RCRA Facility Investigation – Remedial Investigation/ Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site Appendix A – Comprehensive Risk Assessment

Volume 10 of 15
Upper Woman Drainage Exposure Unit

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ACRONYMS AND ABBREVIATIONS

μg/kg	micrograms per kilogram
μg/L	micrograms per liter
AI	adequate intake
AL	action level
AUF	area use factor
BAF	bioaccumulation factor
bgs	below ground surface
BW	body weight
BZ	Buffer Zone
CAD/ROD	Corrective Action Decision/Record of Decision
CDH	Colorado Department of Health
CDPHE	Colorado Department of Public Health and Environment
cfs	cubic feet per second
CNHP	Colorado Natural Heritage Program
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CSF	cancer slope factor
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
DRI	dietary reference intake
ECOC	ecological contaminant of concern
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern

Eco-SSL	Ecological Soil Screening Level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
FWS	U.S. Fish and Wildlife Service
HHRA	Human Health Risk Assessment
HQ	hazard quotient
HRR	Historical Release Report
IA	Industrial Area
IAEU	Industrial Area Exposure Unit
IAG	Interagency Agreement
IDEU	Inter-Drainage Exposure Unit
IHSS	Individual Hazardous Substance Site
kg	kilogram
K-H	Kaiser-Hill Company, L.L.C.
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
L_{og} K_{ow}	log octanol-water portioning coefficient
MDC	maximum detected concentration
mg	milligram
mg/day	milligrams per day
mg/kg	milligrams per kilogram
mg/kg BW/day	milligrams per kilogram receptor body weight per day

mg/L	milligrams per liter
mL	milliliter
mL/day	milliliters per day
N/A	not applicable
NFAA	No Further Accelerated Action
NNEU	No Name Gulch Drainage Exposure Unit
NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
OU	Operable Unit
PAC	Potential Area of Concern
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi	picocurie
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOC	potential contaminant of concern
PMJM	Preble’s meadow jumping mouse
PRG	preliminary remediation goal
QAPjP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RDA	recommended daily allowance
RDI	recommended daily intake
RFCA	Rocky Flats Cleanup Agreement
RfD	reference dose
RFETS	Rocky Flats Environmental Technology Site

RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SCM	site conceptual model
TCDD	2,3,7,8-tetrachorodibenzo-p-dioxin
TEQ	toxic equivalent
tESL	threshold ecological screening level
TRV	toxicity reference value
UBC	Under Building Contamination
UCL	upper confidence limit
UL	upper limit (daily intake)
UT	uncertain toxicity
UTL	upper tolerance limit
UWOEU	Upper Woman Drainage Exposure Unit
WRV	wildlife refuge visitor
WRW	wildlife refuge worker

EXECUTIVE SUMMARY

This report presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the 524-acre Upper Woman Drainage Exposure Unit (EU) (UWOEU) at the Rocky Flats Environmental Technology Site (RFETS). The purpose of this report is to assess risks to human health and ecological receptors posed by exposure to contaminants of concern (COCs) and ecological contaminants of potential concern (ECOPCs) remaining at the UWOEU after completion of accelerated actions at RFETS.

Benzo(a)pyrene and dioxins/furans were the only COCs selected for surface soil/surface sediment in the UWOEU. Dioxin/furan concentrations were converted to 2,3,7,8-tetrachorodibenzo-p-dioxin (TCDD) toxicity equivalents (TEQs) for COC screening and risk characterization. Although benzo(a)pyrene was selected as a COC and was evaluated quantitatively in the HHRA, it has not necessarily been directly associated with historical Individual Hazardous Substance Sites (IHSSs) in the UWOEU, but could be associated with traffic, pavement degradation, or pavement operations in the UWOEU and the nearby Industrial Area EU (IAEU). No COCs were selected for subsurface soil/sediment.

Noncancer risks for benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were not evaluated because those COCs do not have noncancer toxicity values. Risks were calculated for benzo(a)pyrene and 2,3,7,8 TCDD (TEQ). The estimated Tier 1 total excess lifetime cancer risk to the wildlife refuge worker (WRW) at the UWOEU is 8E-06, and the Tier 2 risk is 4E-06. The estimated Tier 1 total excess lifetime cancer risk to the wildlife refuge visitor (WRV) at the UWOEU is 9E-06, while the Tier 2 risk is 4E-06. The excess lifetime cancer risks for the WRW and WRV in the UWOEU are within the U.S. Environmental Protection Agency (EPA) acceptable risk range (i.e., within or below 1E-04 to 1E-06).

It is important to note that the samples with the highest benzo(a)pyrene concentrations are located in an area that is now several feet beneath a cover for the Original Landfill. Because exposure to benzo(a)pyrene at these locations is not anticipated, the benzo(a)pyrene concentration estimates for the UWOEU and the associated risk are likely overestimated. As part of the uncertainty analysis, the upper confidence limit (UCL) was calculated for benzo(a)pyrene using only samples in the UWOEU that are located outside the Original Landfill cover. This UCL is less than the PRG; therefore, benzo(a)pyrene would not be identified as a COC for the portion of UWOEU that is outside the Original Landfill cover. Accordingly, risks associated with exposure to benzo(a)pyrene in the UWOEU in areas outside the Original Landfill cover are less than 1E-06.

Exposure to the 2,3,7,8 TCDD (TEQ) in soil is also not anticipated because these samples are located approximately 20 feet below ground surface (bgs). These samples were taken as confirmation samples in an excavation following an accelerated action and, therefore, were classified as surface soil samples. However, the locations are actually approximately 20 feet bgs and not accessible by the WRW or WRV.

