingestion of soil	Ingestion rate - adult	mg/day	50	[4, e]	100	[2,4, d]
	Ingestion rate - older child	mg/day	50		100	
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**1.09E-07**		**4.18E-07**	
	HIF (cancer)	**kg/kg-day**	**2.34E-08**		**1.79E-07**	
Ingestion of Fish	Ingestion rate - adult	g/day	23	[6, f]	93	[6, f]
	Ingestion rate - older child	g/day	23	[6, f]	93	[6, f]
	Exposure frequency	days/yr	365	[3]	365	[3]
	Conversion Factor	kg/g	1.00E-03		1.00E-03	
	HIF (noncancer)	**kg/kg-day**	**3.82E-04**		**1.48E-03**	
	HIF (cancer)	**kg/kg-day**	**8.18E-05**		**6.34E-04**	
Dermal Exposure to Soil	Exposed Surface Area as adult	cm^2/event	6,032	[2, g]	6,032	[2, g]
	Exposed Surface Area as older child	cm^2/event	3,749	[1, g]	3,749	[1, g]
	Adherence Factor - adult	mg/cm^2	0.01	[5]	0.07	[5]
	Adherence Factor - older child	mg/cm^2	0.01	[5]	0.07	[5]
	Dermal Absorption Fraction (ABSd)	unitless	CS	[5]	CS	[5]
	Event Frequency	events/day	1	[5]	1	[5]
	Conversion Factor	kg/mg	1.00E-06		1.00E-06	
	HIF (noncancer)	**kg/kg-day**	**1.04E-07**		**1.45E-06**	
	HIF (cancer)	**kg/kg-day**	**2.24E-08**		**6.21E-07**	

RME = Reasonable Maximum Exposure; CTE = Central Tendency Exposure; CS = chemical-specific

Sources:

[1] USEPA 2011. Exposure Factors Handbook.

[2] USEPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

[3] USEPA 1989. Risk Assessment Guidance for Superfund, Volume I, Part A.

[4] Professional judgement

[5] USEPA 2004. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E). Office of Solid Waste and Emergency Response. July.

[6] USEPA 2016. A Fish Consumption Survey of the Shoshone-Bannock Tribes. December.

Notes:

[a] Table 8-1. Age-weighted average based on body weights of children 6-<11 years old and 11-<16 years old.

[b] Assumes exposure occurs over the course of 24 weeks (roughly April - September) at a frequency of 2 day/week for a CTE receptor and 4 days/week for an RME receptor.

[c] Accounts for an older child exposed from 6 to 16 years of age.

[d] Assumes a value similar to that of an adult resident.

[e] CTE value is assumed to be half that of the RME receptor.

[f] RME value based on 95th percentile NCI value and CTE value based on mean NCI value for Group 2 adult consuming fishers of the Shoshone-Bannock Tribes (Table S2).

[g] Weighted average surface areas (Tables 7-1 and 7-2) calculated assuming exposure to head, hands, forearms, lower legs, and feet (similar to that of a resident).

Table 3-20. OU3 Groundwater Sample Summary by Well

Well Type	Well ID	Sample Date	Sample Number	Analysis		
				Dioxins/Furans	Total Metals	Aroclors
Shallow Wells	ATMW6	4/14/2014	ATMW-6_4/14/14_NM	X	X	X
		12/15/2015	ATMW6_20151215_NM	X		
		6/2/2016	ATMW6_20160602_NM			
		7/7/2017	ATMW6_20170707_NM	X	X	
	NFMW10	12/17/2015	NFMW10_20151217_NM	X		
		6/7/2016	NFMW10_20160607_NM	X		X
		7/10/2017	NFMW10_20170710_NM	X	X	X
	NFMW11	12/17/2015	NFMW11_20151217_NM	X		
		6/7/2016	NFMW11_20160607_NM	X		
		7/12/2017	NFMW11_20170712_NM	X	X	X
	NFMW19	12/17/2015	NFMW19_20151217_NM	X		
		6/7/2016	NFMW19_20160607_NM	X		X
		7/11/2017	NFMW19_20170711_NM	X	X	X
	NFMW1D	4/16/2014	NFMW1d_4/16/14_NM	X	X	X
		12/18/2015	NFMW1d_20151218_NM	X		
		6/8/2016	NFMW1d_20160608_NM	X		
		7/10/2017	NFMW1d_20170710_NM	X	X	X
	NFMW1S	4/16/2014	NFMW1s_4/16/14_NM	X	X	X
	NFMW2	4/15/2014	NFMW-2_4/15/14_NM	X	X	X
		12/18/2015	NFMW2_20151218_NM	X		
		6/8/2016	NFMW2_20160608_NM	X		X
		7/12/2017	NFMW2_20170712_NM	X	X	X
	NFMW20	12/17/2015	NFMW20_20151217_NM	X		
		6/7/2016	NFMW20_20160607_NM	X		X
		7/11/2017	NFMW20_20170711_NM	X	X	X
	NFMW3	4/16/2014	NFMW-3_4/16/14_NM	X	X	X
		12/18/2015	NFMW3_20151218_NM	X		
		6/8/2016	NFMW3_20160608_NM	X		
		7/10/2017	NFMW3_20170710_NM	X	X	
	NFMW4	4/15/2014	NFMW-4_4/15/14_NM	X	X	X
		12/16/2015	NFMW4_20151216_NM	X		
		6/6/2016	NFMW4_20160606_NM	X		
		7/5/2017	NFMW4_20170705_NM	X	X	
	NFMW5	4/15/2014	NFMW-5_4/15/14_NM	X	X	X
		12/10/2015	NFMW5_20151210_NM	X		X
		6/2/2016	NFMW5_20160602_NM	X		X
		7/11/2017	NFMW5_20170711_NM	X	X	
	NFMW6	4/15/2014	NFMW-6_4/15/14_NM	X	X	X
		12/18/2015	NFMW6_20151218_NM	X		
		7/12/2017	NFMW6_20170712_NM	X	X	X
	NFMW7	12/9/2015	NFMW7_20151209_NM	X		X
		6/8/2016	NFMW7_20160608_NM	X		
		7/10/2017	NFMW7_20170710_NM	X	X	
	NFMW8	12/17/2015	NFMW8_20151217_NM	X		
		6/8/2016	NFMW8_20160608_NM	X		
		7/6/2017	NFMW8_20170706_NM	X	X	
	NFMW9	12/21/2015	NFMW9_20151221_NM	X		
		6/8/2016	NFMW9_20160608_NM	X		
		7/10/2017	NFMW9_20170710_NM	X	X	X

Shallow Wells	SMW10	12/14/2015	SMW10_20151214_NM	X		
		6/3/2016	SMW10_20160603_NM	X		
		6/28/2017	SMW10_20170628_NM	X	X	
	SMW11	12/14/2015	SMW11_20151214_NM	X		
		6/3/2016	SMW11_20160603_NM	X		
		6/29/2017	SMW11_20170629_NM	X	X	
	SMW12	12/14/2015	SMW12_20151214_NM	X		
		6/6/2016	SMW12_20160606_NM	X		
		6/29/2017	SMW12_20170629_NM	X	X	
	SMW13	12/15/2015	SMW13_20151215_NM	X		
		6/6/2016	SMW13_20160606_NM	X		
		6/29/2017	SMW13_20170629_NM	X	X	
	SMW14	12/15/2015	SMW14_20151215_NM	X		
		6/6/2016	SMW14_20160606_NM	X		
		7/6/2017	SMW14_20170706_NM	X	X	
	SMW15	4/16/2014	SMW-15_4/16/14_NM	X	X	X
		12/15/2015	SMW15_20151215_NM	X		
		6/6/2016	SMW15_20160606_NM	X		
		7/10/2017	SMW15_20170710_NM	X	X	
	SMW16	4/15/2014	SMW-16_4/15/14_NM	X	X	X
		12/16/2015	SMW16_20151216_NM	X		
		6/7/2016	SMW16_20160607_NM	X		
		3/27/2017	SMW16_20170327_NM	X		X
		7/6/2017	SMW16_20170706_NM	X	X	
	SMW17	12/16/2015	SMW17_20151216_NM	X		
		6/6/2016	SMW17_20160606_NM	X		
		3/27/2017	SMW17_20170327_NM	X		X
		6/30/2017	SMW17_20170630_NM	X	X	X
	SMW18	12/16/2015	SMW18_20151216_NM	X		
		3/29/2017	SMW18_20170329_NM	X		X
		7/5/2017	SMW18_20170705_NM	X	X	
	SMW19	12/16/2015	SMW19_20151216_NM	X		
		6/7/2016	SMW19_20160607_NM	X		
		7/5/2017	SMW19_20170705_NM	X	X	
	TW2R	4/15/2014	TW-2R_4/15/14_NM	X	X	X
		12/15/2015	TW2R_20151215_NM	X		
		6/6/2016	TW2R_20160606_NM	X		
		6/29/2017	TW2R_20170629_NM	X	X	
	TW5R	12/14/2015	TW5R_20151214_NM	X		
Deep Wells	SMW16D	3/27/2017	SMW16D_20170327_NM	X		X
		7/6/2017	SMW16D_20170706_NM	X	X	X
	SMW17D	3/28/2017	SMW17D_20170328_NM	X		X
		6/30/2017	SMW17D_20170630_NM	X	X	X
	SMW18D	3/29/2017	SMW18D_20170329_NM	X		X
		7/6/2017	SMW18D_20170706_NM	X	X	X

Table 3-21. OU3 Upland Soil Sample Summary by Grid

Grid	Sample ID	Type	Dioxins/Furans	Antimony	Mercury
26	HP18-1-SS_4/10/14_NM	5-pt comp.	X	X	X
	HP18-TP1-SS_4/1/14_NM	5-pt comp.	X		
	Grid 26-SB-(24-30in)_20171018_NM	SB (grab)	X	X	X
	HP18-TP1-SB-8.0_4/1/14_NM	SB (grab)	X		
27	Grid 27-SSComp-01_20171019_NM	20-pt comp.	X	X	X
28	Grid 28-SSComp-01_20171019_NM	20-pt comp.	X	X	X
29	Grid 29-SSComp-01_20171019_NM	20-pt comp.	X	X	X
	Grid 29-SB-(24-30in)_20171018_NM	SB (grab)	X	X	X
30	Grid 30-SSComp-01_20171020_NM	20-pt comp.	X	X	X
31	HP18-TP3-SS_4/1/14_NM	5-pt comp.	X	X	X
	SS1-HP18-(0-2)c	5-pt comp.	X		X
	SS2-HP18-(5-7)c	5-pt comp.	X		X
	HP18-TP3-SB-5.0_4/1/14_NM	SB (grab)	X	X	X
32	HP18-SSC-IB_4/10/14_NM	5-pt comp.	X	X	X
33	Grid 33-SSComp-01_20171020_NM	20-pt comp.	X	X	X
	Grid 33-SB-(24-30in)_20171017_NM	SB (grab)	X	X	X
34	Grid 34-SSComp-01_20171019_NM	20-pt comp.	X	X	X
35	HP18-SSC-ditch_4/10/14_NM	5-pt comp.	X	X	X
36	HP16-1-SS_4/10/14_NM	5-pt comp.	X	X	X
37	Grid 37-SSComp-01_20171020_NM	20-pt comp.	X	X	X
	SS3-HP16-(0-2)c	5-pt comp.	X		X
	SS4-HP16-(5-7)c	5-pt comp.	X		X
38	Grid 38-SB-(24-30in)_20171017_NM	SB (grab)	X	X	X
39	Grid 39-SSComp-01_20171020_NM	20-pt comp.	X	X	X
	HP16-TP2-SS_4/1/14_NM	5-pt comp.	X	X	X
	HP16-TP2-SB-3.5_4/1/14_NM	SB (grab)	X	X	X
40	SS5-IBJ-(0-2)c	5-pt comp.	X		X
	SS6-IBJ-(5-7)c	5-pt comp.	X		X
41	IBJ-TP1-SS_4/1/14_NM	5-pt comp.	X	X	X
	IBJ-TP1-SB-3.0_4/1/14_NM	SB (grab)	X	X	X
	IBJ-TP1-SB-5.5_4/1/14_NM	SB (grab)	X	X	X
42	SS7-HP13-(0-2)c	5-pt comp.	X		X
	SS8-HP13-(5-7)c	5-pt comp.	X		X
43	Grid 43-SSComp-01_20171023_NM	20-pt comp.	X	X	X
44	Grid 44-SSComp-01_20171023_NM	20-pt comp.	X	X	X
	CRP-1-SS_4/10/14_NM	5-pt comp.	X	X	X
45	Grid 45-SB-(24-30in)_20171017_NM	SB (grab)	X	X	X
46	SS10-HP12-(5-7)c	5-pt comp.	X		X
	SS9-HP12-(0-2)c	5-pt comp.	X		X
	SB30-AB3-(0-10)c	SB (grab)	X		X
47	Grid 47-SSComp-01_20171023_NM	20-pt comp.	X	X	X
	SB31-AB3-(0-10)c	SB (grab)	X		X
48	NPP-TP1-SS_4/1/14_NM	5-pt comp.	X	X	X
49	SS13-HP9-(0-2)c	5-pt comp.	X		X
	SS14-HP9-(5-7)c	5-pt comp.	X		X
50	AB II-SSComp-01_20171025_NM	30-pt comp.	3	3	3
	P8-SSComp-01_20171025_NM	30-pt comp.	2	2	2
	SB23-P8-(0-4)c	SB (grab)	X		X
51	SB29-AB2-(0-10)c	SB (grab)	X		X
52	NPP-TP2-SB-4.0_4/2/14_NM	SB (grab)	X		
	SB27-AB1-(0-6)c	SB (grab)	X		X
	SB28-AB2-(0-10)c	SB (grab)	X		X
	SB32-NPP-(0-6)c	SB (grab)	X		X

Table 3-21. OU3 Upland Soil Sample Summary by Grid

Grid	Sample ID	Type	Dioxins/Furans	Antimony	Mercury
53	Grid 53-SSComp-01_20171020_NM	20-pt comp.	X	X	X
	Grid 53-SB-(24-30in)_20171018_NM	SB (grab)	X	X	X
54	P8-TP3-SS_4/4/14_NM	5-pt comp.	X	X	X
	P8-TP3-SB-2.5_4/4/14_NM	SB (grab)	X	X	X
	SB24-P8-(0-4)c	SB (grab)	X		X
55	SB19-TP3-SS_4/4/14_NM	5-pt comp.	X	X	X
	SB19-TP3-SB-8.0_4/4/14_NM	SB (grab)	X	X	X
	SB35-sb19-(0-6)c	SB (grab)	X		X
56	SPP-SSComp-01_20171025_NM	30-pt comp.	2	2	2
	AB1-TP3-SS_4/4/14_NM	5-pt comp.	X	X	X
	AB1-TP3-SB-2.2_4/4/14_NM	SB (grab)	X	X	X
	SB33-SPP-(0-12)c	SB (grab)	X		X
58	HP9-1-SS_4/10/14_NM	5-pt comp.	X	X	X
	HP9-1-SB-1.0_5/29/14_NM	SB (grab)	X	X	X
59	P8dc-SSComp-01_20171024_NM	30-pt comp.	X	X	X
	SS15-HP9-(0-2)c	5-pt comp.	X		X
	SS16-HP9-(5-7)c	5-pt comp.	X		X
	SB25-P8dc-(0-5)c	SB (grab)	X		X
	SB26-P8dc-(0-6)c	SB (grab)	X		X
60	Grid 60-SSComp-01_20171023_NM	20-pt comp.	X	X	X
	SB36-sb20-(0-10)c	SB (grab)	X		X
	SB37-sb20-(0-10)c	SB (grab)	X		X
61	Grid 61-SSComp-01_20171023_NM	20-pt comp.	X	X	X
62	SB34-SPP-(0-12)c	SB (grab)	X		X
64	Grid 64-SSComp-01_20171024_NM	20-pt comp.	X	X	X
	SB19-SWB6-(0-10)c	SB (grab)	X		X
	SB21-SWB6-(0-10)c	SB (grab)	X		X
65	SB13-P4-(2-10)c	SB (grab)	X		X
66	SWBA-SSComp-01_20171024_NM	30-pt comp.	2	2	2
	P4-BH1-SS_4/4/14_NM	5-pt comp.	X	X	X
	P4-BH1-SB-8-10_4/4/14_NM	SB (grab)	X	X	X
	SB11-P4-(0-10)c	SB (grab)	X		X
	SB15-P5-(0-10)c	SB (grab)	X		X
67	P3-SSComp-01_20171020_NM	20-pt comp.	4	4	4
	SB7-P3-(2-10)c	SB (grab)	X		X
	SB9-SWBA-(0-10)c	SB (grab)	X		X
70	P5S-BH1-SS_4/4/14_NM	5-pt comp.	X	X	X
	SB17-P5-(2-10)c	SB (grab)	X		X
71	P5-BH2-SS_4/3/14_NM	5-pt comp.	X	X	X
	P5-BH2-SB-6-8_4/3/14_NM	SB (grab)	X	X	X
	SB5-P3-(0-10)c	SB (grab)	X		X
72	P3-BH1-SS_4/3/14_NM	5-pt comp.	X	X	X
74	Grid 74-SSComp-01_20171023_NM	20-pt comp.	X	X	X
	P17-BH1-SS_4/3/14_NM	5-pt comp.	X	X	X
	SB1-P17-(0-10)c	SB (grab)	X		X
	SB3-P17-(0-10)c	SB (grab)	X		X
75	Grid 75,78-SSComp-01_20171023_NM	20-pt comp.	2	2	2
	Grid 75,78-SB-(24-30in)_20171018_NM	SB (grab)	2	2	2
76	Grid 76,77,79,80-SSComp-01_20171023_NM	20-pt comp.	4	4	4
	IBK-1-SS_4/16/14_NM	5-pt comp.	X	X	X
	SS11-IBK-(0-2)c	5-pt comp.	X		X
	SS12-IBK-(5-7)c	5-pt comp.	X		X
	Grid 76,77,79,80-SB-(24-30in)_20171018_NM	SB (grab)	4	4	4

SB = subsurface; comp = composite

Table 3-22. OU3 Floodplain Soil Sample Summary by Grid

Grid	Sample ID	Type	Dioxins/Furans	Barium	Mercury
81	Grid 81-SSComp-01_20171024_NM	20-pt comp.	X	X	X
	Grid 81-SB-(24-30in)_20171018_NM	SB (grab)	X	X	X
82	Grid 82-SSComp-01_20171024_NM	20-pt comp.	X	X	X
84	Grid 84-SSComp-01_20171026_NM	20-pt comp.	X	X	X
85	Grid 85-SB-(24-30in)_20171018_NM	SB (grab)	X	X	X
86	HP13A-1-SS_4/10/14_NM	5-pt comp.	X	X	X
	HP13A-1-SB-1.0_5/29/14_NM	SB (grab)	X	X	X
87	SE16-HP13-(0-2)c	5-pt comp.	X	X	X
	Grid 87-SB-(24-30in)_20171017_NM	SB (grab)	X	X	X
88	SE15-HP13-(0-2)c	5-pt comp.	X	X	X
89	Grid 89-SSComp-01_20171026_NM	20-pt comp.	X	X	X
	SE14-HP13-(0-2)c	5-pt comp.	X	X	X
	SE17-HP13a-(0-2)c	5-pt comp.	X	X	X
	Grid 89-SB-(24-30in)_20171017_NM	SB (grab)	X	X	X
90	SE11-HP11-(0-2)c	5-pt comp.	X	X	X
	SE13-HP12-(0-2)c	5-pt comp.	X	X	X
91	SE12-HP12-(0-2)c	5-pt comp.	X	X	X
	SE9-HP10-(0-2)c	5-pt comp.	X	X	X
93	SE10-HP11-(0-2)c	5-pt comp.	X	X	X
	SE8-HP10-(0-2)c	5-pt comp.	X	X	X
94	Grid 94-SSComp-01_20171026_NM	20-pt comp.	X	X	X
	SE6-HP7-(0-2)c	5-pt comp.	X	X	X
	SE7-HP7-(0-2)c	5-pt comp.		X	X
	Grid 94-SB-(24-30in)_20171018_NM	SB (grab)	X	X	X
95	SE3-HP1-(0-2)c	5-pt comp.	X	X	X
	SE4-HP1-(0-2)c	5-pt comp.	X	X	X
	SE5-HP2-(0-2)c	5-pt comp.	X	X	X
97	HP2-TP3-SS_4/2/14_NM	5-pt comp.	X	X	X
	HP2-TP3-SB-5.5_4/2/14_NM	SB (grab)	X	X	X
98	SE1-HP1a-(0-2)c	5-pt comp.	X	X	X
	SE2-HP1a-(0-2)c	5-pt comp.	X	X	X
	Grid 98-SB-(24-30in)_20171018_NM	SB (grab)	X	X	X

SB = subsurface; comp = composite

Table 4-1. Human Health Toxicity Values for OU3 COPCs

Analyte	CAS No.	Oral				Note	Dermal			Inhalation				Note
		RfD (mg/kg-day)	Source	CSF $(mg/kg\text{-}day)^{-1}$	Source		Absorption Fraction	RfD_{ABS} (mg/kg-day) [1]	CSF_{ABS} $(mg/kg\text{-}day)^{-1}$ [2]	RfC (mg/m^3)	Source	UR $(\mu g/m^3)^{-1}$	Source	
2,3,7,8-TCDD	1746-01-6	7.0E-10	I	1.3E+05	C		1	7.0E-10	1.3E+05	4.0E-08	C	3.8E+01	C	[3]
Aroclor-1254	11097-69-1	2.0E-05	I	2.0E+00	I		1	2.0E-05	2.0E+00					
Arsenic (inorganic arsenic)	7440-38-2	3.0E-04	I	1.5E+00	I		1	3.0E-04	1.5E+00	1.5E-05	C	4.3E-03	I	
Antimony (antimony potassium tartrate)	28300-74-5	4.0E-04	I				0.15	6.0E-05						
Barium	7440-39-3	2.0E-01	I				0.07	1.4E-02		5.0E-04	H			
Cadmium (diet)	7440-43-9	1.0E-03	I				0.025	2.5E-05		1.0E-05	A	1.8E-03	I	
Chromium	7440-47-3	1.3E+00	I			[4]	0.013	1.7E-02						
Cobalt	7440-48-4	3.0E-04	P				1	3.0E-04		6.0E-06	P	9.0E-03	P	
Iron	7439-89-6	7.0E-01	P				1	7.0E-01						
Manganese (Nonfood)	7439-96-5	4.7E-02	I			[5]	0.04	1.9E-03		5.0E-05	I			
Mercury (mercuric chloride)	7487-94-7	3.0E-04	I				0.07	2.1E-05						
Vanadium	7440-62-2	5.0E-03	S			[6]	0.026	1.3E-04						

Key: I = IRIS; P = PPRTV; S = USEPA RSL User's Guide; H = HEAST; C = CalEPA.

Notes:

[1] Absorbed Reference Doses for Dermal were derived using the Oral Reference Dose as follows: $RFD_{ABS} = RfD_o * ABS_{GI}$ (Equation 4.3 from USEPA 2004).

[2] Absorbed Cancer Slope Factors for Dermal were derived using the Oral Cancer Slope Factors as follows: $SF_{ABS} = SF_o / ABS_{GI}$ (Equation 4.2 from USEPA 2004).

[3] USEPA (2013) noted that the contribution of the inhalation pathway to total risk is well below 1%.

[4] Assumes a 1:6 ratio for Cr(III):Cr(VI).

[5] The IRIS RfD (0.14 mg/kg-day) is adjusted by dividing by a modifying factor of 3.

[6] Based on factoring out the molecular weight of the oxide ion from the RfD for vanadium pentoxide.

Table 5-1. Total Non-Cancer Hazards (Incidental Ingestion + Dermal Contact) for Receptors Exposed to OU3 Upland Soils

Grid	Non-Cancer HI									
	Resident		Worker		Construction Worker		Hiker		Camper	
	CTE	RME	CTE	RME	CTE	RME	CTE	RME	CTE	RME
26	1E-02	4E-02	4E-03	9E-03	3E-03	1E-02	7E-04	3E-03	2E-03	5E-03
27	6E-03	1E-02	1E-03	3E-03	1E-03	5E-03	3E-04	1E-03	7E-04	2E-03
28	2E-03	4E-03	4E-04	9E-04	4E-04	1E-03	8E-05	3E-04	2E-04	6E-04
29	7E-03	2E-02	2E-03	4E-03	2E-03	7E-03	4E-04	1E-03	9E-04	3E-03
30	5E-03	1E-02	1E-03	3E-03	1E-03	4E-03	2E-04	8E-04	6E-04	2E-03
31	9E-04	2E-03	2E-04	5E-04	2E-04	9E-04	4E-05	2E-04	1E-04	3E-04
32	8E-04	2E-03	2E-04	4E-04	2E-04	7E-04	4E-05	1E-04	1E-04	3E-04
33	2E-03	6E-03	6E-04	1E-03	6E-04	2E-03	1E-04	5E-04	3E-04	9E-04
34	2E-03	5E-03	5E-04	1E-03	5E-04	2E-03	9E-05	4E-04	2E-04	7E-04
35	1E-03	4E-03	4E-04	8E-04	3E-04	1E-03	7E-05	3E-04	2E-04	5E-04
36	2E-02	6E-02	6E-03	1E-02	6E-03	2E-02	1E-03	5E-03	3E-03	9E-03
37	4E-03	1E-02	1E-03	2E-03	9E-04	4E-03	2E-04	7E-04	5E-04	1E-03
39	8E-03	2E-02	2E-03	5E-03	2E-03	7E-03	4E-04	1E-03	1E-03	3E-03
40	5E-03	1E-02	1E-03	3E-03	1E-03	5E-03	3E-04	1E-03	7E-04	2E-03
41	9E-03	2E-02	2E-03	5E-03	2E-03	7E-03	4E-04	2E-03	1E-03	3E-03
42	1E-02	3E-02	3E-03	6E-03	2E-03	1E-02	5E-04	2E-03	1E-03	4E-03
43	1E-02	3E-02	3E-03	7E-03	3E-03	1E-02	6E-04	2E-03	2E-03	4E-03
44	1E-02	3E-02	2E-03	6E-03	2E-03	9E-03	5E-04	2E-03	1E-03	3E-03
46	4E-03	1E-02	9E-04	2E-03	9E-04	4E-03	2E-04	7E-04	5E-04	1E-03
47	5E-02	1E-01	1E-02	3E-02	1E-02	4E-02	2E-03	9E-03	6E-03	2E-02
48	1E-01	3E-01	3E-02	7E-02	3E-02	1E-01	6E-03	2E-02	2E-02	5E-02
49	7E-02	2E-01	2E-02	4E-02	2E-02	6E-02	3E-03	1E-02	8E-03	2E-02
50	6E-02	2E-01	2E-02	4E-02	1E-02	6E-02	3E-03	1E-02	8E-03	2E-02
51	7E-02	2E-01	2E-02	4E-02	2E-02	6E-02	3E-03	1E-02	9E-03	2E-02
52	7E-02	2E-01	2E-02	4E-02	2E-02	6E-02	3E-03	1E-02	9E-03	2E-02
53	7E-02	2E-01	2E-02	4E-02	2E-02	7E-02	4E-03	1E-02	9E-03	3E-02
54	5E-02	1E-01	1E-02	3E-02	1E-02	4E-02	3E-03	1E-02	7E-03	2E-02
55	1E-01	3E-01	3E-02	8E-02	3E-02	1E-01	6E-03	2E-02	2E-02	5E-02
56	1E-01	4E-01	4E-02	8E-02	3E-02	1E-01	7E-03	3E-02	2E-02	5E-02
58	2E-01	5E-01	5E-02	1E-01	4E-02	2E-01	1E-02	4E-02	2E-02	7E-02
59	4E-02	1E-01	1E-02	2E-02	7E-03	3E-02	2E-03	7E-03	5E-03	1E-02
60	2E-02	5E-02	5E-03	1E-02	5E-03	2E-02	1E-03	4E-03	3E-03	8E-03
61	1E-02	4E-02	4E-03	8E-03	3E-03	1E-02	7E-04	3E-03	2E-03	5E-03
62	1E-01	4E-01	4E-02	8E-02	3E-02	1E-01	7E-03	3E-02	2E-02	5E-02
64	5E-02	1E-01	1E-02	3E-02	1E-02	5E-02	3E-03	1E-02	7E-03	2E-02
66	2E-03	6E-03	6E-04	1E-03	9E-04	4E-03	1E-04	5E-04	3E-04	9E-04
67	8E-02	2E-01	2E-02	4E-02	2E-02	7E-02	4E-03	1E-02	1E-02	3E-02
68	2E-01	5E-01	5E-02	1E-01	4E-02	2E-01	9E-03	4E-02	2E-02	7E-02
70	1E-02	2E-02	2E-03	6E-03	3E-03	1E-02	5E-04	2E-03	1E-03	3E-03
71	2E-01	4E-01	4E-02	9E-02	3E-02	1E-01	7E-03	3E-02	2E-02	5E-02
72	2E-01	4E-01	4E-02	9E-02	4E-02	2E-01	8E-03	3E-02	2E-02	6E-02
74	7E-01	2E+00	2E-01	4E-01	2E-01	6E-01	3E-02	1E-01	9E-02	2E-01
75	8E-04	2E-03	2E-04	4E-04	2E-04	7E-04	4E-05	1E-04	1E-04	3E-04
76	5E-03	1E-02	1E-03	3E-03	1E-03	4E-03	2E-04	9E-04	6E-04	2E-03
77	6E-03	2E-02	1E-03	3E-03	1E-03	5E-03	3E-04	1E-03	7E-04	2E-03
78	8E-04	2E-03	2E-04	4E-04	2E-04	7E-04	4E-05	1E-04	1E-04	3E-04
79	6E-03	2E-02	1E-03	3E-03	1E-03	5E-03	3E-04	1E-03	7E-04	2E-03
80	6E-03	2E-02	1E-03	3E-03	1E-03	5E-03	3E-04	1E-03	7E-04	2E-03

Shading indicates hazards above USEPA's unacceptable risk criteria (HQ>1).

Table 5-2. Total Non-Cancer Hazards (Incidental Ingestion + Dermal Contact) for Receptors Exposed to OU3 Floodplain Soils

Grid	Non-Cancer HI					
	Hiker		Camper		Fisher	
	CTE	RME	CTE	RME	CTE	RME
81	1E-04	5E-04	4E-04	1E-03	2E-04	8E-04
82	1E-04	4E-04	3E-04	8E-04	2E-04	7E-04
84	1E-04	4E-04	3E-04	8E-04	2E-04	6E-04
86	2E-03	9E-03	6E-03	2E-02	3E-03	1E-02
87	1E-03	4E-03	3E-03	8E-03	2E-03	6E-03
88	7E-03	3E-02	2E-02	5E-02	1E-02	4E-02
89	1E-03	5E-03	3E-03	9E-03	2E-03	7E-03
90	7E-03	3E-02	2E-02	5E-02	1E-02	4E-02
91	3E-03	1E-02	8E-03	2E-02	4E-03	2E-02
93	6E-03	2E-02	2E-02	4E-02	9E-03	3E-02
94	4E-03	1E-02	1E-02	3E-02	6E-03	2E-02
95	3E-03	1E-02	7E-03	2E-02	4E-03	2E-02
97	4E-04	1E-03	1E-03	3E-03	6E-04	2E-03
98	2E-03	9E-03	6E-03	2E-02	4E-03	1E-02

Table 5-3. Summary of Non-Cancer Hazards to Hypothetical Future Residents in Grid 74 from Exposures to OU3 Upland Surface Soils

Grid	COPC	Non-Cancer HQ CTE	Non-Cancer HQ RME
74	TEQ (ND=1/2 MDL)	7E-01	2E+00
	Mercury	1E-03	3E-03
	Antimony	9E-03	2E-02
	Cadmium	1E-02	3E-02
	Total	7E-01	2E+00

Shading indicates hazards above USEPA's unacceptable risk criteria (HQ>1).

Table 5-4. Summary of Non-Cancer Hazards and
Ingestion of OU3 Groundwater

Receptor	Non-Cancer HI	
	CTE	RME
Hypothetical Future Resident	5E+00	1E+01
Hypothetical Future Commercial/Industrial Worker	2E+00	4E+00

Shading indicates hazards above USEPA's unacceptable risk criteria (I

Table 5-5. Combined Non-Cancer HI
(Manganese in GW + COPCs in Soil)

Well ID	Grid	Manganese in GW Non-Cancer HQ CTE	Manganese in GW Non-Cancer HQ RME	COPCs in Surface Soil Non-Cancer HI CTE	COPCs in Surface Soil Non-Cancer HI RME	GW + Soil Non-Cancer HI CTE	GW + Soil Non-Cancer HI RME
SMW18	34	7E-01	2E+00	2E-03	5E-03	7E-01	2E+00
NFMW4	37	2E+00	6E+00	4E-03	1E-02	2E+00	6E+00
NFMW12	40	1E+00	3E+00	5E-03	1E-02	1E+00	3E+00
SMW19	46	8E-01	2E+00	4E-03	1E-02	8E-01	2E+00
NFMW11	51	7E-01	2E+00	7E-02	2E-01	8E-01	2E+00
NFMW20	53	3E+00	8E+00	7E-02	2E-01	3E+00	8E+00
NFMW10	60	7E-01	2E+00	2E-02	5E-02	7E-01	2E+00
NFMW2	62	1E+00	3E+00	1E-01	4E-01	1E+00	4E+00
NFMW6	62	8E-01	2E+00	1E-01	4E-01	9E-01	2E+00
SMW16	64	2E+00	4E+00	5E-02	1E-01	2E+00	4E+00
NFMW1S	65	3E-02	9E-02				
NFMW9	66	1E+00	4E+00	2E-03	6E-03	1E+00	4E+00
NFMW8	69	2E+00	6E+00				
NFMW3	71	2E+00	4E+00	2E-01	4E-01	2E+00	5E+00
NFMW7	73	7E-02	2E-01				
ATMW6	75	5E-01	1E+00	8E-04	2E-03	5E-01	1E+00

Shading indicates hazards above USEPA's unacceptable risk criteria (HQ>1).

Table 5-6. Non-Cancer Hazards and Cancer Risks for Ingestion of Aroclor-1254 and TEQ in Fish by a Recreational Fisher

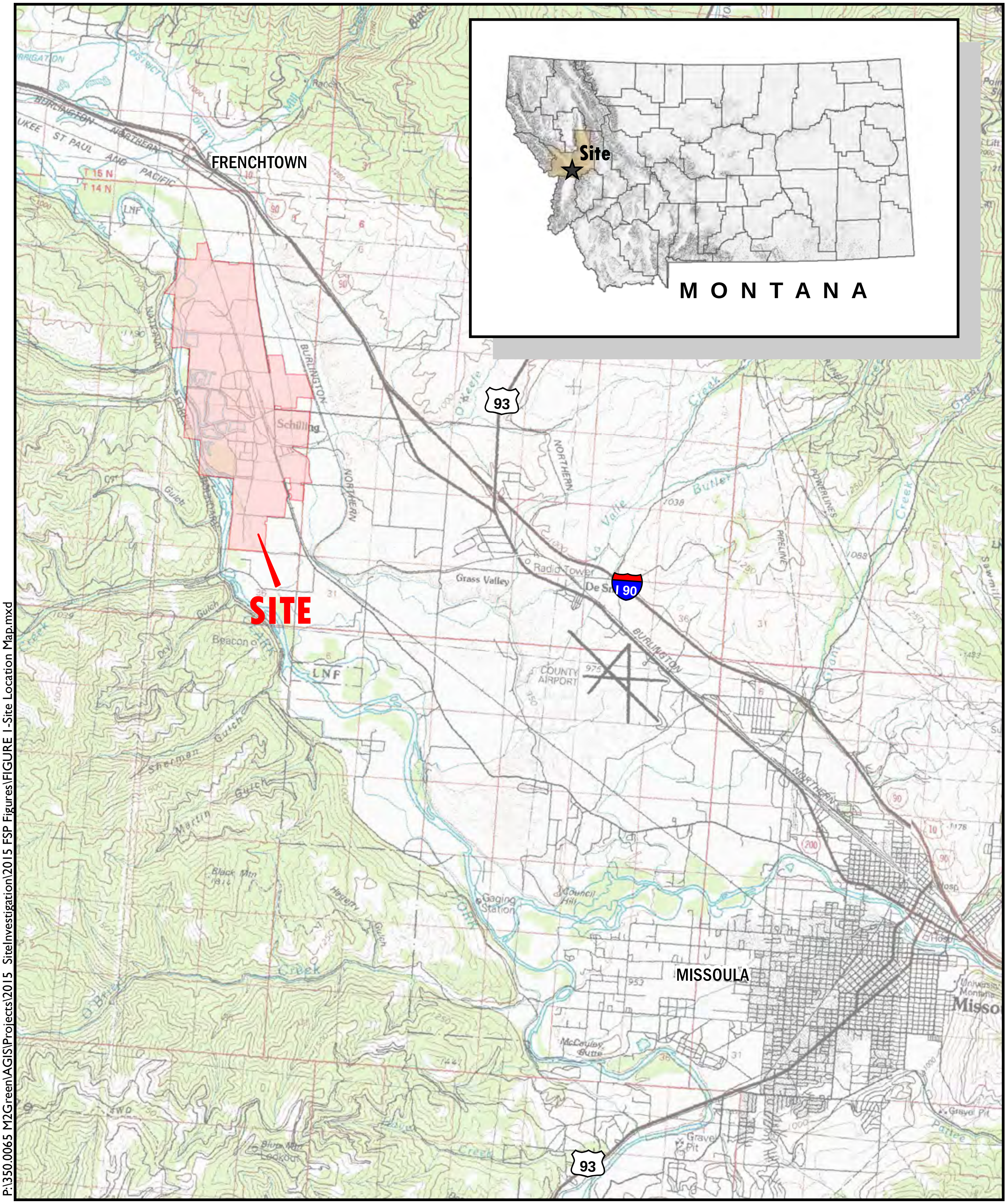
COPC	Non-Cancer HI		Cancer Risk	
	CTE	RME	CTE	RME
Aroclor-1254	3E-01	1E+00	3E-06	2E-05
TEQ (ND=1/2 DL)	3E-02	1E-01		
Total	4E-01	1E+00	3E-06	2E-05

Table 5-7. Non-Cancer Hazards and Cancer Risks for Ingestion of Aroclor-1254 and TEQ in Fish by a Tribal Fisher

COPC	Non-Cancer HI		Cancer Risk	
	CTE	RME	CTE	RME
Aroclor-1254	6E-01	2E+00	5E-06	4E-05
TEQ (ND=1/2 DL)	6E-02	2E-01		
Total	7E-01	3E+00	5E-06	4E-05

Shading indicates hazards above USEPA's unacceptable risk criteria (HQ>1; risk > 1E-04).

FIGURES



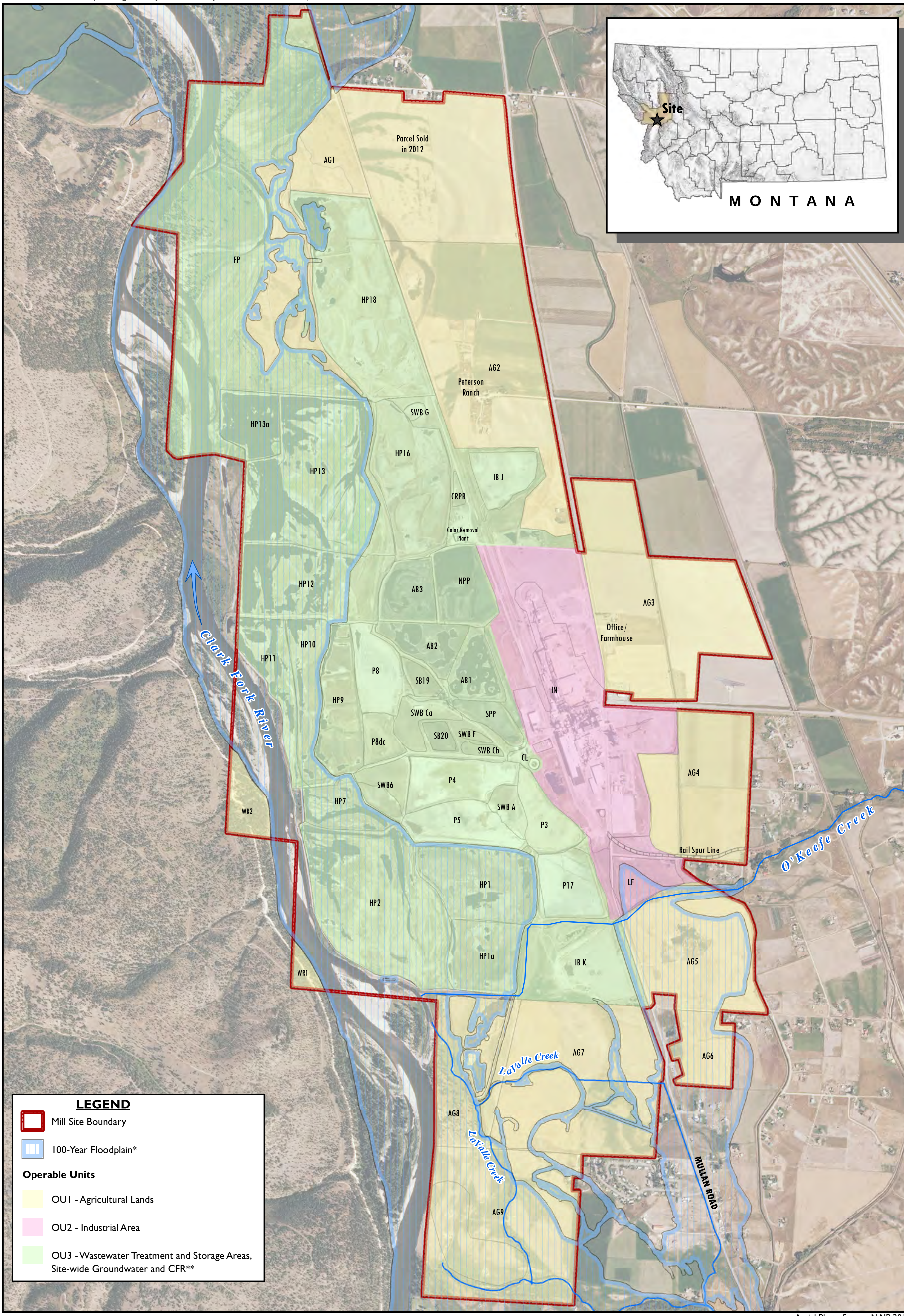
Source: Montana USGS 100K Topographic Map

0 Feet 10,000

NewFields

Site Location Map
Former Frenchtown Mill Site
Missoula County, Montana
FIGURE 2-1

P:\350.0065 M2Green\AGIS\Projects\2015_SiteInvestigation\2015 RIWP Figures\FIGURE 2 - Site Plan and Operable Units.mxd Revised 10/8/2015



*Floodplain Source:
As defined by the Federal Emergency Management Agency (FEMA) 2013 Digital Flood Insurance Rate Map (DFIRM). (NFIP 2013)

**Where Contaminant of Potential Concern from the Site have come to be located in the CFR

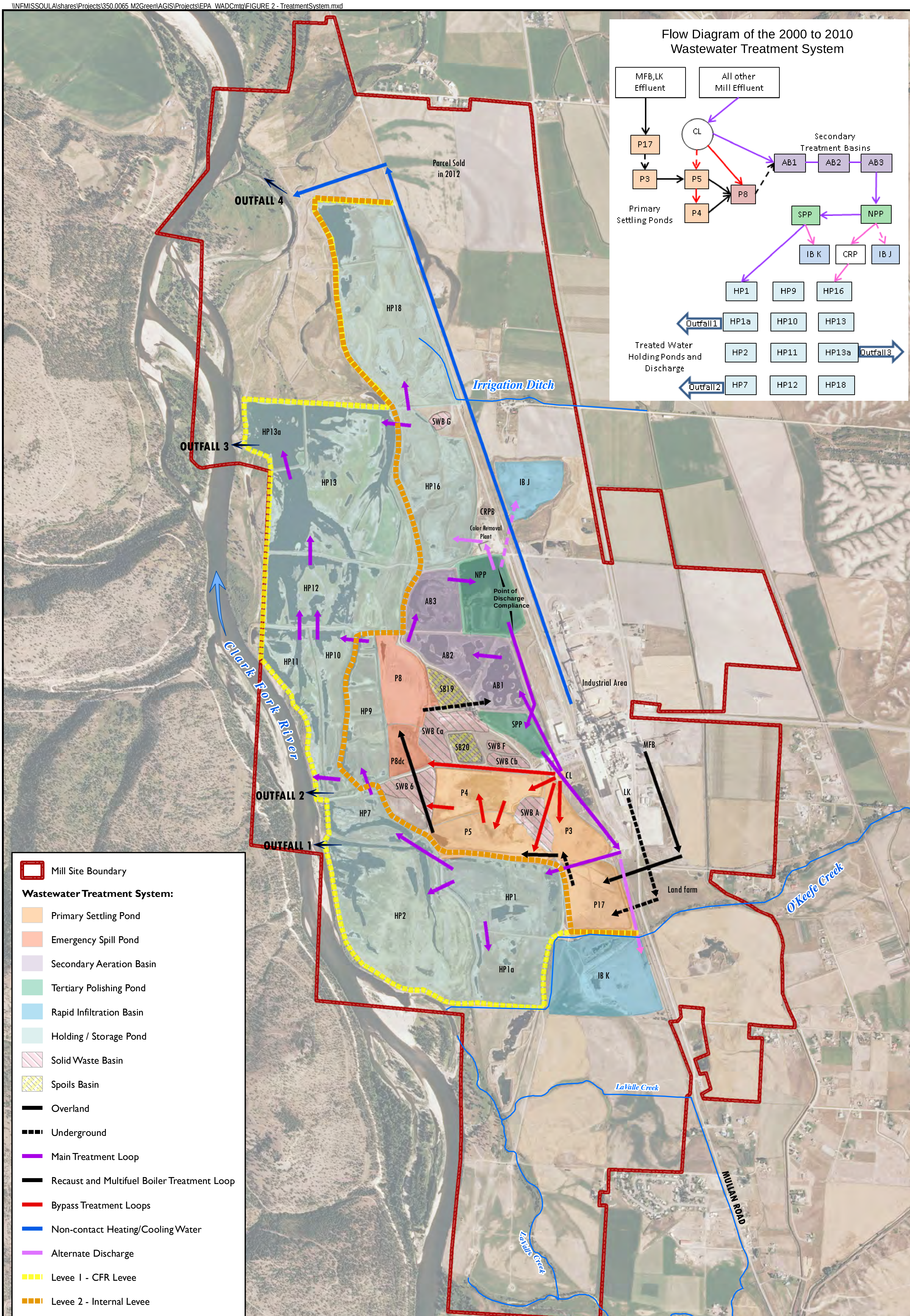
Notes

AG - Agricultural Land
AB - Aeration Stabilization Basin
CFR - Clark Fork River
CRPB - Color Removal Plant Basin
CL - Clarifier
FP - Floodplain Area
HP - Holding or Storage Pond
IB - Rapid Infiltration Basin
LF - Land farm
IN - Industrial Area
NPP - North Polishing Pond
OU - Operable Unit
P - Settling Pond
SB - Spoils Basin
SPP - South Polishing Pond
SWB - Solid Waste Basin
WR - West of the Clark Fork River

NewFields

Site Plan and Operable Units
Former Frenchtown Mill Site
Missoula County, Montana
FIGURE 2-2

\\NFMISSOULA\shares\Projects\350.0065 M2Green\AGIS\Projects\EPA_WADCmtg\FIGURE 2 - TreatmentSystem.mxd



Aerial Photo Source: NAIP 2011

0 1,600
Feet

NewFields

Wastewater Treatment System Overview from 2000 through 2010.