The ECOPC identification process streamlines the ecological risk characterization by focusing the assessment on ecological contaminants of interest (ECOIs) that are present in the UWOEU. The ECOPC identification process is described in the Comprehensive Risk Assessment (CRA) Methodology (U.S. Department of Energy [DOE] 2005a) and additional details are provided in Appendix A, Volume 2 of the Remedial Investigation/Feasibility Study (RI/FS) Report. Antimony, copper, nickel, silver, tin, uranium, vanadium, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, total dioxins and total PCBs were identified as ECOPCs for representative populations of non-Preble's meadow jumping mouse (PMJM) receptors in surface soil. ECOPCs for individual PMJM receptors included antimony, chromium, copper, manganese, molybdenum, nickel, tin, vanadium, zinc, and total PCBs. No ECOPCs were identified in subsurface soil for burrowing receptors.

ECOPC/receptor pairs were evaluated in the risk characterization using conservative default exposure and risk assumptions as defined in the CRA Methodology. Tier 1 and Tier 2 exposure point concentrations (EPCs) were used in the risk characterization: Tier 1 EPCs are based on the upper confidence limits of the arithmetic mean concentration for the EU data set and Tier 2 EPCs are calculated using a spatially weighted averaging approach. In addition, a refinement of the exposure and risk models based on chemical-specific uncertainties associated with the initial default exposure models were completed for several ECOPC/receptor pairs to provide a refined estimate of potential risk. Using Tier 1 EPCs and default exposure and risk assumptions, no observed adverse effect level (NOAEL) or no observed effect concentration (NOEC) hazard quotients (HQs) ranged from 49 (nickel/deer mouse - insectivore) to 1 (several ECOPC/receptor pairs). NOAEL or NOEC HQs ranged from 65 (nickel/deer mouse - insectivore) to less than 1 several ECOPC/receptor pairs) using Tier 2 EPCs and default exposure and risk assumptions.

For terrestrial plants, antimony, silver, uranium, and vanadium all had HQs greater than or equal to 1 using Tier 1 and Tier 2 EPCs. However, there is low confidence placed in the ecological screening levels (ESLs) for terrestrial plants for all four of these ECOPCs. As discussed in Attachment 5, additional NOEC or lowest observed effect concentration (LOEC) values for antimony, silver and uranium were either not acceptable for use in the CRA (low confidence in the additional values) or not available in the literature. For vanadium, an additional LOEC value was available for refined risk calculations.

For antimony, the HQ was equal to 1 using the Tier 1 UTL and equal to 2 using the Tier 2 UTL. For silver, the HQ was equal to 2 using the Tier 1 UTL and equal to 1 using the Tier 2 UTL. Therefore, risks to populations of terrestrial plants from exposure to antimony and silver in surface soils are likely to be low but with a high level of uncertainty due to low confidence in the ESLs. For uranium, HQs were greater than 1 using both the Tier 1 and Tier 2 UTLs. Therefore, risks to populations of terrestrial plants from exposure to uranium in surface soils is likely to be low to moderate but there is a high level of uncertainty in this risk calculation because of the low confidence in the ESL.

For vanadium, HQs based on the default ESL (2 mg/kg) were greater than 1 using both the Tier 1 and Tier 2 UTLs. The uncertainty assessment recommended using an additional LOEC value (50 mg/kg) in a refined risk calculation. HQs were less than 1 using both the Tier 1 and Tier 2 EPCs in the refined analysis. The potential for risk to terrestrial plant populations in the UWOEU from exposure to vanadium in surface soils is likely to be low although there is high uncertainty or low confidence in both ESLs used in the risk calculations. In addition, the HQ based on the default ESL and the background UTL (HQ = 23) is similar to the HQ based on the default ESL and the UWOEU UTL (HQ = 24).

Most of the ECOPC/receptor pairs for birds and mammals had lowest observed adverse effect level (LOAEL) HQs less than or equal to 1 using the default assumptions used in the risk calculations. However, the following ECOPC/receptor pairs had LOAEL HQs greater than 1 using the default exposure and toxicity assumptions:

- Antimony/deer mouse (insectivore) – The LOAEL HQ was equal to 3 using the Tier 2 EPC in the default risk model. There is a high level of uncertainty associated with the use of the default upper-bound BAF and the default TRV in the risk calculations (see Attachment 5). Additional BAFs and TRVs for antimony are unavailable for a refined analysis. Given that no LOAEL HQs were greater than 1 in the grid analysis, the potential for risks to populations of small mammals such as the deer mouse (insectivore) are likely to be low. However, there is considerable uncertainty or low confidence in the default risk model.

- Antimony/PMJM – The LOAEL HQ was equal to 2 in Patch #20 using the default risk model. There is a high level of uncertainty associated with the use of the default upper-bound BAF and the default TRV in the risk calculations (see Attachment 5). Additional BAFs and TRVs for antimony are unavailable for a refined analysis. Given that the LOAEL HQ is only equal to 2, risks to PMJM receptors within Patch #20 are likely to be low but somewhat elevated over the remaining patches, while risks within all other habitat patches at UWOEU are likely low. However, there is considerable uncertainty or low confidence in the default risk model.

- Nickel/deer mouse (insectivore) – The default LOAEL HQs were equal to 5 and 7 using the Tier 1 and Tier 2 EPCs, respectively. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, no LOAEL HQs greater than 1 were calculated. In addition, HQs were also calculated using additional TRVs from Sample et al. (1996). No HQs greater than 1 were calculated using either the NOAEL or the LOAEL TRV in the refined analysis. Based on these additional risk calculations using the median BAF or the additional NOAEL or LOAEL TRVs, risks to populations of small mammals such as the deer mouse (insectivore) receptor are likely to be low.

- Nickel/PMJM - LOAEL HQs were greater than 1 in Patches #19, #20, and #21 using default exposure and toxicity assumptions. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, LOAEL HQs were less than 1 in all three patches. Using additional TRVs for nickel resulted in NOAEL and LOAEL HQs less than 1 with either BAF in the calculations in all three patches. Based on the additional risk calculations using either the median BAF or the additional TRVs in the refined analysis, risks to the PMJM receptor from exposure to nickel are likely to be low.

- Di-n-butylphthalate/mourning dove (insectivore) – LOAEL HQs were equal to 3 using the Tier 1 EPC and equal to 2 using the Tier 2 EPC. No median BAF or additional TRVs were available for refined risk calculations. Therefore, the risk of potential adverse effects to populations of small birds such as the mourning dove (insectivore) receptor are likely to be low to moderate although there is considerable uncertainty or low confidence in the default risk model. In addition, there is no known source of di-n-butylphthalate at UWOEU.

- Total dioxins/deer mouse (insectivore) - The LOAEL HQ was equal to 3 using the Tier 1 EPC and less than 1 using the Tier 2 EPC. No median BAF or additional TRVs were available for refined risk calculations. Therefore, the risk of potential adverse effects to populations of small mammals such as the deer mouse (insectivore) receptor is likely to be low to moderate. However, there are uncertainties in the default risk model as discussed in Attachment 5 and the LOAEL HQs were less than 1 using the Tier 2 EPC in the risk calculations.

Based on default and refined calculations, site-related risks are likely to be low to moderate with some high levels of uncertainty for the ecological receptors evaluated in the UWOEU. In addition, data collected on wildlife abundance and diversity indicates that wildlife species richness remains high at RFETS. There are no significant risks to ecological receptors or high levels of uncertainty with the data, and therefore, there are no ecological contaminants of concern (ECOCs) for the UWOEU.

1.0 INTRODUCTION

This volume of the Comprehensive Risk Assessment (CRA) presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the Upper Woman Drainage Exposure Unit (EU) (UWOEU) at the Rocky Flats Environmental Technology Site (RFETS) (Figure 1.1).

The anticipated future land use of RFETS is a wildlife refuge. Consequently, two human receptors, a wildlife refuge worker (WRW) and a wildlife refuge visitor (WRV), are evaluated in this risk assessment consistent with this land use. A variety of representative terrestrial and aquatic receptors is evaluated in the ERA including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species present at RFETS. The HHRA and ERA methods and selection of receptors are described in detail in the approved Final CRA Work Plan and Methodology Revision 1 (U.S. Department of Energy [DOE] 2005a) (hereafter referred to as the CRA Methodology).

1.1 Upper Woman Drainage Exposure Unit Description

This section provides a brief description of the UWOEU, including its location at RFETS, historical activities in the area, topography, surface water features, vegetation, and ecological resources. A more detailed description of these features and additional information regarding the geology, hydrology, and soil types at RFETS is included in Section 2.0, Physical Characteristics of the Study Area contained in the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report). This information is also summarized in Appendix A, Volume 2 of the RI/FS Report.

The 2005 Annual update to the Historical Release Report (HRR) (DOE 2005b) provides descriptions of known or suspected releases of hazardous substances that occurred at RFETS. The original HRR (DOE 1992) organized these known or suspected historical sources of contamination as Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), or Under Building Contamination (UBC) sites (hereafter collectively referred to as historical IHSSs). Individual historical IHSSs and groups of historical IHSSs were also designated as Operable Units (OUs). Over the course of cleanup under the 1991 Interagency Agreement (IAG 1991) and the 1996 Rocky Flats Cleanup Agreement (RFCA 1996), the DOE has thoroughly investigated and characterized contamination associated with these historical IHSSs. Historical IHSSs have been dispositioned through appropriate remedial actions or by determining that No Further Accelerated Action (NFAA) is required, pursuant to the applicable IAG and RFCA requirements. Some OUs have also been dispositioned in accordance with an OU-specific Corrective Action Decision/Record of Decision (CAD/ROD).

A more detailed description of the regulatory agreements and the investigation and cleanup history under these agreements is contained in Section 1.0 of the RI/FS Report. Section 1.4.3 of the RI/FS Report describes the accelerated action process, while

Table 1.4 of the RI/FS Report summarizes the disposition of all historical IHSSs at RFETS. The 2005 Annual Update to the HRR (DOE 2005b) provides a description of the potential contaminant releases for each IHSS and any interim response to the releases; identification of potential contaminants based on process knowledge and site data; data collection activities; accelerated action activities (if any); and the basis for recommending NFAA.

Several historical IHSSs exist within the UWOEU (Table 1.1 and Figure 1.2) and all have received regulatory agency-approved No Further Actions (NFAs) or NFAAs. This is documented in the Annual Updates to the HRR as noted in Table 1.1. In general, the NFAs and NFAAs are based on human health exposures. The intent of the ecological component of the CRA is to evaluate any potential risk to ecological receptors associated with the residual contamination at the site following the accelerated actions.

1.1.1 Exposure Unit Characteristics and Location

The UWOEU comprises 524 acres in the southwestern portion of RFETS (Figure 1.1) and contains several distinguishing features:

- The UWOEU is located within the Buffer Zone (BZ) OU immediately south of areas that were used historically for operation of RFETS (the Industrial Area [IA]).
- The UWOEU includes much of Upper Woman Creek and three named tributaries of Upper Woman Creek: Owl Branch, Antelope Creek, and Hideout Draw.
- The South Interceptor Ditch (SID) is a lateral ditch that traverses the hillside south of the IA and parallels Woman Creek on the uphill side. The SID was originally designed to capture effectively all runoff from the IA that would otherwise flow into Woman Creek. The portion of the SID overlying the original landfill was removed as part of the remediation of the original landfill.
- Potential historical sources within the UWOEU include the Original Landfill (PAC SW-115), the Ash Pits (PACs SW-133.1 through SW-133.4, SW-1701, and SW-1702), and the incinerator facility (IHSS 133.5).