Notes

AB - Aeration Stabilization Basin
CL - Clarifier
CRPB - Color Removal Plant Basin
HP - Holding or Storage Pond
IB - Rapid Infiltration Basin
LK - Lime Kiln
MFB - Multifuel Boiler
NPP - North Polishing Pond
P - Settling Pond
SB - Spoils Basin
SPP - South Polishing Pond
SWB - Solid Waste Basin

Schematic of 2000 - 2010
Wastewater Treatment System
Former Frenchtown Mill Site
Missoula County, Montana
FIGURE 2-3

Figure 2-4 Location of Surface Soil Samples in OU3 Upland: Smurfit-Stone/Frenchtown Mill Site, Montana

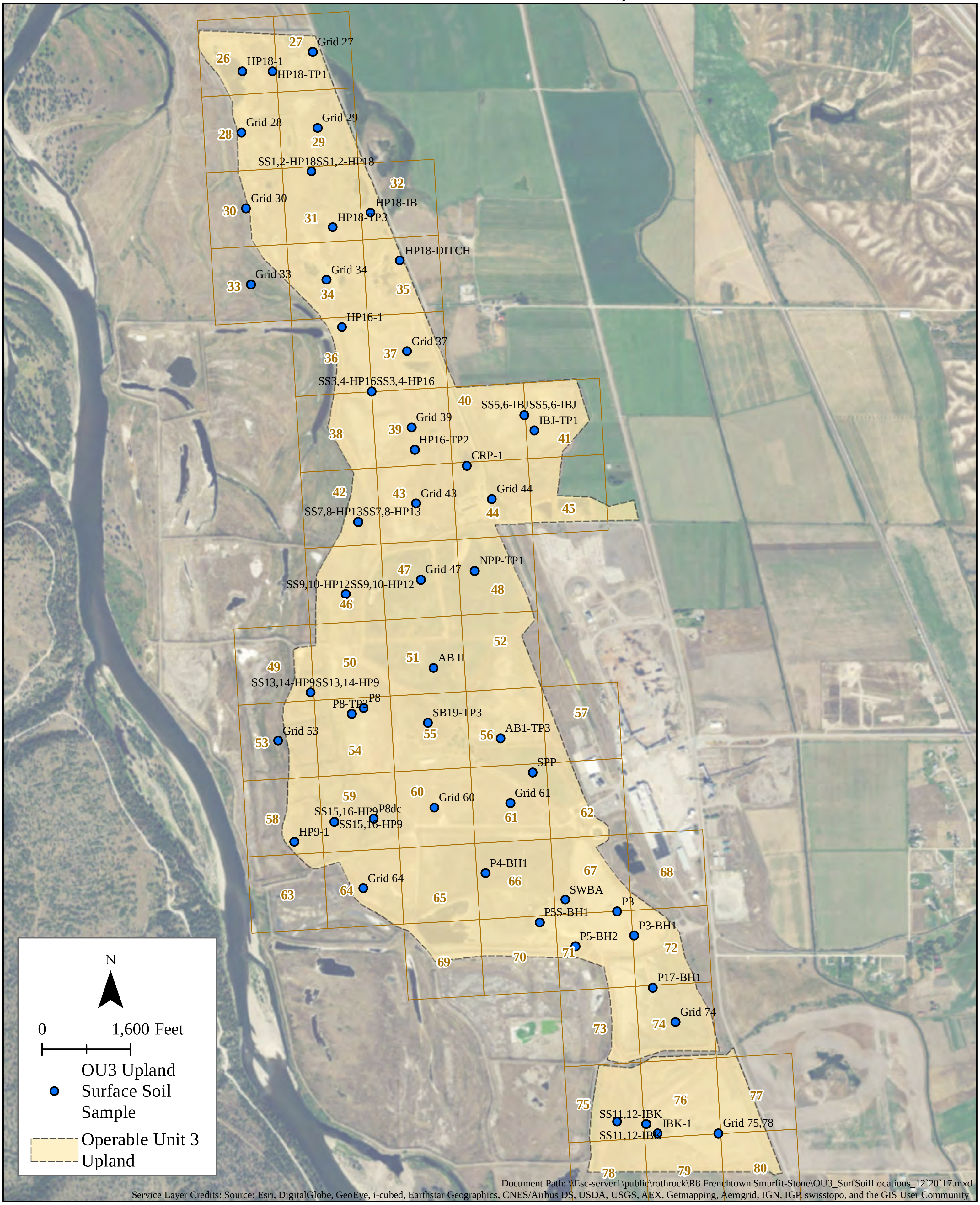


Figure 2-5. Location of Surface Soil Samples in OU3 Floodplain:
Smurfit-Stone/Frenchtown Mill Site, Montana

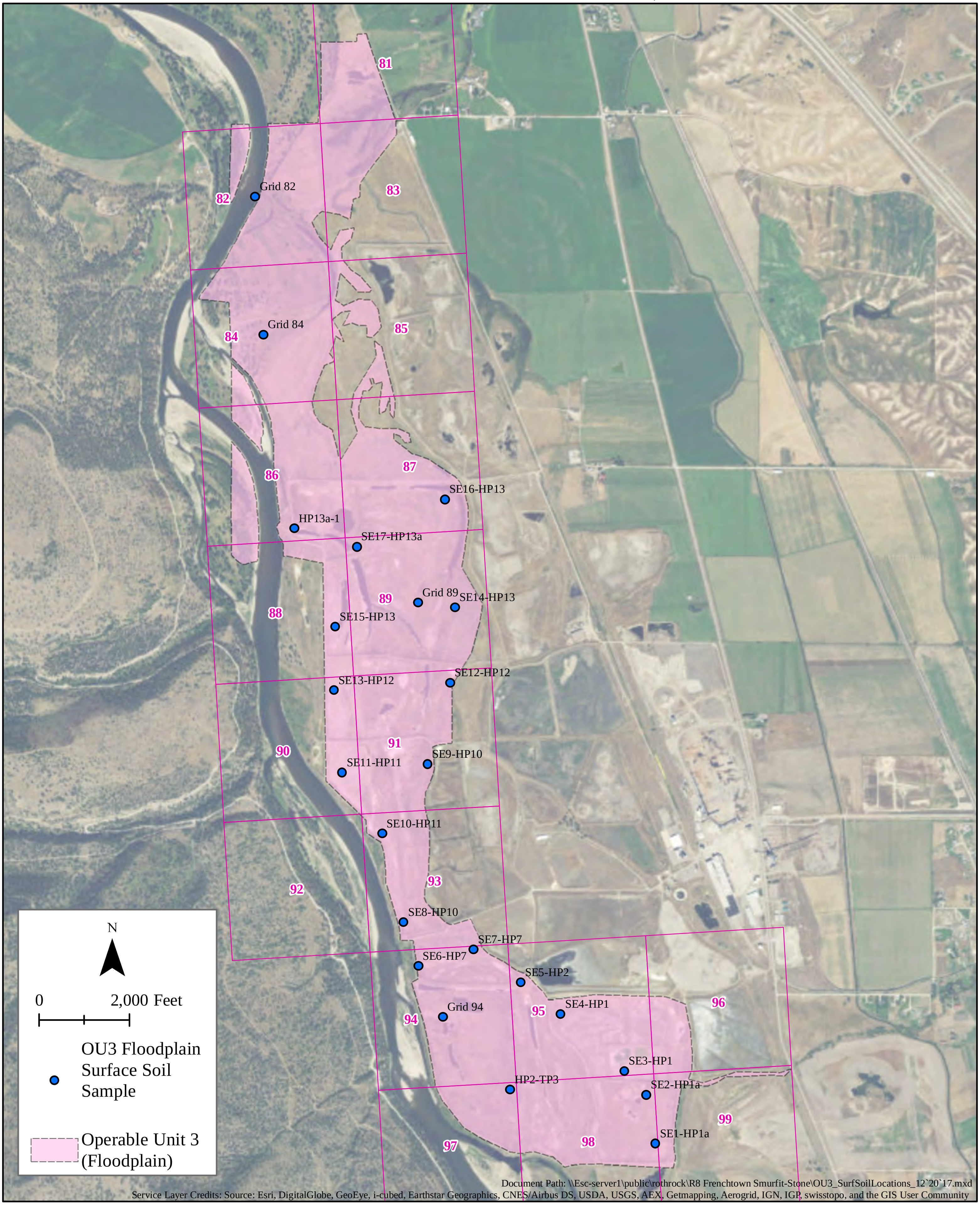


Figure 2-6. Location of Subsurface Soil Samples in OU3: Smurfit-Stone/Frenchtown Mill Site, Montana

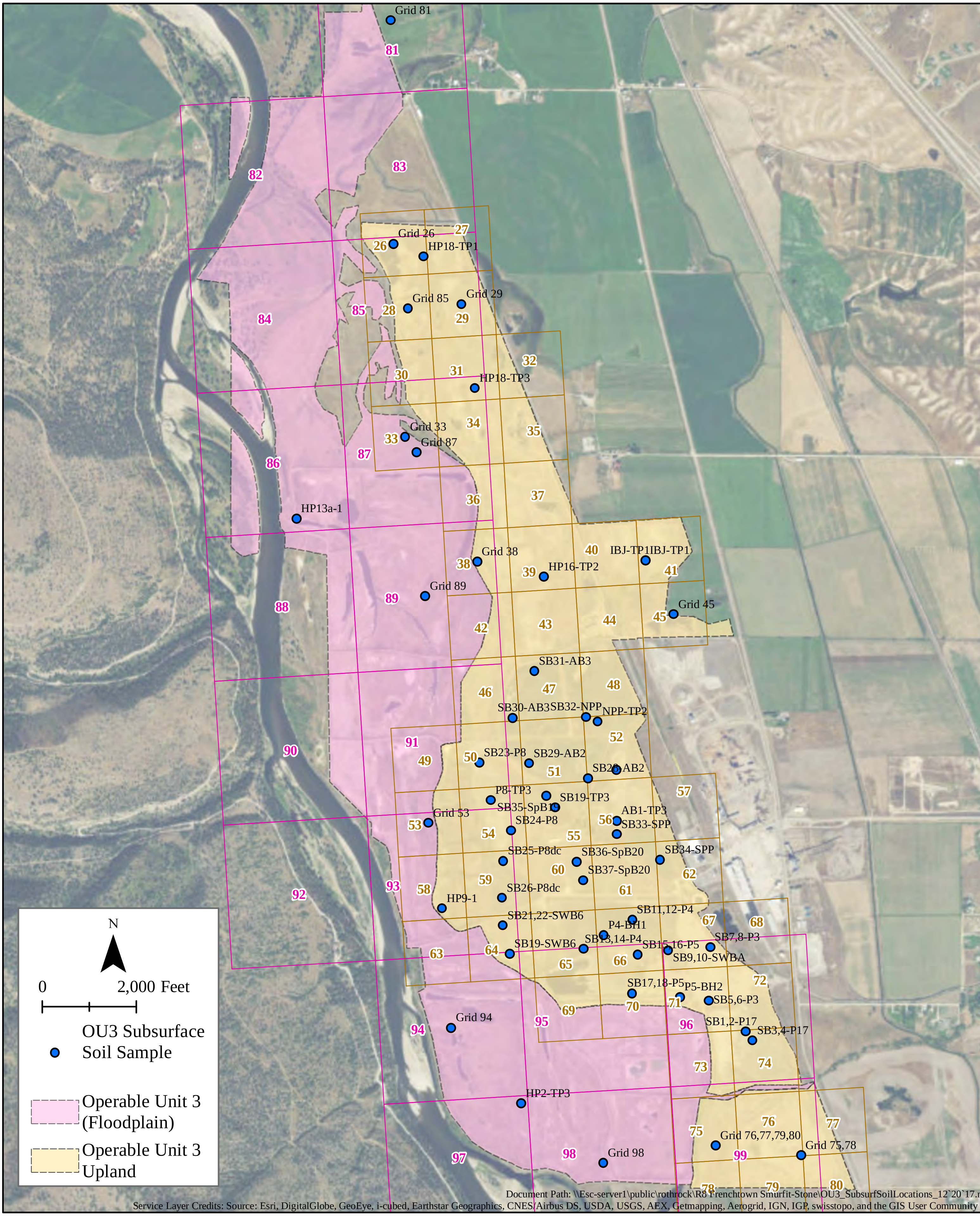
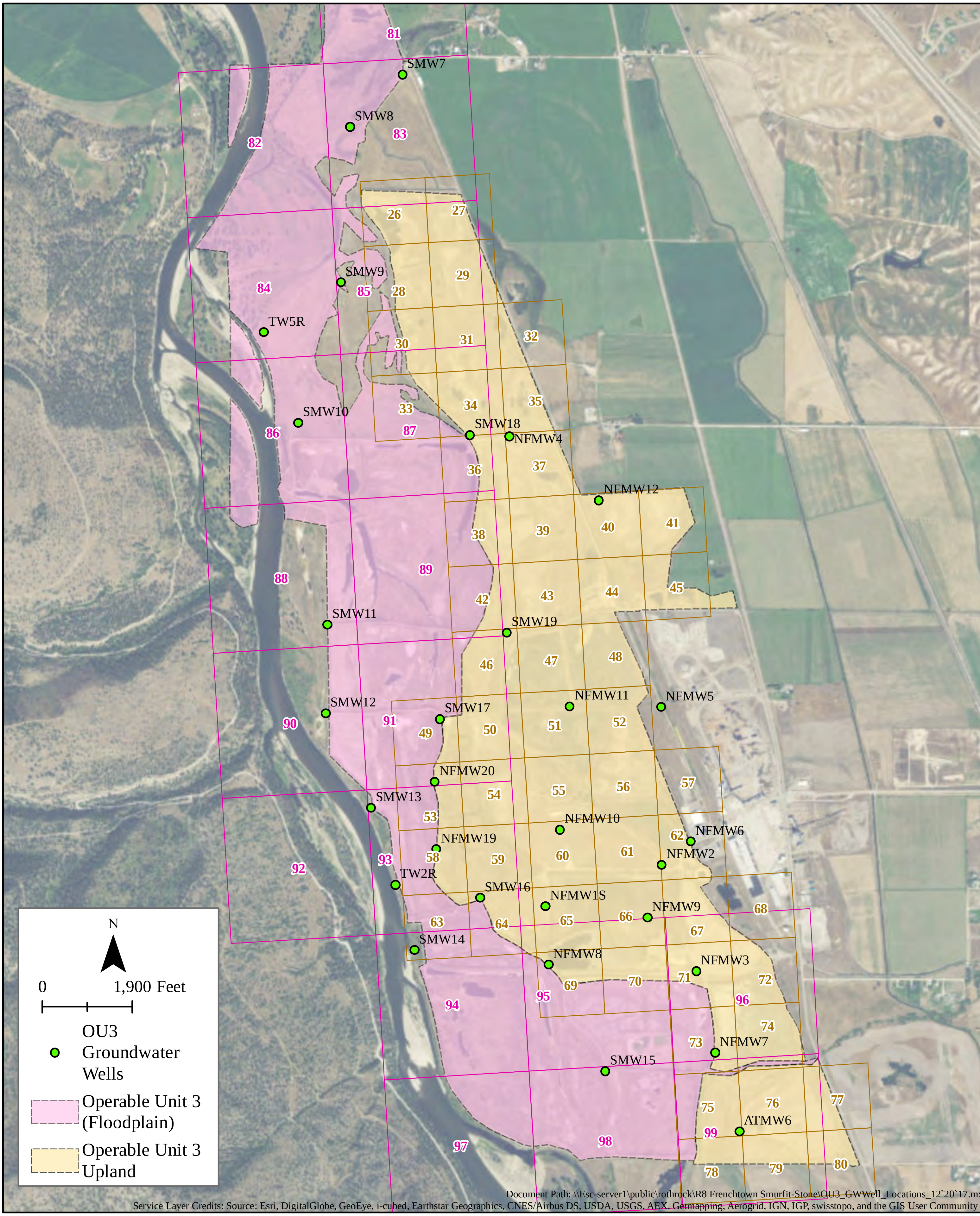
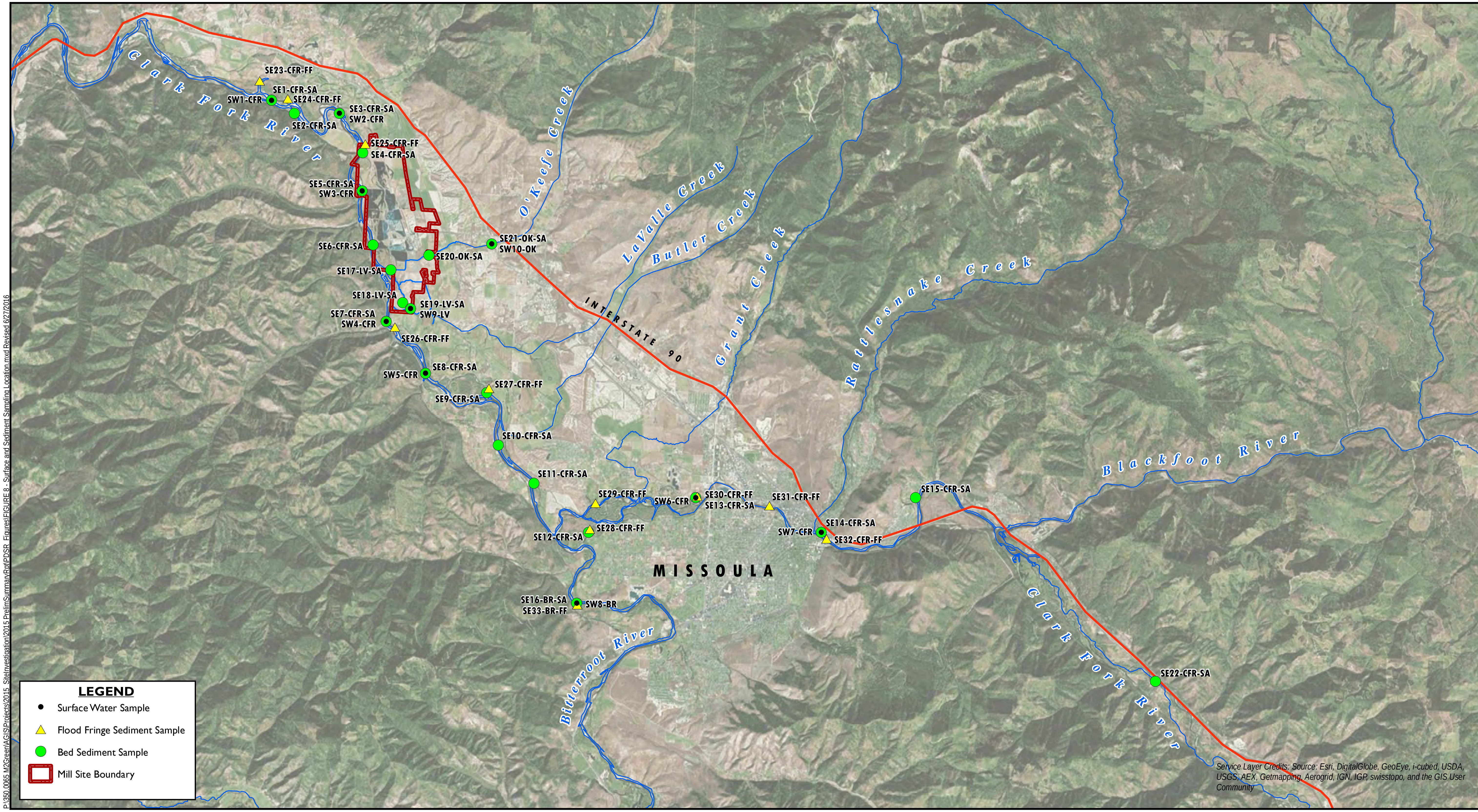
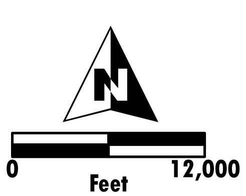


Figure 2-7. Location of Groundwater Wells in OU3:
Smurfit-Stone/Frenchtown Mill Site, Montana





P:\350.0065 M2Green\AGIS\Projects\2015_SiteInvestigation\2015 PrelimSummaryRpt\PDSR_Figures\FIGURE 8 - Surface and Sediment Sampling Location.mxd Revised 6/27/2016



NewFields

Surface Water and Sediment
Sampling Locations
Former Frenchtown Mill Site
Missoula County, Montana
FIGURE 2-8

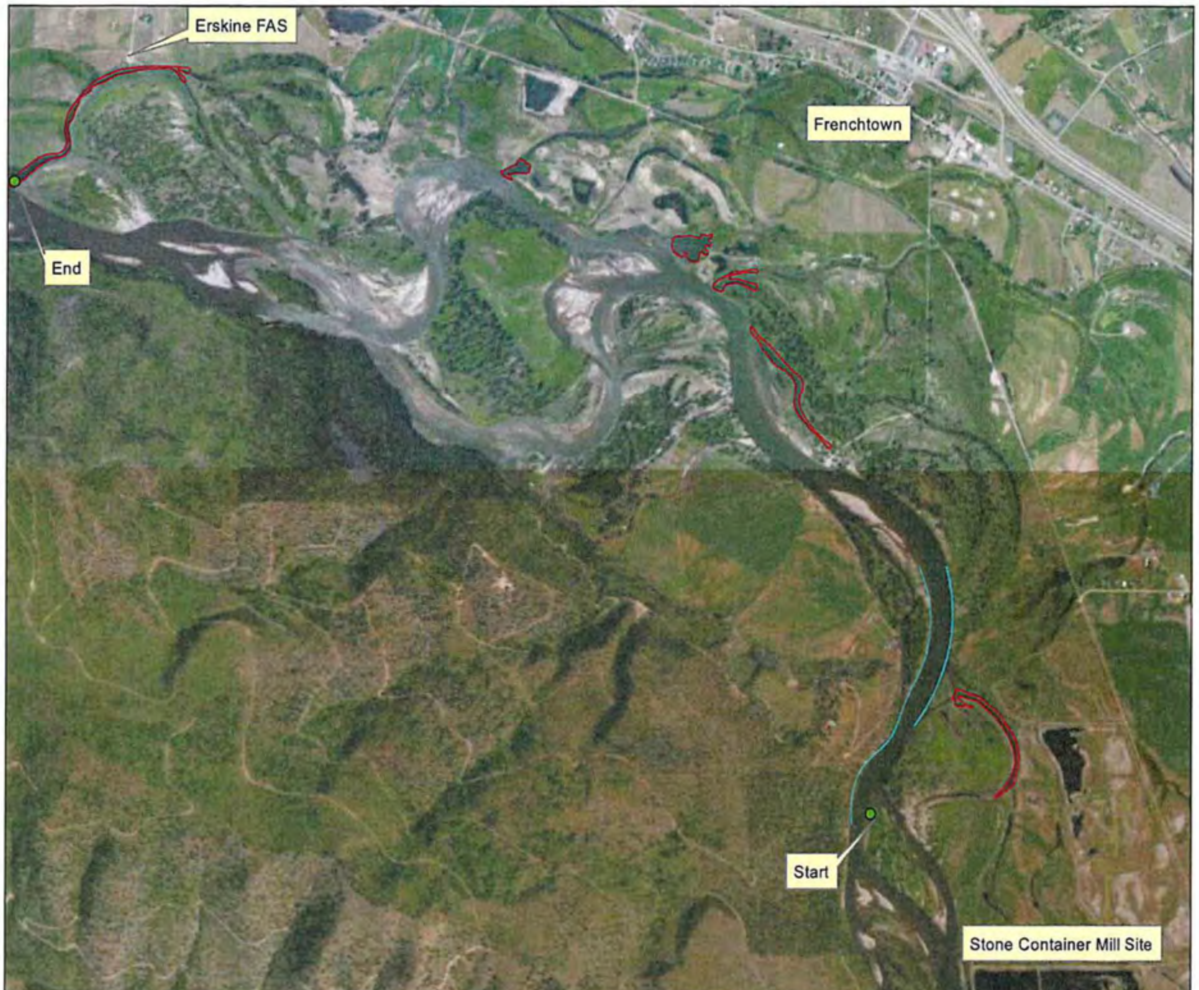
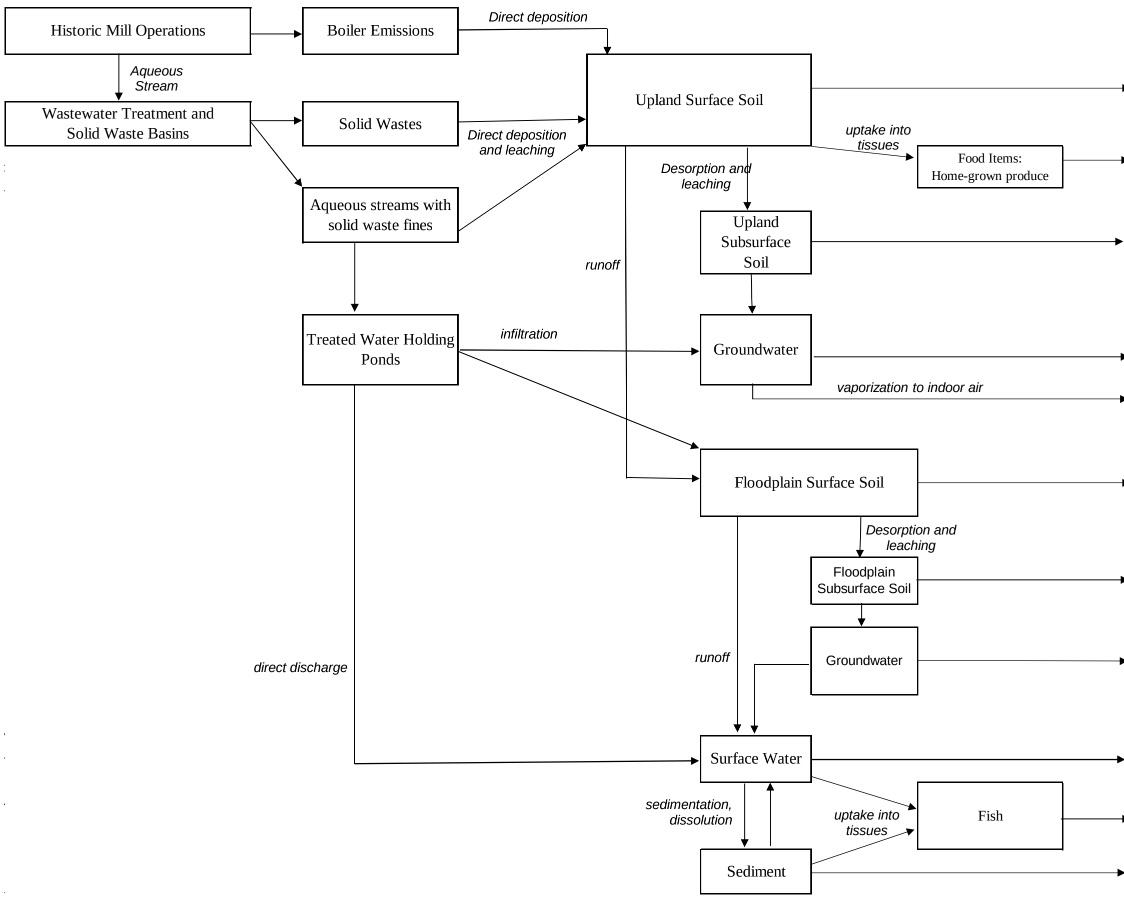


Figure 2-9. Adapted from Schmetterling and Selch (2013). Study area of the Clark Fork River downstream of the Smurfit-Stone/Frenchtown Mill site. The red lines depict sampling locations of northern pike and blue lines show where rainbow trout were captured.

Figure 3-1. Conceptual Site Model for Human Exposure at the OU3 Site



Exposure Route	Residential	Commercial	Construction	Recreational	Tribal
Inhalation	❍	❍	●	❍	
Ingestion	●	●	●	●	
Dermal	●	●	●	●	
Ingestion	X				
Ingestion			●		
Dermal			●		
Ingestion	●	●			
Dermal	❍	❍			
Inhalation	❍	❍			
Inhalation				❍	❍
Ingestion				●	●
Dermal				●	●
Ingestion					
Dermal					
Inhalation					
Ingestion					
Dermal					
Ingestion				●	●
Dermal				●	●
Ingestion				●	●
Ingestion				●	●
Dermal				●	●

Receptor Populations [1]

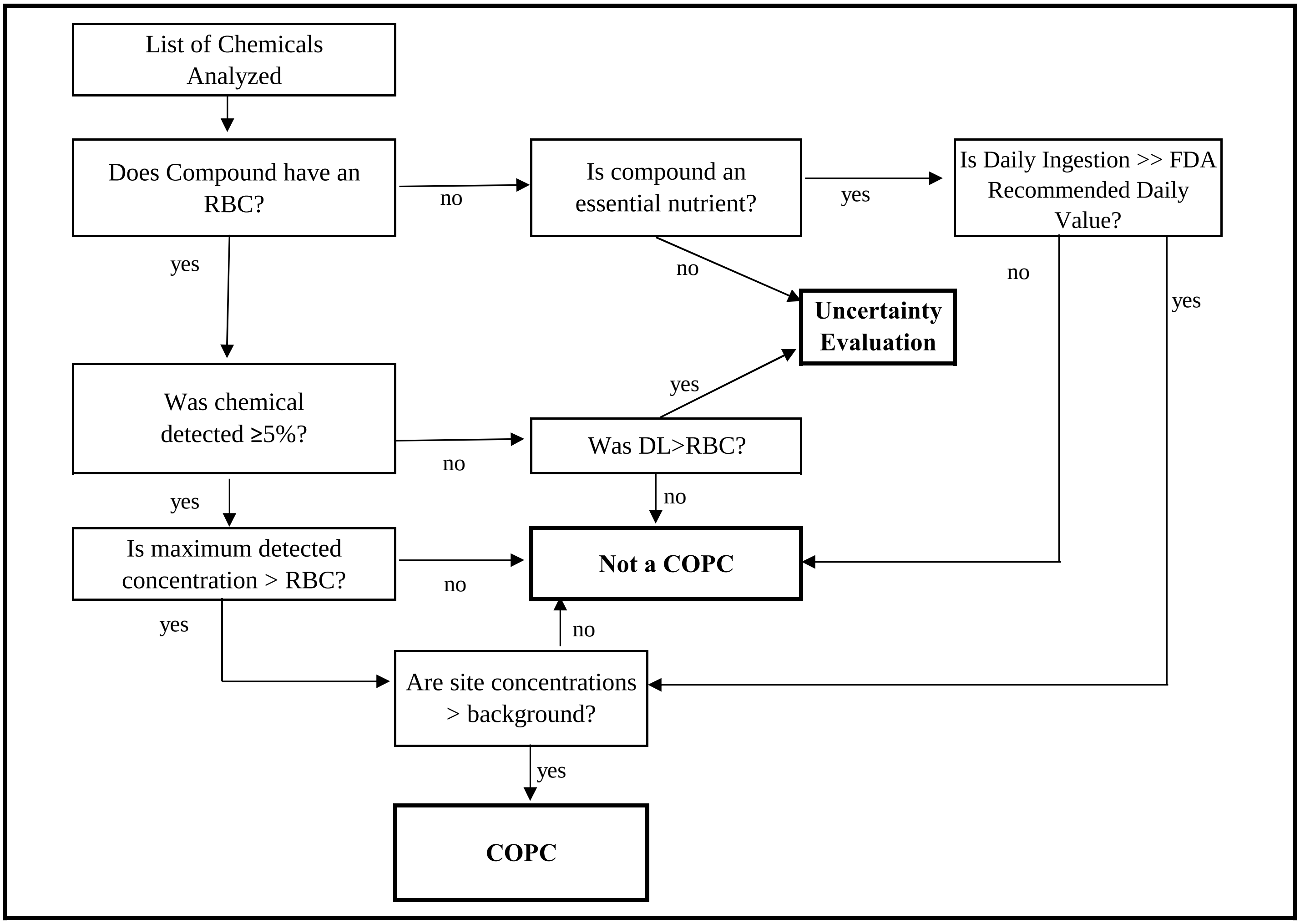
LEGEND

●	Pathway is complete and might be significant; quantitative evaluation.
❍	Pathway is complete, but is relatively minor; semi-quantitative evaluation.
X	Pathway is or may be complete, however, data are lacking. Qualitative evaluation only.
	Pathway is not complete; no evaluation required.

Notes

[1] Hypothetical future exposures to soil by residents and/or workers will be evaluated in upland soils only. As per County regulations, no future building development is permitted within the Clark Fork River Floodplain. Therefore, the only receptor populations that will be evaluated for exposures within the floodplain are recreational visitors and tribal fishers.

Figure 3-2. COPC Selection Procedure for Human Health



Notes:

RBC = Risk-based concentration (HQ = 0.1, Cancer risk = 1E-06)

COPC = chemical of potential concern

DL = detection limit

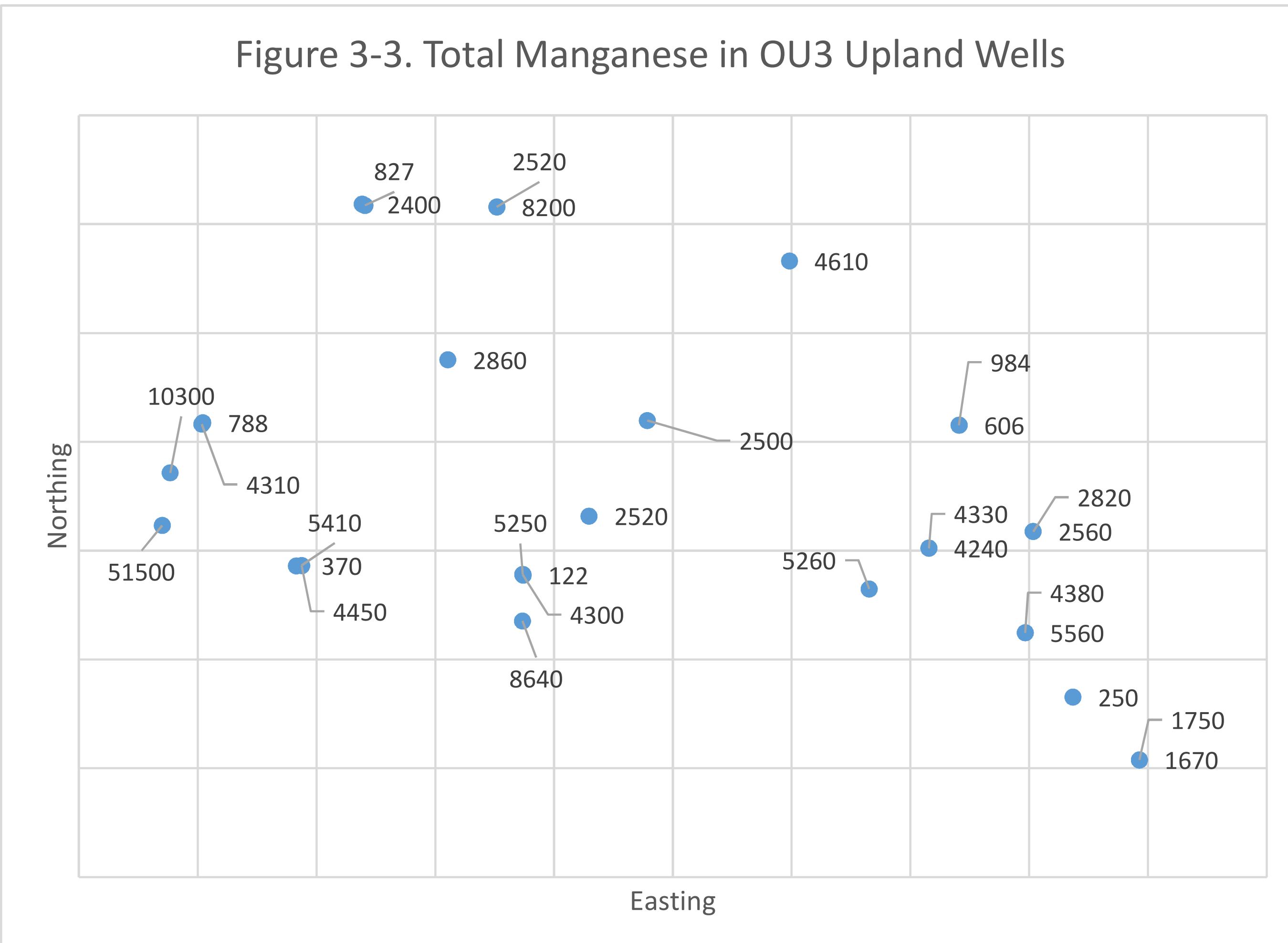


Figure 3-3. Total Manganese in OU3 Upland Wells
827
2400
2520
8200
4610
2860
984
606
10300
788
2500
4310
51500
5410
370
4450
5250
122
4300
8640
2520
5260
4330
4240
2820
2560
4380
5560
250
1750
1670
Northing
Easting

Figure 5-1. Total Manganese Hazard Quotients in OU3 Groundwater: Smurfit-Stone/Frenchtown Mill Site, Montana

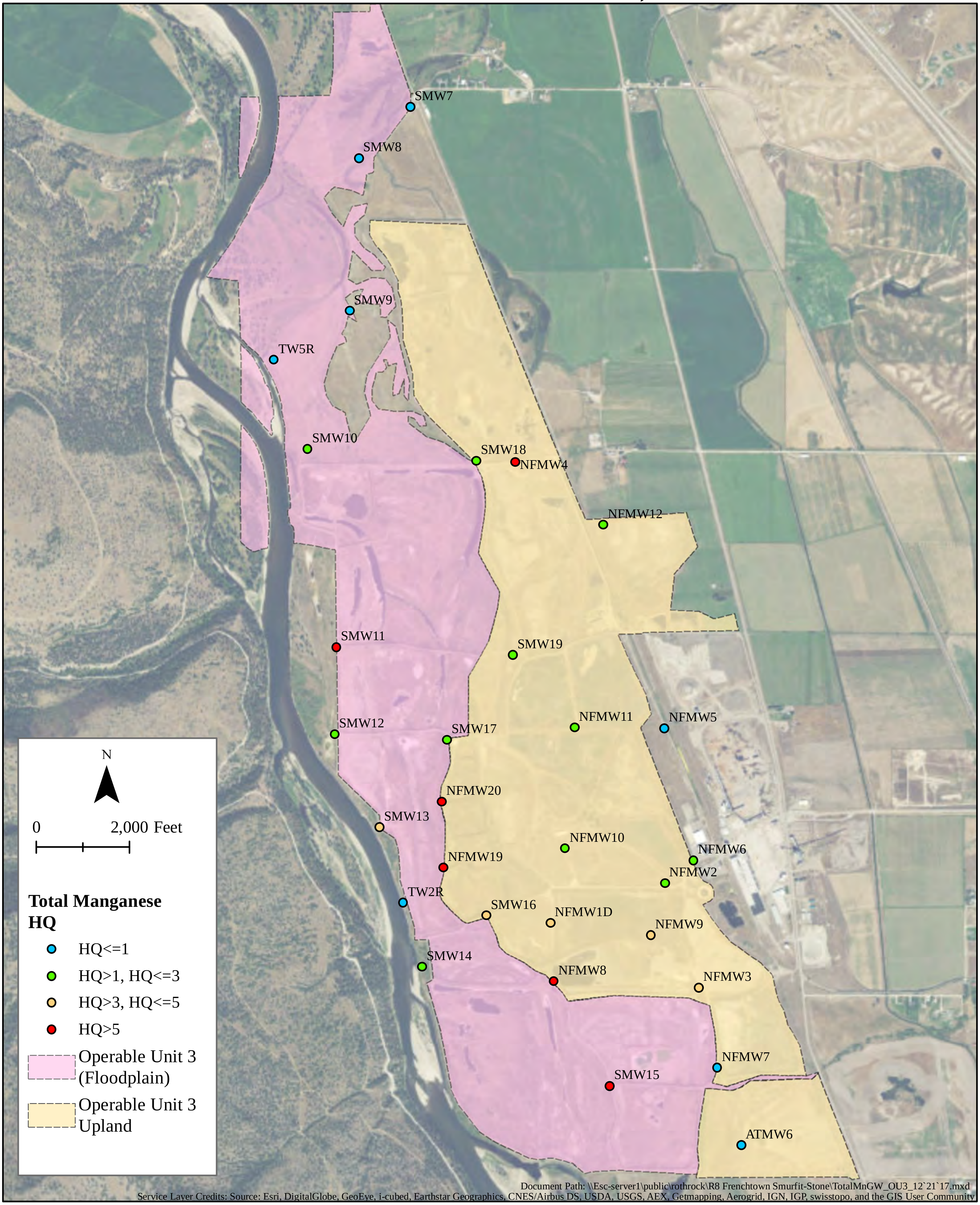
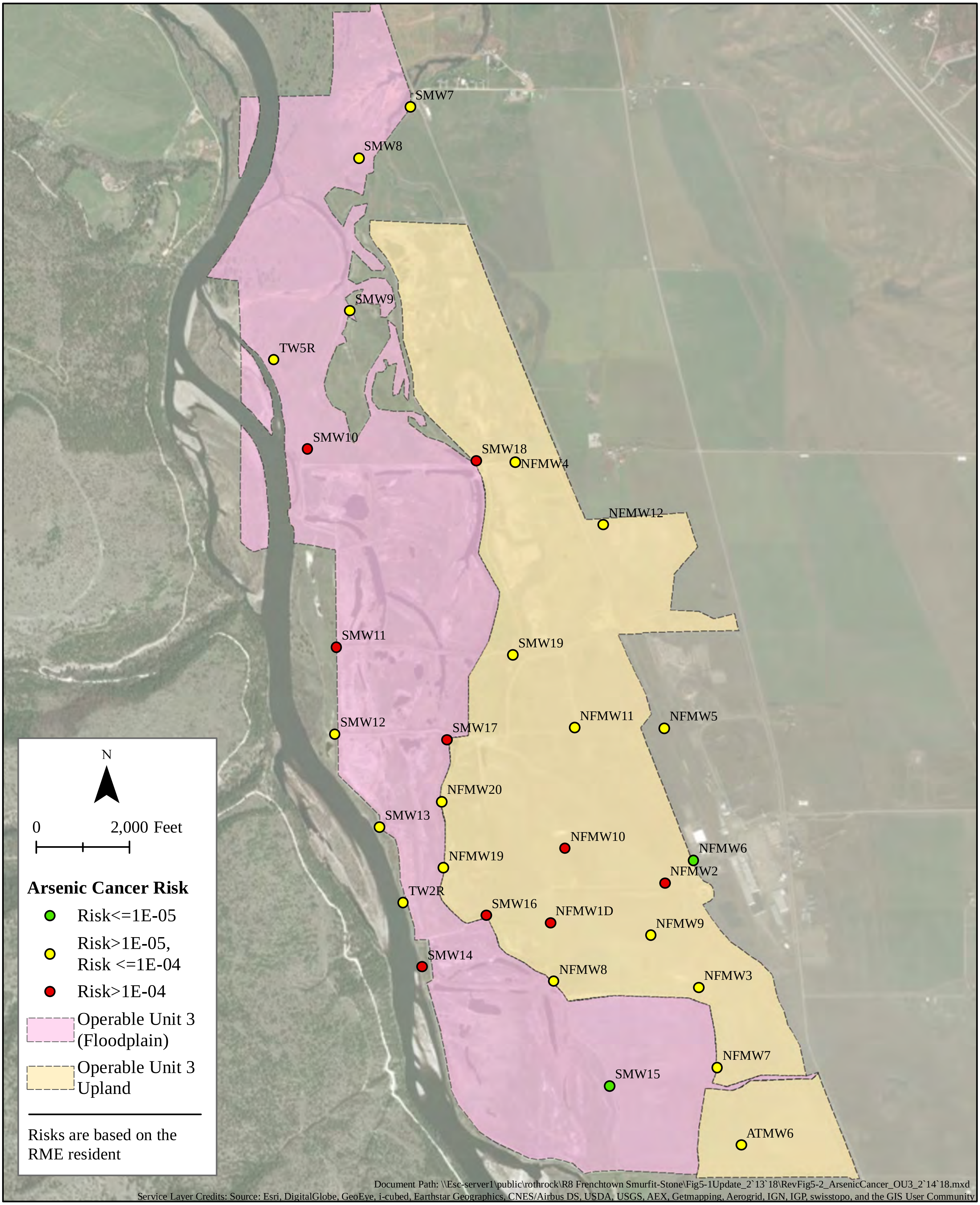


Figure 5-2. Arsenic Cancer Risk in OU3 Groundwater: Smurfit-Stone/Frenchtown Mill Site, Montana



APPENDICES

APPENDIX A

OU3 Data Summary

1.0 INTRODUCTION

This appendix summarizes the data utilized in this OU3 HHRA. As described in the main text of this OU3 HHRA, soil, groundwater, sediment, surface water and fish tissue samples were collected within OU3 (inclusive of the Clark Fork River [CFR] adjacent to and immediately downstream of the Site) in 2014, 2015, 2016 and 2017. These data were collected by NewFields following approved sampling plans as part of ongoing RI activities. Additional data not collected by NewFields utilized in this OU3 HHRA includes background soil data collected across Montana by the Montana Department of Environmental Quality (MDEQ), fish tissue data collected by the Montana Fish, Wildlife and Parks (MTFWP), and background metals data in sediments and surface waters of the CFR collected by the U.S. Geological Survey (USGS). All data collected by NewFields have been uploaded to a USEPA Scribe database for the Smurfit-Stone/Frenchtown Mill Site. Data considered for use in the OU3 HHRA were based on a Scribe download conducted on December 5, 2017. Not all of the data in Scribe were utilized in the OU3 risk evaluations presented within the HHRA. The available raw data (Site and background) were reduced to produce the Site and background datasets utilized in the OU3 HHRA as described below. Data used in the OU3 HHRA are provided as an electronic data file in Attachment 1 to this appendix.

2.0 DATA SUMMARY

2.1 Soil

2.1.1 Site Soil

Soil samples were collected in April/May 2014 and December 2015 at locations throughout the upland and floodplain areas of OU3. Upland soil samples included surface soil samples collected from wastewater treatment basins, subsurface soil samples collected from borings in the settling ponds, aeration basins, and spoils basins, surface and subsurface soil samples collected at potential source locations from opportunistic test pits, and opportunistic subsurface samples collected while drilling monitoring wells. Floodplain soil samples were collected from holding ponds inside of the 100-year floodplain that were used to store treated wastewater but are presently dry for a majority of the year save for during spring when runoff is high.

Surface soil samples from wastewater treatment basins and ponds were collected from 0 to 2 inches and from 5 to 7 inches below the surface. Surface soil samples were also collected from 0 to 6 inches below the surface in the opportunistic test pits. Subsurface soil samples were collected at varying depths down to 30 ft bgs in upland soils and down to 6 ft bgs in floodplain soils as described in NewFields (2016). OU3 soil samples were analyzed for dioxins/furans, metals, and polychlorinated biphenyls (PCBs; reported as Aroclors). OU3 soil samples were not analyzed for SVOCs or VOCs based on the low level of detection of these contaminants observed in OU2 soil samples.

2.1.2 Background Soil

The MDEQ has produced two reports summarizing efforts to quantify background concentrations of dioxins and furans and metals in surface soil samples collected across Montana (MDEQ 2011, 2013). The summary reports are publicly available online[12]. The raw data files supporting MDEQ (2013) are also publicly available online[1]. USEPA received the raw data files supporting MDEQ (2011) directly from MDEQ. Brief descriptions of these data and how they were utilized for the purposes of the OU3 HHRA are presented below.

2.1.2.1 Dioxins/Furans

In 2008, MDEQ collected composite surface soil samples (0-2 inches below ground surface) from locations that were not indicated to be impacted by point sources of dioxins (MDEQ 2011). Surface soil samples were collected using a stratified approach based on land use category and were analyzed for polychlorinated dioxins and dibenzofurans. Land use categories were first stratified into two primary categories, urban and rural, and were then stratified into secondary categories, as follows:

- Urban secondary categories: residential, commercial, or industrial.
- Rural secondary categories: agricultural, open space, or forest.

MDEQ had identified several samples as possible outliers in the dioxin dataset using visual inspection of histograms, box plots, and normal-quantile plots for each secondary land use category (MDEQ 2011). The USEPA identified the following samples as outliers that were excluded from analysis given that the reported TEQ concentrations exceeded the maximum detected TEQ values reported in Table 4 of the MDEQ (2011) report:

- MBDS-R02-F01
- MBDS-R10-F01
- MBDS-R02-O01
- MBDS-U18-R01

[1] http://deq.mt.gov/Land/statesuperfund/background
[2] https://deq.mt.gov/Portals/112/Land/StateSuperfund/Documents/DioxinGuide/DioxinBackgroundStudy.pdf

- MBDS-U19-R01
- MBDS-U20-C01

2.1.2.2 Metals

In 2012, the MDEQ collected composite surface soil samples (0-6 inches below ground surface) from locations that were not indicated to be impacted by point sources of inorganics (MDEQ 2013). All soil samples were analyzed for total analyte list (TAL) metals and mercury in both the bulk (unsieved) and fine (60-mesh sieved) fractions. Only the bulk results were utilized in the OU3 HHRA. No outlier analysis was performed on the MDEQ inorganics data (MDEQ 2013). The "detection limit" value included in the raw data file (believed to be the reporting limit) was used to evaluate non-detects.

2.2 Groundwater

2.2.1 Site Groundwater

Within the Scribe database, the location zone for all groundwater samples is entered as "OU3". Based on past discussions between the USEPA, MDEQ and the RPs, the following groundwater wells have been identified for inclusion in the OU3 HHRA: ATMW6, NFMW1, NFMW2, NFMW3, NFMW4, NFMW5, NFMW6, NFMW7, NFMW8, NFMW9, NFMW10, NFMW11, NFMW12, NFMW19, NFMW20, SMW7, SMW8, SMW9, SMW10, SMW11, SMW12, SMW13, SMW14, SMW15, SMW16, SMW17, SMW18, SMW19, TW2R, TW5R. Groundwater sampling occurred in April 2014, December 2015, May/June 2016, and January/March 2017 at 35 wells identified to be within or on the boundary of OU3. Three of the 35 wells were identified as deep wells. OU3 groundwater samples were analyzed for dioxins/furans, metals (total and dissolved), PCBs (as Aroclors), SVOCs and VOCs. Groundwater samples were also analyzed for miscellaneous parameters (e.g., measures of water quality such as alkalinity and pH, as well as ions such as chloride and fluoride).

2.2.2 Background Groundwater

The USEPA, the MDEQ and the RPs have identified the following five wells as background groundwater locations: CountyMW, SMW1, SMW5, SMW6, and WFBW. Background groundwater data are available for samples collected from these wells as part of RI activities conducted at the Site in April 2014, December 2015, May 2016, and March, June, and July 2017. Samples collected from these wells have been analyzed for dioxins/furans, PCBs (as Aroclor mixtures), total and dissolved metals, SVOCs, and VOCs.

2.3 Sediment

2.3.1 Site Sediment

Sediment samples were collected in 2015. In November, bed sediment samples were collected within the CFR downstream, adjacent to, and upstream of the Site. In December, additional sediment sampling was conducted along the CFR from the flood fringe of the 100-year floodplain downstream and upstream of the Site. Sediment samples were analyzed for dioxins/furans and metals. Miscellaneous parameters (e.g., organic carbon, percent fines) were also measured. Two of the bed sediment samples were also analyzed for PCBs (as Aroclors) and SVOCs.

2.3.2 Background Sediment

A bed sediment sample was collected from each of 11 locations upstream of the Smurfit-Stone Site to support RI activities. Bed sediment samples were analyzed for dioxins/furans, PCBs (as Aroclor mixtures), metals, and SVOCs. In addition, 8 flood fringe sediment samples were collected along the CFR upstream of the Site. These samples were analyzed for dioxins/furans and metals.

The U.S. Geological Survey (USGS) collects bed sediment samples annually (typically in August) at monitoring stations in the upper Clark Fork Basin of western Montana (Dodge et al. 2017). Bed sediment samples have been collected intermittently by USGS at selected sites since 1986 (Dodge et al. 2017). Three USGS monitoring stations have been identified in the Clark Fork River (CFR) by the USEPA, the MDEQ and the RPs as appropriate for inclusion in the background dataset for the Site: 12340500 CFR above Missoula, 12334550 CFR at Turah, and 12331800 CFR near Drummond (Figure 5, taken from Dodge et al. 2017). USGS sediment samples were analyzed for select metals (arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, and zinc). USGS data for 26 bed sediment samples collected in 2013, 2014, and 2015 were obtained directly from USGS.

2.4 Surface Water

2.4.1 Site Surface Water

Surface water samples were collected in November 2015 within the CFR downstream, adjacent to, and upstream of the Site at locations coincident with the bed sediment samples. In total, three surface water samples were collected adjacent to or downstream of the Site and analyzed for dioxins/furans, metals (total and dissolved), and miscellaneous parameters (e.g., measures of water quality such as alkalinity and pH, as well as ions such as chloride and fluoride). Two of the three surface water samples were also analyzed for PCBs (as Aroclors) and SVOCs.

2.4.2 Background Surface Water

Surface water samples were collected from each of 5 locations upstream of the Site to support RI activities. Samples were analyzed for dioxins/furans, PCBs (as Aroclor mixtures), total and dissolved metals, and SVOCs.

The USGS periodically collects surface water samples at monitoring stations across the country (Dodge et al. 2017). Water samples from the upper Clark Fork Basin have been collected by USGS since 1985 (Dodge et al. 2017). The same three USGS monitoring stations listed above for sediment were identified for inclusion in this assessment. USGS surface water samples were analyzed for select metals (total and dissolved; arsenic, cadmium, copper, iron, lead, manganese, and zinc). USGS data were downloaded from the USGS National Water Information System for 45 samples collected in March, April, May, June, July, August, and October 2015; March, April, May, June, and October 2016; and March, April and August 2017 (USGS 2017). This includes all samples currently in USGS's National Water Information System (USGS 2017) from January 2015 through present (as of 12/27/2017).

2.5 Fish Tissue

2.5.1 Site Fish Tissue

The Montana Fish, Wildlife and Parks (MFWP) conducted a fish sampling study in 2013 (Schmetterling and Selch 2013). In the spring of 2013, MFWP collected samples of northern pike and rainbow trout from areas in the CFR in backwaters, sloughs and margins along a 10-km reach of the CFR downstream of the Site. Five-fish composite skinless fillet samples (three northern pike and four rainbow trout) were analyzed for mercury, selenium, PCBs (as Aroclor mixtures), and dioxins and furans. Non-detects were evaluated based on the minimum reporting limit for mercury, selenium and Aroclors. Dioxin and furan congeners flagged as non-detects were evaluated based on the estimated detection limits.

2.5.2 Background Fish Tissue

No fish tissue data have been collected within the CFR upstream of the Site as part of the ongoing remedial investigation. In 1992, the USEPA released the final report for the National Study of Chemical Residues in Fish which was a one-time screening investigation to determine the prevalence of selected bioaccumulative pollutants in fish (USEPA 1992). Beginning in 1986, 388 lake, river, or stream locations were sampled. Fillet samples of adult brown trout were collected from Warm Springs, composited and analyzed as a single sample for mercury and dioxins/furans. In 1998, Tetra Tech collected whole body mountain whitefish tissue samples for dioxin analysis in order to meet Montana Pollutant Discharge Elimination System (MPDES) permit requirements. A single composite sample was collected from one location just upstream of the Smurfit-Stone/Frenchtown Mill Site.

In 2009, the USEPA released a final report for the National Study of Chemical Residues in Lake Fish Tissue which presented a statistically-based national survey of contaminants in fish from lakes and reservoirs in the lower 48 states (USEPA 2009). During 2000-2003, the USEPA collected fish from 500 lakes and reservoirs selected randomly. Adult predator fish species (e.g., bass or trout) ranging in length from 122-840 mm were collected. In total, 486 predator fish composite fillet samples and 395 bottom-dwelling fish whole body composite samples were submitted for laboratory analysis of mercury, arsenic (5 forms of inorganic and organic), PCBs (individual congeners and as Aroclors), dioxins/furans, pesticides and other SVOCs. USEPA also conducted a similar study of river fish which is referenced in the USEPA (2009) report. During the summers of 2008 and 2009, the USEPA collected adult fish from 1,924 randomly selected urban and non-urban river and stream sites in the conterminous United States. In 2016, the USEPA released a final report for the National Rivers and Streams Assessment 2008-2009: A Collaborative Survey (NRSA) which presented a statistically based survey on the condition of the nation’s perennial rivers and streams in the lower 48 states (USEPA 2016). However, this report focused on evaluation of mercury in fish as a primary biological indicator of condition. Results for the other chemicals analyzed in fish tissue will be presented in future publications. The raw data files were obtained from the USEPA for use in quantitative analysis. Fillet samples from predator fish species (e.g., bass or trout; ranging in length from 101-683 mm) were composited and analyzed for mercury and selenium.

3.0 DATA REDUCTION

3.1 Categorization as Surface Soil and Subsurface Soil

For the purposes of the HHRA, surface soil samples were classified as samples collected from a starting depth of either zero or one inch down to six inches below ground surface (bgs). Samples collected from at or below one foot bgs were classified as subsurface soil samples. Subsurface data used in the OU3 HHRA were restricted to samples collected within the top 10 feet bgs.

3.2 Treatment of Multiple Surface Samples from a Single Location

In the OU3 upland area, surface soil sampling conducted in 2015 included collecting two separate samples from a single location from the top 7 inches of soil. A sample was collected from the 0-2 inch depth, and from the 5-7 inch depth. Because these two samples both characterize the same 0-6 inch surface sampling location, the maximum concentration result for each contaminant was used.

3.3 Treatment of Field Duplicates

In accordance with the RIWP QAPP, blind field duplicates (one for every twenty natural samples) were collected for Quality Assurance/Quality Control purposes. Two concentration results for a parent sample-duplicate pair were reduced to a single value for each contaminant as follows:

- If both the parent sample and the duplicate sample results were detected, the maximum detected concentration was retained and the result was flagged as a detect.

- If both the parent sample and the duplicate sample results were qualified as not detected, the maximum MDL was retained and the result was flagged as a non-detect.

- If one result from the sample pair was detected, while the other was qualified as not detected, the detected concentration was retained and the result was flagged as a detect.

Total PCB and TEQ concentrations were calculated for each parent sample and field duplicate as described in Section 2.6. For each sample pair, the results were reduced to a single value for each calculated result in accordance with the protocol presented above. Duplicate reduction was not done at the congener level.

3.4 Treatment of Multiple Analytical Results

Some soil samples collected within OU3 were analyzed using two extraction methods during VOC analysis: EPA 5035/5030B and EPA 5035 Low. This resulted in several samples having two results for each VOC in the Scribe database. These results were reduced to a single value for each contaminant as follows:

- If both the results were detected, the maximum detected concentration was retained and the result was flagged as a detect.

- If both results were qualified as not detected, the maximum MDL was retained and the result was flagged as a non-detect.

- If one of the results was detected, while the other was qualified as not detected, the detected concentration was retained and the result was flagged as a detect.

3.5 Treatment of Non-detects

USEPA Region 8 evaluates analytical results qualified as non-detects using the respective MDL values. As per the analytical reports included in the RI Work Plan, the MDL is defined as the smallest amount that we can be 99% certain of seeing, if it is present. Using the MDL to evaluate non-detects minimizes false positives. The MDL is usually lower than the RL which is the level at which method, permit, regulatory and customer-specific objectives are incorporated. Reporting non-detects to higher detection limits than needed tends to adversely impact data quality and increase data uncertainty. Thus, to remain consistent with other regional site assessments, non-detects were evaluated using the MDL.

When calculating summary statistics, NDs were evaluated at ½ MDL. When inputting data to ProUCL for the purposes of comparing Site and background data or calculating 95 UCL values, ND data were based on the MDL. The exception to this approach was in the OU3 surface soil data input to ProUCL to compare Site concentrations to background concentrations reported in the MDEQ background soil reports. In this case, NDs were evaluated using the RL consistent with the MDEQ background data files.

3.6 Calculation of TEQ

Because dioxin and furan congeners and dioxin-like PCBs all act by the same mechanism as 2,3,7,8-TCDD, data for the dioxin and furan congeners and dioxin-like PCBs was converted to a TCDD toxicity equivalent value (TEQ) by computing the sum across congeners of the product of congener-specific concentration and relative Toxicity Equivalence Factor (TEF):

$$TEQ = \sum (Ci \times TEFi)$$

TEFs were based on USEPA (2010). In the Site database, separate TEQ values were calculated for dioxins and furans, dioxin-like PCBs, and dioxins, furans, and dioxin-like PCBs combined. For each type of TEQ, three alternative values were computed in the Site database, differing in the numeric concentration values assigned to concentrations flagged as ND as: ND = 0, ND = ½ RL, and ND = ½ MDL. A TEQ concentration is flagged as ND only if no individual was detected in that sample.

The background soil database contains calculated TEQ values that were provided by MDEQ. These TEQ concentrations are based on evaluating non-detects at one-half the RL. MDEQ (2011) does not provide an MDL in their raw data files.

4.0 REFERENCES

Dodge, K.A., Hornberger, M.I., and Turner, M.A. 2017. Water-quality, bed-sediment, and biological data (October 2014 through September 2015) and statistical summaries of data for streams in the Clark Fork Basin, Montana: U.S. Geological Survey Open-File Report 2016–1201, 122 p.

MDEQ. 2011. Montana Dioxin Background Investigation Report. Montana Department of Environmental Quality. April 2011.

MDEQ. 2013. Background Concentrations of Inorganic Constituents in Montana Surface Soils. Montana Department of Environmental Quality. September 2013.

NewFields. 2015. Remedial Investigation Work Plan. Smurfit Stone/Frenchtown Mill Missoula County, Montana. November.

NewFields. 2016. Preliminary Data Summary Report. Smurfit Stone/Frenchtown Mill, Missoula County, Montana. June.

Schmetterling and Selch 2013. Preliminary Investigations into the Toxicity of Game Fish in the Clark Fork River downstream from the Smurfit Stone Container Mill. Montana Fish, Wildlife and Parks. July.

TetraTech. 1998. MPDES Compliance Monitoring for Dioxins and Furans in Alluvial Sediment and Fish near the Stone Container Corporation Plant at Missoula, Montana. January.

USEPA. 1992. The National Study of Chemical Residues in Fish. EPA-823-R-92-008a. September.

USEPA 2010. Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8-Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds. EPA/100/R 10/005. December.

USEPA. 2016. National Rivers and Streams Assessment 2008-2009: A Collaborative Survey. EPA/841/R-16/007. March.

ATTACHMENT 1

Data Used in the Smurfit-Stone/Frenchtown Mill OU3 HHRA

Electronic File

[Appendix A_Attachment 1.xlsx]

APPENDIX B

Screening Level Evaluations

This appendix presents a screening level evaluation of those pathways identified as "minor" in the OU3 conceptual site model (CSM) (see Figure 3-1 of the main document). These pathways include the following:

- Inhalation of soil particulates generated via wind erosion
- Inhalation of vapors released from surface soils
- Dermal contact with groundwater used in future residential and commercial buildings

As discussed in the main text of the human health risk assessment (HHRA) for the OU3 Site, ingestion is the primary pathway by which exposure to site media is expected to occur at the OU3 Site. In general, the above pathways are considered minor exposure pathways when compared to the ingestion pathway. This screening level evaluation considers the relative risks from exposure to a chemical from each of the pathways listed above compared to the relative risks from exposure of the same chemical via the ingestion pathway.

Inhalation of Contaminants in Soil

As described in the main text of this HHRA, human receptors at the OU3 Site may be exposed to contaminated soil via inhalation of soil particulates suspended in air by wind disturbance or via inhalation of vapors in the air emitted from soil. This section evaluates the relative comparison between the ingestion pathway and the inhalation pathway for exposures to soil. The basic equations recommended by USEPA (1989; 2009) for evaluating exposures via ingestion and inhalation are described in brief below.

Ingestion Exposures

The daily ingested intake for chronic exposures is calculated as (USEPA 1989):

$$DI = C \cdot (IR / BW) \cdot (EF \cdot ED / AT)$$

where:

DI	=	Daily intake of chemical (mg per kg of body weight per day).
C	=	Concentration of the chemical in the contaminated environmental medium (soil, water) to which the person is exposed. The units are mg/kg for soil and mg/m^3 for air.
IR	=	Intake rate of the contaminated environmental medium. The units are kg/day for soil and L/day for water.
BW	=	Body weight of the exposed person (kg).

EF	=	Exposure frequency (days/year).
ED	=	Exposure duration (years).
AT	=	Averaging time (days).

Inhalation Exposures

The inhaled exposure concentration (EC) for chronic exposures is calculated as (USEPA 2009):

$$EC = Ca \cdot (ET \cdot EF \cdot ED / AT)$$

where:

EC	=	Exposure Concentration (μg/m^3). This is the time-weighted concentration based on the characteristics of the exposure scenario being evaluated.
Ca	=	Concentration of the chemical in air (μg/m^3) to which the person is exposed.
ET	=	Exposure time (hours/day).
EF	=	Exposure frequency (days/year).
ED	=	Exposure duration (years).
AT	=	Averaging time (hours).

and

$$Ca = Cs / PEF \text{ or } VF$$

where:

Cs	=	Concentration of the chemical in soil (mg/kg)
PEF	=	Particulate Emission Factor (m^3/kg)
VF	=	Volatilization Factor (m^3/kg)

To compare the relative contributions to exposure from the two pathways, non-cancer hazards and cancer risks were calculated as follows:

Non-cancer hazard quotients

$$HQ = DI / RfD \text{ (ingestion pathway)}$$

$$HQ = EC / RfC \text{ (inhalation pathway)}$$

<u>Cancer risks</u>

Risk = DI · SF (ingestion pathway)

Risk = EC · UR (inhalation pathway)

Based on the above equations, the relative magnitude of risks from inhalation exposures can be compared to risks from ingestion exposure by calculating the ratio as follows:

Ratio = Inhalation Risk / Ingestion Risk

Using the exposure parameters for a resident, cancer risks and non-cancer HQ values were calculated for 2,3,7,8-TCDD (herein referred to as dioxin) as an example, assuming an arbitrary soil concentration.

Media	Endpoint	Pathway	Ratio (Inhalation/Ingestion)
Soil	Cancer	Inhalation (particulates)	6E-05 (<0.01%)
		Inhalation (vapor)	4E-02 (4%)
	Non-cancer	Inhalation (particulates)	3E-06 (<0.001%)
		Inhalation (vapor)	2E-03 (0.2%)

As shown in the table above, risks from inhalation exposures are small compared to risks from ingestion exposures (<5%). These findings support designating the inhalation pathways for soil exposures as minor for the purposes of this assessment.

Dermal Contact with Water

As described in the main text of this HHRA, if groundwater were used in future residential buildings at the OU3 site, residents may be exposed while bathing/showering. The basic equations recommended by USEPA (1989; 2004) for evaluating exposures and risk via dermal contact are described in brief below.

<u>Dermal Exposure</u>

The dermally absorbed dose (DAD) is quantified using an equation of the following general form (USEPA 2004):

$$DAD = DA_{event} \cdot EF \cdot ED \cdot EV \cdot SA / (BW \cdot AT)$$

where:

DAD	=	Dermally absorbed dose (mg of chemical per kg of body weight per day).
DA_{event}	=	Absorbed dose per event (mg of chemical per square centimeter of skin surface area per event).
EF	=	Exposure frequency (days/year).
ED	=	Exposure duration (years).
EV	=	Event frequency (events/day).
SA	=	Surface area (cm^2).
BW	=	Body weight of the exposed person (kg).
AT	=	Averaging time (days).

<u>Non-cancer hazard quotients</u>

$$HQ = DAD/RfD_{ABS} \quad \text{(dermal pathway; } RfD_{ABS}=RfD \cdot ABS_{GI}\text{)}$$

<u>Cancer Risk</u>

$$Risk = DAD \cdot SF_{ABS} \text{ (dermal pathway; } SF_{ABS} = SF/ABS_{GI}\text{)}$$

Using the exposure parameters for a resident, dermal cancer risks and non-cancer HQ values were calculated for antimony as an example, assuming an arbitrary water concentration. The (dermal/ingestion) ratio between the non-cancer HQs for antimony is 8E-05 (0.01%). These findings support designating the dermal pathway for groundwater exposures to hypothetical future commercial workers as minor for the purposes of this assessment.

References

USEPA. 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A). United States Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC.

USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. United States Environmental Protection Agency, Office of Emergency and Remedial Response. EPA/540/R/99/005. July.

USEPA. 2009. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). Final. United States Environmental Protection Agency, Office of Emergency and Remedial Response. EPA-540-R-070-002. OSWER 9285.7-82. January.

USEPA. 2016. Vapor Intrusion Screening Level Calculator (VISL). Version 3.5.1. Based on the May 2016 USEPA Regional Screening Level Tables. https://www.epa.gov/vaporintrusion/vapor-intrusion-screening-levels-visls.

APPENDIX C

ProUCL Output

OU3 UPLAND SOIL

ALUMINUM
Sample 1 Data: Aluminum
Sample 2 Data: BkgAluminum

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	0	0
Number of Detect Data	95	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	1090	4150
Maximum Detect	21000	33700
Mean of Detects	8371	15522
Median of Detects	7620	15000
SD of Detects	4708	5758

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	6309
Standardized WMW U-Stat	-8.317
Mean (U)	5320
SD(U) - Adj ties	429.4
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	4.52E-17

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

ANTIMONY
Sample 1 Data: Antimony
Sample 2 Data: BkgAntimony

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	61	112
Number of Non-Detects	26	23
Number of Detect Data	35	89
Minimum Non-Detect	0.48	0.1
Maximum Non-Detect	0.94	0.1
Percent Non-detects	42.62%	20.54%
Minimum Detect	0.15	0.1
Maximum Detect	3.9	1.2
Mean of Detects	0.986	0.233
Median of Detects	0.73	0.2
SD of Detects	0.915	0.194

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.94 (Max DL) are ranked the same

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	5.297
Critical z (0.05)	-1.645
P-Value	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	5.297
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	1.18E-07

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

ARSENIC
Sample 1 Data: Arsenic
Sample 2 Data: BkgArsenic

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	0	0
Number of Detect Data	95	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	0.88	1.5
Maximum Detect	42.8	81.9
Mean of Detects	5.255	11.41
Median of Detects	3	8.45
SD of Detects	7.342	11.6

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	6376
Standardized WMW U-Stat	-8.161
Mean (U)	5320
SD(U) - Adj ties	429.4
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1.66E-16

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

CADMIUM

Sample 1 Data: Cadmium
Sample 2 Data: BkgCadmium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	12	15
Number of Detect Data	83	97
Minimum Non-Detect	0.031	0.1
Maximum Non-Detect	0.05	0.1
Percent Non-detects	12.63%	13.39%
Minimum Detect	0.046	0.1
Maximum Detect	8.3	1.1
Mean of Detects	1.52	0.326
Median of Detects	0.52	0.3
SD of Detects	1.998	0.193

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.1 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	2.284
Critical z (0.05)	-1.645
P-Value	0.989

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	2.284
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.0224

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

CHROMIUM

Sample 1 Data: Chromium
Sample 2 Data: BkgChromium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	0	0
Number of Detect Data	95	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	2.5	3.2
Maximum Detect	58.2	130
Mean of Detects	15.69	19.6
Median of Detects	12.4	18.05
SD of Detects	10.24	12.22

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	8047
Standardized WMW U-Stat	-4.271
Mean (U)	5320
SD(U) - Adj ties	429.4
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	9.74E-06

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

COBALT

Sample 1 Data: Cobalt
Sample 2 Data: BkgCobalt

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	1	0
Number of Detect Data	94	112
Minimum Non-Detect	0.46	N/A
Maximum Non-Detect	0.46	N/A
Percent Non-detects	1.05%	0.00%
Minimum Detect	1.1	2.1
Maximum Detect	11	16.4
Mean of Detects	3.252	7.33
Median of Detects	2.8	6.9
SD of Detects	1.812	2.756

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	5486
Standardized WMW U-Stat	-10.24
Mean (U)	5320
SD(U) - Adj ties	429.4
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	6.87E-25

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

IRON

Sample 1 Data: Iron
Sample 2 Data: BkgIron

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	0	0
Number of Detect Data	95	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	586	6430
Maximum Detect	20800	59200
Mean of Detects	8153	18184
Median of Detects	7790	17650
SD of Detects	4581	6781

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	5477
Standardized WMW U-Stat	-10.26
Mean (U)	5320
SD(U) - Adj ties	429.4
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	5.59E-25

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

MANGANESE

Sample 1 Data: Manganese
Sample 2 Data: BkgManganese

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	0	0
Number of Detect Data	95	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	33.1	74
Maximum Detect	2700	2920
Mean of Detects	628.3	508.4
Median of Detects	302	425
SD of Detects	700	369.2

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	8925
Standardized WMW U-Stat	-2.226
Mean (U)	5320
SD(U) - Adj ties	429.4
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.013

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

MERCURY

Sample 1 Data: Mercury
Sample 2 Data: BkgMercury

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	16	111
Number of Detect Data	79	1
Minimum Non-Detect	0.0059	0.05
Maximum Non-Detect	0.02	0.05
Percent Non-detects	16.84%	99.11%
Minimum Detect	0.012	0.068
Maximum Detect	8	0.068
Mean of Detects	0.503	0.068
Median of Detects	0.11	0.068
SD of Detects	1.128	N/A

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.05 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	9.154
Critical z (0.05)	-1.645
P-Value	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	9.154
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

THALLIUM

Sample 1 Data: Thallium
Sample 2 Data: BkgThallium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	14	0
Number of Detect Data	81	112
Minimum Non-Detect	0.012	N/A
Maximum Non-Detect	0.1	N/A
Percent Non-detects	14.74%	0.00%
Minimum Detect	0.026	7.00%
Maximum Detect	0.96	0.84
Mean of Detects	0.16	0.248
Median of Detects	0.12	0.235
SD of Detects	0.158	0.112

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	6329
Standardized WMW U-Stat	-8.344
Mean (U)	5320
SD(U) - Adj ties	429.3
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	3.60E-17

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

VANADIUM

Sample 1 Data: Vanadium
Sample 2 Data: BkgVanadium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	95	112
Number of Non-Detects	0	0
Number of Detect Data	95	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	0.61	6.7
Maximum Detect	119	92.2
Mean of Detects	16.42	30.94
Median of Detects	11.8	29.6
SD of Detects	17.14	13.48

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	6102
Standardized WMW U-Stat	-8.799
Mean (U)	5320
SD(U) - Adj ties	429.4
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	6.92E-19

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

TEQ (ND=1/2 RL) vs. Background Urban

Sample 1 Data: TEQNDRL
Sample 2 Data: TEQ-urban

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	98	59
Number of Non-Detects	0	1
Number of Detect Data	98	58
Minimum Non-Detect	N/A	1.24E-07
Maximum Non-Detect	N/A	1.24E-07
Percent Non-detects	0.00%	1.69%
Minimum Detect	2.16E-07	1.30E-07
Maximum Detect	7.56E-04	9.34E-06
Mean of Detects	1.96E-05	1.61E-06
Median of Detects	2.72E-06	1.16E-06
SD of Detects	7.93E-05	1.65E-06

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	8919
Standardized WMW U-Stat	4.264
Mean (U)	2891
SD(U) - Adj ties	275.9
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	8919
WMW U-Stat	4068
Standardized WMW U-Stat	4.264
Mean (U)	2891
SD(U) - Adj ties	275.9
Lower Approximate U-Stat Critical Value (0.0:	-1.96
Upper Approximate U-Stat Critical Value (0.9	1.96
P-Value (Adjusted for Ties)	2.01E-05

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

TEQ (ND=1/2 RL) vs. Background Rural

Sample 1 Data: TEQNDRL
Sample 2 Data: TEQ-rural

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	98	58
Number of Non-Detects	0	6
Number of Detect Data	98	52
Minimum Non-Detect	N/A	1.12E-07
Maximum Non-Detect	N/A	1.10E-06
Percent Non-detects	0.00%	10.34%
Minimum Detect	2.16E-07	1.20E-07
Maximum Detect	7.56E-04	1.85E-06
Mean of Detects	1.96E-05	7.49E-07
Median of Detects	2.72E-06	6.65E-07
SD of Detects	7.93E-05	4.72E-07

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 1.0986E-6 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	6.889
Critical z (0.05)	-1.645
P-Value	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	6.889
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	5.62E-12

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

TEQ (ND=1/2 RL) vs. Background Residential

Sample 1 Data: TEQNDRL
Sample 2 Data: TEQ-Res

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	98	21
Number of Non-Detects	0	1
Number of Detect Data	98	20
Minimum Non-Detect	N/A	1.24E-07
Maximum Non-Detect	N/A	1.24E-07
Percent Non-detects	0.00%	4.76%
Minimum Detect	2.16E-07	1.51E-07
Maximum Detect	7.56E-04	2.71E-06
Mean of Detects	1.96E-05	1.03E-06
Median of Detects	2.72E-06	9.27E-07
SD of Detects	7.93E-05	7.48E-07

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	6454
Standardized WMW U-Stat	3.998
Mean (U)	1029
SD(U) - Adj ties	143.5
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	6454
WMW U-Stat	1603
Standardized WMW U-Stat	3.998
Mean (U)	1029
SD(U) - Adj ties	143.5
Lower Approximate U-Stat Critical Value (0.0	-1.96
Upper Approximate U-Stat Critical Value (0.9	1.96
P-Value (Adjusted for Ties)	6.40E-05

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

TEQ (ND=1/2 RL) vs. Background Commercial/Industrial

Sample 1 Data: TEQNDRL
Sample 2 Data: TEQ-CI

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	98	38
Number of Non-Detects	0	0
Number of Detect Data	98	38
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	2.16E-07	1.30E-07
Maximum Detect	7.56E-04	9.34E-06
Mean of Detects	1.96E-05	1.92E-06
Median of Detects	2.72E-06	1.32E-06
SD of Detects	7.93E-05	1.90E-06

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	7316
Standardized WMW U-Stat	2.922
Mean (U)	1862
SD(U) - Adj ties	206.2
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.998

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	7316
WMW U-Stat	2465
Standardized WMW U-Stat	2.922
Mean (U)	1862
SD(U) - Adj ties	206.2
Lower Approximate U-Stat Critical Value (0.0	-1.96
Upper Approximate U-Stat Critical Value (0.9	1.96
P-Value (Adjusted for Ties)	0.00348

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

OU3 FLOODPLAIN SOIL

ALUMINUM

Sample 1 Data: Aluminum
Sample 2 Data: BkgAluminum

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	0	0
Number of Detect Data	32	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	2460	4150
Maximum Detect	21500	33700
Mean of Detects	10059	15522
Median of Detects	9625	15000
SD of Detects	4982	5758

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1393
Standardized WMW U-Stat	-4.457
Mean (U)	1792
SD(U) - Adj ties	208.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	4.15E-06

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

ARSENIC

Sample 1 Data: Arsenic
Sample 2 Data: BkgArsenic

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	0	0
Number of Detect Data	32	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	0.57	1.5
Maximum Detect	14.9	81.9
Mean of Detects	4.975	11.41
Median of Detects	4.35	8.45
SD of Detects	3.715	11.6

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1251
Standardized WMW U-Stat	-5.142
Mean (U)	1792
SD(U) - Adj ties	208.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1.36E-07

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

BARIUM

Sample 1 Data: Barium
Sample 2 Data: BkgBarium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	0	0
Number of Detect Data	32	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	29.3	32
Maximum Detect	2840	575
Mean of Detects	545.9	195.8
Median of Detects	343	171.5
SD of Detects	603.7	105.8

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	3023
Standardized WMW U-Stat	3.373
Mean (U)	1792
SD(U) - Adj ties	208.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	3023
WMW U-Stat	2495
Standardized WMW U-Stat	3.376
Mean (U)	1792
SD(U) - Adj ties	208.1
Lower Approximate U-Stat Critical Value (0.0:	-1.96
Upper Approximate U-Stat Critical Value (0.9	1.96
P-Value (Adjusted for Ties)	7.36E-04

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

CHROMIUM

Sample 1 Data: Chromium
Sample 2 Data: BkgChromium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	0	0
Number of Detect Data	32	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	3.3	3.2
Maximum Detect	45.2	130
Mean of Detects	16.49	19.6
Median of Detects	15.45	18.05
SD of Detects	10.48	12.22

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1916
Standardized WMW U-Stat	-1.944
Mean (U)	1792
SD(U) - Adj ties	208.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.026

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

COBALT

Sample 1 Data: Cobalt
Sample 2 Data: BkgCobalt

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	0	0
Number of Detect Data	32	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	1.3	2.1
Maximum Detect	7.1	16.4
Mean of Detects	3.434	7.33
Median of Detects	3.15	6.9
SD of Detects	1.461	2.756

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	831.5
Standardized WMW U-Stat	-7.156
Mean (U)	1792
SD(U) - Adj ties	208.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	4.14E-13

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

IRON

Sample 1 Data: Iron
Sample 2 Data: BkgIron

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	0	0
Number of Detect Data	32	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	4550	6430
Maximum Detect	22900	59200
Mean of Detects	9889	18184
Median of Detects	9285	17650
SD of Detects	4132	6781

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	933
Standardized WMW U-Stat	-6.668
Mean (U)	1792
SD(U) - Adj ties	208.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1.30E-11

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

MANGANESE

Sample 1 Data: Manganese

Sample 2 Data: BkgManganese

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	0	0
Number of Detect Data	32	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	41.2	74
Maximum Detect	1800	2920
Mean of Detects	435.7	508.4
Median of Detects	300	425
SD of Detects	504.6	369.2

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1664
Standardized WMW U-Stat	-3.157
Mean (U)	1792
SD(U) - Adj ties	208.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	7.97E-04

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

MERCURY

Sample 1 Data: Mercury

Sample 2 Data: BkgMercury

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	3	111
Number of Detect Data	29	1
Minimum Non-Detect	0.019	0.05
Maximum Non-Detect	0.021	0.05
Percent Non-detects	9.38%	99.11%
Minimum Detect	0.02	0.068
Maximum Detect	5.3	0.068
Mean of Detects	0.79	0.068
Median of Detects	0.2	0.068
SD of Detects	1.363	N/A

WMW test is meant for a Single Detection Limit Case

Use of Gehan or T-W test is suggested when multiple detection limits are present

All observations <= 0.05 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	9.747
Critical z (0.05)	-1.645
P-Value	1

Conclusion with Alpha = 0.05

Do Not Reject H0, Conclude Sample 1 >= Sample 2

P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	9.747
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 <> Sample 2

P-Value < alpha (0.05)

THALLIUM

Sample 1 Data: Thallium

Sample 2 Data: BkgThallium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	3	0
Number of Detect Data	29	112
Minimum Non-Detect	0.099	N/A
Maximum Non-Detect	0.12	N/A
Percent Non-detects	9.38%	0.00%
Minimum Detect	0.044	0.07
Maximum Detect	0.22	0.84
Mean of Detects	0.138	0.248
Median of Detects	0.15	0.235
SD of Detects	0.0517	0.112

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1063
Standardized WMW U-Stat	-6.065
Mean (U)	1792
SD(U) - Adj ties	207.9
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	6.59E-10

Conclusion with Alpha = 0.05

Reject H0, Conclude Sample 1 < Sample 2

P-Value < alpha (0.05)

VANADIUM

Sample 1 Data: Vanadium
Sample 2 Data: BkgVanadium

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	32	112
Number of Non-Detects	0	0
Number of Detect Data	32	112
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	4.1	6.7
Maximum Detect	46.2	92.2
Mean of Detects	18.02	30.94
Median of Detects	15.55	29.6
SD of Detects	11.29	13.48

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1220
Standardized WMW U-Stat	-5.288
Mean (U)	1792
SD(U) - Adj ties	208.1
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	6.17E-08

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

TEQ (ND=1/2 RL) vs. Background Urban

Sample 1 Data: TEQNDRL
Sample 2 Data: TEQ-urban

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	59
Number of Non-Detects	0	1
Number of Detect Data	31	58
Minimum Non-Detect	N/A	1.24E-07
Maximum Non-Detect	N/A	1.24E-07
Percent Non-detects	0.00%	1.69%
Minimum Detect	3.18E-07	1.30E-07
Maximum Detect	1.02E-04	9.34E-06
Mean of Detects	1.85E-05	1.61E-06
Median of Detects	7.13E-06	1.16E-06
SD of Detects	2.65E-05	1.65E-06

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1878
Standardized WMW U-Stat	3.965
Mean (U)	914.5
SD(U) - Adj ties	117.8
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	1878
WMW U-Stat	1382
Standardized WMW U-Stat	3.965
Mean (U)	914.5
SD(U) - Adj ties	117.8
Lower Approximate U-Stat Critical Value (0.0	-1.96
Upper Approximate U-Stat Critical Value (0.9	1.96
P-Value (Adjusted for Ties)	7.33E-05

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

TEQ (ND=1/2 RL) vs. Background Rural

Sample 1 Data: TEQNDRL
Sample 2 Data: TEQ-rural

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	58
Number of Non-Detects	0	6
Number of Detect Data	31	52
Minimum Non-Detect	N/A	1.12E-07
Maximum Non-Detect	N/A	1.10E-06
Percent Non-detects	0.00%	10.34%
Minimum Detect	3.18E-07	1.20E-07
Maximum Detect	1.02E-04	1.85E-06
Mean of Detects	1.85E-05	7.49E-07
Median of Detects	7.13E-06	6.65E-07
SD of Detects	2.65E-05	4.72E-07

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 1.0986E-6 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	5.226
Critical z (0.05)	-1.645
P-Value	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	5.226
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	1.73E-07

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

GROUNDWATER

TEQ (ND=0)

Sample 1 Data: TEQND0
Sample 2 Data: bKGTEQND0

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	71	12
Number of Non-Detects	13	11
Number of Detect Data	58	1
Minimum Non-Detect	0	0
Maximum Non-Detect	0	0
Percent Non-detects	18.31%	91.67%
Minimum Detect	1.28E-09	1.83E-07
Maximum Detect	6.49E-06	1.83E-07
Mean of Detects	5.30E-07	1.83E-07
Median of Detects	6.01E-08	1.83E-07
SD of Detects	1.36E-06	N/A

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	3284
Standardized WMW U-Stat	3.946
Mean (U)	426
SD(U) - Adj ties	77.23
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	3284
WMW U-Stat	727.5
Standardized WMW U-Stat	3.952
Mean (U)	426
SD(U) - Adj ties	77.23
Lower Approximate U-Stat Critical Value (0.02	-1.96
Upper Approximate U-Stat Critical Value (0.97	1.96
P-Value (Adjusted for Ties)	7.75E-05

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

TEQ (ND=1/2 RL)

Sample 1 Data: TEQNDRL
Sample 2 Data: BKGTEQNDRL

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	71	12
Number of Non-Detects	13	11
Number of Detect Data	58	1
Minimum Non-Detect	9.57E-07	1.22E-06
Maximum Non-Detect	2.64E-06	3.36E-06
Percent Non-detects	18.31%	91.67%
Minimum Detect	9.55E-07	9.96E-07
Maximum Detect	1.15E-05	9.96E-07
Mean of Detects	2.40E-06	9.96E-07
Median of Detects	2.00E-06	9.96E-07
SD of Detects	1.82E-06	N/A

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 3.3648E-6 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	2.95
Critical z (0.05)	-1.645
P-Value	0.998

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	2.95
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.00318

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

TEQ (ND=1/2 MDL)

Sample 1 Data: TEQNDMDL
Sample 2 Data: Bkg-TEQNDhalfMDL

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	71	12
Number of Non-Detects	13	11
Number of Detect Data	58	1
Minimum Non-Detect	3.28E-07	3.63E-07
Maximum Non-Detect	4.29E-07	7.92E-07
Percent Non-detects	18.31%	91.67%
Minimum Detect	3.29E-07	4.96E-07
Maximum Detect	6.81E-06	4.96E-07
Mean of Detects	9.01E-07	4.96E-07
Median of Detects	4.52E-07	4.96E-07
SD of Detects	1.33E-06	N/A

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are pr
All observations <= 7.9248E-7 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	3.362
Critical z (0.05)	-1.645
P-Value	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	3.362
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	7.74E-04