The UWOEU is bounded by the Inter-Drainage EU (IDEU) and Industrial Area EU (IAEU) to the north, the Lower Woman Drainage EU (LWOEU) on the east, and the Southwest BZ Area EU (SWEU) to the south. The property west of the UWOEU is an agricultural parcel managed by the Colorado State Land Board to generate income in support of public education.

1.1.2 Topography and Surface Water Hydrology

As shown on a recent aerial photograph of the UWOEU (Figure 1.3), the UWOEU is the dissected edge of an alluvial pediment that slopes gently to the east. The UWOEU includes the valleys of Upper Woman Creek and a number of its tributaries. Upper Woman Creek and Owl Branch originate west of RFETS and flow east into the UWOEU, where they converge. Farther downstream, Antelope Creek enters from the southwest, and the SID runs parallel to Woman Creek to the north. The SID was designed to intercept runoff flowing south from the IA toward Woman Creek and to segregate it from runoff originating in other areas of the Woman Creek drainage. From the UWOEU, the SID continues downstream and discharges into Pond C-2, while Woman Creek flows into Pond C-1, and then is diverted around Pond C-2. The portion of the SID overlying the original landfill has been removed as part of the remediation of the original landfill.

1.1.3 Flora and Fauna

Vegetation in the UWOEU is predominantly grassland. The major components are mesic mixed grasslands and xeric tallgrass prairie (Figure 1.4). The mesic mixed grassland is comprised of western wheatgrass (*Agropyron smithii*), blue grama (*Bouteloua gracilis*), side-oats grama (*Bouteloua curtipendula*), prairie junegrass (*Koeleria pyramidata*), Canada bluegrass (*Poa compressa*), Kentucky bluegrass (*Poa pratensis*), green needlegrass (*Stipa virigula*), and little bluestem (*Andropogon scoparius*). The xeric tallgrass prairie is distinguished by the plant species big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparius*), Indian-grass (*Sorghastrum nutans*), prairie dropseed (*Sporobolus heterolepis*), and switchgrass (*Panicum virgatum*). Xeric grasslands within the EU occur on the gently sloping pediment areas, and mesic mixed grasslands are found on hillsides where drainage ways become more defined. Wet meadows, short marshlands, cattail marshlands, riparian shrublands and riparian woodlands are found along Woman Creek, Antelope Springs, and within small seep-springs.

Grasslands are important to wildlife and grassland conditions within the UWOEU are good but weeds and introduced grass species have degraded grasslands in some areas (PTI 1997). A prescribed burn was conducted in April 2000 (K-H 2001) to reduce weed infestation and remove accumulated thatch in the xeric grasslands within the southwestern corner of the EU. Weed control, erosion control, and reclamation activities on going within the EU will continue to promote native grasslands at RFETS.

No federally listed plant species are known to occur at RFETS. However, the xeric tallgrass prairie, tall upland shrubland, riparian shrubland, and plains cottonwood riparian woodland communities are considered rare and sensitive plant communities by the Colorado Natural Heritage Program (CNHP). RFETS also supports populations of four rare plant species that are listed as rare or imperiled by the CNHP. These include forktip three-awn (*Aristida basiramea*), mountain-loving sedge (*Carex oreocharis*), carrionflower greenbriar (*Smilax herbacea var. lasioneuron*), and dwarf wild indigo (*Amorpha nana*).

Numerous animal species have been observed at RFETS, and the more common ones are expected to be present in the UWOEU. Common large and medium-sized mammals likely to live at or frequent the UWOEU include mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), and desert cottontail (*Sylvilagus audubonii*). The most common reptile observed at RFETS is the western prairie rattlesnake (*Crotalis viridus*). Common bird species include meadowlark (*Sturnella neglecta*), vesper sparrow (*Pooecetes gramineus*), and red-winged blackbird. The most common small mammal species include deer mice (*Peromyscus maniculatus*), meadow voles (*Microtus pennsylvanicus*), and Mexican woodrat (*Neotoma mexicana*).

RFETS supports two wildlife species listed as threatened or endangered species under the Endangered Species Act (U.S. Fish and Wildlife Service [USFWS] 2005). The PMJM (*Zapus hudsonius preblei*) and the bald eagle (*Haliaeetus leucocephalus*) are listed as threatened species. The PMJM is a federally listed threatened species found at RFETS. The preferred habitat for the PMJM is the riparian corridors bordering RFETS' streams, ponds, and wetlands with an adjacent thin band of upland grasslands. The bald eagle occasionally forages at RFETS although no nests have been identified on site.

There are also a number of wildlife species that have been observed at RFETS that are species of concern by the State of Colorado (USFWS 2005). The plains sharp-tailed grouse (*Tympanuchus phasianellus jamesii*) is listed as endangered by the State and has been observed infrequently at RFETS. The western burrowing owl (*Athene cunicularia hypugea*) is listed as threatened by the State and is a known resident or regular visitor at RFETS. The ferruginous hawk (*Buteo regalis*), American peregrine falcon (*Falco peregrinus*), and the northern leopard frog (*Rana pipiens*) are listed as species of special concern by the State and are considered known residents or regular visitors at RFETS. The following species are listed as species of special concern and are observed infrequently at RFETS: greater sandhill crane (*Grus canadensis tibida*), long-billed curlew (*Numenius americanus*), mountain plover (*Charadrius montanus*), and the common garter snake (*Thamnophis sirtalis*).

More information on the plant communities and animal species that exist within RFETS is provided in Section 2.0 of the RI/FS Report.

1.1.4 Preble's Meadow Jumping Mouse Habitat within Upper Woman Exposure Unit

The UWOEU supports habitat for the federally protected PMJM. PMJM habitat within the EU occurs along Woman Creek above the C-1 pond to the western border of RFETS. PMJM have been captured within UWOEU for over a decade (Ebasco 1992; DOE 1995; K-H 1998a, 1998b, 2001). Upper Woman Creek supports approximately 6.5 (±1) individuals per kilometer (km) of stream (K-H 2001). This equates to approximately 16 individuals in the EU.

In an effort to characterize habitat discontinuity and provide indications of varying habitat quality, sitewide PMJM habitat patches were developed. Figure 1.5 presents PMJM patches within UWOEU. Patch #22 that cross-over into the Lower Woman Drainage EU is evaluated in LWOEU because a higher percentage of the patch is within LWOEU. PMJM patches aid in the evaluation of surface soil within PMJM habitat, giving a spatial understanding of areas that may be used by individual PMJM or subpopulations of PMJM. More detail on the methodology of creating sitewide PMJM habitat patches can be found in Appendix A, Volume 2, Section 3.2 of the RI/FS Report.

PMJM habitat within the UWOEU was divided into three habitat patches, each containing habitat capable of supporting several PMJM.[1] The patches vary in size and shape dependent on their location within the Woman Creek drainage and discontinuity or habitat quality of surrounding patches. PMJM have been found in each of these three patches. The following is a brief discussion of the three patches within the UWOEU (Figure 1.5) and the reasons they are considered distinct:

- Patch #19 – This patch contains habitat at the upper end of Woman Creek. The riparian zone is narrow and supports leadplant shrubs and a mixture of willow shrublands and riparian woodlands. Densities of PMJM are much less than patches further downstream. The upper end of the patch corresponds to the RFETS boundary. The lower end corresponds to the confluence of a second tributary to Woman Creek.

- Patch # 20A and 20B – This patch is a combination of habitat along Woman Creek (20A) and a seep area to the south (20B). These areas can be considered one unit based on the hydrological connection, as supporting wetlands bridge the gap between the two habitat areas (USFWS 2005). The upper boundary for this patch corresponds to the confluence of a second tributary to Woman Creek. This patch contains mature willow shrubs and few cottonwood trees. A diversion ditch bisects the patch that diverts Woman Creek away from the base of the old landfill. The lower boundary corresponds to a change in the maturity of riparian shrubs.

- Patch #21A, 21B, and 21C – This patch contains a series of leadplant riparian shrubs and riparian woodlands with adjacent short marsh and short upland shrubs. It is different from the vegetation found in adjacent patches and lacks contiguous willow shrubs. The patch is located at the confluence of Woman Creek and Antelope Springs. An adjacent, but distinct, area of snowberry is part of this patch based on the hydrological connection of supporting wetlands (USFWS 2005).

1.1.5 Data Description

Data have been collected at RFETS under regulatory agency-approved Work Plans, Sampling and Analysis Plans (SAPs), and Quality Assurance Project Plans (QAPjPs) to meet data quality objectives (DQOs) and appropriate U.S. Environmental Protection Agency (EPA) and Colorado Department of Public Health and Environment (CDPHE) guidance. Surface soil, subsurface soil, sediment, surface water, and groundwater samples were collected from the UWOEU. The data set for the CRA was prepared in accordance with data processing steps described in Appendix A, Volume 2, Attachment 2 of the RI/FS Report. Surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil are the media evaluated in the HHRA and ERA (Table 1.2). The sampling locations for these media are shown on Figures 1.6 and 1.7, and data summaries for detected analytes in each medium are provided in Tables 1.3 through 1.7. Toxicity equivalence factors and toxicity equivalent concentrations for 2,3,7,8-tetrachorodibenzo-p-dioxin (TCDD) in surface soil/surface sediment, subsurface

[1] PMJM patch #22, while partially located within the UWOEU, is evaluated as part of the LWOEU.

soil/subsurface sediment, and subsurface soil are presented in Tables 1.8 and 1.9. Potential contaminants of concern (PCOCs) that were analyzed for but not detected are presented in Attachment 1. Detection limits are compared to preliminary remediation goals (PRGs) and ecological screening levels (ESLs), and discussed in Attachment 1 (Tables A1.1 through A1.4).

In accordance with the CRA Methodology (DOE 2005a), only data collected on or after June 28, 1991, and data for subsurface soil and subsurface sediment samples with a starting depth less than or equal to 8 feet below ground surface (bgs) are used in the CRA. Subsurface soil and subsurface sediment data are limited to this depth because it is not anticipated that the WRW or burrowing animals will dig to deeper depths. A detailed description of data storage and processing methods is provided in Appendix A, Volume 2 of the RI/FS Report.

The CRA analytical data set for the UWOEU is provided on a compact disc (CD) presented in Attachment 6. The CD includes the data used in the CRA, as well as data not considered useable. Additional criteria for exclusion of data from use in the CRA are presented in Appendix A, Volume 2 of the RI/FS Report.

The sampling data used for the UWOEU HHRA and ERA are as follows:

- Combined surface soil/surface sediment data (HHRA);
- Combined subsurface soil/subsurface sediment data (HHRA);
- Surface soil data (ERA); and,
- Subsurface soil data (ERA).