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

ALUMINUM

Sample 1 Data: Al
Sample 2 Data: BkgAl

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	0	1
Number of Detect Data	31	5
Minimum Non-Detect	N/A	1.2
Maximum Non-Detect	N/A	1.2
Percent Non-detects	0.00%	16.67%
Minimum Detect	4.2	3.3
Maximum Detect	12800	34.6
Mean of Detects	589.4	12.78
Median of Detects	77.7	9.7
SD of Detects	2283	12.49

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	673
Standardized WMW U-Stat	3.441
Mean (U)	93
SD(U) - Adj ties	24.27
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	673
WMW U-Stat	177
Standardized WMW U-Stat	3.441
Mean (U)	93
SD(U) - Adj ties	24.27
Lower Approximate U-Stat Critical Value (0.02	-1.96
Upper Approximate U-Stat Critical Value (0.97	1.96
P-Value (Adjusted for Ties)	5.81E-04

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

ANTIMONY

Sample 1 Data: Antimony
Sample 2 Data: BkgSb

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	13	2
Number of Detect Data	18	4
Minimum Non-Detect	0.12	0.12
Maximum Non-Detect	0.25	0.25
Percent Non-detects	41.94%	33.33%
Minimum Detect	0.073	0.13
Maximum Detect	2.5	0.22
Mean of Detects	0.524	0.168
Median of Detects	0.345	0.16
SD of Detects	0.601	0.0377

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.25 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	0.866
Critical z (0.05)	-1.645
P-Value	0.807

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	0.866
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.386

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

ARSENIC

Sample 1 Data: Arsenic
Sample 2 Data: Bkg-TotAs

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	0	0
Number of Detect Data	31	6
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	0.34	0.48
Maximum Detect	54.3	5.1
Mean of Detects	8.505	2.363
Median of Detects	4.4	1.7
SD of Detects	10.58	1.819

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	637
Standardized WMW U-Stat	1.958
Mean (U)	93
SD(U) - Adj ties	24.27
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.975

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	637
WMW U-Stat	141
Standardized WMW U-Stat	1.979
Mean (U)	93
SD(U) - Adj ties	24.27
Lower Approximate U-Stat Critical Value (0.02	-1.96
Upper Approximate U-Stat Critical Value (0.97	1.96
P-Value (Adjusted for Ties)	0.0479

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

BARIUM

Sample 1 Data: Barium
Sample 2 Data: Bkg-TotBa

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	0	0
Number of Detect Data	31	6
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	34.2	170
Maximum Detect	960	359
Mean of Detects	239.8	233.2
Median of Detects	136	211.5
SD of Detects	243.2	75.71

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	561
Standardized WMW U-Stat	-1.174
Mean (U)	93
SD(U) - Adj ties	24.27
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.12

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	561
WMW U-Stat	65
Standardized WMW U-Stat	-1.154
Mean (U)	93
SD(U) - Adj ties	24.27
Lower Approximate U-Stat Critical Value (0.02	-1.96
Upper Approximate U-Stat Critical Value (0.97	1.96
P-Value (Adjusted for Ties)	0.249

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

CADMIUM

Sample 1 Data: Cadmium
Sample 2 Data: BkgCd

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	20	6
Number of Detect Data	11	0
Minimum Non-Detect	0.013	0.013
Maximum Non-Detect	0.033	0.033
Percent Non-detects	64.52%	100.00%
Minimum Detect	0.022	N/A
Maximum Detect	0.91	N/A
Mean of Detects	0.158	N/A
Median of Detects	0.074	N/A
SD of Detects	0.258	N/A

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.033 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	1.689
Critical z (0.05)	-1.645
P-Value	0.954

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	1.689
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.0912

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

CHROMIUM

Sample 1 Data: Chromium
Sample 2 Data: Bkg-TotCr

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	1	1
Number of Detect Data	30	5
Minimum Non-Detect	0.22	0.22
Maximum Non-Detect	0.22	0.22
Percent Non-detects	3.23%	16.67%
Minimum Detect	0.18	0.18
Maximum Detect	15.6	0.52
Mean of Detects	3.109	0.346
Median of Detects	1.75	0.36
SD of Detects	3.524	0.122

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits
All observations <= 0.22 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	2.577
Critical z (0.05)	-1.645
P-Value	0.995

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	2.577
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.00998

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

COBALT
Sample 1 Data: Cobalt
Sample 2 Data: Bkg-TotCo

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	500.00%	300.00%
Number of Detect Data	26	3
Minimum Non-Detect	0.15	0.021
Maximum Non-Detect	0.25	0.25
Percent Non-detects	16.13%	50.00%
Minimum Detect	0.15	0.026
Maximum Detect	98.4	0.05
Mean of Detects	4.933	0.0383
Median of Detects	0.54	0.039
SD of Detects	19.14	0.012

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.25 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	3.217
Critical z (0.05)	-1.645
P-Value	0.999

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	3.217
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.0013

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

COPPER
Sample 1 Data: Copper
Sample 2 Data: BkgCu

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	3	0
Number of Detect Data	28	6
Minimum Non-Detect	0.22	N/A
Maximum Non-Detect	0.4	N/A
Percent Non-detects	9.68%	0.00%
Minimum Detect	0.23	1.1
Maximum Detect	21	6.6
Mean of Detects	3.452	2.6
Median of Detects	1.2	1.95
SD of Detects	5.002	2.009

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	556
Standardized WMW U-Stat	-1.388
Mean (U)	93
SD(U) - Adj ties	24.26
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.0826

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	556
WMW U-Stat	60
Standardized WMW U-Stat	-1.367
Mean (U)	93
SD(U) - Adj ties	24.26
Lower Approximate U-Stat Critical Value (0.02	-1.96
Upper Approximate U-Stat Critical Value (0.97	1.96
P-Value (Adjusted for Ties)	0.172

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

IRON
Sample 1 Data: Iron
Sample 2 Data: BkgFe

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	1	4
Number of Detect Data	30	2
Minimum Non-Detect	18.5	8
Maximum Non-Detect	18.5	18.5
Percent Non-detects	3.23%	66.67%
Minimum Detect	24.6	22.1
Maximum Detect	44900	95.7
Mean of Detects	5187	58.9
Median of Detects	1285	58.9
SD of Detects	9489	52.04

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are pr
All observations <= 18.5 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	3.589
Critical z (0.05)	-1.645
P-Value	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	3.589
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	3.32E-04

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

MAGNESIUM
Sample 1 Data: Magnesium
Sample 2 Data: BkgMg

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	0	0
Number of Detect Data	31	6
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	491	15400
Maximum Detect	150000	23700
Mean of Detects	44334	19600
Median of Detects	25100	19850
SD of Detects	43852	3349

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	610.5
Standardized WMW U-Stat	0.865
Mean (U)	93
SD(U) - Adj ties	24.27
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.807

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	610.5
WMW U-Stat	114.5
Standardized WMW U-Stat	0.886
Mean (U)	93
SD(U) - Adj ties	24.27
Lower Approximate U-Stat Critical Value (0.02	-1.96
Upper Approximate U-Stat Critical Value (0.97	1.96
P-Value (Adjusted for Ties)	3.76E-01

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

MANGANESE
Sample 1 Data: Manganese
Sample 2 Data: Bkg-TotMn

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	0	1
Number of Detect Data	31	5
Minimum Non-Detect	N/A	0.14
Maximum Non-Detect	N/A	0.14
Percent Non-detects	0.00%	16.67%
Minimum Detect	122	0.15
Maximum Detect	51500	2.8
Mean of Detects	5042	1.248
Median of Detects	2860	0.89
SD of Detects	8977	1.199

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	682
Standardized WMW U-Stat	3.812
Mean (U)	93
SD(U) - Adj ties	24.27
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	682
WMW U-Stat	186
Standardized WMW U-Stat	3.832
Mean (U)	93
SD(U) - Adj ties	24.27
Lower Approximate U-Stat Critical Value (0.02	-1.96
Upper Approximate U-Stat Critical Value (0.97	1.96
P-Value (Adjusted for Ties)	1.27E-04

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

NICKEL
Sample 1 Data: Nickel
Sample 2 Data: BkgNi

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	1	4
Number of Detect Data	30	2
Minimum Non-Detect	0.23	0.099
Maximum Non-Detect	0.23	0.12
Percent Non-detects	3.23%	66.67%
Minimum Detect	0.13	0.51
Maximum Detect	90.6	0.8
Mean of Detects	7.637	0.655
Median of Detects	3.25	0.655
SD of Detects	16.4	0.205

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits
All observations <= 0.23 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	3.344
Critical z (0.05)	-1.645
P-Value	1

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	3.344
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	8.27E-04

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

THALLIUM

Sample 1 Data: Thallium
Sample 2 Data: BkgTl

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	27	6
Number of Detect Data	4	0
Minimum Non-Detect	0.0072	0.0072
Maximum Non-Detect	0.028	0.028
Percent Non-detects	87.10%	100.00%
Minimum Detect	0.01	N/A
Maximum Detect	0.22	N/A
Mean of Detects	0.064	N/A
Median of Detects	0.013	N/A
SD of Detects	0.104	N/A

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.028 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	1.135
Critical z (0.05)	-1.645
P-Value	0.872

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	1.135
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.256

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

VANADIUM

Sample 1 Data: Vanadium
Sample 2 Data: BkgV

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	31	6
Number of Non-Detects	2	0
Number of Detect Data	29	6
Minimum Non-Detect	0.27	N/A
Maximum Non-Detect	0.27	N/A
Percent Non-detects	6.45%	0.00%
Minimum Detect	0.84	0.52
Maximum Detect	120	1.6
Mean of Detects	16.9	1.115
Median of Detects	7.2	1.2
SD of Detects	25.65	0.454

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	648.5
Standardized WMW U-Stat	2.433
Mean (U)	93
SD(U) - Adj ties	24.25
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.993

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	648.5
WMW U-Stat	152.5
Standardized WMW U-Stat	2.454
Mean (U)	93
SD(U) - Adj ties	24.25
Lower Approximate U-Stat Critical Value (0.02	-1.96
Upper Approximate U-Stat Critical Value (0.97	1.96
P-Value (Adjusted for Ties)	0.0141

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 <> Sample 2
P-Value < alpha (0.05)

CHLOROBENZENE

Sample 1 Data: Chlorobenzene
Sample 2 Data: BkgChlorbenzene

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	26	4
Number of Non-Detects	24	4
Number of Detect Data	2	0
Minimum Non-Detect	0.066	0.066
Maximum Non-Detect	0.23	0.23
Percent Non-detects	92.31%	100.00%
Minimum Detect	15.7	N/A
Maximum Detect	28.2	N/A
Mean of Detects	21.95	N/A
Median of Detects	21.95	N/A
SD of Detects	8.839	N/A

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits
All observations <= 0.23 (Max DL) are ranked the same

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	0.564
Critical z (0.05)	-1.645
P-Value	0.714

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	0.564
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.573

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

AROCLOR-1260
Sample 1 Data: Aroclor1260
Sample 2 Data: BkgAroclor1260

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	34	6
Number of Non-Detects	29	6
Number of Detect Data	5	0
Minimum Non-Detect	0.016	0.015
Maximum Non-Detect	0.036	0.036
Percent Non-detects	85.29%	100.00%
Minimum Detect	0.059	N/A
Maximum Detect	0.31	N/A
Mean of Detects	0.132	N/A
Median of Detects	0.087	N/A
SD of Detects	0.102	N/A

WMW test is meant for a Single Detection Limit Case
Use of Gehan or T-W test is suggested when multiple detection limits are present
All observations <= 0.036 (Max DL) are ranked the same

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2
There are no detects in at least on of the groups - no analysis will be performed
Graphical displays may be helpful!

Sample 1 vs Sample 2 Gehan Test

H0: Mean of Sample 1 >= Mean of background

Gehan z Test Value	0.989
Critical z (0.05)	-1.645
P-Value	0.839

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2
P-Value >= alpha (0.05)

H0: Mean of Sample 1 = Mean of background

Gehan z Test Value	0.989
Lower Critical z (0.025)	-1.96
Upper Critical z (0.975)	1.96
P-Value	0.323

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2
P-Value >= alpha (0.05)

APPENDIX C. PROUCL OUTPUT

FISH

Wilcoxon-Mann-Whitney Sample 1 vs Sample 2 Comparison Test for Data Sets with Non-Detects

User Selected Options	
Full Precision	OFF
Confidence Coefficient	95%

Mercury

Mercury vs. National River Data

Sample 1 Data: SiteMercury
Sample 2 Data: BkgMercury

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	7	356
Number of Non-Detects	0	0
Number of Detect Data	7	356
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	0.0308	0.0214
Maximum Detect	0.253	1.419
Mean of Detects	0.107	0.281
Median of Detects	0.0462	0.225
SD of Detects	0.0897	0.214

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	531
Standardized WMW U-Stat	-2.704
Mean (U)	1246
SD(U) - Adj ties	274.9
Approximate U-Stat Critical Value (0.05)	-1.645
P-Value (Adjusted for Ties)	0.00342

Conclusion with Alpha = 0.05
Reject H0, Conclude Sample 1 < Sample 2
P-Value < alpha (0.05)

Mercury vs. Montana River Data

Sample 1 Data: SiteMercury
Sample 2 Data: BkgMercuryMT

Raw Statistics

	Sample 1	Sample 2
Number of Valid Data	7	6
Number of Non-Detects	0	0
Number of Detect Data	7	6
Minimum Non-Detect	N/A	N/A
Maximum Non-Detect	N/A	N/A
Percent Non-detects	0.00%	0.00%
Minimum Detect	0.0308	0.0255
Maximum Detect	0.253	0.26
Mean of Detects	0.107	0.125
Median of Detects	0.0462	0.0855
SD of Detects	0.0897	0.0957

Wilcoxon-Mann-Whitney (WMW) Test

H0: Mean/Median of Sample 1 >= Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	45
WMW U-Stat	17
Mean (U)	21
SD(U) - Adj ties	7
WMW U-Stat Critical Value (0.05)	9
Standardized WMW U-Stat	-0.644
Approximate P-Value	0.26

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 >= Sample 2

H0: Mean/Median of Sample 1 = Mean/Median of Sample 2

Sample 1 Rank Sum W-Stat	45
WMW U-Stat	17
Mean (U)	21
SD(U) - Adj ties	7
Lower U-Stat Critical Value (0.025)	7
Upper U-Stat Critical Value (0.975)	35
Standardized WMW U-Stat	-0.572
Approximate P-Value	0.567

Conclusion with Alpha = 0.05
Do Not Reject H0, Conclude Sample 1 = Sample 2

APPENDIX D

Detailed Risk Calculations

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population	**Hypothetical Future Residents**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC	RBA	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
26	TEQ (ND=1/2 MDL)	3.6E-06	1.00	5.4E-12	1.4E-11	7.0E-10	8E-03	2E-02
	Mercury	1.4E-01	1.00	2.1E-07	5.4E-07	3.0E-04	7E-04	2E-03
	Antimony	1.5E+00	1.00	2.2E-06	5.8E-06	4.0E-04	6E-03	1E-02
	Cadmium	7.0E-01	1.00	1.0E-06	2.7E-06	1.0E-03	1E-03	3E-03
27	TEQ (ND=1/2 MDL)	2.4E-06	1.00	3.6E-12	9.4E-12	7.0E-10	5E-03	1E-02
	Mercury	1.2E-02	1.00	1.8E-08	4.6E-08	3.0E-04	6E-05	2E-04
	Antimony	9.0E-02	1.00	1.3E-07	3.5E-07	4.0E-04	3E-04	9E-04
	Cadmium	6.4E-02	1.00	9.6E-08	2.5E-07	1.0E-03	1E-04	2E-04
28	TEQ (ND=1/2 MDL)	5.3E-07	1.00	7.9E-13	2.1E-12	7.0E-10	1E-03	3E-03
	Mercury	1.6E-02	1.00	2.4E-08	6.2E-08	3.0E-04	8E-05	2E-04
	Antimony	9.0E-02	1.00	1.3E-07	3.5E-07	4.0E-04	3E-04	9E-04
	Cadmium	7.3E-02	1.00	1.1E-07	2.8E-07	1.0E-03	1E-04	3E-04
29	TEQ (ND=1/2 MDL)	2.9E-06	1.00	4.3E-12	1.1E-11	7.0E-10	6E-03	2E-02
	Mercury	3.3E-02	1.00	4.9E-08	1.3E-07	3.0E-04	2E-04	4E-04
	Antimony	1.9E-01	1.00	2.8E-07	7.4E-07	4.0E-04	7E-04	2E-03
	Cadmium	1.4E-01	1.00	2.1E-07	5.4E-07	1.0E-03	2E-04	5E-04
30	TEQ (ND=1/2 MDL)	1.7E-06	1.00	2.5E-12	6.5E-12	7.0E-10	4E-03	9E-03
	Mercury	2.4E-02	1.00	3.6E-08	9.3E-08	3.0E-04	1E-04	3E-04
	Antimony	2.0E-01	1.00	3.0E-07	7.7E-07	4.0E-04	7E-04	2E-03
	Cadmium	1.3E-01	1.00	1.9E-07	5.0E-07	1.0E-03	2E-04	5E-04
31	TEQ (ND=1/2 MDL)	4.7E-07	1.00	7.0E-13	1.8E-12	7.0E-10	1E-03	3E-03
	Mercury	3.4E-03	1.00	5.1E-09	1.3E-08	3.0E-04	2E-05	4E-05
	Antimony	4.1E-02	1.00	6.1E-08	1.6E-07	4.0E-04	2E-04	4E-04
	Cadmium	4.4E-02	1.00	6.6E-08	1.7E-07	1.0E-03	7E-05	2E-04
32	TEQ (ND=1/2 MDL)	9.3E-08	1.00	1.4E-13	3.6E-13	7.0E-10	2E-04	5E-04
	Mercury	3.1E-03	1.00	4.6E-09	1.2E-08	3.0E-04	2E-05	4E-05
	Antimony	1.5E-01	1.00	2.2E-07	5.8E-07	4.0E-04	6E-04	1E-03
	Cadmium	4.6E-02	1.00	6.9E-08	1.8E-07	1.0E-03	7E-05	2E-04
33	TEQ (ND=1/2 MDL)	9.4E-07	1.00	1.4E-12	3.6E-12	7.0E-10	2E-03	5E-03
	Mercury	1.7E-02	1.00	2.5E-08	6.6E-08	3.0E-04	8E-05	2E-04
	Antimony	9.0E-02	1.00	1.3E-07	3.5E-07	4.0E-04	3E-04	9E-04
	Cadmium	1.3E-01	1.00	1.9E-07	5.0E-07	1.0E-03	2E-04	5E-04
34	TEQ (ND=1/2 MDL)	7.0E-07	1.00	1.0E-12	2.7E-12	7.0E-10	1E-03	4E-03
	Mercury	1.3E-02	1.00	1.9E-08	5.0E-08	3.0E-04	6E-05	2E-04
	Antimony	8.5E-02	1.00	1.3E-07	3.3E-07	4.0E-04	3E-04	8E-04
	Cadmium	9.3E-02	1.00	1.4E-07	3.6E-07	1.0E-03	1E-04	4E-04
35	TEQ (ND=1/2 MDL)	2.1E-07	1.00	3.2E-13	8.3E-13	7.0E-10	5E-04	1E-03
	Mercury	1.8E-02	1.00	2.7E-08	7.0E-08	3.0E-04	9E-05	2E-04
	Antimony	2.3E-01	1.00	3.4E-07	8.9E-07	4.0E-04	9E-04	2E-03
	Cadmium	1.9E-01	1.00	2.8E-07	7.4E-07	1.0E-03	3E-04	7E-04
36	TEQ (ND=1/2 MDL)	9.1E-06	1.00	1.4E-11	3.5E-11	7.0E-10	2E-02	5E-02
	Mercury	2.7E-01	1.00	4.0E-07	1.0E-06	3.0E-04	1E-03	3E-03
	Antimony	8.0E-01	1.00	1.2E-06	3.1E-06	4.0E-04	3E-03	8E-03
	Cadmium	8.5E-01	1.00	1.3E-06	3.3E-06	1.0E-03	1E-03	3E-03
37	TEQ (ND=1/2 MDL)	1.4E-06	1.00	2.1E-12	5.4E-12	7.0E-10	3E-03	8E-03
	Mercury	4.0E-02	1.00	6.0E-08	1.5E-07	3.0E-04	2E-04	5E-04
	Antimony	3.3E-01	1.00	4.9E-07	1.3E-06	4.0E-04	1E-03	3E-03
	Cadmium	2.6E-01	1.00	3.8E-07	9.9E-07	1.0E-03	4E-04	1E-03
39	TEQ (ND=1/2 MDL)	2.7E-06	1.00	4.0E-12	1.0E-11	7.0E-10	6E-03	1E-02
	Mercury	7.4E-02	1.00	1.1E-07	2.9E-07	3.0E-04	4E-04	1E-03
	Antimony	4.3E-01	1.00	6.4E-07	1.6E-06	4.0E-04	2E-03	4E-03
	Cadmium	3.3E-01	1.00	5.0E-07	1.3E-06	1.0E-03	5E-04	1E-03
40	TEQ (ND=1/2 MDL)	3.4E-06	1.00	5.1E-12	1.3E-11	7.0E-10	7E-03	2E-02
	Mercury	4.0E-02	1.00	6.0E-08	1.5E-07	3.0E-04	2E-04	5E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.8E-01	1.00	4.2E-07	1.1E-06	1.0E-03	4E-04	1E-03
41	TEQ (ND=1/2 MDL)	3.9E-06	1.00	5.8E-12	1.5E-11	7.0E-10	8E-03	2E-02
	Mercury	5.7E-02	1.00	8.5E-08	2.2E-07	3.0E-04	3E-04	7E-04
	Antimony	4.2E-02	1.00	6.3E-08	1.6E-07	4.0E-04	2E-04	4E-04
	Cadmium	2.8E-01	1.00	4.2E-07	1.1E-06	1.0E-03	4E-04	1E-03

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population	**Hypothetical Future Residents**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC	RBA	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
42	TEQ (ND=1/2 MDL)	7.5E-06	1.00	1.1E-11	2.9E-11	7.0E-10	2E-02	4E-02
	Mercury	1.6E-01	1.00	2.4E-07	6.2E-07	3.0E-04	8E-04	2E-03
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	3.2E-01	1.00	4.8E-07	1.2E-06	1.0E-03	5E-04	1E-03
43	TEQ (ND=1/2 MDL)	3.9E-06	1.00	5.8E-12	1.5E-11	7.0E-10	8E-03	2E-02
	Mercury	1.2E-01	1.00	1.8E-07	4.6E-07	3.0E-04	6E-04	2E-03
	Antimony	7.6E-01	1.00	1.1E-06	2.9E-06	4.0E-04	3E-03	7E-03
	Cadmium	4.7E-01	1.00	7.0E-07	1.8E-06	1.0E-03	7E-04	2E-03
44	TEQ (ND=1/2 MDL)	2.1E-06	1.00	3.1E-12	8.0E-12	7.0E-10	4E-03	1E-02
	Mercury	1.6E-01	1.00	2.3E-07	6.0E-07	3.0E-04	8E-04	2E-03
	Antimony	1.2E+00	1.00	1.7E-06	4.5E-06	4.0E-04	4E-03	1E-02
	Cadmium	8.0E-01	1.00	1.2E-06	3.1E-06	1.0E-03	1E-03	3E-03
46	TEQ (ND=1/2 MDL)	3.0E-06	1.00	4.5E-12	1.2E-11	7.0E-10	6E-03	2E-02
	Mercury	4.1E-02	1.00	6.1E-08	1.6E-07	3.0E-04	2E-04	5E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.4E-01	1.00	3.6E-07	9.3E-07	1.0E-03	4E-04	9E-04
47	TEQ (ND=1/2 MDL)	1.6E-05	1.00	2.4E-11	6.3E-11	7.0E-10	3E-02	9E-02
	Mercury	8.1E-01	1.00	1.2E-06	3.1E-06	3.0E-04	4E-03	1E-02
	Antimony	1.6E+00	1.00	2.4E-06	6.2E-06	4.0E-04	6E-03	2E-02
	Cadmium	5.2E+00	1.00	7.8E-06	2.0E-05	1.0E-03	8E-03	2E-02
48	TEQ (ND=1/2 MDL)	4.9E-05	1.00	7.4E-11	1.9E-10	7.0E-10	1E-01	3E-01
	Mercury	2.5E+00	1.00	3.7E-06	9.7E-06	3.0E-04	1E-02	3E-02
	Antimony	2.4E+00	1.00	3.6E-06	9.3E-06	4.0E-04	9E-03	2E-02
	Cadmium	8.3E+00	1.00	1.2E-05	3.2E-05	1.0E-03	1E-02	3E-02
49	TEQ (ND=1/2 MDL)	4.0E-05	1.00	6.0E-11	1.5E-10	7.0E-10	9E-02	2E-01
	Mercury	8.0E+00	1.00	1.2E-05	3.1E-05	3.0E-04	4E-02	1E-01
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.0E+00	1.00	3.0E-06	7.7E-06	1.0E-03	3E-03	8E-03
50	TEQ (ND=1/2 MDL)	2.4E-05	1.00	3.6E-11	9.4E-11	7.0E-10	5E-02	1E-01
	Mercury	7.5E-01	1.00	1.1E-06	2.9E-06	3.0E-04	4E-03	1E-02
	Antimony	1.2E+00	1.00	1.7E-06	4.5E-06	4.0E-04	4E-03	1E-02
	Cadmium	3.9E+00	1.00	5.8E-06	1.5E-05	1.0E-03	6E-03	2E-02
51	TEQ (ND=1/2 MDL)	2.7E-05	1.00	4.1E-11	1.1E-10	7.0E-10	6E-02	2E-01
	Mercury	6.3E-01	1.00	9.4E-07	2.4E-06	3.0E-04	3E-03	8E-03
	Antimony	1.4E+00	1.00	2.1E-06	5.4E-06	4.0E-04	5E-03	1E-02
	Cadmium	5.0E+00	1.00	7.5E-06	1.9E-05	1.0E-03	7E-03	2E-02
52	TEQ (ND=1/2 MDL)	2.7E-05	1.00	4.1E-11	1.1E-10	7.0E-10	6E-02	2E-01
	Mercury	6.3E-01	1.00	9.4E-07	2.4E-06	3.0E-04	3E-03	8E-03
	Antimony	1.4E+00	1.00	2.1E-06	5.4E-06	4.0E-04	5E-03	1E-02
	Cadmium	5.0E+00	1.00	7.5E-06	1.9E-05	1.0E-03	7E-03	2E-02
53	TEQ (ND=1/2 MDL)	2.3E-05	1.00	3.4E-11	8.8E-11	7.0E-10	5E-02	1E-01
	Mercury	4.3E+00	1.00	6.4E-06	1.7E-05	3.0E-04	2E-02	6E-02
	Antimony	4.6E-01	1.00	6.9E-07	1.8E-06	4.0E-04	2E-03	4E-03
	Cadmium	1.2E+00	1.00	1.8E-06	4.6E-06	1.0E-03	2E-03	5E-03
54	TEQ (ND=1/2 MDL)	2.0E-05	1.00	3.0E-11	7.8E-11	7.0E-10	4E-02	1E-01
	Mercury	8.5E-01	1.00	1.3E-06	3.3E-06	3.0E-04	4E-03	1E-02
	Antimony	1.0E+00	1.00	1.6E-06	4.0E-06	4.0E-04	4E-03	1E-02
	Cadmium	3.1E+00	1.00	4.6E-06	1.2E-05	1.0E-03	5E-03	1E-02
55	TEQ (ND=1/2 MDL)	5.5E-05	1.00	8.3E-11	2.1E-10	7.0E-10	1E-01	3E-01
	Mercury	1.1E+00	1.00	1.6E-06	4.3E-06	3.0E-04	5E-03	1E-02
	Antimony	1.2E+00	1.00	1.8E-06	4.6E-06	4.0E-04	4E-03	1E-02
	Cadmium	5.6E+00	1.00	8.4E-06	2.2E-05	1.0E-03	8E-03	2E-02
56	TEQ (ND=1/2 MDL)	5.9E-05	1.00	8.8E-11	2.3E-10	7.0E-10	1E-01	3E-01
	Mercury	1.3E+00	1.00	1.9E-06	5.0E-06	3.0E-04	6E-03	2E-02
	Antimony	1.7E+00	1.00	2.6E-06	6.6E-06	4.0E-04	6E-03	2E-02
	Cadmium	6.7E+00	1.00	1.0E-05	2.6E-05	1.0E-03	1E-02	3E-02

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population	**Hypothetical Future Residents**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC	RBA	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
58	TEQ (ND=1/2 MDL)	8.3E-05	1.00	1.3E-10	3.2E-10	7.0E-10	2E-01	5E-01
	Mercury	1.2E+00	1.00	1.8E-06	4.6E-06	3.0E-04	6E-03	2E-02
	Antimony	2.3E+00	1.00	3.4E-06	8.9E-06	4.0E-04	9E-03	2E-02
	Cadmium	4.8E+00	1.00	7.2E-06	1.9E-05	1.0E-03	7E-03	2E-02
59	TEQ (ND=1/2 MDL)	1.6E-05	1.00	2.4E-11	6.1E-11	7.0E-10	3E-02	9E-02
	Mercury	1.0E+00	1.00	1.5E-06	3.9E-06	3.0E-04	5E-03	1E-02
	Antimony	8.2E-01	1.00	1.2E-06	3.2E-06	4.0E-04	3E-03	8E-03
	Cadmium	3.3E+00	1.00	5.0E-06	1.3E-05	1.0E-03	5E-03	1E-02
60	TEQ (ND=1/2 MDL)	8.7E-06	1.00	1.3E-11	3.4E-11	7.0E-10	2E-02	5E-02
	Mercury	1.9E-01	1.00	2.8E-07	7.4E-07	3.0E-04	9E-04	2E-03
	Antimony	3.1E-01	1.00	4.6E-07	1.2E-06	4.0E-04	1E-03	3E-03
	Cadmium	1.7E+00	1.00	2.5E-06	6.6E-06	1.0E-03	3E-03	7E-03
61	TEQ (ND=1/2 MDL)	5.8E-06	1.00	8.7E-12	2.2E-11	7.0E-10	1E-02	3E-02
	Mercury	1.1E-01	1.00	1.6E-07	4.3E-07	3.0E-04	5E-04	1E-03
	Antimony	2.0E-01	1.00	3.0E-07	7.7E-07	4.0E-04	7E-04	2E-03
	Cadmium	1.1E+00	1.00	1.6E-06	4.3E-06	1.0E-03	2E-03	4E-03
62	TEQ (ND=1/2 MDL)	6.0E-05	1.00	8.9E-11	2.3E-10	7.0E-10	1E-01	3E-01
	Mercury	1.3E+00	1.00	1.9E-06	5.0E-06	3.0E-04	6E-03	2E-02
	Antimony	1.8E+00	1.00	2.7E-06	7.0E-06	4.0E-04	7E-03	2E-02
	Cadmium	7.0E+00	1.00	1.0E-05	2.7E-05	1.0E-03	1E-02	3E-02
64	TEQ (ND=1/2 MDL)	1.6E-05	1.00	2.5E-11	6.4E-11	7.0E-10	4E-02	9E-02
	Mercury	3.6E+00	1.00	5.4E-06	1.4E-05	3.0E-04	2E-02	5E-02
	Antimony	1.1E-01	1.00	1.6E-07	4.1E-07	4.0E-04	4E-04	1E-03
	Cadmium	7.9E-01	1.00	1.2E-06	3.1E-06	1.0E-03	1E-03	3E-03
66	TEQ (ND=1/2 MDL)	6.1E-07	1.00	9.1E-13	2.4E-12	7.0E-10	1E-03	3E-03
	Mercury	6.6E-02	1.00	9.9E-08	2.6E-07	3.0E-04	3E-04	9E-04
	Antimony	2.2E-01	1.00	3.3E-07	8.5E-07	4.0E-04	8E-04	2E-03
	Cadmium	9.0E-01	1.00	1.3E-06	3.5E-06	1.0E-03	1E-03	3E-03
67	TEQ (ND=1/2 MDL)	3.4E-05	1.00	5.1E-11	1.3E-10	7.0E-10	7E-02	2E-01
	Mercury	4.5E-02	1.00	6.7E-08	1.7E-07	3.0E-04	2E-04	6E-04
	Antimony	7.8E-01	1.00	1.2E-06	3.0E-06	4.0E-04	3E-03	8E-03
	Cadmium	2.5E+00	1.00	3.7E-06	9.6E-06	1.0E-03	4E-03	1E-02
68	TEQ (ND=1/2 MDL)	8.3E-05	1.00	1.2E-10	3.2E-10	7.0E-10	2E-01	5E-01
	Mercury	1.0E-02	1.00	1.5E-08	3.9E-08	3.0E-04	5E-05	1E-04
	Antimony	1.6E+00	1.00	2.4E-06	6.2E-06	4.0E-04	6E-03	2E-02
	Cadmium	4.8E+00	1.00	7.2E-06	1.9E-05	1.0E-03	7E-03	2E-02
70	TEQ (ND=1/2 MDL)	3.3E-06	1.00	5.0E-12	1.3E-11	7.0E-10	7E-03	2E-02
	Mercury	1.1E-01	1.00	1.6E-07	4.3E-07	3.0E-04	5E-04	1E-03
	Antimony	4.7E-01	1.00	7.0E-07	1.8E-06	4.0E-04	2E-03	5E-03
	Cadmium	1.8E+00	1.00	2.7E-06	7.0E-06	1.0E-03	3E-03	7E-03
71	TEQ (ND=1/2 MDL)	6.7E-05	1.00	1.0E-10	2.6E-10	7.0E-10	1E-01	4E-01
	Mercury	1.0E-02	1.00	1.5E-08	3.9E-08	3.0E-04	5E-05	1E-04
	Antimony	1.3E+00	1.00	1.9E-06	5.0E-06	4.0E-04	5E-03	1E-02
	Cadmium	4.1E+00	1.00	6.1E-06	1.6E-05	1.0E-03	6E-03	2E-02
72	TEQ (ND=1/2 MDL)	7.1E-05	1.00	1.1E-10	2.7E-10	7.0E-10	2E-01	4E-01
	Mercury	1.0E-02	1.00	1.5E-08	3.9E-08	3.0E-04	5E-05	1E-04
	Antimony	1.3E+00	1.00	2.0E-06	5.1E-06	4.0E-04	5E-03	1E-02
	Cadmium	4.3E+00	1.00	6.4E-06	1.7E-05	1.0E-03	6E-03	2E-02
74	TEQ (ND=1/2 MDL)	3.1E-04	1.00	4.6E-10	1.2E-09	7.0E-10	7E-01	2E+00
	Mercury	2.2E-01	1.00	3.4E-07	8.7E-07	3.0E-04	1E-03	3E-03
	Antimony	2.4E+00	1.00	3.6E-06	9.2E-06	4.0E-04	9E-03	2E-02
	Cadmium	6.4E+00	1.00	9.6E-06	2.5E-05	1.0E-03	1E-02	2E-02
75	TEQ (ND=1/2 MDL)	1.5E-07	1.00	2.3E-13	5.9E-13	7.0E-10	3E-04	8E-04
	Mercury	1.4E-02	1.00	2.1E-08	5.4E-08	3.0E-04	7E-05	2E-04
	Antimony	9.5E-02	1.00	1.4E-07	3.7E-07	4.0E-04	4E-04	9E-04
	Cadmium	1.5E-01	1.00	2.2E-07	5.8E-07	1.0E-03	2E-04	6E-04
76	TEQ (ND=1/2 MDL)	2.0E-06	1.00	3.0E-12	7.7E-12	7.0E-10	4E-03	1E-02
	Mercury	2.4E-02	1.00	3.5E-08	9.1E-08	3.0E-04	1E-04	3E-04
	Antimony	1.2E-01	1.00	1.8E-07	4.6E-07	4.0E-04	4E-04	1E-03
	Cadmium	1.2E-01	1.00	1.8E-07	4.7E-07	1.0E-03	2E-04	5E-04

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population	**Hypothetical Future Residents**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC	RBA	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
77	TEQ (ND=1/2 MDL)	2.5E-06	1.00	3.7E-12	9.5E-12	7.0E-10	5E-03	1E-02
	Mercury	2.4E-02	1.00	3.6E-08	9.3E-08	3.0E-04	1E-04	3E-04
	Antimony	9.5E-02	1.00	1.4E-07	3.7E-07	4.0E-04	4E-04	9E-04
	Cadmium	1.3E-01	1.00	1.9E-07	5.0E-07	1.0E-03	2E-04	5E-04
78	TEQ (ND=1/2 MDL)	1.5E-07	1.00	2.3E-13	5.9E-13	7.0E-10	3E-04	8E-04
	Mercury	1.4E-02	1.00	2.1E-08	5.4E-08	3.0E-04	7E-05	2E-04
	Antimony	9.5E-02	1.00	1.4E-07	3.7E-07	4.0E-04	4E-04	9E-04
	Cadmium	1.5E-01	1.00	2.2E-07	5.8E-07	1.0E-03	2E-04	6E-04
79	TEQ (ND=1/2 MDL)	2.5E-06	1.00	3.7E-12	9.5E-12	7.0E-10	5E-03	1E-02
	Mercury	2.4E-02	1.00	3.6E-08	9.3E-08	3.0E-04	1E-04	3E-04
	Antimony	9.5E-02	1.00	1.4E-07	3.7E-07	4.0E-04	4E-04	9E-04
	Cadmium	1.3E-01	1.00	1.9E-07	5.0E-07	1.0E-03	2E-04	5E-04
80	TEQ (ND=1/2 MDL)	2.5E-06	1.00	3.7E-12	9.5E-12	7.0E-10	5E-03	1E-02
	Mercury	2.4E-02	1.00	3.6E-08	9.3E-08	3.0E-04	1E-04	3E-04
	Antimony	9.5E-02	1.00	1.4E-07	3.7E-07	4.0E-04	4E-04	9E-04
	Cadmium	1.3E-01	1.00	1.9E-07	5.0E-07	1.0E-03	2E-04	5E-04

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population	**Hypothetical Future Residents**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil**
Exposure Route	**Dermal Contact**

Grid	COPC	EPC	ABSd	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
26	TEQ (ND=1/2 MDL)	3.6E-06	0.03	1.6E-13	1.2E-12	7.0E-10	2E-04	2E-03
	Cadmium	7.0E-01	0.001	1.1E-09	7.6E-09	2.5E-05	4E-05	3E-04
27	TEQ (ND=1/2 MDL)	2.4E-06	0.03	1.1E-13	7.9E-13	7.0E-10	2E-04	1E-03
	Cadmium	6.4E-02	0.001	9.6E-11	7.0E-10	2.5E-05	4E-06	3E-05
28	TEQ (ND=1/2 MDL)	5.3E-07	0.03	2.4E-14	1.7E-13	7.0E-10	3E-05	2E-04
	Cadmium	7.3E-02	0.001	1.1E-10	8.0E-10	2.5E-05	4E-06	3E-05
29	TEQ (ND=1/2 MDL)	2.9E-06	0.03	1.3E-13	9.4E-13	7.0E-10	2E-04	1E-03
	Cadmium	1.4E-01	0.001	2.1E-10	1.5E-09	2.5E-05	8E-06	6E-05
30	TEQ (ND=1/2 MDL)	1.7E-06	0.03	7.6E-14	5.5E-13	7.0E-10	1E-04	8E-04
	Cadmium	1.3E-01	0.001	2.0E-10	1.4E-09	2.5E-05	8E-06	6E-05
31	TEQ (ND=1/2 MDL)	4.7E-07	0.03	2.1E-14	1.5E-13	7.0E-10	3E-05	2E-04
	Cadmium	4.4E-02	0.001	6.6E-11	4.8E-10	2.5E-05	3E-06	2E-05
32	TEQ (ND=1/2 MDL)	9.3E-08	0.03	4.2E-15	3.0E-14	7.0E-10	6E-06	4E-05
	Cadmium	4.6E-02	0.001	6.9E-11	5.0E-10	2.5E-05	3E-06	2E-05
33	TEQ (ND=1/2 MDL)	9.4E-07	0.03	4.3E-14	3.1E-13	7.0E-10	6E-05	4E-04
	Cadmium	1.3E-01	0.001	2.0E-10	1.4E-09	2.5E-05	8E-06	6E-05
34	TEQ (ND=1/2 MDL)	7.0E-07	0.03	3.2E-14	2.3E-13	7.0E-10	5E-05	3E-04
	Cadmium	9.3E-02	0.001	1.4E-10	1.0E-09	2.5E-05	6E-06	4E-05
35	TEQ (ND=1/2 MDL)	2.1E-07	0.03	9.7E-15	7.0E-14	7.0E-10	1E-05	1E-04
	Cadmium	1.9E-01	0.001	2.9E-10	2.1E-09	2.5E-05	1E-05	8E-05
36	TEQ (ND=1/2 MDL)	9.1E-06	0.03	4.1E-13	3.0E-12	7.0E-10	6E-04	4E-03
	Cadmium	8.5E-01	0.001	1.3E-09	9.3E-09	2.5E-05	5E-05	4E-04
37	TEQ (ND=1/2 MDL)	1.4E-06	0.03	6.3E-14	4.5E-13	7.0E-10	9E-05	6E-04
	Cadmium	2.6E-01	0.001	3.9E-10	2.8E-09	2.5E-05	2E-05	1E-04
39	TEQ (ND=1/2 MDL)	2.7E-06	0.03	1.2E-13	8.8E-13	7.0E-10	2E-04	1E-03
	Cadmium	3.3E-01	0.001	5.0E-10	3.6E-09	2.5E-05	2E-05	1E-04
40	TEQ (ND=1/2 MDL)	3.4E-06	0.03	1.6E-13	1.1E-12	7.0E-10	2E-04	2E-03
	Cadmium	2.8E-01	0.001	4.2E-10	3.1E-09	2.5E-05	2E-05	1E-04
41	TEQ (ND=1/2 MDL)	3.9E-06	0.03	1.7E-13	1.3E-12	7.0E-10	2E-04	2E-03
	Cadmium	2.8E-01	0.001	4.2E-10	3.1E-09	2.5E-05	2E-05	1E-04
42	TEQ (ND=1/2 MDL)	7.5E-06	0.03	3.4E-13	2.4E-12	7.0E-10	5E-04	3E-03
	Cadmium	3.2E-01	0.001	4.8E-10	3.5E-09	2.5E-05	2E-05	1E-04
43	TEQ (ND=1/2 MDL)	3.9E-06	0.03	1.8E-13	1.3E-12	7.0E-10	3E-04	2E-03
	Cadmium	4.7E-01	0.001	7.1E-10	5.1E-09	2.5E-05	3E-05	2E-04
44	TEQ (ND=1/2 MDL)	2.1E-06	0.03	9.4E-14	6.8E-13	7.0E-10	1E-04	1E-03
	Cadmium	8.0E-01	0.001	1.2E-09	8.7E-09	2.5E-05	5E-05	3E-04
46	TEQ (ND=1/2 MDL)	3.0E-06	0.03	1.4E-13	9.8E-13	7.0E-10	2E-04	1E-03
	Cadmium	2.4E-01	0.001	3.6E-10	2.6E-09	2.5E-05	1E-05	1E-04
47	TEQ (ND=1/2 MDL)	1.6E-05	0.03	7.3E-13	5.3E-12	7.0E-10	1E-03	8E-03
	Cadmium	5.2E+00	0.001	7.8E-09	5.7E-08	2.5E-05	3E-04	2E-03
48	TEQ (ND=1/2 MDL)	4.9E-05	0.03	2.2E-12	1.6E-11	7.0E-10	3E-03	2E-02
	Cadmium	8.3E+00	0.001	1.3E-08	9.0E-08	2.5E-05	5E-04	4E-03
49	TEQ (ND=1/2 MDL)	4.0E-05	0.03	1.8E-12	1.3E-11	7.0E-10	3E-03	2E-02
	Cadmium	2.0E+00	0.001	3.0E-09	2.2E-08	2.5E-05	1E-04	9E-04
50	TEQ (ND=1/2 MDL)	2.4E-05	0.03	1.1E-12	7.9E-12	7.0E-10	2E-03	1E-02
	Cadmium	3.9E+00	0.001	5.9E-09	4.2E-08	2.5E-05	2E-04	2E-03
51	TEQ (ND=1/2 MDL)	2.7E-05	0.03	1.2E-12	9.0E-12	7.0E-10	2E-03	1E-02
	Cadmium	5.0E+00	0.001	7.5E-09	5.4E-08	2.5E-05	3E-04	2E-03
52	TEQ (ND=1/2 MDL)	2.7E-05	0.03	1.2E-12	9.0E-12	7.0E-10	2E-03	1E-02
	Cadmium	5.0E+00	0.001	7.5E-09	5.4E-08	2.5E-05	3E-04	2E-03
53	TEQ (ND=1/2 MDL)	2.3E-05	0.03	1.0E-12	7.4E-12	7.0E-10	1E-03	1E-02
	Cadmium	1.2E+00	0.001	1.8E-09	1.3E-08	2.5E-05	7E-05	5E-04
54	TEQ (ND=1/2 MDL)	2.0E-05	0.03	9.1E-13	6.6E-12	7.0E-10	1E-03	9E-03
	Cadmium	3.1E+00	0.001	4.6E-09	3.3E-08	2.5E-05	2E-04	1E-03
55	TEQ (ND=1/2 MDL)	5.5E-05	0.03	2.5E-12	1.8E-11	7.0E-10	4E-03	3E-02
	Cadmium	5.6E+00	0.001	8.4E-09	6.1E-08	2.5E-05	3E-04	2E-03
56	TEQ (ND=1/2 MDL)	5.9E-05	0.03	2.7E-12	1.9E-11	7.0E-10	4E-03	3E-02
	Cadmium	6.7E+00	0.001	1.0E-08	7.3E-08	2.5E-05	4E-04	3E-03