The data for these media are briefly described below.

In addition, because ecological contaminants of potential concern (ECOPCs) were identified for soil in this EU, surface water data were used in the ERA as part of the overall intake of ECOPCs by ecological receptor. The surface water data used in the ERA are summarized in Table 8.4. Surface water and sediment are assessed for ecological receptors on an Aquatic Exposure Unit (AEU) basis in Appendix A, Volume 15B of the RI/FS Report. An assessment of the surface water, groundwater-to-surface water, and volatilization pathways for human health are presented in Appendix A, Volume 2 of the RI/FS Report.

Surface Soil/Surface Sediment

The combined surface soil/surface sediment data set for the UWOEU consists of up to 217 samples that were analyzed for inorganics (166 samples), organics (148 samples), and radionuclides (217 samples) (Table 1.2). The data include sediment samples collected to depths down to 0.5 feet bgs. The samples were collected in the UWOEU between August 1991 and March 2005. The sampling locations for surface soil and surface sediment are shown on Figure 1.6. All sample locations within the UWOEU were not necessarily analyzed for all analyte groups (see Table 1.3). The samples collected in 2004 were located on a 30-acre grid, as described in CRA SAP Addendum #04-01 (DOE 2004). For the grid sampling, five individual samples were collected and composited from each 30-acre cell, one from each quadrant and one in the center, as described in the CRA SAP Addendum #04-01 (DOE 2004). Most of the evenly spaced surface soil sampling locations on Figure 1.6 represent the 30-acre grid samples.

The data summary for detected analytes in surface soil/surface sediment for the UWOEU is presented in Table 1.3. Detected analytes included representatives from the inorganic, organic, and radionuclide analyte groups. A summary of analytes that were not detected in surface soil/surface sediment is presented and discussed in Attachment 1.

Subsurface Soil/Subsurface Sediment

The combined subsurface soil/subsurface sediment data set for the UWOEU consists of up to 298 samples analyzed for organics, 258 for inorganics, and 252 for radionuclides (Table 1.2). The data include subsurface sediment samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet bgs. The subsurface soil/subsurface sediment samples were collected in the UWOEU between August 1991 and July 2004. The sampling locations for subsurface soil and subsurface sediment are shown on Figure 1.7. All sample locations within the UWOEU were not necessarily analyzed for all analyte groups (see Table 1.4). The data summary for subsurface soil/subsurface sediment in the UWOEU is presented in Table 1.4. Detected analytes included representatives from the inorganic, organic, and radionuclide analyte groups. A summary of analytes that were not detected in subsurface soil/subsurface sediment is presented and discussed in Attachment 1.

Surface Soil

Data meeting the CRA requirements are available for up to 45 surface soil samples within PMJM habitat collected in the UWOEU that were analyzed for inorganics (35 samples), organics (28 samples), and radionuclides (45 samples) (Table 1.2). The surface soil sampling locations within PMJM habitat are shown on Figure 1.5. All sample locations within the UWOEU were not necessarily analyzed for all analyte groups (see Tables 1.5 and 1.6). Data meeting the CRA requirements are available for up to 177 surface soil samples collected in the UWOEU that were analyzed for inorganics (135 samples), organics (121 samples), and radionuclides (177 samples) (Table 1.2). The surface soil sampling locations for the UWOEU are shown on Figure 1.6. Surface soil samples were collected in the UWOEU from August 1991 to August 2005.

The data summary for detected analytes in UWOEU surface soil is presented in Table 1.5, while the data summary for the detected analytes for those samples within designated PMJM habitat is presented in Table 1.6. Radionuclides, organics, and inorganics were all detected in UWOEU surface soil samples. A summary of analytes that were not detected in surface soil in the UWOEU is presented and discussed in Attachment 1.

Subsurface Soil

The subsurface soil data set for the UWOEU consists of up to 297 samples. All 297 samples were analyzed for organics, 257 for inorganics, and 251 for radionuclides (Table 1.2). Subsurface soil samples used in the CRA are defined in the CRA Methodology as soil samples with a starting depth less than or equal to 8 feet bgs and an ending depth below 0.5 feet bgs. The samples were collected in the UWOEU between August 1991 and July 2004. Subsurface soil sampling locations are shown on Figure 1.7. All sample locations within the UWOEU were not necessarily analyzed for all analyte groups (see Table 1.7).

The data summary for detected analytes in subsurface soil for the UWOEU is presented in Table 1.7. Subsurface soil samples were analyzed for inorganics, organics, and radionuclides, and representatives from all three analyte groups were detected. A summary of analytes that were not detected in subsurface soil is presented and discussed in Attachment 1.

1.2 Data Adequacy Assessment

A data adequacy assessment was performed to determine whether the available data set discussed in the previous section is adequate for risk assessment purposes. The data adequacy assessment rules are presented in the CRA Methodology, and a detailed data adequacy assessment for the data used in the CRA is presented in Appendix A, Volume 2, Attachment 3 of the RI/FS Report. The adequacy of the data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. If the data do not meet the guidelines, other lines of evidence (e.g., information on potential historical sources of contamination, migration pathways, and the concentration levels in the media) are examined to determine if it is possible to make risk management decisions given the data limitations.

The findings from the data adequacy assessment applicable to all EUs are as follows:

- The radionuclide and inorganic surface soil data are adequate for the purposes of the CRA.