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population **Hypothetical Future Residents**
Exposure Area **Random 20-acre grids across OU3 Upland Area**
Medium **Surface Soil**
Exposure Route **Dermal Contact**

				Non-Cancer				
Grid	COPC	EPC	ABSd	DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
58	TEQ (ND=1/2 MDL)	8.3E-05	0.03	3.8E-12	2.7E-11	7.0E-10	5E-03	4E-02
	Cadmium	4.8E+00	0.001	7.2E-09	5.2E-08	2.5E-05	3E-04	2E-03
59	TEQ (ND=1/2 MDL)	1.6E-05	0.03	7.2E-13	5.2E-12	7.0E-10	1E-03	7E-03
	Cadmium	3.3E+00	0.001	5.0E-09	3.6E-08	2.5E-05	2E-04	1E-03
60	TEQ (ND=1/2 MDL)	8.7E-06	0.03	3.9E-13	2.8E-12	7.0E-10	6E-04	4E-03
	Cadmium	1.7E+00	0.001	2.6E-09	1.9E-08	2.5E-05	1E-04	7E-04
61	TEQ (ND=1/2 MDL)	5.8E-06	0.03	2.6E-13	1.9E-12	7.0E-10	4E-04	3E-03
	Cadmium	1.1E+00	0.001	1.7E-09	1.2E-08	2.5E-05	7E-05	5E-04
62	TEQ (ND=1/2 MDL)	6.0E-05	0.03	2.7E-12	1.9E-11	7.0E-10	4E-03	3E-02
	Cadmium	7.0E+00	0.001	1.1E-08	7.6E-08	2.5E-05	4E-04	3E-03
64	TEQ (ND=1/2 MDL)	1.6E-05	0.03	7.4E-13	5.4E-12	7.0E-10	1E-03	8E-03
	Cadmium	7.9E-01	0.001	1.2E-09	8.6E-09	2.5E-05	5E-05	3E-04
66	TEQ (ND=1/2 MDL)	6.1E-07	0.03	2.8E-14	2.0E-13	7.0E-10	4E-05	3E-04
	Cadmium	9.0E-01	0.001	1.4E-09	9.8E-09	2.5E-05	5E-05	4E-04
67	TEQ (ND=1/2 MDL)	3.4E-05	0.03	1.5E-12	1.1E-11	7.0E-10	2E-03	2E-02
	Cadmium	2.5E+00	0.001	3.7E-09	2.7E-08	2.5E-05	1E-04	1E-03
68	TEQ (ND=1/2 MDL)	8.3E-05	0.03	3.7E-12	2.7E-11	7.0E-10	5E-03	4E-02
	Cadmium	4.8E+00	0.001	7.2E-09	5.2E-08	2.5E-05	3E-04	2E-03
70	TEQ (ND=1/2 MDL)	3.3E-06	0.03	1.5E-13	1.1E-12	7.0E-10	2E-04	2E-03
	Cadmium	1.8E+00	0.001	2.7E-09	2.0E-08	2.5E-05	1E-04	8E-04
71	TEQ (ND=1/2 MDL)	6.7E-05	0.03	3.0E-12	2.2E-11	7.0E-10	4E-03	3E-02
	Cadmium	4.1E+00	0.001	6.2E-09	4.5E-08	2.5E-05	2E-04	2E-03
72	TEQ (ND=1/2 MDL)	7.1E-05	0.03	3.2E-12	2.3E-11	7.0E-10	5E-03	3E-02
	Cadmium	4.3E+00	0.001	6.4E-09	4.7E-08	2.5E-05	3E-04	2E-03
74	TEQ (ND=1/2 MDL)	3.1E-04	0.03	1.4E-11	1.0E-10	7.0E-10	2E-02	1E-01
	Cadmium	6.4E+00	0.001	9.7E-09	7.0E-08	2.5E-05	4E-04	3E-03
75	TEQ (ND=1/2 MDL)	1.5E-07	0.03	6.9E-15	5.0E-14	7.0E-10	1E-05	7E-05
	Cadmium	1.5E-01	0.001	2.3E-10	1.6E-09	2.5E-05	9E-06	7E-05
76	TEQ (ND=1/2 MDL)	2.0E-06	0.03	9.0E-14	6.5E-13	7.0E-10	1E-04	9E-04
	Cadmium	1.2E-01	0.001	1.8E-10	1.3E-09	2.5E-05	7E-06	5E-05
77	TEQ (ND=1/2 MDL)	2.5E-06	0.03	1.1E-13	8.0E-13	7.0E-10	2E-04	1E-03
	Cadmium	1.3E-01	0.001	2.0E-10	1.4E-09	2.5E-05	8E-06	6E-05
78	TEQ (ND=1/2 MDL)	1.5E-07	0.03	6.9E-15	5.0E-14	7.0E-10	1E-05	7E-05
	Cadmium	1.5E-01	0.001	2.3E-10	1.6E-09	2.5E-05	9E-06	7E-05
79	TEQ (ND=1/2 MDL)	2.5E-06	0.03	1.1E-13	8.0E-13	7.0E-10	2E-04	1E-03
	Cadmium	1.3E-01	0.001	2.0E-10	1.4E-09	2.5E-05	8E-06	6E-05
80	TEQ (ND=1/2 MDL)	2.5E-06	0.03	1.1E-13	8.0E-13	7.0E-10	2E-04	1E-03
	Cadmium	1.3E-01	0.001	2.0E-10	1.4E-09	2.5E-05	8E-06	6E-05

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population — **Hypothetical Future Commercial/Industrial Workers**
Exposure Area — **Random 20-acre grids across OU3 Upland Area**
Medium — **Surface Soil**
Exposure Route — **Incidental Ingestion**

Grid	COPC	EPC mg/kg	RBA	Non-Cancer DI (mg/kg-d) CTE	Non-Cancer DI (mg/kg-d) RME	RfD mg/kg-d	HQ CTE	HQ RME
26	TEQ (ND=1/2 MDL)	3.6E-06	1.00	1.3E-12	3.1E-12	7.0E-10	2E-03	4E-03
	Mercury	1.4E-01	1.00	5.3E-08	1.2E-07	3.0E-04	2E-04	4E-04
	Antimony	1.5E+00	1.00	5.6E-07	1.3E-06	4.0E-04	1E-03	3E-03
	Cadmium	7.0E-01	1.00	2.6E-07	6.0E-07	1.0E-03	3E-04	6E-04
27	TEQ (ND=1/2 MDL)	2.4E-06	1.00	9.1E-13	2.1E-12	7.0E-10	1E-03	3E-03
	Mercury	1.2E-02	1.00	4.5E-09	1.0E-08	3.0E-04	2E-05	3E-05
	Antimony	9.0E-02	1.00	3.4E-08	7.7E-08	4.0E-04	8E-05	2E-04
	Cadmium	6.4E-02	1.00	2.4E-08	5.5E-08	1.0E-03	2E-05	5E-05
28	TEQ (ND=1/2 MDL)	5.3E-07	1.00	2.0E-13	4.5E-13	7.0E-10	3E-04	6E-04
	Mercury	1.6E-02	1.00	6.0E-09	1.4E-08	3.0E-04	2E-05	5E-05
	Antimony	9.0E-02	1.00	3.4E-08	7.7E-08	4.0E-04	8E-05	2E-04
	Cadmium	7.3E-02	1.00	2.7E-08	6.3E-08	1.0E-03	3E-05	6E-05
29	TEQ (ND=1/2 MDL)	2.9E-06	1.00	1.1E-12	2.5E-12	7.0E-10	2E-03	4E-03
	Mercury	3.3E-02	1.00	1.2E-08	2.8E-08	3.0E-04	4E-05	9E-05
	Antimony	1.9E-01	1.00	7.1E-08	1.6E-07	4.0E-04	2E-04	4E-04
	Cadmium	1.4E-01	1.00	5.3E-08	1.2E-07	1.0E-03	5E-05	1E-04
30	TEQ (ND=1/2 MDL)	1.7E-06	1.00	6.3E-13	1.4E-12	7.0E-10	9E-04	2E-03
	Mercury	2.4E-02	1.00	9.0E-09	2.1E-08	3.0E-04	3E-05	7E-05
	Antimony	2.0E-01	1.00	7.5E-08	1.7E-07	4.0E-04	2E-04	4E-04
	Cadmium	1.3E-01	1.00	4.9E-08	1.1E-07	1.0E-03	5E-05	1E-04
31	TEQ (ND=1/2 MDL)	4.7E-07	1.00	1.7E-13	4.0E-13	7.0E-10	2E-04	6E-04
	Mercury	3.4E-03	1.00	1.3E-09	2.9E-09	3.0E-04	4E-06	1E-05
	Antimony	4.1E-02	1.00	1.5E-08	3.5E-08	4.0E-04	4E-05	9E-05
	Cadmium	4.4E-02	1.00	1.7E-08	3.8E-08	1.0E-03	2E-05	4E-05
32	TEQ (ND=1/2 MDL)	9.3E-08	1.00	3.5E-14	8.0E-14	7.0E-10	5E-05	1E-04
	Mercury	3.1E-03	1.00	1.2E-09	2.7E-09	3.0E-04	4E-06	9E-06
	Antimony	1.5E-01	1.00	5.6E-08	1.3E-07	4.0E-04	1E-04	3E-04
	Cadmium	4.6E-02	1.00	1.7E-08	3.9E-08	1.0E-03	2E-05	4E-05
33	TEQ (ND=1/2 MDL)	9.4E-07	1.00	3.5E-13	8.1E-13	7.0E-10	5E-04	1E-03
	Mercury	1.7E-02	1.00	6.4E-09	1.5E-08	3.0E-04	2E-05	5E-05
	Antimony	9.0E-02	1.00	3.4E-08	7.7E-08	4.0E-04	8E-05	2E-04
	Cadmium	1.3E-01	1.00	4.9E-08	1.1E-07	1.0E-03	5E-05	1E-04
34	TEQ (ND=1/2 MDL)	7.0E-07	1.00	2.6E-13	6.0E-13	7.0E-10	4E-04	9E-04
	Mercury	1.3E-02	1.00	4.9E-09	1.1E-08	3.0E-04	2E-05	4E-05
	Antimony	8.5E-02	1.00	3.2E-08	7.3E-08	4.0E-04	8E-05	2E-04
	Cadmium	9.3E-02	1.00	3.5E-08	8.0E-08	1.0E-03	3E-05	8E-05
35	TEQ (ND=1/2 MDL)	2.1E-07	1.00	8.0E-14	1.8E-13	7.0E-10	1E-04	3E-04
	Mercury	1.8E-02	1.00	6.8E-09	1.5E-08	3.0E-04	2E-05	5E-05
	Antimony	2.3E-01	1.00	8.6E-08	2.0E-07	4.0E-04	2E-04	5E-04
	Cadmium	1.9E-01	1.00	7.1E-08	1.6E-07	1.0E-03	7E-05	2E-04
36	TEQ (ND=1/2 MDL)	9.1E-06	1.00	3.4E-12	7.8E-12	7.0E-10	5E-03	1E-02
	Mercury	2.7E-01	1.00	1.0E-07	2.3E-07	3.0E-04	3E-04	8E-04
	Antimony	8.0E-01	1.00	3.0E-07	6.8E-07	4.0E-04	8E-04	2E-03
	Cadmium	8.5E-01	1.00	3.2E-07	7.3E-07	1.0E-03	3E-04	7E-04
37	TEQ (ND=1/2 MDL)	1.4E-06	1.00	5.2E-13	1.2E-12	7.0E-10	7E-04	2E-03
	Mercury	4.0E-02	1.00	1.5E-08	3.4E-08	3.0E-04	5E-05	1E-04
	Antimony	3.3E-01	1.00	1.2E-07	2.8E-07	4.0E-04	3E-04	7E-04
	Cadmium	2.6E-01	1.00	9.6E-08	2.2E-07	1.0E-03	1E-04	2E-04
39	TEQ (ND=1/2 MDL)	2.7E-06	1.00	1.0E-12	2.3E-12	7.0E-10	1E-03	3E-03
	Mercury	7.4E-02	1.00	2.8E-08	6.3E-08	3.0E-04	9E-05	2E-04
	Antimony	4.3E-01	1.00	1.6E-07	3.6E-07	4.0E-04	4E-04	9E-04
	Cadmium	3.3E-01	1.00	1.2E-07	2.8E-07	1.0E-03	1E-04	3E-04
40	TEQ (ND=1/2 MDL)	3.4E-06	1.00	1.3E-12	2.9E-12	7.0E-10	2E-03	4E-03
	Mercury	4.0E-02	1.00	1.5E-08	3.4E-08	3.0E-04	5E-05	1E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.8E-01	1.00	1.1E-07	2.4E-07	1.0E-03	1E-04	2E-04
41	TEQ (ND=1/2 MDL)	3.9E-06	1.00	1.4E-12	3.3E-12	7.0E-10	2E-03	5E-03
	Mercury	5.7E-02	1.00	2.1E-08	4.9E-08	3.0E-04	7E-05	2E-04
	Antimony	4.2E-02	1.00	1.6E-08	3.6E-08	4.0E-04	4E-05	9E-05
	Cadmium	2.8E-01	1.00	1.1E-07	2.4E-07	1.0E-03	1E-04	2E-04
42	TEQ (ND=1/2 MDL)	7.5E-06	1.00	2.8E-12	6.4E-12	7.0E-10	4E-03	9E-03
	Mercury	1.6E-01	1.00	6.0E-08	1.4E-07	3.0E-04	2E-04	5E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	3.2E-01	1.00	1.2E-07	2.7E-07	1.0E-03	1E-04	3E-04
43	TEQ (ND=1/2 MDL)	3.9E-06	1.00	1.5E-12	3.3E-12	7.0E-10	2E-03	5E-03
	Mercury	1.2E-01	1.00	4.5E-08	1.0E-07	3.0E-04	2E-04	3E-04
	Antimony	7.6E-01	1.00	2.9E-07	6.5E-07	4.0E-04	7E-04	2E-03
	Cadmium	4.7E-01	1.00	1.8E-07	4.0E-07	1.0E-03	2E-04	4E-04
44	TEQ (ND=1/2 MDL)	2.1E-06	1.00	7.8E-13	1.8E-12	7.0E-10	1E-03	3E-03
	Mercury	1.6E-01	1.00	5.9E-08	1.3E-07	3.0E-04	2E-04	4E-04
	Antimony	1.2E+00	1.00	4.4E-07	1.0E-06	4.0E-04	1E-03	2E-03
	Cadmium	8.0E-01	1.00	3.0E-07	6.8E-07	1.0E-03	3E-04	7E-04
46	TEQ (ND=1/2 MDL)	3.0E-06	1.00	1.1E-12	2.6E-12	7.0E-10	2E-03	4E-03
	Mercury	4.1E-02	1.00	1.5E-08	3.5E-08	3.0E-04	5E-05	1E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.4E-01	1.00	9.0E-08	2.1E-07	1.0E-03	9E-05	2E-04
47	TEQ (ND=1/2 MDL)	1.6E-05	1.00	6.1E-12	1.4E-11	7.0E-10	9E-03	2E-02
	Mercury	8.1E-01	1.00	3.0E-07	6.9E-07	3.0E-04	1E-03	2E-03
	Antimony	1.6E+00	1.00	6.0E-07	1.4E-06	4.0E-04	2E-03	3E-03
	Cadmium	5.2E+00	1.00	2.0E-06	4.5E-06	1.0E-03	2E-03	4E-03
48	TEQ (ND=1/2 MDL)	4.9E-05	1.00	1.8E-11	4.2E-11	7.0E-10	3E-02	6E-02
	Mercury	2.5E+00	1.00	9.4E-07	2.1E-06	3.0E-04	3E-03	7E-03
	Antimony	2.4E+00	1.00	9.0E-07	2.1E-06	4.0E-04	2E-03	5E-03
	Cadmium	8.3E+00	1.00	3.1E-06	7.1E-06	1.0E-03	3E-03	7E-03
49	TEQ (ND=1/2 MDL)	4.0E-05	1.00	1.5E-11	3.4E-11	7.0E-10	2E-02	5E-02
	Mercury	8.0E+00	1.00	3.0E-06	6.8E-06	3.0E-04	1E-02	2E-02
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.0E+00	1.00	7.5E-07	1.7E-06	1.0E-03	8E-04	2E-03
50	TEQ (ND=1/2 MDL)	2.4E-05	1.00	9.1E-12	2.1E-11	7.0E-10	1E-02	3E-02
	Mercury	7.5E-01	1.00	2.8E-07	6.4E-07	3.0E-04	9E-04	2E-03
	Antimony	1.2E+00	1.00	4.3E-07	9.8E-07	4.0E-04	1E-03	2E-03
	Cadmium	3.9E+00	1.00	1.5E-06	3.3E-06	1.0E-03	1E-03	3E-03
51	TEQ (ND=1/2 MDL)	2.7E-05	1.00	1.0E-11	2.3E-11	7.0E-10	1E-02	3E-02
	Mercury	6.3E-01	1.00	2.4E-07	5.4E-07	3.0E-04	8E-04	2E-03
	Antimony	1.4E+00	1.00	5.3E-07	1.2E-06	4.0E-04	1E-03	3E-03
	Cadmium	5.0E+00	1.00	1.9E-06	4.3E-06	1.0E-03	2E-03	4E-03
52	TEQ (ND=1/2 MDL)	2.7E-05	1.00	1.0E-11	2.3E-11	7.0E-10	1E-02	3E-02
	Mercury	6.3E-01	1.00	2.4E-07	5.4E-07	3.0E-04	8E-04	2E-03

52	Antimony	1.4E+00	1.00	5.3E-07	1.2E-06	4.0E-04	1E-03	3E-03
	Cadmium	5.0E+00	1.00	1.9E-06	4.3E-06	1.0E-03	2E-03	4E-03
53	TEQ (ND=1/2 MDL)	2.3E-05	1.00	8.5E-12	1.9E-11	7.0E-10	1E-02	3E-02
	Mercury	4.3E+00	1.00	1.6E-06	3.7E-06	3.0E-04	5E-03	1E-02
	Antimony	4.6E-01	1.00	1.7E-07	3.9E-07	4.0E-04	4E-04	1E-03
	Cadmium	1.2E+00	1.00	4.5E-07	1.0E-06	1.0E-03	5E-04	1E-03
54	TEQ (ND=1/2 MDL)	2.0E-05	1.00	7.6E-12	1.7E-11	7.0E-10	1E-02	2E-02
	Mercury	8.5E-01	1.00	3.2E-07	7.3E-07	3.0E-04	1E-03	2E-03
	Antimony	1.0E+00	1.00	3.9E-07	8.9E-07	4.0E-04	1E-03	2E-03
	Cadmium	3.1E+00	1.00	1.2E-06	2.6E-06	1.0E-03	1E-03	3E-03
55	TEQ (ND=1/2 MDL)	5.5E-05	1.00	2.1E-11	4.7E-11	7.0E-10	3E-02	7E-02
	Mercury	1.1E+00	1.00	4.1E-07	9.4E-07	3.0E-04	1E-03	3E-03
	Antimony	1.2E+00	1.00	4.5E-07	1.0E-06	4.0E-04	1E-03	3E-03
	Cadmium	5.6E+00	1.00	2.1E-06	4.8E-06	1.0E-03	2E-03	5E-03
56	TEQ (ND=1/2 MDL)	5.9E-05	1.00	2.2E-11	5.0E-11	7.0E-10	3E-02	7E-02
	Mercury	1.3E+00	1.00	4.8E-07	1.1E-06	3.0E-04	2E-03	4E-03
	Antimony	1.7E+00	1.00	6.4E-07	1.5E-06	4.0E-04	2E-03	4E-03
	Cadmium	6.7E+00	1.00	2.5E-06	5.7E-06	1.0E-03	2E-03	6E-03
58	TEQ (ND=1/2 MDL)	8.3E-05	1.00	3.1E-11	7.1E-11	7.0E-10	4E-02	1E-01
	Mercury	1.2E+00	1.00	4.5E-07	1.0E-06	3.0E-04	2E-03	3E-03
	Antimony	2.3E+00	1.00	8.6E-07	2.0E-06	4.0E-04	2E-03	5E-03
	Cadmium	4.8E+00	1.00	1.8E-06	4.1E-06	1.0E-03	2E-03	4E-03
59	TEQ (ND=1/2 MDL)	1.6E-05	1.00	5.9E-12	1.4E-11	7.0E-10	8E-03	2E-02
	Mercury	1.0E+00	1.00	3.7E-07	8.5E-07	3.0E-04	1E-03	3E-03
	Antimony	8.2E-01	1.00	3.1E-07	7.0E-07	4.0E-04	8E-04	2E-03
	Cadmium	3.3E+00	1.00	1.2E-06	2.8E-06	1.0E-03	1E-03	3E-03
60	TEQ (ND=1/2 MDL)	8.7E-06	1.00	3.3E-12	7.4E-12	7.0E-10	5E-03	1E-02
	Mercury	1.9E-01	1.00	7.1E-08	1.6E-07	3.0E-04	2E-04	5E-04
	Antimony	3.1E-01	1.00	1.2E-07	2.7E-07	4.0E-04	3E-04	7E-04
	Cadmium	1.7E+00	1.00	6.4E-07	1.5E-06	1.0E-03	6E-04	1E-03
61	TEQ (ND=1/2 MDL)	5.8E-06	1.00	2.2E-12	5.0E-12	7.0E-10	3E-03	7E-03
	Mercury	1.1E-01	1.00	4.1E-08	9.4E-08	3.0E-04	1E-04	3E-04
	Antimony	2.0E-01	1.00	7.5E-08	1.7E-07	4.0E-04	2E-04	4E-04
	Cadmium	1.1E+00	1.00	4.1E-07	9.4E-07	1.0E-03	4E-04	9E-04
62	TEQ (ND=1/2 MDL)	6.0E-05	1.00	2.2E-11	5.1E-11	7.0E-10	3E-02	7E-02
	Mercury	1.3E+00	1.00	4.9E-07	1.1E-06	3.0E-04	2E-03	4E-03
	Antimony	1.8E+00	1.00	6.8E-07	1.5E-06	4.0E-04	2E-03	4E-03
	Cadmium	7.0E+00	1.00	2.6E-06	6.0E-06	1.0E-03	3E-03	6E-03
64	TEQ (ND=1/2 MDL)	1.6E-05	1.00	6.2E-12	1.4E-11	7.0E-10	9E-03	2E-02
	Mercury	3.6E+00	1.00	1.4E-06	3.1E-06	3.0E-04	5E-03	1E-02
	Antimony	1.1E-01	1.00	3.9E-08	9.0E-08	4.0E-04	1E-04	2E-04
	Cadmium	7.9E-01	1.00	3.0E-07	6.8E-07	1.0E-03	3E-04	7E-04
66	TEQ (ND=1/2 MDL)	6.1E-07	1.00	2.3E-13	5.2E-13	7.0E-10	3E-04	7E-04
	Mercury	6.6E-02	1.00	2.5E-08	5.7E-08	3.0E-04	8E-05	2E-04
	Antimony	2.2E-01	1.00	8.2E-08	1.9E-07	4.0E-04	2E-04	5E-04
	Cadmium	9.0E-01	1.00	3.4E-07	7.7E-07	1.0E-03	3E-04	8E-04
67	TEQ (ND=1/2 MDL)	3.4E-05	1.00	1.3E-11	2.9E-11	7.0E-10	2E-02	4E-02
	Mercury	4.5E-02	1.00	1.7E-08	3.8E-08	3.0E-04	6E-05	1E-04
	Antimony	7.8E-01	1.00	2.9E-07	6.7E-07	4.0E-04	7E-04	2E-03
	Cadmium	2.5E+00	1.00	9.3E-07	2.1E-06	1.0E-03	9E-04	2E-03
68	TEQ (ND=1/2 MDL)	8.3E-05	1.00	3.1E-11	7.1E-11	7.0E-10	4E-02	1E-01
	Mercury	1.0E-02	1.00	3.8E-09	8.6E-09	3.0E-04	1E-05	3E-05
	Antimony	1.6E+00	1.00	6.0E-07	1.4E-06	4.0E-04	2E-03	3E-03
	Cadmium	4.8E+00	1.00	1.8E-06	4.1E-06	1.0E-03	2E-03	4E-03
70	TEQ (ND=1/2 MDL)	3.3E-06	1.00	1.2E-12	2.9E-12	7.0E-10	2E-03	4E-03
	Mercury	1.1E-01	1.00	4.1E-08	9.4E-08	3.0E-04	1E-04	3E-04
	Antimony	4.7E-01	1.00	1.8E-07	4.0E-07	4.0E-04	4E-04	1E-03
	Cadmium	1.8E+00	1.00	6.8E-07	1.5E-06	1.0E-03	7E-04	2E-03
71	TEQ (ND=1/2 MDL)	6.7E-05	1.00	2.5E-11	5.7E-11	7.0E-10	4E-02	8E-02
	Mercury	1.0E-02	1.00	3.8E-09	8.6E-09	3.0E-04	1E-05	3E-05
	Antimony	1.3E+00	1.00	4.9E-07	1.1E-06	4.0E-04	1E-03	3E-03
	Cadmium	4.1E+00	1.00	1.5E-06	3.5E-06	1.0E-03	2E-03	4E-03
72	TEQ (ND=1/2 MDL)	7.1E-05	1.00	2.7E-11	6.1E-11	7.0E-10	4E-02	9E-02
	Mercury	1.0E-02	1.00	3.8E-09	8.6E-09	3.0E-04	1E-05	3E-05
	Antimony	1.3E+00	1.00	5.0E-07	1.1E-06	4.0E-04	1E-03	3E-03
	Cadmium	4.3E+00	1.00	1.6E-06	3.7E-06	1.0E-03	2E-03	4E-03
74	TEQ (ND=1/2 MDL)	3.1E-04	1.00	1.2E-10	2.6E-10	7.0E-10	2E-01	4E-01
	Mercury	2.2E-01	1.00	8.4E-08	1.9E-07	3.0E-04	3E-04	6E-04
	Antimony	2.4E+00	1.00	8.9E-07	2.0E-06	4.0E-04	2E-03	5E-03
	Cadmium	6.4E+00	1.00	2.4E-06	5.5E-06	1.0E-03	2E-03	5E-03
75	TEQ (ND=1/2 MDL)	1.5E-07	1.00	5.7E-14	1.3E-13	7.0E-10	8E-05	2E-04
	Mercury	1.4E-02	1.00	5.3E-09	1.2E-08	3.0E-04	2E-05	4E-05
	Antimony	9.5E-02	1.00	3.6E-08	8.1E-08	4.0E-04	9E-05	2E-04
	Cadmium	1.5E-01	1.00	5.6E-08	1.3E-07	1.0E-03	6E-05	1E-04
76	TEQ (ND=1/2 MDL)	2.0E-06	1.00	7.4E-13	1.7E-12	7.0E-10	1E-03	2E-03
	Mercury	2.4E-02	1.00	8.9E-09	2.0E-08	3.0E-04	3E-05	7E-05
	Antimony	1.2E-01	1.00	4.5E-08	1.0E-07	4.0E-04	1E-04	3E-04
	Cadmium	1.2E-01	1.00	4.6E-08	1.0E-07	1.0E-03	5E-05	1E-04
77	TEQ (ND=1/2 MDL)	2.5E-06	1.00	9.2E-13	2.1E-12	7.0E-10	1E-03	3E-03
	Mercury	2.4E-02	1.00	9.0E-09	2.1E-08	3.0E-04	3E-05	7E-05
	Antimony	9.5E-02	1.00	3.6E-08	8.1E-08	4.0E-04	9E-05	2E-04
	Cadmium	1.3E-01	1.00	4.9E-08	1.1E-07	1.0E-03	5E-05	1E-04
78	TEQ (ND=1/2 MDL)	1.5E-07	1.00	5.7E-14	1.3E-13	7.0E-10	8E-05	2E-04
	Mercury	1.4E-02	1.00	5.3E-09	1.2E-08	3.0E-04	2E-05	4E-05
	Antimony	9.5E-02	1.00	3.6E-08	8.1E-08	4.0E-04	9E-05	2E-04
	Cadmium	1.5E-01	1.00	5.6E-08	1.3E-07	1.0E-03	6E-05	1E-04
79	TEQ (ND=1/2 MDL)	2.5E-06	1.00	9.2E-13	2.1E-12	7.0E-10	1E-03	3E-03
	Mercury	2.4E-02	1.00	9.0E-09	2.1E-08	3.0E-04	3E-05	7E-05
	Antimony	9.5E-02	1.00	3.6E-08	8.1E-08	4.0E-04	9E-05	2E-04
	Cadmium	1.3E-01	1.00	4.9E-08	1.1E-07	1.0E-03	5E-05	1E-04
80	TEQ (ND=1/2 MDL)	2.5E-06	1.00	9.2E-13	2.1E-12	7.0E-10	1E-03	3E-03
	Mercury	2.4E-02	1.00	9.0E-09	2.1E-08	3.0E-04	3E-05	7E-05
	Antimony	9.5E-02	1.00	3.6E-08	8.1E-08	4.0E-04	9E-05	2E-04
	Cadmium	1.3E-01	1.00	4.9E-08	1.1E-07	1.0E-03	5E-05	1E-04

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population	**Hypothetical Future Commercial/Industrial Workers**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil**
Exposure Route	**Dermal Contact**

Grid	COPC	EPC	ABSd	Non-Cancer DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
26	TEQ (ND=1/2 MDL)	3.6E-06	0.03	2.0E-13	3.9E-13	7.0E-10	3E-04	6E-04
	Cadmium	7.0E-01	0.001	1.3E-09	2.5E-09	2.5E-05	5E-05	1E-04
27	TEQ (ND=1/2 MDL)	2.4E-06	0.03	1.3E-13	2.6E-13	7.0E-10	2E-04	4E-04
	Cadmium	6.4E-02	0.001	1.2E-10	2.3E-10	2.5E-05	5E-06	9E-06
28	TEQ (ND=1/2 MDL)	5.3E-07	0.03	2.9E-14	5.8E-14	7.0E-10	4E-05	8E-05
	Cadmium	7.3E-02	0.001	1.4E-10	2.6E-10	2.5E-05	5E-06	1E-05
29	TEQ (ND=1/2 MDL)	2.9E-06	0.03	1.6E-13	3.1E-13	7.0E-10	2E-04	4E-04
	Cadmium	1.4E-01	0.001	2.6E-10	5.1E-10	2.5E-05	1E-05	2E-05
30	TEQ (ND=1/2 MDL)	1.7E-06	0.03	9.3E-14	1.8E-13	7.0E-10	1E-04	3E-04
	Cadmium	1.3E-01	0.001	2.4E-10	4.7E-10	2.5E-05	1E-05	2E-05
31	TEQ (ND=1/2 MDL)	4.7E-07	0.03	2.6E-14	5.1E-14	7.0E-10	4E-05	7E-05
	Cadmium	4.4E-02	0.001	8.1E-11	1.6E-10	2.5E-05	3E-06	6E-06
32	TEQ (ND=1/2 MDL)	9.3E-08	0.03	5.2E-15	1.0E-14	7.0E-10	7E-06	1E-05
	Cadmium	4.6E-02	0.001	8.5E-11	1.7E-10	2.5E-05	3E-06	7E-06
33	TEQ (ND=1/2 MDL)	9.4E-07	0.03	5.2E-14	1.0E-13	7.0E-10	7E-05	1E-04
	Cadmium	1.3E-01	0.001	2.4E-10	4.7E-10	2.5E-05	1E-05	2E-05
34	TEQ (ND=1/2 MDL)	7.0E-07	0.03	3.9E-14	7.6E-14	7.0E-10	6E-05	1E-04
	Cadmium	9.3E-02	0.001	1.7E-10	3.4E-10	2.5E-05	7E-06	1E-05
35	TEQ (ND=1/2 MDL)	2.1E-07	0.03	1.2E-14	2.3E-14	7.0E-10	2E-05	3E-05
	Cadmium	1.9E-01	0.001	3.5E-10	6.9E-10	2.5E-05	1E-05	3E-05
36	TEQ (ND=1/2 MDL)	9.1E-06	0.03	5.0E-13	9.8E-13	7.0E-10	7E-04	1E-03
	Cadmium	8.5E-01	0.001	1.6E-09	3.1E-09	2.5E-05	6E-05	1E-04
37	TEQ (ND=1/2 MDL)	1.4E-06	0.03	7.7E-14	1.5E-13	7.0E-10	1E-04	2E-04
	Cadmium	2.6E-01	0.001	4.7E-10	9.3E-10	2.5E-05	2E-05	4E-05
39	TEQ (ND=1/2 MDL)	2.7E-06	0.03	1.5E-13	2.9E-13	7.0E-10	2E-04	4E-04
	Cadmium	3.3E-01	0.001	6.1E-10	1.2E-09	2.5E-05	2E-05	5E-05
40	TEQ (ND=1/2 MDL)	3.4E-06	0.03	1.9E-13	3.7E-13	7.0E-10	3E-04	5E-04
	Cadmium	2.8E-01	0.001	5.2E-10	1.0E-09	2.5E-05	2E-05	4E-05
41	TEQ (ND=1/2 MDL)	3.9E-06	0.03	2.1E-13	4.2E-13	7.0E-10	3E-04	6E-04
	Cadmium	2.8E-01	0.001	5.2E-10	1.0E-09	2.5E-05	2E-05	4E-05
42	TEQ (ND=1/2 MDL)	7.5E-06	0.03	4.2E-13	8.1E-13	7.0E-10	6E-04	1E-03
	Cadmium	3.2E-01	0.001	5.9E-10	1.2E-09	2.5E-05	2E-05	5E-05
43	TEQ (ND=1/2 MDL)	3.9E-06	0.03	2.2E-13	4.2E-13	7.0E-10	3E-04	6E-04
	Cadmium	4.7E-01	0.001	8.7E-10	1.7E-09	2.5E-05	3E-05	7E-05
44	TEQ (ND=1/2 MDL)	2.1E-06	0.03	1.2E-13	2.3E-13	7.0E-10	2E-04	3E-04
	Cadmium	8.0E-01	0.001	1.5E-09	2.9E-09	2.5E-05	6E-05	1E-04
46	TEQ (ND=1/2 MDL)	3.0E-06	0.03	1.7E-13	3.3E-13	7.0E-10	2E-04	5E-04
	Cadmium	2.4E-01	0.001	4.4E-10	8.7E-10	2.5E-05	2E-05	3E-05
47	TEQ (ND=1/2 MDL)	1.6E-05	0.03	9.0E-13	1.8E-12	7.0E-10	1E-03	3E-03
	Cadmium	5.2E+00	0.001	9.6E-09	1.9E-08	2.5E-05	4E-04	8E-04
48	TEQ (ND=1/2 MDL)	4.9E-05	0.03	2.7E-12	5.4E-12	7.0E-10	4E-03	8E-03
	Cadmium	8.3E+00	0.001	1.5E-08	3.0E-08	2.5E-05	6E-04	1E-03
49	TEQ (ND=1/2 MDL)	4.0E-05	0.03	2.2E-12	4.3E-12	7.0E-10	3E-03	6E-03
	Cadmium	2.0E+00	0.001	3.7E-09	7.2E-09	2.5E-05	1E-04	3E-04
50	TEQ (ND=1/2 MDL)	2.4E-05	0.03	1.4E-12	2.6E-12	7.0E-10	2E-03	4E-03
	Cadmium	3.9E+00	0.001	7.2E-09	1.4E-08	2.5E-05	3E-04	6E-04
51	TEQ (ND=1/2 MDL)	2.7E-05	0.03	1.5E-12	3.0E-12	7.0E-10	2E-03	4E-03
	Cadmium	5.0E+00	0.001	9.3E-09	1.8E-08	2.5E-05	4E-04	7E-04
52	TEQ (ND=1/2 MDL)	2.7E-05	0.03	1.5E-12	3.0E-12	7.0E-10	2E-03	4E-03
	Cadmium	5.0E+00	0.001	9.3E-09	1.8E-08	2.5E-05	4E-04	7E-04
53	TEQ (ND=1/2 MDL)	2.3E-05	0.03	1.3E-12	2.5E-12	7.0E-10	2E-03	4E-03
	Cadmium	1.2E+00	0.001	2.2E-09	4.3E-09	2.5E-05	9E-05	2E-04
54	TEQ (ND=1/2 MDL)	2.0E-05	0.03	1.1E-12	2.2E-12	7.0E-10	2E-03	3E-03
	Cadmium	3.1E+00	0.001	5.7E-09	1.1E-08	2.5E-05	2E-04	4E-04
55	TEQ (ND=1/2 MDL)	5.5E-05	0.03	3.1E-12	6.0E-12	7.0E-10	4E-03	9E-03
	Cadmium	5.6E+00	0.001	1.0E-08	2.0E-08	2.5E-05	4E-04	8E-04
56	TEQ (ND=1/2 MDL)	5.9E-05	0.03	3.3E-12	6.4E-12	7.0E-10	5E-03	9E-03
	Cadmium	6.7E+00	0.001	1.2E-08	2.4E-08	2.5E-05	5E-04	1E-03
58	TEQ (ND=1/2 MDL)	8.3E-05	0.03	4.6E-12	9.1E-12	7.0E-10	7E-03	1E-02
	Cadmium	4.8E+00	0.001	8.9E-09	1.7E-08	2.5E-05	4E-04	7E-04
59	TEQ (ND=1/2 MDL)	1.6E-05	0.03	8.8E-13	1.7E-12	7.0E-10	1E-03	2E-03
	Cadmium	3.3E+00	0.001	6.2E-09	1.2E-08	2.5E-05	2E-04	5E-04
60	TEQ (ND=1/2 MDL)	8.7E-06	0.03	4.8E-13	9.4E-13	7.0E-10	7E-04	1E-03
	Cadmium	1.7E+00	0.001	3.1E-09	6.2E-09	2.5E-05	1E-04	2E-04
61	TEQ (ND=1/2 MDL)	5.8E-06	0.03	3.2E-13	6.3E-13	7.0E-10	5E-04	9E-04
	Cadmium	1.1E+00	0.001	2.0E-09	4.0E-09	2.5E-05	8E-05	2E-04
62	TEQ (ND=1/2 MDL)	6.0E-05	0.03	3.3E-12	6.5E-12	7.0E-10	5E-03	9E-03
	Cadmium	7.0E+00	0.001	1.3E-08	2.5E-08	2.5E-05	5E-04	1E-03
64	TEQ (ND=1/2 MDL)	1.6E-05	0.03	9.1E-13	1.8E-12	7.0E-10	1E-03	3E-03
	Cadmium	7.9E-01	0.001	1.5E-09	2.9E-09	2.5E-05	6E-05	1E-04
66	TEQ (ND=1/2 MDL)	6.1E-07	0.03	3.4E-14	6.6E-14	7.0E-10	5E-05	9E-05
	Cadmium	9.0E-01	0.001	1.7E-09	3.3E-09	2.5E-05	7E-05	1E-04
67	TEQ (ND=1/2 MDL)	3.4E-05	0.03	1.9E-12	3.7E-12	7.0E-10	3E-03	5E-03
	Cadmium	2.5E+00	0.001	4.6E-09	9.0E-09	2.5E-05	2E-04	4E-04
68	TEQ (ND=1/2 MDL)	8.3E-05	0.03	4.6E-12	9.0E-12	7.0E-10	7E-03	1E-02
	Cadmium	4.8E+00	0.001	8.9E-09	1.7E-08	2.5E-05	4E-04	7E-04
70	TEQ (ND=1/2 MDL)	3.3E-06	0.03	1.8E-13	3.6E-13	7.0E-10	3E-04	5E-04
	Cadmium	1.8E+00	0.001	3.3E-09	6.5E-09	2.5E-05	1E-04	3E-04
71	TEQ (ND=1/2 MDL)	6.7E-05	0.03	3.7E-12	7.2E-12	7.0E-10	5E-03	1E-02
	Cadmium	4.1E+00	0.001	7.6E-09	1.5E-08	2.5E-05	3E-04	6E-04
72	TEQ (ND=1/2 MDL)	7.1E-05	0.03	3.9E-12	7.7E-12	7.0E-10	6E-03	1E-02
	Cadmium	4.3E+00	0.001	7.9E-09	1.6E-08	2.5E-05	3E-04	6E-04
74	TEQ (ND=1/2 MDL)	3.1E-04	0.03	1.7E-11	3.3E-11	7.0E-10	2E-02	5E-02
	Cadmium	6.4E+00	0.001	1.2E-08	2.3E-08	2.5E-05	5E-04	9E-04
75	TEQ (ND=1/2 MDL)	1.5E-07	0.03	8.4E-15	1.7E-14	7.0E-10	1E-05	2E-05
	Cadmium	1.5E-01	0.001	2.8E-10	5.4E-10	2.5E-05	1E-05	2E-05
76	TEQ (ND=1/2 MDL)	2.0E-06	0.03	1.1E-13	2.2E-13	7.0E-10	2E-04	3E-04
	Cadmium	1.2E-01	0.001	2.2E-10	4.4E-10	2.5E-05	9E-06	2E-05
77	TEQ (ND=1/2 MDL)	2.5E-06	0.03	1.4E-13	2.7E-13	7.0E-10	2E-04	4E-04
	Cadmium	1.3E-01	0.001	2.4E-10	4.7E-10	2.5E-05	1E-05	2E-05
78	TEQ (ND=1/2 MDL)	1.5E-07	0.03	8.4E-15	1.7E-14	7.0E-10	1E-05	2E-05
	Cadmium	1.5E-01	0.001	2.8E-10	5.4E-10	2.5E-05	1E-05	2E-05
79	TEQ (ND=1/2 MDL)	2.5E-06	0.03	1.4E-13	2.7E-13	7.0E-10	2E-04	4E-04
	Cadmium	1.3E-01	0.001	2.4E-10	4.7E-10	2.5E-05	1E-05	2E-05
80	TEQ (ND=1/2 MDL)	2.5E-06	0.03	1.4E-13	2.7E-13	7.0E-10	2E-04	4E-04
	Cadmium	1.3E-01	0.001	2.4E-10	4.7E-10	2.5E-05	1E-05	2E-05

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population	**Current/Hypothetical Future Hikers**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC	RBA	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
26	TEQ (ND=1/2 MDL)	3.6E-06	1.00	2.6E-13	1.0E-12	7.0E-10	4E-04	1E-03
	Mercury	1.4E-01	1.00	1.0E-08	3.9E-08	3.0E-04	3E-05	1E-04
	Antimony	1.5E+00	1.00	1.1E-07	4.2E-07	4.0E-04	3E-04	1E-03
	Cadmium	7.0E-01	1.00	5.1E-08	2.0E-07	1.0E-03	5E-05	2E-04
27	TEQ (ND=1/2 MDL)	2.4E-06	1.00	1.8E-13	6.8E-13	7.0E-10	3E-04	1E-03
	Mercury	1.2E-02	1.00	8.7E-10	3.3E-09	3.0E-04	3E-06	1E-05
	Antimony	9.0E-02	1.00	6.5E-09	2.5E-08	4.0E-04	2E-05	6E-05
	Cadmium	6.4E-02	1.00	4.7E-09	1.8E-08	1.0E-03	5E-06	2E-05
28	TEQ (ND=1/2 MDL)	5.3E-07	1.00	3.9E-14	1.5E-13	7.0E-10	6E-05	2E-04
	Mercury	1.6E-02	1.00	1.2E-09	4.5E-09	3.0E-04	4E-06	1E-05
	Antimony	9.0E-02	1.00	6.5E-09	2.5E-08	4.0E-04	2E-05	6E-05
	Cadmium	7.3E-02	1.00	5.3E-09	2.0E-08	1.0E-03	5E-06	2E-05
29	TEQ (ND=1/2 MDL)	2.9E-06	1.00	2.1E-13	8.1E-13	7.0E-10	3E-04	1E-03
	Mercury	3.3E-02	1.00	2.4E-09	9.2E-09	3.0E-04	8E-06	3E-05
	Antimony	1.9E-01	1.00	1.4E-08	5.3E-08	4.0E-04	3E-05	1E-04
	Cadmium	1.4E-01	1.00	1.0E-08	3.9E-08	1.0E-03	1E-05	4E-05
30	TEQ (ND=1/2 MDL)	1.7E-06	1.00	1.2E-13	4.7E-13	7.0E-10	2E-04	7E-04
	Mercury	2.4E-02	1.00	1.7E-09	6.7E-09	3.0E-04	6E-06	2E-05
	Antimony	2.0E-01	1.00	1.5E-08	5.6E-08	4.0E-04	4E-05	1E-04
	Cadmium	1.3E-01	1.00	9.5E-09	3.6E-08	1.0E-03	9E-06	4E-05
31	TEQ (ND=1/2 MDL)	4.7E-07	1.00	3.4E-14	1.3E-13	7.0E-10	5E-05	2E-04
	Mercury	3.4E-03	1.00	2.5E-10	9.6E-10	3.0E-04	8E-07	3E-06
	Antimony	4.1E-02	1.00	2.9E-09	1.1E-08	4.0E-04	7E-06	3E-05
	Cadmium	4.4E-02	1.00	3.2E-09	1.2E-08	1.0E-03	3E-06	1E-05
32	TEQ (ND=1/2 MDL)	9.3E-08	1.00	6.8E-15	2.6E-14	7.0E-10	1E-05	4E-05
	Mercury	3.1E-03	1.00	2.3E-10	8.6E-10	3.0E-04	8E-07	3E-06
	Antimony	1.5E-01	1.00	1.1E-08	4.2E-08	4.0E-04	3E-05	1E-04
	Cadmium	4.6E-02	1.00	3.3E-09	1.3E-08	1.0E-03	3E-06	1E-05
33	TEQ (ND=1/2 MDL)	9.4E-07	1.00	6.8E-14	2.6E-13	7.0E-10	1E-04	4E-04
	Mercury	1.7E-02	1.00	1.2E-09	4.7E-09	3.0E-04	4E-06	2E-05
	Antimony	9.0E-02	1.00	6.5E-09	2.5E-08	4.0E-04	2E-05	6E-05
	Cadmium	1.3E-01	1.00	9.5E-09	3.6E-08	1.0E-03	9E-06	4E-05
34	TEQ (ND=1/2 MDL)	7.0E-07	1.00	5.1E-14	2.0E-13	7.0E-10	7E-05	3E-04
	Mercury	1.3E-02	1.00	9.5E-10	3.6E-09	3.0E-04	3E-06	1E-05
	Antimony	8.5E-02	1.00	6.2E-09	2.4E-08	4.0E-04	2E-05	6E-05
	Cadmium	9.3E-02	1.00	6.8E-09	2.6E-08	1.0E-03	7E-06	3E-05
35	TEQ (ND=1/2 MDL)	2.1E-07	1.00	1.6E-14	6.0E-14	7.0E-10	2E-05	9E-05
	Mercury	1.8E-02	1.00	1.3E-09	5.0E-09	3.0E-04	4E-06	2E-05
	Antimony	2.3E-01	1.00	1.7E-08	6.4E-08	4.0E-04	4E-05	2E-04
	Cadmium	1.9E-01	1.00	1.4E-08	5.3E-08	1.0E-03	1E-05	5E-05
36	TEQ (ND=1/2 MDL)	9.1E-06	1.00	6.6E-13	2.5E-12	7.0E-10	9E-04	4E-03
	Mercury	2.7E-01	1.00	2.0E-08	7.5E-08	3.0E-04	7E-05	3E-04
	Antimony	8.0E-01	1.00	5.8E-08	2.2E-07	4.0E-04	1E-04	6E-04
	Cadmium	8.5E-01	1.00	6.2E-08	2.4E-07	1.0E-03	6E-05	2E-04
37	TEQ (ND=1/2 MDL)	1.4E-06	1.00	1.0E-13	3.9E-13	7.0E-10	1E-04	6E-04
	Mercury	4.0E-02	1.00	2.9E-09	1.1E-08	3.0E-04	1E-05	4E-05
	Antimony	3.3E-01	1.00	2.4E-08	9.2E-08	4.0E-04	6E-05	2E-04
	Cadmium	2.6E-01	1.00	1.9E-08	7.1E-08	1.0E-03	2E-05	7E-05
39	TEQ (ND=1/2 MDL)	2.7E-06	1.00	2.0E-13	7.5E-13	7.0E-10	3E-04	1E-03
	Mercury	7.4E-02	1.00	5.4E-09	2.1E-08	3.0E-04	2E-05	7E-05
	Antimony	4.3E-01	1.00	3.1E-08	1.2E-07	4.0E-04	8E-05	3E-04
	Cadmium	3.3E-01	1.00	2.4E-08	9.3E-08	1.0E-03	2E-05	9E-05
40	TEQ (ND=1/2 MDL)	3.4E-06	1.00	2.5E-13	9.6E-13	7.0E-10	4E-04	1E-03
	Mercury	4.0E-02	1.00	2.9E-09	1.1E-08	3.0E-04	1E-05	4E-05
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.8E-01	1.00	2.0E-08	7.8E-08	1.0E-03	2E-05	8E-05
41	TEQ (ND=1/2 MDL)	3.9E-06	1.00	2.8E-13	1.1E-12	7.0E-10	4E-04	2E-03
	Mercury	5.7E-02	1.00	4.1E-09	1.6E-08	3.0E-04	1E-05	5E-05
	Antimony	4.2E-02	1.00	3.1E-09	1.2E-08	4.0E-04	8E-06	3E-05
	Cadmium	2.8E-01	1.00	2.0E-08	7.8E-08	1.0E-03	2E-05	8E-05
42	TEQ (ND=1/2 MDL)	7.5E-06	1.00	5.4E-13	2.1E-12	7.0E-10	8E-04	3E-03
	Mercury	1.6E-01	1.00	1.2E-08	4.5E-08	3.0E-04	4E-05	1E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	3.2E-01	1.00	2.3E-08	8.9E-08	1.0E-03	2E-05	9E-05
43	TEQ (ND=1/2 MDL)	3.9E-06	1.00	2.8E-13	1.1E-12	7.0E-10	4E-04	2E-03
	Mercury	1.2E-01	1.00	8.7E-09	3.3E-08	3.0E-04	3E-05	1E-04
	Antimony	7.6E-01	1.00	5.5E-08	2.1E-07	4.0E-04	1E-04	5E-04
	Cadmium	4.7E-01	1.00	3.4E-08	1.3E-07	1.0E-03	3E-05	1E-04
44	TEQ (ND=1/2 MDL)	2.1E-06	1.00	1.5E-13	5.8E-13	7.0E-10	2E-04	8E-04
	Mercury	1.6E-01	1.00	1.1E-08	4.4E-08	3.0E-04	4E-05	1E-04
	Antimony	1.2E+00	1.00	8.5E-08	3.2E-07	4.0E-04	2E-04	8E-04
	Cadmium	8.0E-01	1.00	5.8E-08	2.2E-07	1.0E-03	6E-05	2E-04
46	TEQ (ND=1/2 MDL)	3.0E-06	1.00	2.2E-13	8.4E-13	7.0E-10	3E-04	1E-03
	Mercury	4.1E-02	1.00	3.0E-09	1.1E-08	3.0E-04	1E-05	4E-05
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.4E-01	1.00	1.7E-08	6.7E-08	1.0E-03	2E-05	7E-05
47	TEQ (ND=1/2 MDL)	1.6E-05	1.00	1.2E-12	4.5E-12	7.0E-10	2E-03	6E-03
	Mercury	8.1E-01	1.00	5.9E-08	2.3E-07	3.0E-04	2E-04	8E-04
	Antimony	1.6E+00	1.00	1.2E-07	4.5E-07	4.0E-04	3E-04	1E-03
	Cadmium	5.2E+00	1.00	3.8E-07	1.5E-06	1.0E-03	4E-04	1E-03
48	TEQ (ND=1/2 MDL)	4.9E-05	1.00	3.6E-12	1.4E-11	7.0E-10	5E-03	2E-02
	Mercury	2.5E+00	1.00	1.8E-07	7.0E-07	3.0E-04	6E-04	2E-03
	Antimony	2.4E+00	1.00	1.7E-07	6.7E-07	4.0E-04	4E-04	2E-03
	Cadmium	8.3E+00	1.00	6.0E-07	2.3E-06	1.0E-03	6E-04	2E-03
49	TEQ (ND=1/2 MDL)	4.0E-05	1.00	2.9E-12	1.1E-11	7.0E-10	4E-03	2E-02
	Mercury	8.0E+00	1.00	5.8E-07	2.2E-06	3.0E-04	2E-03	7E-03
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.0E+00	1.00	1.5E-07	5.6E-07	1.0E-03	1E-04	6E-04
50	TEQ (ND=1/2 MDL)	2.4E-05	1.00	1.8E-12	6.8E-12	7.0E-10	3E-03	1E-02
	Mercury	7.5E-01	1.00	5.5E-08	2.1E-07	3.0E-04	2E-04	7E-04
	Antimony	1.2E+00	1.00	8.4E-08	3.2E-07	4.0E-04	2E-04	8E-04
	Cadmium	3.9E+00	1.00	2.8E-07	1.1E-06	1.0E-03	3E-04	1E-03
51	TEQ (ND=1/2 MDL)	2.7E-05	1.00	2.0E-12	7.6E-12	7.0E-10	3E-03	1E-02
	Mercury	6.3E-01	1.00	4.6E-08	1.8E-07	3.0E-04	2E-04	6E-04
	Antimony	1.4E+00	1.00	1.0E-07	3.9E-07	4.0E-04	3E-04	1E-03
	Cadmium	5.0E+00	1.00	3.6E-07	1.4E-06	1.0E-03	4E-04	1E-03

52	TEQ (ND=1/2 MDL)	2.7E-05	1.00	2.0E-12	7.6E-12	7.0E-10	3E-03	1E-02
	Mercury	6.3E-01	1.00	4.6E-08	1.8E-07	3.0E-04	2E-04	6E-04
	Antimony	1.4E+00	1.00	1.0E-07	3.9E-07	4.0E-04	3E-04	1E-03
	Cadmium	5.0E+00	1.00	3.6E-07	1.4E-06	1.0E-03	4E-04	1E-03
53	TEQ (ND=1/2 MDL)	2.3E-05	1.00	1.7E-12	6.3E-12	7.0E-10	2E-03	9E-03
	Mercury	4.3E+00	1.00	3.1E-07	1.2E-06	3.0E-04	1E-03	4E-03
	Antimony	4.6E-01	1.00	3.3E-08	1.3E-07	4.0E-04	8E-05	3E-04
	Cadmium	1.2E+00	1.00	8.7E-08	3.3E-07	1.0E-03	9E-05	3E-04
54	TEQ (ND=1/2 MDL)	2.0E-05	1.00	1.5E-12	5.6E-12	7.0E-10	2E-03	8E-03
	Mercury	8.5E-01	1.00	6.2E-08	2.4E-07	3.0E-04	2E-04	8E-04
	Antimony	1.0E+00	1.00	7.6E-08	2.9E-07	4.0E-04	2E-04	7E-04
	Cadmium	3.1E+00	1.00	2.2E-07	8.6E-07	1.0E-03	2E-04	9E-04
55	TEQ (ND=1/2 MDL)	5.5E-05	1.00	4.0E-12	1.5E-11	7.0E-10	6E-03	2E-02
	Mercury	1.1E+00	1.00	8.0E-08	3.1E-07	3.0E-04	3E-04	1E-03
	Antimony	1.2E+00	1.00	8.7E-08	3.3E-07	4.0E-04	2E-04	8E-04
	Cadmium	5.6E+00	1.00	4.1E-07	1.6E-06	1.0E-03	4E-04	2E-03
56	TEQ (ND=1/2 MDL)	5.9E-05	1.00	4.3E-12	1.6E-11	7.0E-10	6E-03	2E-02
	Mercury	1.3E+00	1.00	9.4E-08	3.6E-07	3.0E-04	3E-04	1E-03
	Antimony	1.7E+00	1.00	1.2E-07	4.8E-07	4.0E-04	3E-04	1E-03
	Cadmium	6.7E+00	1.00	4.8E-07	1.9E-06	1.0E-03	5E-04	2E-03
58	TEQ (ND=1/2 MDL)	8.3E-05	1.00	6.1E-12	2.3E-11	7.0E-10	9E-03	3E-02
	Mercury	1.2E+00	1.00	8.7E-08	3.3E-07	3.0E-04	3E-04	1E-03
	Antimony	2.3E+00	1.00	1.7E-07	6.4E-07	4.0E-04	4E-04	2E-03
	Cadmium	4.8E+00	1.00	3.5E-07	1.3E-06	1.0E-03	3E-04	1E-03
59	TEQ (ND=1/2 MDL)	1.6E-05	1.00	1.2E-12	4.4E-12	7.0E-10	2E-03	6E-03
	Mercury	1.0E+00	1.00	7.3E-08	2.8E-07	3.0E-04	2E-04	9E-04
	Antimony	8.2E-01	1.00	6.0E-08	2.3E-07	4.0E-04	1E-04	6E-04
	Cadmium	3.3E+00	1.00	2.4E-07	9.3E-07	1.0E-03	2E-04	9E-04
60	TEQ (ND=1/2 MDL)	8.7E-06	1.00	6.3E-13	2.4E-12	7.0E-10	9E-04	3E-03
	Mercury	1.9E-01	1.00	1.4E-08	5.3E-08	3.0E-04	5E-05	2E-04
	Antimony	3.1E-01	1.00	2.3E-08	8.6E-08	4.0E-04	6E-05	2E-04
	Cadmium	1.7E+00	1.00	1.2E-07	4.7E-07	1.0E-03	1E-04	5E-04
61	TEQ (ND=1/2 MDL)	5.8E-06	1.00	4.2E-13	1.6E-12	7.0E-10	6E-04	2E-03
	Mercury	1.1E-01	1.00	8.0E-09	3.1E-08	3.0E-04	3E-05	1E-04
	Antimony	2.0E-01	1.00	1.5E-08	5.6E-08	4.0E-04	4E-05	1E-04
	Cadmium	1.1E+00	1.00	8.0E-08	3.1E-07	1.0E-03	8E-05	3E-04
62	TEQ (ND=1/2 MDL)	6.0E-05	1.00	4.3E-12	1.7E-11	7.0E-10	6E-03	2E-02
	Mercury	1.3E+00	1.00	9.5E-08	3.6E-07	3.0E-04	3E-04	1E-03
	Antimony	1.8E+00	1.00	1.3E-07	5.0E-07	4.0E-04	3E-04	1E-03
	Cadmium	7.0E+00	1.00	5.1E-07	2.0E-06	1.0E-03	5E-04	2E-03
64	TEQ (ND=1/2 MDL)	1.6E-05	1.00	1.2E-12	4.6E-12	7.0E-10	2E-03	7E-03
	Mercury	3.6E+00	1.00	2.6E-07	1.0E-06	3.0E-04	9E-04	3E-03
	Antimony	1.1E-01	1.00	7.6E-09	2.9E-08	4.0E-04	2E-05	7E-05
	Cadmium	7.9E-01	1.00	5.7E-08	2.2E-07	1.0E-03	6E-05	2E-04
66	TEQ (ND=1/2 MDL)	6.1E-07	1.00	4.4E-14	1.7E-13	7.0E-10	6E-05	2E-04
	Mercury	6.6E-02	1.00	4.8E-09	1.8E-08	3.0E-04	2E-05	6E-05
	Antimony	2.2E-01	1.00	1.6E-08	6.1E-08	4.0E-04	4E-05	2E-04
	Cadmium	9.0E-01	1.00	6.5E-08	2.5E-07	1.0E-03	7E-05	3E-04
67	TEQ (ND=1/2 MDL)	3.4E-05	1.00	2.5E-12	9.5E-12	7.0E-10	4E-03	1E-02
	Mercury	4.5E-02	1.00	3.3E-09	1.2E-08	3.0E-04	1E-05	4E-05
	Antimony	7.8E-01	1.00	5.7E-08	2.2E-07	4.0E-04	1E-04	5E-04
	Cadmium	2.5E+00	1.00	1.8E-07	6.9E-07	1.0E-03	2E-04	7E-04
68	TEQ (ND=1/2 MDL)	8.3E-05	1.00	6.0E-12	2.3E-11	7.0E-10	9E-03	3E-02
	Mercury	1.0E-02	1.00	7.3E-10	2.8E-09	3.0E-04	2E-06	9E-06
	Antimony	1.6E+00	1.00	1.2E-07	4.5E-07	4.0E-04	3E-04	1E-03
	Cadmium	4.8E+00	1.00	3.5E-07	1.3E-06	1.0E-03	3E-04	1E-03
70	TEQ (ND=1/2 MDL)	3.3E-06	1.00	2.4E-13	9.3E-13	7.0E-10	3E-04	1E-03
	Mercury	1.1E-01	1.00	8.0E-09	3.1E-08	3.0E-04	3E-05	1E-04
	Antimony	4.7E-01	1.00	3.4E-08	1.3E-07	4.0E-04	9E-05	3E-04
	Cadmium	1.8E+00	1.00	1.3E-07	5.0E-07	1.0E-03	1E-04	5E-04
71	TEQ (ND=1/2 MDL)	6.7E-05	1.00	4.8E-12	1.9E-11	7.0E-10	7E-03	3E-02
	Mercury	1.0E-02	1.00	7.3E-10	2.8E-09	3.0E-04	2E-06	9E-06
	Antimony	1.3E+00	1.00	9.4E-08	3.6E-07	4.0E-04	2E-04	9E-04
	Cadmium	4.1E+00	1.00	3.0E-07	1.1E-06	1.0E-03	3E-04	1E-03
72	TEQ (ND=1/2 MDL)	7.1E-05	1.00	5.1E-12	2.0E-11	7.0E-10	7E-03	3E-02
	Mercury	1.0E-02	1.00	7.3E-10	2.8E-09	3.0E-04	2E-06	9E-06
	Antimony	1.3E+00	1.00	9.7E-08	3.7E-07	4.0E-04	2E-04	9E-04
	Cadmium	4.3E+00	1.00	3.1E-07	1.2E-06	1.0E-03	3E-04	1E-03
74	TEQ (ND=1/2 MDL)	3.1E-04	1.00	2.2E-11	8.6E-11	7.0E-10	3E-02	1E-01
	Mercury	2.2E-01	1.00	1.6E-08	6.2E-08	3.0E-04	5E-05	2E-04
	Antimony	2.4E+00	1.00	1.7E-07	6.6E-07	4.0E-04	4E-04	2E-03
	Cadmium	6.4E+00	1.00	4.7E-07	1.8E-06	1.0E-03	5E-04	2E-03
75	TEQ (ND=1/2 MDL)	1.5E-07	1.00	1.1E-14	4.2E-14	7.0E-10	2E-05	6E-05
	Mercury	1.4E-02	1.00	1.0E-09	3.9E-09	3.0E-04	3E-06	1E-05
	Antimony	9.5E-02	1.00	6.9E-09	2.7E-08	4.0E-04	2E-05	7E-05
	Cadmium	1.5E-01	1.00	1.1E-08	4.2E-08	1.0E-03	1E-05	4E-05
76	TEQ (ND=1/2 MDL)	2.0E-06	1.00	1.4E-13	5.5E-13	7.0E-10	2E-04	8E-04
	Mercury	2.4E-02	1.00	1.7E-09	6.6E-09	3.0E-04	6E-06	2E-05
	Antimony	1.2E-01	1.00	8.7E-09	3.3E-08	4.0E-04	2E-05	8E-05
	Cadmium	1.2E-01	1.00	8.8E-09	3.4E-08	1.0E-03	9E-06	3E-05
77	TEQ (ND=1/2 MDL)	2.5E-06	1.00	1.8E-13	6.9E-13	7.0E-10	3E-04	1E-03
	Mercury	2.4E-02	1.00	1.7E-09	6.7E-09	3.0E-04	6E-06	2E-05
	Antimony	9.5E-02	1.00	6.9E-09	2.7E-08	4.0E-04	2E-05	7E-05
	Cadmium	1.3E-01	1.00	9.5E-09	3.6E-08	1.0E-03	9E-06	4E-05
78	TEQ (ND=1/2 MDL)	1.5E-07	1.00	1.1E-14	4.2E-14	7.0E-10	2E-05	6E-05
	Mercury	1.4E-02	1.00	1.0E-09	3.9E-09	3.0E-04	3E-06	1E-05
	Antimony	9.5E-02	1.00	6.9E-09	2.7E-08	4.0E-04	2E-05	7E-05
	Cadmium	1.5E-01	1.00	1.1E-08	4.2E-08	1.0E-03	1E-05	4E-05
79	TEQ (ND=1/2 MDL)	2.5E-06	1.00	1.8E-13	6.9E-13	7.0E-10	3E-04	1E-03
	Mercury	2.4E-02	1.00	1.7E-09	6.7E-09	3.0E-04	6E-06	2E-05
	Antimony	9.5E-02	1.00	6.9E-09	2.7E-08	4.0E-04	2E-05	7E-05
	Cadmium	1.3E-01	1.00	9.5E-09	3.6E-08	1.0E-03	9E-06	4E-05
80	TEQ (ND=1/2 MDL)	2.5E-06	1.00	1.8E-13	6.9E-13	7.0E-10	3E-04	1E-03
	Mercury	2.4E-02	1.00	1.7E-09	6.7E-09	3.0E-04	6E-06	2E-05
	Antimony	9.5E-02	1.00	6.9E-09	2.7E-08	4.0E-04	2E-05	7E-05
	Cadmium	1.3E-01	1.00	9.5E-09	3.6E-08	1.0E-03	9E-06	4E-05

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population **Current/Hypothetical Future Hikers**
Exposure Area **Random 20-acre grids across OU3 Upland Area**
Medium **Surface Soil**
Exposure Route **Dermal Contact**

Grid	COPC	EPC	ABSd	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
26	TEQ (ND=1/2 MDL)	3.6E-06	0.03	7.5E-15	1.0E-13	7.0E-10	1E-05	1E-04
	Cadmium	7.0E-01	0.001	4.9E-11	6.8E-10	2.5E-05	2E-06	3E-05
27	TEQ (ND=1/2 MDL)	2.4E-06	0.03	5.1E-15	7.0E-14	7.0E-10	7E-06	1E-04
	Cadmium	6.4E-02	0.001	4.5E-12	6.2E-11	2.5E-05	2E-07	2E-06
28	TEQ (ND=1/2 MDL)	5.3E-07	0.03	1.1E-15	1.5E-14	7.0E-10	2E-06	2E-05
	Cadmium	7.3E-02	0.001	5.1E-12	7.0E-11	2.5E-05	2E-07	3E-06
29	TEQ (ND=1/2 MDL)	2.9E-06	0.03	6.0E-15	8.4E-14	7.0E-10	9E-06	1E-04
	Cadmium	1.4E-01	0.001	9.7E-12	1.4E-10	2.5E-05	4E-07	5E-06
30	TEQ (ND=1/2 MDL)	1.7E-06	0.03	3.5E-15	4.9E-14	7.0E-10	5E-06	7E-05
	Cadmium	1.3E-01	0.001	9.0E-12	1.3E-10	2.5E-05	4E-07	5E-06
31	TEQ (ND=1/2 MDL)	4.7E-07	0.03	9.7E-16	1.3E-14	7.0E-10	1E-06	2E-05
	Cadmium	4.4E-02	0.001	3.1E-12	4.2E-11	2.5E-05	1E-07	2E-06
32	TEQ (ND=1/2 MDL)	9.3E-08	0.03	1.9E-16	2.7E-15	7.0E-10	3E-07	4E-06
	Cadmium	4.6E-02	0.001	3.2E-12	4.4E-11	2.5E-05	1E-07	2E-06
33	TEQ (ND=1/2 MDL)	9.4E-07	0.03	2.0E-15	2.7E-14	7.0E-10	3E-06	4E-05
	Cadmium	1.3E-01	0.001	9.0E-12	1.3E-10	2.5E-05	4E-07	5E-06
34	TEQ (ND=1/2 MDL)	7.0E-07	0.03	1.5E-15	2.0E-14	7.0E-10	2E-06	3E-05
	Cadmium	9.3E-02	0.001	6.5E-12	9.0E-11	2.5E-05	3E-07	4E-06
35	TEQ (ND=1/2 MDL)	2.1E-07	0.03	4.5E-16	6.2E-15	7.0E-10	6E-07	9E-06
	Cadmium	1.9E-01	0.001	1.3E-11	1.8E-10	2.5E-05	5E-07	7E-06
36	TEQ (ND=1/2 MDL)	9.1E-06	0.03	1.9E-14	2.6E-13	7.0E-10	3E-05	4E-04
	Cadmium	8.5E-01	0.001	5.9E-11	8.2E-10	2.5E-05	2E-06	3E-05
37	TEQ (ND=1/2 MDL)	1.4E-06	0.03	2.9E-15	4.0E-14	7.0E-10	4E-06	6E-05
	Cadmium	2.6E-01	0.001	1.8E-11	2.5E-10	2.5E-05	7E-07	1E-05
39	TEQ (ND=1/2 MDL)	2.7E-06	0.03	5.6E-15	7.8E-14	7.0E-10	8E-06	1E-04
	Cadmium	3.3E-01	0.001	2.3E-11	3.2E-10	2.5E-05	9E-07	1E-05
40	TEQ (ND=1/2 MDL)	3.4E-06	0.03	7.2E-15	9.9E-14	7.0E-10	1E-05	1E-04
	Cadmium	2.8E-01	0.001	1.9E-11	2.7E-10	2.5E-05	8E-07	1E-05
41	TEQ (ND=1/2 MDL)	3.9E-06	0.03	8.0E-15	1.1E-13	7.0E-10	1E-05	2E-04
	Cadmium	2.8E-01	0.001	1.9E-11	2.7E-10	2.5E-05	8E-07	1E-05
42	TEQ (ND=1/2 MDL)	7.5E-06	0.03	1.6E-14	2.2E-13	7.0E-10	2E-05	3E-04
	Cadmium	3.2E-01	0.001	2.2E-11	3.1E-10	2.5E-05	9E-07	1E-05
43	TEQ (ND=1/2 MDL)	3.9E-06	0.03	8.1E-15	1.1E-13	7.0E-10	1E-05	2E-04
	Cadmium	4.7E-01	0.001	3.3E-11	4.5E-10	2.5E-05	1E-06	2E-05
44	TEQ (ND=1/2 MDL)	2.1E-06	0.03	4.3E-15	6.0E-14	7.0E-10	6E-06	9E-05
	Cadmium	8.0E-01	0.001	5.5E-11	7.7E-10	2.5E-05	2E-06	3E-05
46	TEQ (ND=1/2 MDL)	3.0E-06	0.03	6.3E-15	8.7E-14	7.0E-10	9E-06	1E-04
	Cadmium	2.4E-01	0.001	1.7E-11	2.3E-10	2.5E-05	7E-07	9E-06
47	TEQ (ND=1/2 MDL)	1.6E-05	0.03	3.4E-14	4.7E-13	7.0E-10	5E-05	7E-04
	Cadmium	5.2E+00	0.001	3.6E-10	5.0E-09	2.5E-05	1E-05	2E-04
48	TEQ (ND=1/2 MDL)	4.9E-05	0.03	1.0E-13	1.4E-12	7.0E-10	1E-04	2E-03
	Cadmium	8.3E+00	0.001	5.8E-10	8.0E-09	2.5E-05	2E-05	3E-04
49	TEQ (ND=1/2 MDL)	4.0E-05	0.03	8.3E-14	1.2E-12	7.0E-10	1E-04	2E-03
	Cadmium	2.0E+00	0.001	1.4E-10	1.9E-09	2.5E-05	6E-06	8E-05
50	TEQ (ND=1/2 MDL)	2.4E-05	0.03	5.1E-14	7.0E-13	7.0E-10	7E-05	1E-03
	Cadmium	3.9E+00	0.001	2.7E-10	3.8E-09	2.5E-05	1E-05	2E-04
51	TEQ (ND=1/2 MDL)	2.7E-05	0.03	5.7E-14	7.9E-13	7.0E-10	8E-05	1E-03
	Cadmium	5.0E+00	0.001	3.5E-10	4.8E-09	2.5E-05	1E-05	2E-04
52	TEQ (ND=1/2 MDL)	2.7E-05	0.03	5.7E-14	7.9E-13	7.0E-10	8E-05	1E-03
	Cadmium	5.0E+00	0.001	3.5E-10	4.8E-09	2.5E-05	1E-05	2E-04
53	TEQ (ND=1/2 MDL)	2.3E-05	0.03	4.7E-14	6.6E-13	7.0E-10	7E-05	9E-04
	Cadmium	1.2E+00	0.001	8.3E-11	1.2E-09	2.5E-05	3E-06	5E-05
54	TEQ (ND=1/2 MDL)	2.0E-05	0.03	4.2E-14	5.9E-13	7.0E-10	6E-05	8E-04
	Cadmium	3.1E+00	0.001	2.1E-10	3.0E-09	2.5E-05	9E-06	1E-04
55	TEQ (ND=1/2 MDL)	5.5E-05	0.03	1.2E-13	1.6E-12	7.0E-10	2E-04	2E-03
	Cadmium	5.6E+00	0.001	3.9E-10	5.4E-09	2.5E-05	2E-05	2E-04
56	TEQ (ND=1/2 MDL)	5.9E-05	0.03	1.2E-13	1.7E-12	7.0E-10	2E-04	2E-03
	Cadmium	6.7E+00	0.001	4.6E-10	6.4E-09	2.5E-05	2E-05	3E-04
58	TEQ (ND=1/2 MDL)	8.3E-05	0.03	1.7E-13	2.4E-12	7.0E-10	2E-04	3E-03
	Cadmium	4.8E+00	0.001	3.3E-10	4.6E-09	2.5E-05	1E-05	2E-04
59	TEQ (ND=1/2 MDL)	1.6E-05	0.03	3.3E-14	4.6E-13	7.0E-10	5E-05	7E-04
	Cadmium	3.3E+00	0.001	2.3E-10	3.2E-09	2.5E-05	9E-06	1E-04
60	TEQ (ND=1/2 MDL)	8.7E-06	0.03	1.8E-14	2.5E-13	7.0E-10	3E-05	4E-04
	Cadmium	1.7E+00	0.001	1.2E-10	1.6E-09	2.5E-05	5E-06	7E-05
61	TEQ (ND=1/2 MDL)	5.8E-06	0.03	1.2E-14	1.7E-13	7.0E-10	2E-05	2E-04
	Cadmium	1.1E+00	0.001	7.6E-11	1.1E-09	2.5E-05	3E-06	4E-05
62	TEQ (ND=1/2 MDL)	6.0E-05	0.03	1.2E-13	1.7E-12	7.0E-10	2E-04	2E-03
	Cadmium	7.0E+00	0.001	4.9E-10	6.8E-09	2.5E-05	2E-05	3E-04
64	TEQ (ND=1/2 MDL)	1.6E-05	0.03	3.4E-14	4.8E-13	7.0E-10	5E-05	7E-04
	Cadmium	7.9E-01	0.001	5.5E-11	7.6E-10	2.5E-05	2E-06	3E-05
66	TEQ (ND=1/2 MDL)	6.1E-07	0.03	1.3E-15	1.8E-14	7.0E-10	2E-06	3E-05
	Cadmium	9.0E-01	0.001	6.2E-11	8.7E-10	2.5E-05	2E-06	3E-05
67	TEQ (ND=1/2 MDL)	3.4E-05	0.03	7.1E-14	9.8E-13	7.0E-10	1E-04	1E-03
	Cadmium	2.5E+00	0.001	1.7E-10	2.4E-09	2.5E-05	7E-06	1E-04
68	TEQ (ND=1/2 MDL)	8.3E-05	0.03	1.7E-13	2.4E-12	7.0E-10	2E-04	3E-03
	Cadmium	4.8E+00	0.001	3.3E-10	4.6E-09	2.5E-05	1E-05	2E-04
70	TEQ (ND=1/2 MDL)	3.3E-06	0.03	6.9E-15	9.6E-14	7.0E-10	1E-05	1E-04
	Cadmium	1.8E+00	0.001	1.3E-10	1.7E-09	2.5E-05	5E-06	7E-05
71	TEQ (ND=1/2 MDL)	6.7E-05	0.03	1.4E-13	1.9E-12	7.0E-10	2E-04	3E-03
	Cadmium	4.1E+00	0.001	2.9E-10	4.0E-09	2.5E-05	1E-05	2E-04
72	TEQ (ND=1/2 MDL)	7.1E-05	0.03	1.5E-13	2.0E-12	7.0E-10	2E-04	3E-03
	Cadmium	4.3E+00	0.001	3.0E-10	4.1E-09	2.5E-05	1E-05	2E-04
74	TEQ (ND=1/2 MDL)	3.1E-04	0.03	6.4E-13	8.9E-12	7.0E-10	9E-04	1E-02
	Cadmium	6.4E+00	0.001	4.5E-10	6.2E-09	2.5E-05	2E-05	2E-04
75	TEQ (ND=1/2 MDL)	1.5E-07	0.03	3.2E-16	4.4E-15	7.0E-10	5E-07	6E-06
	Cadmium	1.5E-01	0.001	1.0E-11	1.4E-10	2.5E-05	4E-07	6E-06
76	TEQ (ND=1/2 MDL)	2.0E-06	0.03	4.1E-15	5.7E-14	7.0E-10	6E-06	8E-05
	Cadmium	1.2E-01	0.001	8.4E-12	1.2E-10	2.5E-05	3E-07	5E-06
77	TEQ (ND=1/2 MDL)	2.5E-06	0.03	5.1E-15	7.1E-14	7.0E-10	7E-06	1E-04
	Cadmium	1.3E-01	0.001	9.0E-12	1.3E-10	2.5E-05	4E-07	5E-06
78	TEQ (ND=1/2 MDL)	1.5E-07	0.03	3.2E-16	4.4E-15	7.0E-10	5E-07	6E-06
	Cadmium	1.5E-01	0.001	1.0E-11	1.4E-10	2.5E-05	4E-07	6E-06
79	TEQ (ND=1/2 MDL)	2.5E-06	0.03	5.1E-15	7.1E-14	7.0E-10	7E-06	1E-04
	Cadmium	1.3E-01	0.001	9.0E-12	1.3E-10	2.5E-05	4E-07	5E-06
80	TEQ (ND=1/2 MDL)	2.5E-06	0.03	5.1E-15	7.1E-14	7.0E-10	7E-06	1E-04
	Cadmium	1.3E-01	0.001	9.0E-12	1.3E-10	2.5E-05	4E-07	5E-06

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population	**Current/Hypothetical Future Campers**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC	RBA	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
26	TEQ (ND=1/2 MDL)	3.6E-06	1.00	6.7E-13	1.9E-12	7.0E-10	1E-03	3E-03
	Mercury	1.4E-01	1.00	2.6E-08	7.4E-08	3.0E-04	9E-05	2E-04
	Antimony	1.5E+00	1.00	2.8E-07	8.0E-07	4.0E-04	7E-04	2E-03
	Cadmium	7.0E-01	1.00	1.3E-07	3.7E-07	1.0E-03	1E-04	4E-04
27	TEQ (ND=1/2 MDL)	2.4E-06	1.00	4.5E-13	1.3E-12	7.0E-10	6E-04	2E-03
	Mercury	1.2E-02	1.00	2.2E-09	6.4E-09	3.0E-04	7E-06	2E-05
	Antimony	9.0E-02	1.00	1.7E-08	4.8E-08	4.0E-04	4E-05	1E-04
	Cadmium	6.4E-02	1.00	1.2E-08	3.4E-08	1.0E-03	1E-05	3E-05
28	TEQ (ND=1/2 MDL)	5.3E-07	1.00	9.9E-14	2.8E-13	7.0E-10	1E-04	4E-04
	Mercury	1.6E-02	1.00	3.0E-09	8.5E-09	3.0E-04	1E-05	3E-05
	Antimony	9.0E-02	1.00	1.7E-08	4.8E-08	4.0E-04	4E-05	1E-04
	Cadmium	7.3E-02	1.00	1.4E-08	3.9E-08	1.0E-03	1E-05	4E-05
29	TEQ (ND=1/2 MDL)	2.9E-06	1.00	5.4E-13	1.5E-12	7.0E-10	8E-04	2E-03
	Mercury	3.3E-02	1.00	6.2E-09	1.8E-08	3.0E-04	2E-05	6E-05
	Antimony	1.9E-01	1.00	3.6E-08	1.0E-07	4.0E-04	9E-05	3E-04
	Cadmium	1.4E-01	1.00	2.6E-08	7.4E-08	1.0E-03	3E-05	7E-05
30	TEQ (ND=1/2 MDL)	1.7E-06	1.00	3.1E-13	8.9E-13	7.0E-10	4E-04	1E-03
	Mercury	2.4E-02	1.00	4.5E-09	1.3E-08	3.0E-04	1E-05	4E-05
	Antimony	2.0E-01	1.00	3.7E-08	1.1E-07	4.0E-04	9E-05	3E-04
	Cadmium	1.3E-01	1.00	2.4E-08	6.9E-08	1.0E-03	2E-05	7E-05
31	TEQ (ND=1/2 MDL)	4.7E-07	1.00	8.7E-14	2.5E-13	7.0E-10	1E-04	4E-04
	Mercury	3.4E-03	1.00	6.4E-10	1.8E-09	3.0E-04	2E-06	6E-06
	Antimony	4.1E-02	1.00	7.6E-09	2.2E-08	4.0E-04	2E-05	5E-05
	Cadmium	4.4E-02	1.00	8.2E-09	2.3E-08	1.0E-03	8E-06	2E-05
32	TEQ (ND=1/2 MDL)	9.3E-08	1.00	1.7E-14	4.9E-14	7.0E-10	2E-05	7E-05
	Mercury	3.1E-03	1.00	5.8E-10	1.6E-09	3.0E-04	2E-06	5E-06
	Antimony	1.5E-01	1.00	2.8E-08	8.0E-08	4.0E-04	7E-05	2E-04
	Cadmium	4.6E-02	1.00	8.6E-09	2.4E-08	1.0E-03	9E-06	2E-05
33	TEQ (ND=1/2 MDL)	9.4E-07	1.00	1.8E-13	5.0E-13	7.0E-10	3E-04	7E-04
	Mercury	1.7E-02	1.00	3.2E-09	9.0E-09	3.0E-04	1E-05	3E-05
	Antimony	9.0E-02	1.00	1.7E-08	4.8E-08	4.0E-04	4E-05	1E-04
	Cadmium	1.3E-01	1.00	2.4E-08	6.9E-08	1.0E-03	2E-05	7E-05
34	TEQ (ND=1/2 MDL)	7.0E-07	1.00	1.3E-13	3.7E-13	7.0E-10	2E-04	5E-04
	Mercury	1.3E-02	1.00	2.4E-09	6.9E-09	3.0E-04	8E-06	2E-05
	Antimony	8.5E-02	1.00	1.6E-08	4.5E-08	4.0E-04	4E-05	1E-04
	Cadmium	9.3E-02	1.00	1.7E-08	4.9E-08	1.0E-03	2E-05	5E-05
35	TEQ (ND=1/2 MDL)	2.1E-07	1.00	4.0E-14	1.1E-13	7.0E-10	6E-05	2E-04
	Mercury	1.8E-02	1.00	3.4E-09	9.6E-09	3.0E-04	1E-05	3E-05
	Antimony	2.3E-01	1.00	4.3E-08	1.2E-07	4.0E-04	1E-04	3E-04
	Cadmium	1.9E-01	1.00	3.6E-08	1.0E-07	1.0E-03	4E-05	1E-04
36	TEQ (ND=1/2 MDL)	9.1E-06	1.00	1.7E-12	4.8E-12	7.0E-10	2E-03	7E-03
	Mercury	2.7E-01	1.00	5.1E-08	1.4E-07	3.0E-04	2E-04	5E-04
	Antimony	8.0E-01	1.00	1.5E-07	4.2E-07	4.0E-04	4E-04	1E-03
	Cadmium	8.5E-01	1.00	1.6E-07	4.5E-07	1.0E-03	2E-04	5E-04
37	TEQ (ND=1/2 MDL)	1.4E-06	1.00	2.6E-13	7.4E-13	7.0E-10	4E-04	1E-03
	Mercury	4.0E-02	1.00	7.5E-09	2.1E-08	3.0E-04	2E-05	7E-05
	Antimony	3.3E-01	1.00	6.2E-08	1.8E-07	4.0E-04	2E-04	4E-04
	Cadmium	2.6E-01	1.00	4.8E-08	1.4E-07	1.0E-03	5E-05	1E-04
39	TEQ (ND=1/2 MDL)	2.7E-06	1.00	5.0E-13	1.4E-12	7.0E-10	7E-04	2E-03
	Mercury	7.4E-02	1.00	1.4E-08	3.9E-08	3.0E-04	5E-05	1E-04
	Antimony	4.3E-01	1.00	8.0E-08	2.3E-07	4.0E-04	2E-04	6E-04
	Cadmium	3.3E-01	1.00	6.2E-08	1.8E-07	1.0E-03	6E-05	2E-04
40	TEQ (ND=1/2 MDL)	3.4E-06	1.00	6.4E-13	1.8E-12	7.0E-10	9E-04	3E-03
	Mercury	4.0E-02	1.00	7.5E-09	2.1E-08	3.0E-04	2E-05	7E-05
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.8E-01	1.00	5.2E-08	1.5E-07	1.0E-03	5E-05	1E-04
41	TEQ (ND=1/2 MDL)	3.9E-06	1.00	7.2E-13	2.0E-12	7.0E-10	1E-03	3E-03
	Mercury	5.7E-02	1.00	1.1E-08	3.0E-08	3.0E-04	4E-05	1E-04
	Antimony	4.2E-02	1.00	7.9E-09	2.2E-08	4.0E-04	2E-05	6E-05
	Cadmium	2.8E-01	1.00	5.2E-08	1.5E-07	1.0E-03	5E-05	1E-04
42	TEQ (ND=1/2 MDL)	7.5E-06	1.00	1.4E-12	4.0E-12	7.0E-10	2E-03	6E-03
	Mercury	1.6E-01	1.00	3.0E-08	8.5E-08	3.0E-04	1E-04	3E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	3.2E-01	1.00	6.0E-08	1.7E-07	1.0E-03	6E-05	2E-04
43	TEQ (ND=1/2 MDL)	3.9E-06	1.00	7.3E-13	2.1E-12	7.0E-10	1E-03	3E-03
	Mercury	1.2E-01	1.00	2.2E-08	6.4E-08	3.0E-04	7E-05	2E-04
	Antimony	7.6E-01	1.00	1.4E-07	4.0E-07	4.0E-04	4E-04	1E-03
	Cadmium	4.7E-01	1.00	8.8E-08	2.5E-07	1.0E-03	9E-05	2E-04
44	TEQ (ND=1/2 MDL)	2.1E-06	1.00	3.9E-13	1.1E-12	7.0E-10	6E-04	2E-03
	Mercury	1.6E-01	1.00	2.9E-08	8.3E-08	3.0E-04	1E-04	3E-04
	Antimony	1.2E+00	1.00	2.2E-07	6.2E-07	4.0E-04	5E-04	2E-03
	Cadmium	8.0E-01	1.00	1.5E-07	4.2E-07	1.0E-03	1E-04	4E-04
46	TEQ (ND=1/2 MDL)	3.0E-06	1.00	5.6E-13	1.6E-12	7.0E-10	8E-04	2E-03
	Mercury	4.1E-02	1.00	7.7E-09	2.2E-08	3.0E-04	3E-05	7E-05
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.4E-01	1.00	4.5E-08	1.3E-07	1.0E-03	4E-05	1E-04
47	TEQ (ND=1/2 MDL)	1.6E-05	1.00	3.0E-12	8.6E-12	7.0E-10	4E-03	1E-02
	Mercury	8.1E-01	1.00	1.5E-07	4.3E-07	3.0E-04	5E-04	1E-03
	Antimony	1.6E+00	1.00	3.0E-07	8.5E-07	4.0E-04	7E-04	2E-03
	Cadmium	5.2E+00	1.00	9.7E-07	2.8E-06	1.0E-03	1E-03	3E-03
48	TEQ (ND=1/2 MDL)	4.9E-05	1.00	9.2E-12	2.6E-11	7.0E-10	1E-02	4E-02
	Mercury	2.5E+00	1.00	4.7E-07	1.3E-06	3.0E-04	2E-03	4E-03
	Antimony	2.4E+00	1.00	4.5E-07	1.3E-06	4.0E-04	1E-03	3E-03
	Cadmium	8.3E+00	1.00	1.6E-06	4.4E-06	1.0E-03	2E-03	4E-03
49	TEQ (ND=1/2 MDL)	4.0E-05	1.00	7.4E-12	2.1E-11	7.0E-10	1E-02	3E-02
	Mercury	8.0E+00	1.00	1.5E-06	4.2E-06	3.0E-04	5E-03	1E-02
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.0E+00	1.00	3.7E-07	1.1E-06	1.0E-03	4E-04	1E-03
50	TEQ (ND=1/2 MDL)	2.4E-05	1.00	4.6E-12	1.3E-11	7.0E-10	7E-03	2E-02
	Mercury	7.5E-01	1.00	1.4E-07	4.0E-07	3.0E-04	5E-04	1E-03
	Antimony	1.2E+00	1.00	2.2E-07	6.1E-07	4.0E-04	5E-04	2E-03
	Cadmium	3.9E+00	1.00	7.3E-07	2.1E-06	1.0E-03	7E-04	2E-03
51	TEQ (ND=1/2 MDL)	2.7E-05	1.00	5.1E-12	1.5E-11	7.0E-10	7E-03	2E-02
	Mercury	6.3E-01	1.00	1.2E-07	3.3E-07	3.0E-04	4E-04	1E-03
	Antimony	1.4E+00	1.00	2.6E-07	7.4E-07	4.0E-04	7E-04	2E-03
	Cadmium	5.0E+00	1.00	9.4E-07	2.7E-06	1.0E-03	9E-04	3E-03