- For herbicides and pesticides, although the existing surface soil and sediment data may not meet the minimal data adequacy guidelines for each EU, there is considerable site-wide data, and pesticides and herbicides are infrequently detected at low concentrations, generally below PRGs and ESLs. This line of evidence indicates that it is possible to make risk management decisions without additional sampling for these analyte groups

- For dioxins, although the existing surface soil and sediment data do not meet the minimal data adequacy guidelines for each EU, sample locations were specifically targeted for dioxin analysis at historical IHSSs in and near the former Industrial Area where dioxins may have been released based on process knowledge. Some of the dioxin concentrations at the historical IHSSs exceed the PRG and/or ESL. Additional samples were collected in targeted locations that represented low-lying or depositional areas where dioxin contamination may have migrated via runoff from these specific IHSSs. Results indicate that dioxin concentrations are not above the minimum ESL in sediment and dioxins are not detected in surface water. Therefore, although the existing data do not meet the minimal data adequacy guidelines for each EU/AEU, it is possible to make risk management decisions without additional sampling. However, unlike pesticides and herbicides where there is considerably more site-wide data, there is greater uncertainty in the overall risk estimates because fewer samples were collected at the site for dioxins.

- Subsurface soil contamination is largely confined to historical IHSSs (that is, areas of known or suspected historical releases). These areas have been characterized to understand the nature and extent of potential releases. For historical IHSSs where subsurface soil samples were not collected for an analyte group, the presence of this type of subsurface contamination was not expected based on process knowledge. Therefore, the existing subsurface soil data are adequate for the purposes of the CRA.

The findings from the data adequacy report applicable to the UWOEU are as follows:

- The number of surface soil and surface soil/surface sediment samples in the UWNEU for VOCs, SVOCs, PCBs, and dioxins meet the data adequacy guideline.

- The spatial distribution of surface soil samples in the UWOEU for VOCs, SVOCs, PCBs, and dioxins tends to be clustered near historical IHSSs. As a result, Tier 1 exposure point concentration calculations will tend to be conservative (i.e., overestimate exposures). Therefore, the spatial distribution of the data are adequate for the purposes of the CRA.

- The data adequacy guideline for number of samples is met for radionuclides and metals for all the habitat patches in the UWOEU, and is met for all organic analyte groups for patches #20 and #21. It is also met for SVOCs in patch #19. VOC and PCB data do not exist for patch #19. The Ash Pits (IHSS 133) is located in patch #19. Process knowledge and site data indicate that metals, radionuclides, and to a much lesser extent SVOCs are contaminants of the ash (DOE 2005b). Accordingly, the Ash Pits are not a source for VOC and PCB contamination, and constituents in these analyte groups are not likely to be present in surface soil for this PMJM habitat patch. Therefore, although the existing UWOEU PMJM habitat patch data do not meet the minimal data adequacy guidelines for the EU PMJM patches, it is possible to make risk management decisions without additional sampling because the risk are expected to be low for the PMJM.

- Sampling locations are generally well distributed throughout the habitat patches, and therefore, meet the guideline for spatial representativeness.

- The number of surface water samples in the UWOEU for all analyte groups meets the data adequacy guideline. The sample locations are well distributed throughout the UWOEU, and therefore, meet the data adequacy guideline for spatial representativeness.

- With the exception of PCBs, the surface water data are considered temporally representative. Although there are no current PCB data, the historical data indicate PCBs are not detected, and therefore, a temporal trend in concentrations is not expected. However, as discussed in Appendix A, Volume 15B2, Attachment 1 of the RI/FS report, professional judgment suggests PCB-1254, PCB-1260 have the potential to be ECOPCs in the Woman Creek Aquatic Exposure Unit surface water had detection limits been lower, and therefore, there is some uncertainty in the risk assessment process with respect to PCBs in surface water.

- For analytes not detected or detected in less than 5 percent of the samples in surface soil/surface sediment, subsurface soil/subsurface sediment, and subsurface soil, a few analytes have detection limits that exceed PRGs/ESLs, however, the frequencies of PRG/ESL exceedance are either very low, or the maximum detection limit is of similar magnitude to the PRG/ESL. There are 14 analytes in surface soil where some percent of the detection limits exceed the lowest ESL. However, except for 4,4’ dichlorodiphenyltrichloroethane (DDT) and PCB-1260 those analytes that have detection limits that exceed the lowest ESLs contribute only minimal uncertainty to the overall risk estimates because either only a small fraction of the detection limits are greater than the lowest ESL, or professional judgment indicates they are not likely to be ECOPCs in UWOEU surface soil even if detection limits had been lower. There is some uncertainty in the overall risk estimates because of the higher detection limits for DDT and PCB-1260, i.e., overall risks to the UWOEU ecological receptors may be underestimated because DDT and PCB-1260 may have been included as ECOPCs for surface soil had the analytes been detected at a higher frequency using lower detection limits. However, DDT and PCB-1260 do not present a potential for adverse ecological effects if they were detected at their maximum detection limits (see Attachment 1 for a more detailed discussion).

1.3 Data Quality Assessment

A Data Quality Assessment (DQA) of the UWOEU data was conducted to determine whether the data were of sufficient quality for risk assessment use. The DQA is presented in Attachment 2, and an evaluation of the entire RFETS data set is presented in Appendix A, Volume 2 of the RI/FS Report. The quality of the laboratory results were evaluated for compliance with the CRA Methodology DQOs through an overall review of precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters. This review concluded that the data are of sufficient quality for use in the CRA, and the CRA DQOs have been met.

2.0 SELECTION OF HUMAN HEALTH CONTAMINANTS OF CONCERN

The human health contaminant of concern (COC) screening process is described in Section 4.2 of the CRA Methodology and summarized in Appendix A, Volume 2 of the RI/FS Report (Section 2.2).

The human health COC selection process was conducted for surface soil/surface sediment and subsurface soil/subsurface sediment in the UWOEU. Results of the COC selection process are summarized below.