52	TEQ (ND=1/2 MDL)	2.7E-05	1.00	5.1E-12	1.5E-11	7.0E-10	7E-03	2E-02
	Mercury	6.3E-01	1.00	1.2E-07	3.3E-07	3.0E-04	4E-04	1E-03
	Antimony	1.4E+00	1.00	2.6E-07	7.4E-07	4.0E-04	7E-04	2E-03
	Cadmium	5.0E+00	1.00	9.4E-07	2.7E-06	1.0E-03	9E-04	3E-03
53	TEQ (ND=1/2 MDL)	2.3E-05	1.00	4.3E-12	1.2E-11	7.0E-10	6E-03	2E-02
	Mercury	4.3E+00	1.00	8.1E-07	2.3E-06	3.0E-04	3E-03	8E-03
	Antimony	4.6E-01	1.00	8.6E-08	2.4E-07	4.0E-04	2E-04	6E-04
	Cadmium	1.2E+00	1.00	2.2E-07	6.4E-07	1.0E-03	2E-04	6E-04
54	TEQ (ND=1/2 MDL)	2.0E-05	1.00	3.8E-12	1.1E-11	7.0E-10	5E-03	2E-02
	Mercury	8.5E-01	1.00	1.6E-07	4.5E-07	3.0E-04	5E-04	2E-03
	Antimony	1.0E+00	1.00	2.0E-07	5.5E-07	4.0E-04	5E-04	1E-03
	Cadmium	3.1E+00	1.00	5.8E-07	1.6E-06	1.0E-03	6E-04	2E-03
55	TEQ (ND=1/2 MDL)	5.5E-05	1.00	1.0E-11	2.9E-11	7.0E-10	1E-02	4E-02
	Mercury	1.1E+00	1.00	2.1E-07	5.8E-07	3.0E-04	7E-04	2E-03
	Antimony	1.2E+00	1.00	2.2E-07	6.4E-07	4.0E-04	6E-04	2E-03
	Cadmium	5.6E+00	1.00	1.0E-06	3.0E-06	1.0E-03	1E-03	3E-03
56	TEQ (ND=1/2 MDL)	5.9E-05	1.00	1.1E-11	3.1E-11	7.0E-10	2E-02	4E-02
	Mercury	1.3E+00	1.00	2.4E-07	6.8E-07	3.0E-04	8E-04	2E-03
	Antimony	1.7E+00	1.00	3.2E-07	9.1E-07	4.0E-04	8E-04	2E-03
	Cadmium	6.7E+00	1.00	1.2E-06	3.5E-06	1.0E-03	1E-03	4E-03
58	TEQ (ND=1/2 MDL)	8.3E-05	1.00	1.6E-11	4.4E-11	7.0E-10	2E-02	6E-02
	Mercury	1.2E+00	1.00	2.2E-07	6.4E-07	3.0E-04	7E-04	2E-03
	Antimony	2.3E+00	1.00	4.3E-07	1.2E-06	4.0E-04	1E-03	3E-03
	Cadmium	4.8E+00	1.00	9.0E-07	2.5E-06	1.0E-03	9E-04	3E-03
59	TEQ (ND=1/2 MDL)	1.6E-05	1.00	3.0E-12	8.4E-12	7.0E-10	4E-03	1E-02
	Mercury	1.0E+00	1.00	1.9E-07	5.3E-07	3.0E-04	6E-04	2E-03
	Antimony	8.2E-01	1.00	1.5E-07	4.4E-07	4.0E-04	4E-04	1E-03
	Cadmium	3.3E+00	1.00	6.2E-07	1.8E-06	1.0E-03	6E-04	2E-03
60	TEQ (ND=1/2 MDL)	8.7E-06	1.00	1.6E-12	4.6E-12	7.0E-10	2E-03	7E-03
	Mercury	1.9E-01	1.00	3.6E-08	1.0E-07	3.0E-04	1E-04	3E-04
	Antimony	3.1E-01	1.00	5.8E-08	1.6E-07	4.0E-04	1E-04	4E-04
	Cadmium	1.7E+00	1.00	3.2E-07	9.0E-07	1.0E-03	3E-04	9E-04
61	TEQ (ND=1/2 MDL)	5.8E-06	1.00	1.1E-12	3.1E-12	7.0E-10	2E-03	4E-03
	Mercury	1.1E-01	1.00	2.1E-08	5.8E-08	3.0E-04	7E-05	2E-04
	Antimony	2.0E-01	1.00	3.7E-08	1.1E-07	4.0E-04	9E-05	3E-04
	Cadmium	1.1E+00	1.00	2.1E-07	5.8E-07	1.0E-03	2E-04	6E-04
62	TEQ (ND=1/2 MDL)	6.0E-05	1.00	1.1E-11	3.2E-11	7.0E-10	2E-02	5E-02
	Mercury	1.3E+00	1.00	2.4E-07	6.9E-07	3.0E-04	8E-04	2E-03
	Antimony	1.8E+00	1.00	3.4E-07	9.6E-07	4.0E-04	8E-04	2E-03
	Cadmium	7.0E+00	1.00	1.3E-06	3.7E-06	1.0E-03	1E-03	4E-03
64	TEQ (ND=1/2 MDL)	1.6E-05	1.00	3.1E-12	8.7E-12	7.0E-10	4E-03	1E-02
	Mercury	3.6E+00	1.00	6.7E-07	1.9E-06	3.0E-04	2E-03	6E-03
	Antimony	1.1E-01	1.00	2.0E-08	5.6E-08	4.0E-04	5E-05	1E-04
	Cadmium	7.9E-01	1.00	1.5E-07	4.2E-07	1.0E-03	1E-04	4E-04
66	TEQ (ND=1/2 MDL)	6.1E-07	1.00	1.1E-13	3.2E-13	7.0E-10	2E-04	5E-04
	Mercury	6.6E-02	1.00	1.2E-08	3.5E-08	3.0E-04	4E-05	1E-04
	Antimony	2.2E-01	1.00	4.1E-08	1.2E-07	4.0E-04	1E-04	3E-04
	Cadmium	9.0E-01	1.00	1.7E-07	4.8E-07	1.0E-03	2E-04	5E-04
67	TEQ (ND=1/2 MDL)	3.4E-05	1.00	6.4E-12	1.8E-11	7.0E-10	9E-03	3E-02
	Mercury	4.5E-02	1.00	8.4E-09	2.4E-08	3.0E-04	3E-05	8E-05
	Antimony	7.8E-01	1.00	1.5E-07	4.1E-07	4.0E-04	4E-04	1E-03
	Cadmium	2.5E+00	1.00	4.6E-07	1.3E-06	1.0E-03	5E-04	1E-03
68	TEQ (ND=1/2 MDL)	8.3E-05	1.00	1.5E-11	4.4E-11	7.0E-10	2E-02	6E-02
	Mercury	1.0E-02	1.00	1.9E-09	5.3E-09	3.0E-04	6E-06	2E-05
	Antimony	1.6E+00	1.00	3.0E-07	8.5E-07	4.0E-04	7E-04	2E-03
	Cadmium	4.8E+00	1.00	9.0E-07	2.5E-06	1.0E-03	9E-04	3E-03
70	TEQ (ND=1/2 MDL)	3.3E-06	1.00	6.2E-13	1.8E-12	7.0E-10	9E-04	3E-03
	Mercury	1.1E-01	1.00	2.1E-08	5.8E-08	3.0E-04	7E-05	2E-04
	Antimony	4.7E-01	1.00	8.8E-08	2.5E-07	4.0E-04	2E-04	6E-04
	Cadmium	1.8E+00	1.00	3.4E-07	9.6E-07	1.0E-03	3E-04	1E-03
71	TEQ (ND=1/2 MDL)	6.7E-05	1.00	1.2E-11	3.5E-11	7.0E-10	2E-02	5E-02
	Mercury	1.0E-02	1.00	1.9E-09	5.3E-09	3.0E-04	6E-06	2E-05
	Antimony	1.3E+00	1.00	2.4E-07	6.9E-07	4.0E-04	6E-04	2E-03
	Cadmium	4.1E+00	1.00	7.7E-07	2.2E-06	1.0E-03	8E-04	2E-03
72	TEQ (ND=1/2 MDL)	7.1E-05	1.00	1.3E-11	3.8E-11	7.0E-10	2E-02	5E-02
	Mercury	1.0E-02	1.00	1.9E-09	5.3E-09	3.0E-04	6E-06	2E-05
	Antimony	1.3E+00	1.00	2.5E-07	7.1E-07	4.0E-04	6E-04	2E-03
	Cadmium	4.3E+00	1.00	8.0E-07	2.3E-06	1.0E-03	8E-04	2E-03
74	TEQ (ND=1/2 MDL)	3.1E-04	1.00	5.7E-11	1.6E-10	7.0E-10	8E-02	2E-01
	Mercury	2.2E-01	1.00	4.2E-08	1.2E-07	3.0E-04	1E-04	4E-04
	Antimony	2.4E+00	1.00	4.5E-07	1.3E-06	4.0E-04	1E-03	3E-03
	Cadmium	6.4E+00	1.00	1.2E-06	3.4E-06	1.0E-03	1E-03	3E-03
75	TEQ (ND=1/2 MDL)	1.5E-07	1.00	2.8E-14	8.1E-14	7.0E-10	4E-05	1E-04
	Mercury	1.4E-02	1.00	2.6E-09	7.4E-09	3.0E-04	9E-06	2E-05
	Antimony	9.5E-02	1.00	1.8E-08	5.0E-08	4.0E-04	4E-05	1E-04
	Cadmium	1.5E-01	1.00	2.8E-08	8.0E-08	1.0E-03	3E-05	8E-05
76	TEQ (ND=1/2 MDL)	2.0E-06	1.00	3.7E-13	1.1E-12	7.0E-10	5E-04	2E-03
	Mercury	2.4E-02	1.00	4.4E-09	1.3E-08	3.0E-04	1E-05	4E-05
	Antimony	1.2E-01	1.00	2.2E-08	6.4E-08	4.0E-04	6E-05	2E-04
	Cadmium	1.2E-01	1.00	2.3E-08	6.5E-08	1.0E-03	2E-05	6E-05
77	TEQ (ND=1/2 MDL)	2.5E-06	1.00	4.6E-13	1.3E-12	7.0E-10	7E-04	2E-03
	Mercury	2.4E-02	1.00	4.5E-09	1.3E-08	3.0E-04	1E-05	4E-05
	Antimony	9.5E-02	1.00	1.8E-08	5.0E-08	4.0E-04	4E-05	1E-04
	Cadmium	1.3E-01	1.00	2.4E-08	6.9E-08	1.0E-03	2E-05	7E-05
78	TEQ (ND=1/2 MDL)	1.5E-07	1.00	2.8E-14	8.1E-14	7.0E-10	4E-05	1E-04
	Mercury	1.4E-02	1.00	2.6E-09	7.4E-09	3.0E-04	9E-06	2E-05
	Antimony	9.5E-02	1.00	1.8E-08	5.0E-08	4.0E-04	4E-05	1E-04
	Cadmium	1.5E-01	1.00	2.8E-08	8.0E-08	1.0E-03	3E-05	8E-05
79	TEQ (ND=1/2 MDL)	2.5E-06	1.00	4.6E-13	1.3E-12	7.0E-10	7E-04	2E-03
	Mercury	2.4E-02	1.00	4.5E-09	1.3E-08	3.0E-04	1E-05	4E-05
	Antimony	9.5E-02	1.00	1.8E-08	5.0E-08	4.0E-04	4E-05	1E-04
	Cadmium	1.3E-01	1.00	2.4E-08	6.9E-08	1.0E-03	2E-05	7E-05
80	TEQ (ND=1/2 MDL)	2.5E-06	1.00	4.6E-13	1.3E-12	7.0E-10	7E-04	2E-03
	Mercury	2.4E-02	1.00	4.5E-09	1.3E-08	3.0E-04	1E-05	4E-05
	Antimony	9.5E-02	1.00	1.8E-08	5.0E-08	4.0E-04	4E-05	1E-04
	Cadmium	1.3E-01	1.00	2.4E-08	6.9E-08	1.0E-03	2E-05	7E-05

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE SOILS

Population **Current/Hypothetical Future Campers**
Exposure Area **Random 20-acre grids across OU3 Upland Area**
Medium **Surface Soil**
Exposure Route **Dermal Contact**

Grid	COPC	EPC	ABSd	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
26	TEQ (ND=1/2 MDL)	3.6E-06	0.03	2.0E-14	1.6E-13	7.0E-10	3E-05	2E-04
	Cadmium	7.0E-01	0.001	1.3E-10	1.0E-09	2.5E-05	5E-06	4E-05
27	TEQ (ND=1/2 MDL)	2.4E-06	0.03	1.4E-14	1.1E-13	7.0E-10	2E-05	2E-04
	Cadmium	6.4E-02	0.001	1.2E-11	9.6E-11	2.5E-05	5E-07	4E-06
28	TEQ (ND=1/2 MDL)	5.3E-07	0.03	3.0E-15	2.4E-14	7.0E-10	4E-06	3E-05
	Cadmium	7.3E-02	0.001	1.4E-11	1.1E-10	2.5E-05	5E-07	4E-06
29	TEQ (ND=1/2 MDL)	2.9E-06	0.03	1.6E-14	1.3E-13	7.0E-10	2E-05	2E-04
	Cadmium	1.4E-01	0.001	2.6E-11	2.1E-10	2.5E-05	1E-06	8E-06
30	TEQ (ND=1/2 MDL)	1.7E-06	0.03	9.5E-15	7.5E-14	7.0E-10	1E-05	1E-04
	Cadmium	1.3E-01	0.001	2.4E-11	1.9E-10	2.5E-05	1E-06	8E-06
31	TEQ (ND=1/2 MDL)	4.7E-07	0.03	2.6E-15	2.1E-14	7.0E-10	4E-06	3E-05
	Cadmium	4.4E-02	0.001	8.3E-12	6.6E-11	2.5E-05	3E-07	3E-06
32	TEQ (ND=1/2 MDL)	9.3E-08	0.03	5.3E-16	4.2E-15	7.0E-10	8E-07	6E-06
	Cadmium	4.6E-02	0.001	8.7E-12	6.9E-11	2.5E-05	3E-07	3E-06
33	TEQ (ND=1/2 MDL)	9.4E-07	0.03	5.3E-15	4.2E-14	7.0E-10	8E-06	6E-05
	Cadmium	1.3E-01	0.001	2.4E-11	1.9E-10	2.5E-05	1E-06	8E-06
34	TEQ (ND=1/2 MDL)	7.0E-07	0.03	4.0E-15	3.1E-14	7.0E-10	6E-06	4E-05
	Cadmium	9.3E-02	0.001	1.8E-11	1.4E-10	2.5E-05	7E-07	6E-06
35	TEQ (ND=1/2 MDL)	2.1E-07	0.03	1.2E-15	9.6E-15	7.0E-10	2E-06	1E-05
	Cadmium	1.9E-01	0.001	3.6E-11	2.8E-10	2.5E-05	1E-06	1E-05
36	TEQ (ND=1/2 MDL)	9.1E-06	0.03	5.1E-14	4.1E-13	7.0E-10	7E-05	6E-04
	Cadmium	8.5E-01	0.001	1.6E-10	1.3E-09	2.5E-05	6E-06	5E-05
37	TEQ (ND=1/2 MDL)	1.4E-06	0.03	7.8E-15	6.2E-14	7.0E-10	1E-05	9E-05
	Cadmium	2.6E-01	0.001	4.8E-11	3.8E-10	2.5E-05	2E-06	2E-05
39	TEQ (ND=1/2 MDL)	2.7E-06	0.03	1.5E-14	1.2E-13	7.0E-10	2E-05	2E-04
	Cadmium	3.3E-01	0.001	6.3E-11	5.0E-10	2.5E-05	3E-06	2E-05
40	TEQ (ND=1/2 MDL)	3.4E-06	0.03	1.9E-14	1.5E-13	7.0E-10	3E-05	2E-04
	Cadmium	2.8E-01	0.001	5.3E-11	4.2E-10	2.5E-05	2E-06	2E-05
41	TEQ (ND=1/2 MDL)	3.9E-06	0.03	2.2E-14	1.7E-13	7.0E-10	3E-05	2E-04
	Cadmium	2.8E-01	0.001	5.3E-11	4.2E-10	2.5E-05	2E-06	2E-05
42	TEQ (ND=1/2 MDL)	7.5E-06	0.03	4.2E-14	3.4E-13	7.0E-10	6E-05	5E-04
	Cadmium	3.2E-01	0.001	6.0E-11	4.8E-10	2.5E-05	2E-06	2E-05
43	TEQ (ND=1/2 MDL)	3.9E-06	0.03	2.2E-14	1.7E-13	7.0E-10	3E-05	2E-04
	Cadmium	4.7E-01	0.001	8.8E-11	7.0E-10	2.5E-05	4E-06	3E-05
44	TEQ (ND=1/2 MDL)	2.1E-06	0.03	1.2E-14	9.3E-14	7.0E-10	2E-05	1E-04
	Cadmium	8.0E-01	0.001	1.5E-10	1.2E-09	2.5E-05	6E-06	5E-05
46	TEQ (ND=1/2 MDL)	3.0E-06	0.03	1.7E-14	1.3E-13	7.0E-10	2E-05	2E-04
	Cadmium	2.4E-01	0.001	4.5E-11	3.6E-10	2.5E-05	2E-06	1E-05
47	TEQ (ND=1/2 MDL)	1.6E-05	0.03	9.1E-14	7.3E-13	7.0E-10	1E-04	1E-03
	Cadmium	5.2E+00	0.001	9.8E-10	7.8E-09	2.5E-05	4E-05	3E-04
48	TEQ (ND=1/2 MDL)	4.9E-05	0.03	2.8E-13	2.2E-12	7.0E-10	4E-04	3E-03
	Cadmium	8.3E+00	0.001	1.6E-09	1.2E-08	2.5E-05	6E-05	5E-04
49	TEQ (ND=1/2 MDL)	4.0E-05	0.03	2.2E-13	1.8E-12	7.0E-10	3E-04	3E-03
	Cadmium	2.0E+00	0.001	3.8E-10	3.0E-09	2.5E-05	2E-05	1E-04
50	TEQ (ND=1/2 MDL)	2.4E-05	0.03	1.4E-13	1.1E-12	7.0E-10	2E-04	2E-03
	Cadmium	3.9E+00	0.001	7.3E-10	5.8E-09	2.5E-05	3E-05	2E-04
51	TEQ (ND=1/2 MDL)	2.7E-05	0.03	1.5E-13	1.2E-12	7.0E-10	2E-04	2E-03
	Cadmium	5.0E+00	0.001	9.4E-10	7.5E-09	2.5E-05	4E-05	3E-04
52	TEQ (ND=1/2 MDL)	2.7E-05	0.03	1.5E-13	1.2E-12	7.0E-10	2E-04	2E-03
	Cadmium	5.0E+00	0.001	9.4E-10	7.5E-09	2.5E-05	4E-05	3E-04
53	TEQ (ND=1/2 MDL)	2.3E-05	0.03	1.3E-13	1.0E-12	7.0E-10	2E-04	1E-03
	Cadmium	1.2E+00	0.001	2.3E-10	1.8E-09	2.5E-05	9E-06	7E-05
54	TEQ (ND=1/2 MDL)	2.0E-05	0.03	1.1E-13	9.1E-13	7.0E-10	2E-04	1E-03
	Cadmium	3.1E+00	0.001	5.8E-10	4.6E-09	2.5E-05	2E-05	2E-04
55	TEQ (ND=1/2 MDL)	5.5E-05	0.03	3.1E-13	2.5E-12	7.0E-10	4E-04	4E-03
	Cadmium	5.6E+00	0.001	1.1E-09	8.4E-09	2.5E-05	4E-05	3E-04
56	TEQ (ND=1/2 MDL)	5.9E-05	0.03	3.3E-13	2.6E-12	7.0E-10	5E-04	4E-03
	Cadmium	6.7E+00	0.001	1.3E-09	9.9E-09	2.5E-05	5E-05	4E-04
58	TEQ (ND=1/2 MDL)	8.3E-05	0.03	4.7E-13	3.7E-12	7.0E-10	7E-04	5E-03
	Cadmium	4.8E+00	0.001	9.0E-10	7.2E-09	2.5E-05	4E-05	3E-04
59	TEQ (ND=1/2 MDL)	1.6E-05	0.03	8.9E-14	7.1E-13	7.0E-10	1E-04	1E-03
	Cadmium	3.3E+00	0.001	6.3E-10	5.0E-09	2.5E-05	3E-05	2E-04
60	TEQ (ND=1/2 MDL)	8.7E-06	0.03	4.9E-14	3.9E-13	7.0E-10	7E-05	6E-04
	Cadmium	1.7E+00	0.001	3.2E-10	2.5E-09	2.5E-05	1E-05	1E-04
61	TEQ (ND=1/2 MDL)	5.8E-06	0.03	3.3E-14	2.6E-13	7.0E-10	5E-05	4E-04
	Cadmium	1.1E+00	0.001	2.1E-10	1.6E-09	2.5E-05	8E-06	7E-05
62	TEQ (ND=1/2 MDL)	6.0E-05	0.03	3.4E-13	2.7E-12	7.0E-10	5E-04	4E-03
	Cadmium	7.0E+00	0.001	1.3E-09	1.0E-08	2.5E-05	5E-05	4E-04
64	TEQ (ND=1/2 MDL)	1.6E-05	0.03	9.3E-14	7.4E-13	7.0E-10	1E-04	1E-03
	Cadmium	7.9E-01	0.001	1.5E-10	1.2E-09	2.5E-05	6E-06	5E-05
66	TEQ (ND=1/2 MDL)	6.1E-07	0.03	3.4E-15	2.7E-14	7.0E-10	5E-06	4E-05
	Cadmium	9.0E-01	0.001	1.7E-10	1.3E-09	2.5E-05	7E-06	5E-05
67	TEQ (ND=1/2 MDL)	3.4E-05	0.03	1.9E-13	1.5E-12	7.0E-10	3E-04	2E-03
	Cadmium	2.5E+00	0.001	4.7E-10	3.7E-09	2.5E-05	2E-05	1E-04
68	TEQ (ND=1/2 MDL)	8.3E-05	0.03	4.7E-13	3.7E-12	7.0E-10	7E-04	5E-03
	Cadmium	4.8E+00	0.001	9.0E-10	7.2E-09	2.5E-05	4E-05	3E-04
70	TEQ (ND=1/2 MDL)	3.3E-06	0.03	1.9E-14	1.5E-13	7.0E-10	3E-05	2E-04
	Cadmium	1.8E+00	0.001	3.4E-10	2.7E-09	2.5E-05	1E-05	1E-04
71	TEQ (ND=1/2 MDL)	6.7E-05	0.03	3.8E-13	3.0E-12	7.0E-10	5E-04	4E-03
	Cadmium	4.1E+00	0.001	7.7E-10	6.1E-09	2.5E-05	3E-05	2E-04
72	TEQ (ND=1/2 MDL)	7.1E-05	0.03	4.0E-13	3.2E-12	7.0E-10	6E-04	5E-03
	Cadmium	4.3E+00	0.001	8.1E-10	6.4E-09	2.5E-05	3E-05	3E-04
74	TEQ (ND=1/2 MDL)	3.1E-04	0.03	1.7E-12	1.4E-11	7.0E-10	2E-03	2E-02
	Cadmium	6.4E+00	0.001	1.2E-09	9.6E-09	2.5E-05	5E-05	4E-04
75	TEQ (ND=1/2 MDL)	1.5E-07	0.03	8.6E-16	6.8E-15	7.0E-10	1E-06	1E-05
	Cadmium	1.5E-01	0.001	2.8E-11	2.2E-10	2.5E-05	1E-06	9E-06
76	TEQ (ND=1/2 MDL)	2.0E-06	0.03	1.1E-14	8.9E-14	7.0E-10	2E-05	1E-04
	Cadmium	1.2E-01	0.001	2.3E-11	1.8E-10	2.5E-05	9E-07	7E-06
77	TEQ (ND=1/2 MDL)	2.5E-06	0.03	1.4E-14	1.1E-13	7.0E-10	2E-05	2E-04
	Cadmium	1.3E-01	0.001	2.4E-11	1.9E-10	2.5E-05	1E-06	8E-06
78	TEQ (ND=1/2 MDL)	1.5E-07	0.03	8.6E-16	6.8E-15	7.0E-10	1E-06	1E-05
	Cadmium	1.5E-01	0.001	2.8E-11	2.2E-10	2.5E-05	1E-06	9E-06
79	TEQ (ND=1/2 MDL)	2.5E-06	0.03	1.4E-14	1.1E-13	7.0E-10	2E-05	2E-04
	Cadmium	1.3E-01	0.001	2.4E-11	1.9E-10	2.5E-05	1E-06	8E-06
80	TEQ (ND=1/2 MDL)	2.5E-06	0.03	1.4E-14	1.1E-13	7.0E-10	2E-05	2E-04
	Cadmium	1.3E-01	0.001	2.4E-11	1.9E-10	2.5E-05	1E-06	8E-06

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE + SUBSURFACE SOILS

Population	**Hypothetical Future Construction Workers**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil + Subsurface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC	RBA	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
26	TEQ (ND=1/2 MDL)	3.0E-06	1.00	1.1E-12	4.2E-12	7.0E-10	2E-03	6E-03
	Mercury	1.2E-01	1.00	4.1E-08	1.6E-07	3.0E-04	1E-04	5E-04
	Antimony	1.3E+00	1.00	4.4E-07	1.8E-06	4.0E-04	1E-03	4E-03
	Cadmium	5.9E-01	1.00	2.1E-07	8.2E-07	1.0E-03	2E-04	8E-04
27	TEQ (ND=1/2 MDL)	2.4E-06	1.00	8.5E-13	3.4E-12	7.0E-10	1E-03	5E-03
	Mercury	1.2E-02	1.00	4.2E-09	1.7E-08	3.0E-04	1E-05	6E-05
	Antimony	9.0E-02	1.00	3.2E-08	1.3E-07	4.0E-04	8E-05	3E-04
	Cadmium	6.4E-02	1.00	2.2E-08	9.0E-08	1.0E-03	2E-05	9E-05
28	TEQ (ND=1/2 MDL)	5.3E-07	1.00	1.9E-13	7.4E-13	7.0E-10	3E-04	1E-03
	Mercury	1.6E-02	1.00	5.6E-09	2.2E-08	3.0E-04	2E-05	7E-05
	Antimony	9.0E-02	1.00	3.2E-08	1.3E-07	4.0E-04	8E-05	3E-04
	Cadmium	7.3E-02	1.00	2.6E-08	1.0E-07	1.0E-03	3E-05	1E-04
29	TEQ (ND=1/2 MDL)	2.8E-06	1.00	9.8E-13	3.9E-12	7.0E-10	1E-03	6E-03
	Mercury	3.2E-02	1.00	1.1E-08	4.5E-08	3.0E-04	4E-05	2E-04
	Antimony	1.9E-01	1.00	6.5E-08	2.6E-07	4.0E-04	2E-04	7E-04
	Cadmium	1.4E-01	1.00	4.8E-08	1.9E-07	1.0E-03	5E-05	2E-04
30	TEQ (ND=1/2 MDL)	1.7E-06	1.00	5.9E-13	2.3E-12	7.0E-10	8E-04	3E-03
	Mercury	2.4E-02	1.00	8.4E-09	3.4E-08	3.0E-04	3E-05	1E-04
	Antimony	2.0E-01	1.00	7.0E-08	2.8E-07	4.0E-04	2E-04	7E-04
	Cadmium	1.3E-01	1.00	4.6E-08	1.8E-07	1.0E-03	5E-05	2E-04
31	TEQ (ND=1/2 MDL)	4.5E-07	1.00	1.6E-13	6.3E-13	7.0E-10	2E-04	9E-04
	Mercury	3.4E-03	1.00	1.2E-09	4.8E-09	3.0E-04	4E-06	2E-05
	Antimony	4.2E-02	1.00	1.5E-08	5.9E-08	4.0E-04	4E-05	1E-04
	Cadmium	4.1E-02	1.00	1.4E-08	5.7E-08	1.0E-03	1E-05	6E-05
32	TEQ (ND=1/2 MDL)	9.3E-08	1.00	3.3E-14	1.3E-13	7.0E-10	5E-05	2E-04
	Mercury	3.1E-03	1.00	1.1E-09	4.3E-09	3.0E-04	4E-06	1E-05
	Antimony	1.5E-01	1.00	5.3E-08	2.1E-07	4.0E-04	1E-04	5E-04
	Cadmium	4.6E-02	1.00	1.6E-08	6.4E-08	1.0E-03	2E-05	6E-05
33	TEQ (ND=1/2 MDL)	9.0E-07	1.00	3.2E-13	1.3E-12	7.0E-10	5E-04	2E-03
	Mercury	1.7E-02	1.00	5.9E-09	2.3E-08	3.0E-04	2E-05	8E-05
	Antimony	9.1E-02	1.00	3.2E-08	1.3E-07	4.0E-04	8E-05	3E-04
	Cadmium	1.3E-01	1.00	4.4E-08	1.8E-07	1.0E-03	4E-05	2E-04
34	TEQ (ND=1/2 MDL)	7.0E-07	1.00	2.5E-13	9.8E-13	7.0E-10	4E-04	1E-03
	Mercury	1.3E-02	1.00	4.6E-09	1.8E-08	3.0E-04	2E-05	6E-05
	Antimony	8.5E-02	1.00	3.0E-08	1.2E-07	4.0E-04	7E-05	3E-04
	Cadmium	9.3E-02	1.00	3.3E-08	1.3E-07	1.0E-03	3E-05	1E-04
35	TEQ (ND=1/2 MDL)	2.1E-07	1.00	7.5E-14	3.0E-13	7.0E-10	1E-04	4E-04
	Mercury	1.8E-02	1.00	6.3E-09	2.5E-08	3.0E-04	2E-05	8E-05
	Antimony	2.3E-01	1.00	8.1E-08	3.2E-07	4.0E-04	2E-04	8E-04
	Cadmium	1.9E-01	1.00	6.7E-08	2.7E-07	1.0E-03	7E-05	3E-04
36	TEQ (ND=1/2 MDL)	9.1E-06	1.00	3.2E-12	1.3E-11	7.0E-10	5E-03	2E-02
	Mercury	2.7E-01	1.00	9.5E-08	3.8E-07	3.0E-04	3E-04	1E-03
	Antimony	8.0E-01	1.00	2.8E-07	1.1E-06	4.0E-04	7E-04	3E-03
	Cadmium	8.5E-01	1.00	3.0E-07	1.2E-06	1.0E-03	3E-04	1E-03
37	TEQ (ND=1/2 MDL)	1.4E-06	1.00	4.9E-13	1.9E-12	7.0E-10	7E-04	3E-03
	Mercury	4.0E-02	1.00	1.4E-08	5.6E-08	3.0E-04	5E-05	2E-04
	Antimony	3.3E-01	1.00	1.2E-07	4.6E-07	4.0E-04	3E-04	1E-03
	Cadmium	2.6E-01	1.00	9.0E-08	3.6E-07	1.0E-03	9E-05	4E-04
39	TEQ (ND=1/2 MDL)	2.5E-06	1.00	8.9E-13	3.6E-12	7.0E-10	1E-03	5E-03
	Mercury	6.4E-02	1.00	2.2E-08	9.0E-08	3.0E-04	7E-05	3E-04
	Antimony	4.0E-01	1.00	1.4E-07	5.6E-07	4.0E-04	4E-04	1E-03
	Cadmium	2.9E-01	1.00	1.0E-07	4.0E-07	1.0E-03	1E-04	4E-04
40	TEQ (ND=1/2 MDL)	3.4E-06	1.00	1.2E-12	4.8E-12	7.0E-10	2E-03	7E-03
	Mercury	4.0E-02	1.00	1.4E-08	5.6E-08	3.0E-04	5E-05	2E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.8E-01	1.00	9.8E-08	3.9E-07	1.0E-03	1E-04	4E-04
41	TEQ (ND=1/2 MDL)	3.3E-06	1.00	1.2E-12	4.7E-12	7.0E-10	2E-03	7E-03
	Mercury	4.8E-02	1.00	1.7E-08	6.7E-08	3.0E-04	6E-05	2E-04
	Antimony	4.2E-02	1.00	1.5E-08	5.9E-08	4.0E-04	4E-05	1E-04
	Cadmium	2.4E-01	1.00	8.3E-08	3.3E-07	1.0E-03	8E-05	3E-04
42	TEQ (ND=1/2 MDL)	7.5E-06	1.00	2.6E-12	1.0E-11	7.0E-10	4E-03	1E-02
	Mercury	1.6E-01	1.00	5.6E-08	2.2E-07	3.0E-04	2E-04	7E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	3.2E-01	1.00	1.1E-07	4.5E-07	1.0E-03	1E-04	4E-04
43	TEQ (ND=1/2 MDL)	3.9E-06	1.00	1.4E-12	5.5E-12	7.0E-10	2E-03	8E-03
	Mercury	1.2E-01	1.00	4.2E-08	1.7E-07	3.0E-04	1E-04	6E-04
	Antimony	7.6E-01	1.00	2.7E-07	1.1E-06	4.0E-04	7E-04	3E-03
	Cadmium	4.7E-01	1.00	1.6E-07	6.6E-07	1.0E-03	2E-04	7E-04
44	TEQ (ND=1/2 MDL)	2.1E-06	1.00	7.3E-13	2.9E-12	7.0E-10	1E-03	4E-03
	Mercury	1.6E-01	1.00	5.5E-08	2.2E-07	3.0E-04	2E-04	7E-04
	Antimony	1.2E+00	1.00	4.1E-07	1.6E-06	4.0E-04	1E-03	4E-03
	Cadmium	8.0E-01	1.00	2.8E-07	1.1E-06	1.0E-03	3E-04	1E-03
46	TEQ (ND=1/2 MDL)	2.8E-06	1.00	9.7E-13	3.9E-12	7.0E-10	1E-03	6E-03
	Mercury	4.6E-02	1.00	1.6E-08	6.4E-08	3.0E-04	5E-05	2E-04
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.3E-01	1.00	7.9E-08	3.2E-07	1.0E-03	8E-05	3E-04
47	TEQ (ND=1/2 MDL)	1.5E-05	1.00	5.4E-12	2.2E-11	7.0E-10	8E-03	3E-02
	Mercury	7.7E-01	1.00	2.7E-07	1.1E-06	3.0E-04	9E-04	4E-03
	Antimony	1.6E+00	1.00	5.6E-07	2.2E-06	4.0E-04	1E-03	6E-03
	Cadmium	5.0E+00	1.00	1.7E-06	7.0E-06	1.0E-03	2E-03	7E-03
48	TEQ (ND=1/2 MDL)	4.9E-05	1.00	1.7E-11	6.9E-11	7.0E-10	2E-02	1E-01
	Mercury	2.5E+00	1.00	8.8E-07	3.5E-06	3.0E-04	3E-03	1E-02
	Antimony	2.4E+00	1.00	8.4E-07	3.4E-06	4.0E-04	2E-03	8E-03
	Cadmium	8.3E+00	1.00	2.9E-06	1.2E-05	1.0E-03	3E-03	1E-02
49	TEQ (ND=1/2 MDL)	4.0E-05	1.00	1.4E-11	5.6E-11	7.0E-10	2E-02	8E-02
	Mercury	8.0E+00	1.00	2.8E-06	1.1E-05	3.0E-04	9E-03	4E-02
	Antimony	no data	1.00	--	--	4.0E-04	--	--
	Cadmium	2.0E+00	1.00	7.0E-07	2.8E-06	1.0E-03	7E-04	3E-03
50	TEQ (ND=1/2 MDL)	2.4E-05	1.00	8.3E-12	3.3E-11	7.0E-10	1E-02	5E-02
	Mercury	7.5E-01	1.00	2.6E-07	1.0E-06	3.0E-04	9E-04	3E-03
	Antimony	1.2E+00	1.00	4.0E-07	1.6E-06	4.0E-04	1E-03	4E-03
	Cadmium	3.8E+00	1.00	1.3E-06	5.3E-06	1.0E-03	1E-03	5E-03
51	TEQ (ND=1/2 MDL)	2.7E-05	1.00	9.3E-12	3.7E-11	7.0E-10	1E-02	5E-02
	Mercury	6.1E-01	1.00	2.2E-07	8.6E-07	3.0E-04	7E-04	3E-03
	Antimony	1.4E+00	1.00	4.9E-07	2.0E-06	4.0E-04	1E-03	5E-03
	Cadmium	4.9E+00	1.00	1.7E-06	6.8E-06	1.0E-03	2E-03	7E-03

52	TEQ (ND=1/2 MDL)	2.7E-05	1.00	9.3E-12	3.7E-11	7.0E-10	1E-02	5E-02
	Mercury	6.1E-01	1.00	2.1E-07	8.6E-07	3.0E-04	7E-04	3E-03
	Antimony	1.4E+00	1.00	4.9E-07	2.0E-06	4.0E-04	1E-03	5E-03
	Cadmium	4.8E+00	1.00	1.7E-06	6.8E-06	1.0E-03	2E-03	7E-03
53	TEQ (ND=1/2 MDL)	2.2E-05	1.00	7.6E-12	3.0E-11	7.0E-10	1E-02	4E-02
	Mercury	4.1E+00	1.00	1.4E-06	5.8E-06	3.0E-04	5E-03	2E-02
	Antimony	4.4E-01	1.00	1.5E-07	6.2E-07	4.0E-04	4E-04	2E-03
	Cadmium	1.2E+00	1.00	4.0E-07	1.6E-06	1.0E-03	4E-04	2E-03
54	TEQ (ND=1/2 MDL)	1.8E-05	1.00	6.2E-12	2.5E-11	7.0E-10	9E-03	4E-02
	Mercury	7.6E-01	1.00	2.7E-07	1.1E-06	3.0E-04	9E-04	4E-03
	Antimony	1.0E+00	1.00	3.6E-07	1.4E-06	4.0E-04	9E-04	4E-03
	Cadmium	2.5E+00	1.00	8.7E-07	3.5E-06	1.0E-03	9E-04	3E-03
55	TEQ (ND=1/2 MDL)	4.7E-05	1.00	1.6E-11	6.6E-11	7.0E-10	2E-02	9E-02
	Mercury	9.2E-01	1.00	3.2E-07	1.3E-06	3.0E-04	1E-03	4E-03
	Antimony	1.0E+00	1.00	3.5E-07	1.4E-06	4.0E-04	9E-04	4E-03
	Cadmium	4.7E+00	1.00	1.6E-06	6.6E-06	1.0E-03	2E-03	7E-03
56	TEQ (ND=1/2 MDL)	5.0E-05	1.00	1.7E-11	7.0E-11	7.0E-10	2E-02	1E-01
	Mercury	1.1E+00	1.00	3.8E-07	1.5E-06	3.0E-04	1E-03	5E-03
	Antimony	1.7E+00	1.00	5.8E-07	2.3E-06	4.0E-04	1E-03	6E-03
	Cadmium	6.0E+00	1.00	2.1E-06	8.4E-06	1.0E-03	2E-03	8E-03
58	TEQ (ND=1/2 MDL)	7.0E-05	1.00	2.4E-11	9.8E-11	7.0E-10	3E-02	1E-01
	Mercury	1.0E+00	1.00	3.5E-07	1.4E-06	3.0E-04	1E-03	5E-03
	Antimony	1.9E+00	1.00	6.7E-07	2.7E-06	4.0E-04	2E-03	7E-03
	Cadmium	4.0E+00	1.00	1.4E-06	5.6E-06	1.0E-03	1E-03	6E-03
59	TEQ (ND=1/2 MDL)	1.1E-05	1.00	4.0E-12	1.6E-11	7.0E-10	6E-03	2E-02
	Mercury	8.1E-01	1.00	2.8E-07	1.1E-06	3.0E-04	9E-04	4E-03
	Antimony	8.2E-01	1.00	2.9E-07	1.1E-06	4.0E-04	7E-04	3E-03
	Cadmium	3.1E+00	1.00	1.1E-06	4.3E-06	1.0E-03	1E-03	4E-03
60	TEQ (ND=1/2 MDL)	8.6E-06	1.00	3.0E-12	1.2E-11	7.0E-10	4E-03	2E-02
	Mercury	1.9E-01	1.00	6.5E-08	2.6E-07	3.0E-04	2E-04	9E-04
	Antimony	3.1E-01	1.00	1.1E-07	4.3E-07	4.0E-04	3E-04	1E-03
	Cadmium	1.7E+00	1.00	5.8E-07	2.3E-06	1.0E-03	6E-04	2E-03
61	TEQ (ND=1/2 MDL)	5.8E-06	1.00	2.0E-12	8.1E-12	7.0E-10	3E-03	1E-02
	Mercury	1.1E-01	1.00	3.9E-08	1.5E-07	3.0E-04	1E-04	5E-04
	Antimony	2.0E-01	1.00	7.0E-08	2.8E-07	4.0E-04	2E-04	7E-04
	Cadmium	1.1E+00	1.00	3.9E-07	1.5E-06	1.0E-03	4E-04	2E-03
62	TEQ (ND=1/2 MDL)	5.8E-05	1.00	2.0E-11	8.1E-11	7.0E-10	3E-02	1E-01
	Mercury	1.3E+00	1.00	4.4E-07	1.8E-06	3.0E-04	1E-03	6E-03
	Antimony	1.8E+00	1.00	6.3E-07	2.5E-06	4.0E-04	2E-03	6E-03
	Cadmium	6.8E+00	1.00	2.4E-06	9.5E-06	1.0E-03	2E-03	1E-02
64	TEQ (ND=1/2 MDL)	1.6E-05	1.00	5.5E-12	2.2E-11	7.0E-10	8E-03	3E-02
	Mercury	3.4E+00	1.00	1.2E-06	4.8E-06	3.0E-04	4E-03	2E-02
	Antimony	1.1E-01	1.00	3.7E-08	1.5E-07	4.0E-04	9E-05	4E-04
	Cadmium	7.8E-01	1.00	2.7E-07	1.1E-06	1.0E-03	3E-04	1E-03
66	TEQ (ND=1/2 MDL)	1.3E-06	1.00	4.7E-13	1.9E-12	7.0E-10	7E-04	3E-03
	Mercury	6.0E-02	1.00	2.1E-08	8.4E-08	3.0E-04	7E-05	3E-04
	Antimony	2.1E-01	1.00	7.5E-08	3.0E-07	4.0E-04	2E-04	7E-04
	Cadmium	9.4E-01	1.00	3.3E-07	1.3E-06	1.0E-03	3E-04	1E-03
67	TEQ (ND=1/2 MDL)	3.4E-05	1.00	1.2E-11	4.7E-11	7.0E-10	2E-02	7E-02
	Mercury	5.3E-02	1.00	1.9E-08	7.5E-08	3.0E-04	6E-05	2E-04
	Antimony	7.8E-01	1.00	2.7E-07	1.1E-06	4.0E-04	7E-04	3E-03
	Cadmium	2.4E+00	1.00	8.6E-07	3.4E-06	1.0E-03	9E-04	3E-03
68	TEQ (ND=1/2 MDL)	8.3E-05	1.00	2.9E-11	1.2E-10	7.0E-10	4E-02	2E-01
	Mercury	1.0E-02	1.00	3.5E-09	1.4E-08	3.0E-04	1E-05	5E-05
	Antimony	1.6E+00	1.00	5.6E-07	2.2E-06	4.0E-04	1E-03	6E-03
	Cadmium	4.8E+00	1.00	1.7E-06	6.7E-06	1.0E-03	2E-03	7E-03
70	TEQ (ND=1/2 MDL)	3.9E-06	1.00	1.4E-12	5.5E-12	7.0E-10	2E-03	8E-03
	Mercury	9.5E-02	1.00	3.3E-08	1.3E-07	3.0E-04	1E-04	4E-04
	Antimony	4.7E-01	1.00	1.6E-07	6.6E-07	4.0E-04	4E-04	2E-03
	Cadmium	1.9E+00	1.00	6.7E-07	2.7E-06	1.0E-03	7E-04	3E-03
71	TEQ (ND=1/2 MDL)	6.5E-05	1.00	2.3E-11	9.1E-11	7.0E-10	3E-02	1E-01
	Mercury	1.8E-02	1.00	6.3E-09	2.5E-08	3.0E-04	2E-05	8E-05
	Antimony	1.2E+00	1.00	4.3E-07	1.7E-06	4.0E-04	1E-03	4E-03
	Cadmium	4.0E+00	1.00	1.4E-06	5.7E-06	1.0E-03	1E-03	6E-03
72	TEQ (ND=1/2 MDL)	7.1E-05	1.00	2.5E-11	9.9E-11	7.0E-10	4E-02	1E-01
	Mercury	9.8E-03	1.00	3.4E-09	1.4E-08	3.0E-04	1E-05	5E-05
	Antimony	1.3E+00	1.00	4.7E-07	1.9E-06	4.0E-04	1E-03	5E-03
	Cadmium	4.3E+00	1.00	1.5E-06	6.0E-06	1.0E-03	1E-03	6E-03
74	TEQ (ND=1/2 MDL)	3.0E-04	1.00	1.0E-10	4.2E-10	7.0E-10	1E-01	6E-01
	Mercury	1.9E-01	1.00	6.7E-08	2.7E-07	3.0E-04	2E-04	9E-04
	Antimony	2.4E+00	1.00	8.3E-07	3.3E-06	4.0E-04	2E-03	8E-03
	Cadmium	6.4E+00	1.00	2.2E-06	8.9E-06	1.0E-03	2E-03	9E-03
75	TEQ (ND=1/2 MDL)	1.5E-07	1.00	5.2E-14	2.1E-13	7.0E-10	7E-05	3E-04
	Mercury	1.4E-02	1.00	4.7E-09	1.9E-08	3.0E-04	2E-05	6E-05
	Antimony	9.5E-02	1.00	3.3E-08	1.3E-07	4.0E-04	8E-05	3E-04
	Cadmium	1.4E-01	1.00	5.0E-08	2.0E-07	1.0E-03	5E-05	2E-04
76	TEQ (ND=1/2 MDL)	1.9E-06	1.00	6.7E-13	2.7E-12	7.0E-10	1E-03	4E-03
	Mercury	1.9E-02	1.00	6.5E-09	2.6E-08	3.0E-04	2E-05	9E-05
	Antimony	1.3E-01	1.00	4.4E-08	1.8E-07	4.0E-04	1E-04	4E-04
	Cadmium	1.0E-01	1.00	3.5E-08	1.4E-07	1.0E-03	4E-05	1E-04
77	TEQ (ND=1/2 MDL)	2.3E-06	1.00	8.2E-13	3.3E-12	7.0E-10	1E-03	5E-03
	Mercury	2.5E-02	1.00	8.7E-09	3.5E-08	3.0E-04	3E-05	1E-04
	Antimony	1.0E-01	1.00	3.7E-08	1.5E-07	4.0E-04	9E-05	4E-04
	Cadmium	1.2E-01	1.00	4.4E-08	1.7E-07	1.0E-03	4E-05	2E-04
78	TEQ (ND=1/2 MDL)	1.5E-07	1.00	5.2E-14	2.1E-13	7.0E-10	7E-05	3E-04
	Mercury	1.4E-02	1.00	4.7E-09	1.9E-08	3.0E-04	2E-05	6E-05
	Antimony	9.5E-02	1.00	3.3E-08	1.3E-07	4.0E-04	8E-05	3E-04
	Cadmium	1.4E-01	1.00	5.0E-08	2.0E-07	1.0E-03	5E-05	2E-04
79	TEQ (ND=1/2 MDL)	2.3E-06	1.00	8.2E-13	3.3E-12	7.0E-10	1E-03	5E-03
	Mercury	2.5E-02	1.00	8.7E-09	3.5E-08	3.0E-04	3E-05	1E-04
	Antimony	1.0E-01	1.00	3.7E-08	1.5E-07	4.0E-04	9E-05	4E-04
	Cadmium	1.2E-01	1.00	4.4E-08	1.7E-07	1.0E-03	4E-05	2E-04
80	TEQ (ND=1/2 MDL)	2.3E-06	1.00	8.2E-13	3.3E-12	7.0E-10	1E-03	5E-03
	Mercury	2.5E-02	1.00	8.7E-09	3.5E-08	3.0E-04	3E-05	1E-04
	Antimony	1.0E-01	1.00	3.7E-08	1.5E-07	4.0E-04	9E-05	4E-04
	Cadmium	1.2E-01	1.00	4.4E-08	1.7E-07	1.0E-03	4E-05	2E-04

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 UPLAND SURFACE + SUBSURFACE SOILS

Population	**Hypothetical Future Construction Workers**
Exposure Area	**Random 20-acre grids across OU3 Upland Area**
Medium	**Surface Soil + Subsurface Soil**
Exposure Route	**Dermal Contact**

Grid	COPC	EPC	ABSd	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
26	TEQ (ND=1/2 MDL)	3.0E-06	0.03	6.7E-14	4.0E-13	7.0E-10	1E-04	6E-04
	Cadmium	5.9E-01	0.001	4.4E-10	2.6E-09	2.5E-05	2E-05	1E-04
27	TEQ (ND=1/2 MDL)	2.4E-06	0.03	5.4E-14	3.3E-13	7.0E-10	8E-05	5E-04
	Cadmium	6.4E-02	0.001	4.8E-11	2.9E-10	2.5E-05	2E-06	1E-05
28	TEQ (ND=1/2 MDL)	5.3E-07	0.03	1.2E-14	7.2E-14	7.0E-10	2E-05	1E-04
	Cadmium	7.3E-02	0.001	5.5E-11	3.3E-10	2.5E-05	2E-06	1E-05
29	TEQ (ND=1/2 MDL)	2.8E-06	0.03	6.3E-14	3.8E-13	7.0E-10	9E-05	5E-04
	Cadmium	1.4E-01	0.001	1.0E-10	6.2E-10	2.5E-05	4E-06	2E-05
30	TEQ (ND=1/2 MDL)	1.7E-06	0.03	3.8E-14	2.3E-13	7.0E-10	5E-05	3E-04
	Cadmium	1.3E-01	0.001	9.7E-11	5.8E-10	2.5E-05	4E-06	2E-05
31	TEQ (ND=1/2 MDL)	4.5E-07	0.03	1.0E-14	6.1E-14	7.0E-10	1E-05	9E-05
	Cadmium	4.1E-02	0.001	3.1E-11	1.8E-10	2.5E-05	1E-06	7E-06
32	TEQ (ND=1/2 MDL)	9.3E-08	0.03	2.1E-15	1.3E-14	7.0E-10	3E-06	2E-05
	Cadmium	4.6E-02	0.001	3.4E-11	2.1E-10	2.5E-05	1E-06	8E-06
33	TEQ (ND=1/2 MDL)	9.0E-07	0.03	2.0E-14	1.2E-13	7.0E-10	3E-05	2E-04
	Cadmium	1.3E-01	0.001	9.5E-11	5.7E-10	2.5E-05	4E-06	2E-05
34	TEQ (ND=1/2 MDL)	7.0E-07	0.03	1.6E-14	9.4E-14	7.0E-10	2E-05	1E-04
	Cadmium	9.3E-02	0.001	7.0E-11	4.2E-10	2.5E-05	3E-06	2E-05
35	TEQ (ND=1/2 MDL)	2.1E-07	0.03	4.8E-15	2.9E-14	7.0E-10	7E-06	4E-05
	Cadmium	1.9E-01	0.001	1.4E-10	8.5E-10	2.5E-05	6E-06	3E-05
36	TEQ (ND=1/2 MDL)	9.1E-06	0.03	2.0E-13	1.2E-12	7.0E-10	3E-04	2E-03
	Cadmium	8.5E-01	0.001	6.4E-10	3.8E-09	2.5E-05	3E-05	2E-04
37	TEQ (ND=1/2 MDL)	1.4E-06	0.03	3.1E-14	1.9E-13	7.0E-10	4E-05	3E-04
	Cadmium	2.6E-01	0.001	1.9E-10	1.2E-09	2.5E-05	8E-06	5E-05
39	TEQ (ND=1/2 MDL)	2.5E-06	0.03	5.7E-14	3.4E-13	7.0E-10	8E-05	5E-04
	Cadmium	2.9E-01	0.001	2.1E-10	1.3E-09	2.5E-05	9E-06	5E-05
40	TEQ (ND=1/2 MDL)	3.4E-06	0.03	7.7E-14	4.6E-13	7.0E-10	1E-04	7E-04
	Cadmium	2.8E-01	0.001	2.1E-10	1.3E-09	2.5E-05	8E-06	5E-05
41	TEQ (ND=1/2 MDL)	3.3E-06	0.03	7.5E-14	4.5E-13	7.0E-10	1E-04	6E-04
	Cadmium	2.4E-01	0.001	1.8E-10	1.1E-09	2.5E-05	7E-06	4E-05
42	TEQ (ND=1/2 MDL)	7.5E-06	0.03	1.7E-13	1.0E-12	7.0E-10	2E-04	1E-03
	Cadmium	3.2E-01	0.001	2.4E-10	1.4E-09	2.5E-05	1E-05	6E-05
43	TEQ (ND=1/2 MDL)	3.9E-06	0.03	8.8E-14	5.3E-13	7.0E-10	1E-04	8E-04
	Cadmium	4.7E-01	0.001	3.5E-10	2.1E-09	2.5E-05	1E-05	8E-05
44	TEQ (ND=1/2 MDL)	2.1E-06	0.03	4.7E-14	2.8E-13	7.0E-10	7E-05	4E-04
	Cadmium	8.0E-01	0.001	6.0E-10	3.6E-09	2.5E-05	2E-05	1E-04
46	TEQ (ND=1/2 MDL)	2.8E-06	0.03	6.2E-14	3.7E-13	7.0E-10	9E-05	5E-04
	Cadmium	2.3E-01	0.001	1.7E-10	1.0E-09	2.5E-05	7E-06	4E-05
47	TEQ (ND=1/2 MDL)	1.5E-05	0.03	3.5E-13	2.1E-12	7.0E-10	5E-04	3E-03
	Cadmium	5.0E+00	0.001	3.7E-09	2.2E-08	2.5E-05	1E-04	9E-04
48	TEQ (ND=1/2 MDL)	4.9E-05	0.03	1.1E-12	6.6E-12	7.0E-10	2E-03	9E-03
	Cadmium	8.3E+00	0.001	6.2E-09	3.7E-08	2.5E-05	2E-04	1E-03
49	TEQ (ND=1/2 MDL)	4.0E-05	0.03	8.9E-13	5.4E-12	7.0E-10	1E-03	8E-03
	Cadmium	2.0E+00	0.001	1.5E-09	9.0E-09	2.5E-05	6E-05	4E-04
50	TEQ (ND=1/2 MDL)	2.4E-05	0.03	5.3E-13	3.2E-12	7.0E-10	8E-04	5E-03
	Cadmium	3.8E+00	0.001	2.8E-09	1.7E-08	2.5E-05	1E-04	7E-04
51	TEQ (ND=1/2 MDL)	2.7E-05	0.03	6.0E-13	3.6E-12	7.0E-10	9E-04	5E-03
	Cadmium	4.9E+00	0.001	3.6E-09	2.2E-08	2.5E-05	1E-04	9E-04
52	TEQ (ND=1/2 MDL)	2.7E-05	0.03	6.0E-13	3.6E-12	7.0E-10	9E-04	5E-03
	Cadmium	4.8E+00	0.001	3.6E-09	2.2E-08	2.5E-05	1E-04	9E-04
53	TEQ (ND=1/2 MDL)	2.2E-05	0.03	4.9E-13	2.9E-12	7.0E-10	7E-04	4E-03
	Cadmium	1.2E+00	0.001	8.6E-10	5.2E-09	2.5E-05	3E-05	2E-04
54	TEQ (ND=1/2 MDL)	1.8E-05	0.03	4.0E-13	2.4E-12	7.0E-10	6E-04	3E-03
	Cadmium	2.5E+00	0.001	1.9E-09	1.1E-08	2.5E-05	7E-05	4E-04
55	TEQ (ND=1/2 MDL)	4.7E-05	0.03	1.1E-12	6.3E-12	7.0E-10	2E-03	9E-03
	Cadmium	4.7E+00	0.001	3.5E-09	2.1E-08	2.5E-05	1E-04	8E-04
56	TEQ (ND=1/2 MDL)	5.0E-05	0.03	1.1E-12	6.7E-12	7.0E-10	2E-03	1E-02
	Cadmium	6.0E+00	0.001	4.5E-09	2.7E-08	2.5E-05	2E-04	1E-03
58	TEQ (ND=1/2 MDL)	7.0E-05	0.03	1.6E-12	9.4E-12	7.0E-10	2E-03	1E-02
	Cadmium	4.0E+00	0.001	3.0E-09	1.8E-08	2.5E-05	1E-04	7E-04
59	TEQ (ND=1/2 MDL)	1.1E-05	0.03	2.6E-13	1.5E-12	7.0E-10	4E-04	2E-03
	Cadmium	3.1E+00	0.001	2.3E-09	1.4E-08	2.5E-05	9E-05	6E-04
60	TEQ (ND=1/2 MDL)	8.6E-06	0.03	1.9E-13	1.2E-12	7.0E-10	3E-04	2E-03
	Cadmium	1.7E+00	0.001	1.2E-09	7.5E-09	2.5E-05	5E-05	3E-04
61	TEQ (ND=1/2 MDL)	5.8E-06	0.03	1.3E-13	7.8E-13	7.0E-10	2E-04	1E-03
	Cadmium	1.1E+00	0.001	8.2E-10	4.9E-09	2.5E-05	3E-05	2E-04
62	TEQ (ND=1/2 MDL)	5.8E-05	0.03	1.3E-12	7.8E-12	7.0E-10	2E-03	1E-02
	Cadmium	6.8E+00	0.001	5.1E-09	3.0E-08	2.5E-05	2E-04	1E-03
64	TEQ (ND=1/2 MDL)	1.6E-05	0.03	3.6E-13	2.1E-12	7.0E-10	5E-04	3E-03
	Cadmium	7.8E-01	0.001	5.9E-10	3.5E-09	2.5E-05	2E-05	1E-04
66	TEQ (ND=1/2 MDL)	1.3E-06	0.03	3.0E-14	1.8E-13	7.0E-10	4E-05	3E-04
	Cadmium	9.4E-01	0.001	7.0E-10	4.2E-09	2.5E-05	3E-05	2E-04
67	TEQ (ND=1/2 MDL)	3.4E-05	0.03	7.6E-13	4.5E-12	7.0E-10	1E-03	6E-03
	Cadmium	2.4E+00	0.001	1.8E-09	1.1E-08	2.5E-05	7E-05	4E-04
68	TEQ (ND=1/2 MDL)	8.3E-05	0.03	1.9E-12	1.1E-11	7.0E-10	3E-03	2E-02
	Cadmium	4.8E+00	0.001	3.6E-09	2.2E-08	2.5E-05	1E-04	9E-04
70	TEQ (ND=1/2 MDL)	3.9E-06	0.03	8.7E-14	5.2E-13	7.0E-10	1E-04	7E-04
	Cadmium	1.9E+00	0.001	1.4E-09	8.5E-09	2.5E-05	6E-05	3E-04
71	TEQ (ND=1/2 MDL)	6.5E-05	0.03	1.5E-12	8.7E-12	7.0E-10	2E-03	1E-02
	Cadmium	4.0E+00	0.001	3.0E-09	1.8E-08	2.5E-05	1E-04	7E-04
72	TEQ (ND=1/2 MDL)	7.1E-05	0.03	1.6E-12	9.5E-12	7.0E-10	2E-03	1E-02
	Cadmium	4.3E+00	0.001	3.2E-09	1.9E-08	2.5E-05	1E-04	8E-04
74	TEQ (ND=1/2 MDL)	3.0E-04	0.03	6.7E-12	4.0E-11	7.0E-10	1E-02	6E-02
	Cadmium	6.4E+00	0.001	4.8E-09	2.9E-08	2.5E-05	2E-04	1E-03
75	TEQ (ND=1/2 MDL)	1.5E-07	0.03	3.3E-15	2.0E-14	7.0E-10	5E-06	3E-05
	Cadmium	1.4E-01	0.001	1.1E-10	6.5E-10	2.5E-05	4E-06	3E-05
76	TEQ (ND=1/2 MDL)	1.9E-06	0.03	4.3E-14	2.6E-13	7.0E-10	6E-05	4E-04
	Cadmium	1.0E-01	0.001	7.5E-11	4.5E-10	2.5E-05	3E-06	2E-05
77	TEQ (ND=1/2 MDL)	2.3E-06	0.03	5.3E-14	3.2E-13	7.0E-10	8E-05	5E-04
	Cadmium	1.2E-01	0.001	9.3E-11	5.6E-10	2.5E-05	4E-06	2E-05
78	TEQ (ND=1/2 MDL)	1.5E-07	0.03	3.3E-15	2.0E-14	7.0E-10	5E-06	3E-05
	Cadmium	1.4E-01	0.001	1.1E-10	6.5E-10	2.5E-05	4E-06	3E-05
79	TEQ (ND=1/2 MDL)	2.3E-06	0.03	5.3E-14	3.2E-13	7.0E-10	8E-05	5E-04
	Cadmium	1.2E-01	0.001	9.3E-11	5.6E-10	2.5E-05	4E-06	2E-05
80	TEQ (ND=1/2 MDL)	2.3E-06	0.03	5.3E-14	3.2E-13	7.0E-10	8E-05	5E-04
	Cadmium	1.2E-01	0.001	9.3E-11	5.6E-10	2.5E-05	4E-06	2E-05

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 FLOODPLAIN SURFACE SOILS

Population	**Current/Hypothetical Future Hikers**
Exposure Area	**Random 100-acre grids across OU3 Floodplain Area**
Medium	**Surface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC mg/kg	RBA	Non-Cancer DI (mg/kg-d) CTE	Non-Cancer DI (mg/kg-d) RME	Non-Cancer RfD mg/kg-d	Non-Cancer HQ CTE	Non-Cancer HQ RME
81	TEQ (ND=1/2 MDL)	5.7E-07	1.00	4.2E-14	1.6E-13	7.0E-10	6E-05	2E-04
	Mercury	3.3E-02	1.00	2.4E-09	9.2E-09	3.0E-04	8E-06	3E-05
	Barium	1.9E+02	1.00	1.4E-05	5.2E-05	2.0E-01	7E-05	3E-04
82	TEQ (ND=1/2 MDL)	2.8E-07	1.00	2.0E-14	7.8E-14	7.0E-10	3E-05	1E-04
	Mercury	9.7E-02	1.00	7.1E-09	2.7E-08	3.0E-04	2E-05	9E-05
	Barium	1.7E+02	1.00	1.2E-05	4.8E-05	2.0E-01	6E-05	2E-04
84	TEQ (ND=1/2 MDL)	2.5E-07	1.00	1.8E-14	6.9E-14	7.0E-10	3E-05	1E-04
	Mercury	9.0E-02	1.00	6.5E-09	2.5E-08	3.0E-04	2E-05	8E-05
	Barium	1.7E+02	1.00	1.2E-05	4.6E-05	2.0E-01	6E-05	2E-04
86	TEQ (ND=1/2 MDL)	1.8E-05	1.00	1.3E-12	5.1E-12	7.0E-10	2E-03	7E-03
	Mercury	5.3E-01	1.00	3.9E-08	1.5E-07	3.0E-04	1E-04	5E-04
	Barium	4.6E+02	1.00	3.3E-05	1.3E-04	2.0E-01	2E-04	6E-04
87	TEQ (ND=1/2 MDL)	6.8E-06	1.00	4.9E-13	1.9E-12	7.0E-10	7E-04	3E-03
	Mercury	1.0E-01	1.00	7.3E-09	2.8E-08	3.0E-04	2E-05	9E-05
	Barium	7.7E+02	1.00	5.6E-05	2.2E-04	2.0E-01	3E-04	1E-03
88	TEQ (ND=1/2 MDL)	5.6E-05	1.00	4.0E-12	1.6E-11	7.0E-10	6E-03	2E-02
	Mercury	6.9E-01	1.00	5.0E-08	1.9E-07	3.0E-04	2E-04	6E-04
	Barium	1.5E+03	1.00	1.1E-04	4.0E-04	2.0E-01	5E-04	2E-03
89	TEQ (ND=1/2 MDL)	9.7E-06	1.00	7.0E-13	2.7E-12	7.0E-10	1E-03	4E-03
	Mercury	1.8E-01	1.00	1.3E-08	5.0E-08	3.0E-04	4E-05	2E-04
	Barium	5.0E+02	1.00	3.7E-05	1.4E-04	2.0E-01	2E-04	7E-04
90	TEQ (ND=1/2 MDL)	5.5E-05	1.00	4.0E-12	1.5E-11	7.0E-10	6E-03	2E-02
	Mercury	1.5E+00	1.00	1.1E-07	4.2E-07	3.0E-04	4E-04	1E-03
	Barium	7.6E+02	1.00	5.6E-05	2.1E-04	2.0E-01	3E-04	1E-03
91	TEQ (ND=1/2 MDL)	2.3E-05	1.00	1.6E-12	6.3E-12	7.0E-10	2E-03	9E-03
	Mercury	8.3E-01	1.00	6.0E-08	2.3E-07	3.0E-04	2E-04	8E-04
	Barium	9.2E+02	1.00	6.7E-05	2.6E-04	2.0E-01	3E-04	1E-03
93	TEQ (ND=1/2 MDL)	4.6E-05	1.00	3.3E-12	1.3E-11	7.0E-10	5E-03	2E-02
	Mercury	3.2E+00	1.00	2.3E-07	8.8E-07	3.0E-04	8E-04	3E-03
	Barium	4.3E+02	1.00	3.1E-05	1.2E-04	2.0E-01	2E-04	6E-04
94	TEQ (ND=1/2 MDL)	3.2E-05	1.00	2.4E-12	9.1E-12	7.0E-10	3E-03	1E-02
	Mercury	9.4E-01	1.00	6.8E-08	2.6E-07	3.0E-04	2E-04	9E-04
	Barium	4.1E+02	1.00	3.0E-05	1.2E-04	2.0E-01	2E-04	6E-04
95	TEQ (ND=1/2 MDL)	2.1E-05	1.00	1.5E-12	5.9E-12	7.0E-10	2E-03	8E-03
	Mercury	1.0E+00	1.00	7.6E-08	2.9E-07	3.0E-04	3E-04	1E-03
	Barium	3.9E+02	1.00	2.9E-05	1.1E-04	2.0E-01	1E-04	6E-04
97	TEQ (ND=1/2 MDL)	2.7E-06	1.00	2.0E-13	7.6E-13	7.0E-10	3E-04	1E-03
	Mercury	4.1E-02	1.00	3.0E-09	1.1E-08	3.0E-04	1E-05	4E-05
	Barium	2.4E+02	1.00	1.7E-05	6.7E-05	2.0E-01	9E-05	3E-04
98	TEQ (ND=1/2 MDL)	1.4E-05	1.00	1.1E-12	4.0E-12	7.0E-10	2E-03	6E-03
	Mercury	3.1E-01	1.00	2.2E-08	8.5E-08	3.0E-04	7E-05	3E-04
	Barium	2.2E+03	1.00	1.6E-04	6.1E-04	2.0E-01	8E-04	3E-03

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 FLOODPLAIN SURFACE SOILS

Population	**Current/Hypothetical Future Hikers**
Exposure Area	**Random 100-acre grids across OU3 Floodplain Area**
Medium	**Surface Soil**
Exposure Route	**Dermal Contact**

Grid	COPC	EPC	ABSd	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
81	TEQ (ND=1/2 MDL)	5.7E-07	0.03	1.2E-15	1.7E-14	7.0E-10	2E-06	2E-05
82	TEQ (ND=1/2 MDL)	2.8E-07	0.03	6.1E-16	2.3E-15	7.0E-10	9E-07	3E-06
84	TEQ (ND=1/2 MDL)	2.5E-07	0.03	5.4E-16	2.1E-15	7.0E-10	8E-07	3E-06
86	TEQ (ND=1/2 MDL)	1.8E-05	0.03	4.0E-14	1.5E-13	7.0E-10	6E-05	2E-04
87	TEQ (ND=1/2 MDL)	6.8E-06	0.03	1.5E-14	5.7E-14	7.0E-10	2E-05	8E-05
88	TEQ (ND=1/2 MDL)	5.6E-05	0.03	1.2E-13	4.7E-13	7.0E-10	2E-04	7E-04
89	TEQ (ND=1/2 MDL)	9.7E-06	0.03	2.1E-14	8.1E-14	7.0E-10	3E-05	1E-04
90	TEQ (ND=1/2 MDL)	5.5E-05	0.03	1.2E-13	4.6E-13	7.0E-10	2E-04	7E-04
91	TEQ (ND=1/2 MDL)	2.3E-05	0.03	4.9E-14	1.9E-13	7.0E-10	7E-05	3E-04
93	TEQ (ND=1/2 MDL)	4.6E-05	0.03	1.0E-13	3.9E-13	7.0E-10	1E-04	6E-04
94	TEQ (ND=1/2 MDL)	3.2E-05	0.03	7.1E-14	2.7E-13	7.0E-10	1E-04	4E-04
95	TEQ (ND=1/2 MDL)	2.1E-05	0.03	4.6E-14	1.8E-13	7.0E-10	7E-05	3E-04
97	TEQ (ND=1/2 MDL)	2.7E-06	0.03	5.9E-15	2.3E-14	7.0E-10	8E-06	3E-05
98	TEQ (ND=1/2 MDL)	1.4E-05	0.03	3.2E-14	1.2E-13	7.0E-10	5E-05	2E-04

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 FLOODPLAIN SURFACE SOILS

Population	**Current/Hypothetical Future Campers**
Exposure Area	**Random 100-acre grids across OU3 Floodplain Area**
Medium	**Surface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC mg/kg	RBA	Non-Cancer DI (mg/kg-d) CTE	RME	RfD mg/kg-d	HQ CTE	RME
81	TEQ (ND=1/2 MDL)	5.7E-07	1.00	1.1E-13	3.0E-13	7.0E-10	2E-04	4E-04
	Mercury	3.3E-02	1.00	6.2E-09	1.8E-08	3.0E-04	2E-05	6E-05
	Barium	1.9E+02	1.00	3.5E-05	1.0E-04	2.0E-01	2E-04	5E-04
82	TEQ (ND=1/2 MDL)	2.8E-07	1.00	5.2E-14	1.5E-13	7.0E-10	7E-05	2E-04
	Mercury	9.7E-02	1.00	1.8E-08	5.2E-08	3.0E-04	6E-05	2E-04
	Barium	1.7E+02	1.00	3.2E-05	9.1E-05	2.0E-01	2E-04	5E-04
84	TEQ (ND=1/2 MDL)	2.5E-07	1.00	4.6E-14	1.3E-13	7.0E-10	7E-05	2E-04
	Mercury	9.0E-02	1.00	1.7E-08	4.8E-08	3.0E-04	6E-05	2E-04
	Barium	1.7E+02	1.00	3.1E-05	8.8E-05	2.0E-01	2E-04	4E-04
86	TEQ (ND=1/2 MDL)	1.8E-05	1.00	3.4E-12	9.8E-12	7.0E-10	5E-03	1E-02
	Mercury	5.3E-01	1.00	9.9E-08	2.8E-07	3.0E-04	3E-04	9E-04
	Barium	4.6E+02	1.00	8.6E-05	2.4E-04	2.0E-01	4E-04	1E-03
87	TEQ (ND=1/2 MDL)	6.8E-06	1.00	1.3E-12	3.6E-12	7.0E-10	2E-03	5E-03
	Mercury	1.0E-01	1.00	1.9E-08	5.3E-08	3.0E-04	6E-05	2E-04
	Barium	7.7E+02	1.00	1.4E-04	4.1E-04	2.0E-01	7E-04	2E-03
88	TEQ (ND=1/2 MDL)	5.6E-05	1.00	1.0E-11	3.0E-11	7.0E-10	1E-02	4E-02
	Mercury	6.9E-01	1.00	1.3E-07	3.7E-07	3.0E-04	4E-04	1E-03
	Barium	1.5E+03	1.00	2.7E-04	7.7E-04	2.0E-01	1E-03	4E-03
89	TEQ (ND=1/2 MDL)	9.7E-06	1.00	1.8E-12	5.1E-12	7.0E-10	3E-03	7E-03
	Mercury	1.8E-01	1.00	3.4E-08	9.5E-08	3.0E-04	1E-04	3E-04
	Barium	5.0E+02	1.00	9.4E-05	2.7E-04	2.0E-01	5E-04	1E-03
90	TEQ (ND=1/2 MDL)	5.5E-05	1.00	1.0E-11	2.9E-11	7.0E-10	1E-02	4E-02
	Mercury	1.5E+00	1.00	2.8E-07	7.9E-07	3.0E-04	9E-04	3E-03
	Barium	7.6E+02	1.00	1.4E-04	4.1E-04	2.0E-01	7E-04	2E-03
91	TEQ (ND=1/2 MDL)	2.3E-05	1.00	4.2E-12	1.2E-11	7.0E-10	6E-03	2E-02
	Mercury	8.3E-01	1.00	1.6E-07	4.4E-07	3.0E-04	5E-04	1E-03
	Barium	9.2E+02	1.00	1.7E-04	4.9E-04	2.0E-01	9E-04	2E-03
93	TEQ (ND=1/2 MDL)	4.6E-05	1.00	8.6E-12	2.4E-11	7.0E-10	1E-02	3E-02
	Mercury	3.2E+00	1.00	5.9E-07	1.7E-06	3.0E-04	2E-03	6E-03
	Barium	4.3E+02	1.00	8.0E-05	2.3E-04	2.0E-01	4E-04	1E-03
94	TEQ (ND=1/2 MDL)	3.2E-05	1.00	6.1E-12	1.7E-11	7.0E-10	9E-03	2E-02
	Mercury	9.4E-01	1.00	1.8E-07	5.0E-07	3.0E-04	6E-04	2E-03
	Barium	4.1E+02	1.00	7.8E-05	2.2E-04	2.0E-01	4E-04	1E-03
95	TEQ (ND=1/2 MDL)	2.1E-05	1.00	3.9E-12	1.1E-11	7.0E-10	6E-03	2E-02
	Mercury	1.0E+00	1.00	2.0E-07	5.5E-07	3.0E-04	7E-04	2E-03
	Barium	3.9E+02	1.00	7.4E-05	2.1E-04	2.0E-01	4E-04	1E-03
97	TEQ (ND=1/2 MDL)	2.7E-06	1.00	5.1E-13	1.4E-12	7.0E-10	7E-04	2E-03
	Mercury	4.1E-02	1.00	7.7E-09	2.2E-08	3.0E-04	3E-05	7E-05
	Barium	2.4E+02	1.00	4.5E-05	1.3E-04	2.0E-01	2E-04	6E-04
98	TEQ (ND=1/2 MDL)	1.4E-05	1.00	2.7E-12	7.7E-12	7.0E-10	4E-03	1E-02
	Mercury	3.1E-01	1.00	5.7E-08	1.6E-07	3.0E-04	2E-04	5E-04
	Barium	2.2E+03	1.00	4.1E-04	1.2E-03	2.0E-01	2E-03	6E-03

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 FLOODPLAIN SURFACE SOILS

Population	**Current/Hypothetical Future Campers**
Exposure Area	**Random 100-acre grids across OU3 Floodplain Area**
Medium	**Surface Soil**
Exposure Route	**Dermal Contact**

Grid	COPC	EPC	ABSd	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
81	TEQ (ND=1/2 MDL)	5.7E-07	0.03	3.2E-15	2.6E-14	7.0E-10	5E-06	4E-05
82	TEQ (ND=1/2 MDL)	2.8E-07	0.03	1.6E-15	4.5E-15	7.0E-10	2E-06	6E-06
84	TEQ (ND=1/2 MDL)	2.5E-07	0.03	1.4E-15	3.9E-15	7.0E-10	2E-06	6E-06
86	TEQ (ND=1/2 MDL)	1.8E-05	0.03	1.0E-13	2.9E-13	7.0E-10	1E-04	4E-04
87	TEQ (ND=1/2 MDL)	6.8E-06	0.03	3.8E-14	1.1E-13	7.0E-10	5E-05	2E-04
88	TEQ (ND=1/2 MDL)	5.6E-05	0.03	3.1E-13	8.9E-13	7.0E-10	4E-04	1E-03
89	TEQ (ND=1/2 MDL)	9.7E-06	0.03	5.4E-14	1.5E-13	7.0E-10	8E-05	2E-04
90	TEQ (ND=1/2 MDL)	5.5E-05	0.03	3.1E-13	8.8E-13	7.0E-10	4E-04	1E-03
91	TEQ (ND=1/2 MDL)	2.3E-05	0.03	1.3E-13	3.6E-13	7.0E-10	2E-04	5E-04
93	TEQ (ND=1/2 MDL)	4.6E-05	0.03	2.6E-13	7.3E-13	7.0E-10	4E-04	1E-03
94	TEQ (ND=1/2 MDL)	3.2E-05	0.03	1.8E-13	5.2E-13	7.0E-10	3E-04	7E-04
95	TEQ (ND=1/2 MDL)	2.1E-05	0.03	1.2E-13	3.4E-13	7.0E-10	2E-04	5E-04
97	TEQ (ND=1/2 MDL)	2.7E-06	0.03	1.5E-14	4.3E-14	7.0E-10	2E-05	6E-05
98	TEQ (ND=1/2 MDL)	1.4E-05	0.03	8.1E-14	2.3E-13	7.0E-10	1E-04	3E-04

APPENDIX D. DETAILED RISK CALCULATIONS
DIRECT CONTACT TO OU3 FLOODPLAIN SURFACE SOILS

Population	**Current/Hypothetical Future Fisher**
Exposure Area	**Random 100-acre grids across OU3 Floodplain Area**
Medium	**Surface Soil**
Exposure Route	**Incidental Ingestion**

Grid	COPC	EPC mg/kg	RBA	Non-Cancer DI (mg/kg-d) CTE	Non-Cancer DI (mg/kg-d) RME	Non-Cancer RfD mg/kg-d	Non-Cancer HQ CTE	Non-Cancer HQ RME
81	TEQ (ND=1/2 MDL)	5.7E-07	1.00	6.3E-14	2.4E-13	7.0E-10	9E-05	3E-04
	Mercury	3.3E-02	1.00	3.6E-09	1.4E-08	3.0E-04	1E-05	5E-05
	Barium	1.9E+02	1.00	2.1E-05	7.9E-05	2.0E-01	1E-04	4E-04
82	TEQ (ND=1/2 MDL)	2.8E-07	1.00	3.1E-14	1.2E-13	7.0E-10	4E-05	2E-04
	Mercury	9.7E-02	1.00	1.1E-08	4.1E-08	3.0E-04	4E-05	1E-04
	Barium	1.7E+02	1.00	1.9E-05	7.2E-05	2.0E-01	9E-05	4E-04
84	TEQ (ND=1/2 MDL)	2.5E-07	1.00	2.7E-14	1.0E-13	7.0E-10	4E-05	1E-04
	Mercury	9.0E-02	1.00	9.8E-09	3.8E-08	3.0E-04	3E-05	1E-04
	Barium	1.7E+02	1.00	1.8E-05	6.9E-05	2.0E-01	9E-05	3E-04
86	TEQ (ND=1/2 MDL)	1.8E-05	1.00	2.0E-12	7.7E-12	7.0E-10	3E-03	1E-02
	Mercury	5.3E-01	1.00	5.8E-08	2.2E-07	3.0E-04	2E-04	7E-04
	Barium	4.6E+02	1.00	5.0E-05	1.9E-04	2.0E-01	2E-04	1E-03
87	TEQ (ND=1/2 MDL)	6.8E-06	1.00	7.4E-13	2.8E-12	7.0E-10	1E-03	4E-03
	Mercury	1.0E-01	1.00	1.1E-08	4.2E-08	3.0E-04	4E-05	1E-04
	Barium	7.7E+02	1.00	8.4E-05	3.2E-04	2.0E-01	4E-04	2E-03
88	TEQ (ND=1/2 MDL)	5.6E-05	1.00	6.1E-12	2.3E-11	7.0E-10	9E-03	3E-02
	Mercury	6.9E-01	1.00	7.5E-08	2.9E-07	3.0E-04	3E-04	1E-03
	Barium	1.5E+03	1.00	1.6E-04	6.1E-04	2.0E-01	8E-04	3E-03
89	TEQ (ND=1/2 MDL)	9.7E-06	1.00	1.1E-12	4.1E-12	7.0E-10	2E-03	6E-03
	Mercury	1.8E-01	1.00	2.0E-08	7.5E-08	3.0E-04	7E-05	2E-04
	Barium	5.0E+02	1.00	5.5E-05	2.1E-04	2.0E-01	3E-04	1E-03
90	TEQ (ND=1/2 MDL)	5.5E-05	1.00	6.0E-12	2.3E-11	7.0E-10	9E-03	3E-02
	Mercury	1.5E+00	1.00	1.6E-07	6.3E-07	3.0E-04	5E-04	2E-03
	Barium	7.6E+02	1.00	8.3E-05	3.2E-04	2.0E-01	4E-04	2E-03
91	TEQ (ND=1/2 MDL)	2.3E-05	1.00	2.5E-12	9.4E-12	7.0E-10	4E-03	1E-02
	Mercury	8.3E-01	1.00	9.1E-08	3.5E-07	3.0E-04	3E-04	1E-03
	Barium	9.2E+02	1.00	1.0E-04	3.8E-04	2.0E-01	5E-04	2E-03
93	TEQ (ND=1/2 MDL)	4.6E-05	1.00	5.0E-12	1.9E-11	7.0E-10	7E-03	3E-02
	Mercury	3.2E+00	1.00	3.4E-07	1.3E-06	3.0E-04	1E-03	4E-03
	Barium	4.3E+02	1.00	4.7E-05	1.8E-04	2.0E-01	2E-04	9E-04
94	TEQ (ND=1/2 MDL)	3.2E-05	1.00	3.5E-12	1.4E-11	7.0E-10	5E-03	2E-02
	Mercury	9.4E-01	1.00	1.0E-07	3.9E-07	3.0E-04	3E-04	1E-03
	Barium	4.1E+02	1.00	4.5E-05	1.7E-04	2.0E-01	2E-04	9E-04
95	TEQ (ND=1/2 MDL)	2.1E-05	1.00	2.3E-12	8.8E-12	7.0E-10	3E-03	1E-02
	Mercury	1.0E+00	1.00	1.1E-07	4.4E-07	3.0E-04	4E-04	1E-03
	Barium	3.9E+02	1.00	4.3E-05	1.7E-04	2.0E-01	2E-04	8E-04
97	TEQ (ND=1/2 MDL)	2.7E-06	1.00	3.0E-13	1.1E-12	7.0E-10	4E-04	2E-03
	Mercury	4.1E-02	1.00	4.5E-09	1.7E-08	3.0E-04	1E-05	6E-05
	Barium	2.4E+02	1.00	2.6E-05	1.0E-04	2.0E-01	1E-04	5E-04
98	TEQ (ND=1/2 MDL)	1.4E-05	1.00	1.6E-12	6.1E-12	7.0E-10	2E-03	9E-03
	Mercury	3.1E-01	1.00	3.3E-08	1.3E-07	3.0E-04	1E-04	4E-04
	Barium	2.2E+03	1.00	2.4E-04	9.1E-04	2.0E-01	1E-03	5E-03

APPENDIX D. DETAILED RISK CALCULATIONS

DIRECT CONTACT TO OU3 FLOODPLAIN SURFACE SOILS

Population	**Current/Hypothetical Future Fisher**
Exposure Area	**Random 100-acre grids across OU3 Floodplain Area**
Medium	**Surface Soil**
Exposure Route	**Dermal Contact**

Grid	COPC	EPC	ABSd	Non-Cancer				
				DI (mg/kg-d)		RfD	HQ	
		mg/kg		CTE	RME	mg/kg-d	CTE	RME
81	TEQ (ND=1/2 MDL)	5.7E-07	0.03	1.8E-15	2.5E-14	7.0E-10	3E-06	4E-05
82	TEQ (ND=1/2 MDL)	2.8E-07	0.03	9.2E-16	3.5E-15	7.0E-10	1E-06	5E-06
84	TEQ (ND=1/2 MDL)	2.5E-07	0.03	8.1E-16	3.1E-15	7.0E-10	1E-06	4E-06
86	TEQ (ND=1/2 MDL)	1.8E-05	0.03	6.0E-14	2.3E-13	7.0E-10	9E-05	3E-04
87	TEQ (ND=1/2 MDL)	6.8E-06	0.03	2.2E-14	8.5E-14	7.0E-10	3E-05	1E-04
88	TEQ (ND=1/2 MDL)	5.6E-05	0.03	1.8E-13	7.0E-13	7.0E-10	3E-04	1E-03
89	TEQ (ND=1/2 MDL)	9.7E-06	0.03	3.2E-14	1.2E-13	7.0E-10	5E-05	2E-04
90	TEQ (ND=1/2 MDL)	5.5E-05	0.03	1.8E-13	6.9E-13	7.0E-10	3E-04	1E-03
91	TEQ (ND=1/2 MDL)	2.3E-05	0.03	7.4E-14	2.8E-13	7.0E-10	1E-04	4E-04
93	TEQ (ND=1/2 MDL)	4.6E-05	0.03	1.5E-13	5.8E-13	7.0E-10	2E-04	8E-04
94	TEQ (ND=1/2 MDL)	3.2E-05	0.03	1.1E-13	4.1E-13	7.0E-10	2E-04	6E-04
95	TEQ (ND=1/2 MDL)	2.1E-05	0.03	6.9E-14	2.6E-13	7.0E-10	1E-04	4E-04
97	TEQ (ND=1/2 MDL)	2.7E-06	0.03	8.9E-15	3.4E-14	7.0E-10	1E-05	5E-05
98	TEQ (ND=1/2 MDL)	1.4E-05	0.03	4.7E-14	1.8E-13	7.0E-10	7E-05	3E-04

APPENDIX D. DETAILED RISK CALCULATIONS

INGESTION OF GROUNDWATER WITHIN OU3 AS DRINKING WATER

Population	Hypothetical Future Residents
Exposure Area	OU3 Upland
Medium	Groundwater
Exposure Route	Ingestion as drinking water

		Non-Cancer HQ					Cancer				
	EPC	DI (mg/kg-d)		RfD	HQ		DI (mg/kg-d)		oSF	Risk	
COPC	ug/L	CTE	RME	mg/kg-d	CTE	RME	CTE	RME	$(mg/kg\text{-}d)^{-1}$	CTE	RME
TEQ (ND=1/2 MDL)	1.1E-06	1.4E-11	3.8E-11	7.0E-10	2E-02	5E-02					
Aluminum	5.7E-01	7.5E-06	2.0E-05	1.0E+00	8E-06	2E-05					
Arsenic	1.2E+01	1.6E-04	4.2E-04	3.0E-04	5E-01	1E+00	2.7E-05	1.6E-04	1.50E+00	4E-05	2E-04
Chromium	5.8E+00	7.6E-05	2.0E-04	1.3E+00	6E-05	2E-04					
Cobalt	2.4E+01	3.1E-04	8.3E-04	3.0E-04	1E+00	3E+00					
Iron	1.2E+04	1.6E-01	4.3E-01	7.0E-01	2E-01	6E-01					
Manganese	1.2E+04	1.6E-01	4.2E-01	4.7E-02	3E+00	9E+00					
Nickel	2.0E+01	2.6E-04	6.9E-04	2.0E-02	1E-02	3E-02					
Vanadium	3.6E+01	4.7E-04	1.2E-03	5.0E-03	9E-02	2E-01					
Total					5E+00	1E+01				4E-05	2E-04

APPENDIX D. DETAILED RISK CALCULATIONS

INGESTION OF GROUNDWATER WITHIN OU3 AS DRINKING WATER

Population	Hypothetical Future Workers
Exposure Area	OU3 Upland
Medium	Groundwater
Exposure Route	Ingestion as drinking water

		Non-Cancer					Cancer				
	EPC	DI (mg/kg-d)		RfD	HQ		DI (mg/kg-d)		oSF	Risk	
COPC	ug/L	CTE	RME	mg/kg-d	CTE	RME	CTE	RME	$(mg/kg\text{-}d)^{-1}$	CTE	RME
TEQ (ND=1/2 MDL)	1.1E-06	5.1E-12	1.2E-11	7.0E-10	7E-03	2E-02					
Aluminum	5.7E-01	2.7E-06	6.1E-06	1.0E+00	3E-06	6E-06					
Arsenic	1.2E+01	5.7E-05	1.3E-04	3.0E-04	2E-01	4E-01	7.3E-06	4.7E-05	1.50E+00	1E-05	7E-05
Chromium	5.8E+00	2.7E-05	6.2E-05	1.3E+00	2E-05	5E-05					
Cobalt	2.4E+01	1.1E-04	2.6E-04	3.0E-04	4E-01	9E-01					
Iron	1.2E+04	5.8E-02	1.3E-01	7.0E-01	8E-02	2E-01					
Manganese	1.2E+04	5.7E-02	1.3E-01	4.7E-02	1E+00	3E+00					
Nickel	2.0E+01	9.4E-05	2.1E-04	2.0E-02	5E-03	1E-02					
Vanadium	3.6E+01	1.7E-04	3.8E-04	5.0E-03	3E-02	8E-02					
Total					2E+00	4E+00				1E-05	7E-05

APPENDIX D. DETAILED RISK CALCULATIONS

INGESTION OF FISH CAUGHT FROM THE CFR JUST DOWNSTREAM OF THE SITE

Population	Current/Hypothetical Future Recreational Fishers
Exposure Area	CFR within OU3
Medium	Fish Tissue - All Species
Exposure Route	Ingestion

			Non-Cancer						Cancer				
	UCL	CL	DI (mg/kg-d)		RfD	HQ			DI (mg/kg-d)		oSF	Risk	
COPC	mg/kg		CTE	RME	mg/kg-d	CTE	RME		CTE	RME	$(mg/kg\text{-}d)^{-1}$	CTE	RME
Aroclor-1254	0.045	0.70	6.3E-06	2.2E-05	2.0E-05	3E-01	1E+00		1.4E-06	9.3E-06	2.0E+00	3E-06	2E-05
TEQ (ND=1/2MDL)	2.40E-07	0.46	2.2E-11	7.5E-11	7.0E-10	3E-02	1E-01						
Total						3E-01	1E+00					3E-06	2E-05

APPENDIX D. DETAILED RISK CALCULATIONS

INGESTION OF FISH CAUGHT FROM THE CFR JUST DOWNSTREAM OF THE SITE

Population	Current/Hypothetical Future Tribal Fishers
Exposure Area	CFR within OU3
Medium	Fish Tissue - All Species
Exposure Route	Ingestion

			Non-Cancer					Cancer				
	UCL	CL	DI (mg/kg-d)		RfD	HQ		DI (mg/kg-d)		oSF	Risk	
COPC	mg/kg		CTE	RME	mg/kg-d	CTE	RME	CTE	RME	$(mg/kg\text{-}d)^{-1}$	CTE	RME
Aroclor-1254	0.045	0.70	1.2E-05	4.7E-05	2.0E-05	6E-01	2E+00	2.6E-06	2.0E-05	2.0E+00	5E-06	4E-05
TEQ (ND=1/2MDL)	2.40E-07	0.46	4.2E-11	1.6E-10	7.0E-10	6E-02	2E-01					
Total						7E-01	3E+00				5E-06	4E-05