2.1 Contaminant of Concern Selection for Surface Soil/Surface Sediment

Detected PCOCs in surface soil/surface sediment samples (Table 1.3) are screened in accordance with the CRA Methodology to identify the COCs.

2.1.1 Surface Soil/Surface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicological factors are eliminated from assessments in surface soil/surface sediment in accordance with the CRA Methodology.

The essential nutrient screen for analytes detected in surface soil/surface sediment is presented in Table 2.1. The screen includes PCOCs that are essential for human health and do not have toxicity values. The PRG screen in Section 2.1.2 includes essential nutrients for which toxicity criteria are available. Table 2.1 shows the maximum detected concentrations (MDCs) for essential nutrients, daily intake estimates based on the MDCs, and dietary reference intakes (DRIs). The DRIs are identified in the table as recommended daily allowances (RDAs), recommended daily intakes (RDIs), adequate intakes (AIs), and upper limit daily intakes (ULs). The estimated daily maximum intakes are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for surface soil/surface sediment.

2.1.2 Surface Soil/Surface Sediment Preliminary Remediation Goals Screen

Table 2.2 compares MDCs and upper confidence limits (UCLs) to the WRW PRGs for each PCOC. If the MDC and the UCL are greater than the PRG, the PCOC is retained for further screening; otherwise, it is not further evaluated. Arsenic, benzo(a)pyrene, dibenz(a,h)anthracene, 2,3,7,8-TCDD (TEQ), cesium-134, cesium-137, and radium-228 in surface soil/surface sediment had MDCs and UCLs that exceeded the PRGs, and were retained as PCOCs.

PRGs were not available for several PCOCs in surface soil/surface sediment. Analytes without PRGs are listed in Table 2.2 and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

2.1.3 Surface Soil/Surface Sediment Detection Frequency Screen

Arsenic, benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were detected in more than 5 percent of surface soil/surface sediment samples and, therefore, were retained for further evaluation in the COC screen (Table 2.2). Dibenz(a,h)anthracene was detected at less than 5 percent (4.8 percent, Table 1.3). Because the MDC for this chemical was less than 30 times the PRG, dibenz(a,h)anthracene was not further evaluated as a COC. A detection frequency screen was not performed for cesium-134, cesium-137, radium-228, and uranium-235 in surface soil/surface sediment because all reported values for radionuclides are considered detects.

2.1.4 Surface Soil/Surface Sediment Background Analysis

Results of the background statistical comparison for arsenic, cesium 134, cesium-137, radium-228, and uranium-235 are presented in Table 2.3 and discussed in Attachment 3. Box plots for arsenic, cesium 134, cesium-137, radium-228, and uranium-235 (both UWOEU and background) are provided in Attachment 3. Arsenic is the only PCOC that was statistically greater than background at the 0.1 significance level, and it is evaluated further in the professional judgment section.

Following the CRA Methodology, a statistical comparison to background is not performed for organics; therefore, benzo(a)pyrene and 2,3,7,8 TCDD (TEQ) are carried forward into the professional judgment evaluation.

2.1.5 Surface Soil/Surface Sediment Professional Judgment Evaluation

Based on the weight of available evidence evaluated by professional judgment, PCOCs will either be included for further evaluation as COCs or excluded as COCs. The professional judgment evaluation takes into account process knowledge, spatial trends, and pattern recognition. As discussed in Section 1.2 and Attachment 2, the sample results are adequate for use in the professional judgment because they are of sufficient quality for use in the CRA.

As described in Attachment 3, arsenic in surface soil/surface sediment in the UWOEU is not considered a COC because the weight of evidence supports the conclusion that arsenic concentrations in surface soil/surface sediment in the UWOEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations. The surface soil/surface sediment UCL is less than three times greater than the PRG (2.41 milligrams per kilogram [mg/kg]) and the risk potential is essentially equivalent to the background risk potential. The concentrations of arsenic in surface soil/surface sediment samples at the UWOEU are similar to the background data set. Therefore, arsenic is not further evaluated quantitatively.

2.2 Contaminant of Concern Selection for Subsurface Soil/Subsurface Sediment

Detected PCOCs in subsurface soil/subsurface sediment samples (Table 1.4) are screened in accordance with the CRA Methodology to identify the COCs.

2.2.1 Subsurface Soil/Subsurface Sediment Cation/Anion and Essential Nutrient Screen

The major cations and anions that do not have toxicological factors are eliminated from assessments in subsurface soil/subsurface sediment in accordance with the CRA Methodology.

Essential nutrients without toxicity criteria that were detected in subsurface soil/subsurface sediment in the UWOEU are compared to DRIs in Table 2.4. The estimated daily maximum intakes for these PCOCs, based on the nutrient's MDCs and a subsurface soil ingestion rate of 100 milligrams per day (mg/day), are less than the DRIs. Therefore, these PCOCs were not further evaluated as COCs for subsurface soil/subsurface sediment.

2.2.2 Subsurface Soil/Subsurface Sediment Preliminary Remediation Goal Screen

The PRG screen for detected analytes in subsurface soil/subsurface sediment is presented in Table 2.5. Radium-228 was the only PCOC with an MDC and UCL that exceeded the PRG. Therefore, radium-228 was retained as a PCOC.

PRGs were not available for several PCOCs in subsurface soil/subsurface sediment. Analytes without PRGs are listed in Table 2.5 and their effect on the conclusions of the risk assessment results is discussed in the uncertainty section (Section 6.0).

2.2.3 Subsurface Soil/Subsurface Sediment Detection Frequency Screen

The detection frequency screen is not performed for radium-228 in subsurface soil/subsurface sediment because all reported values for radionuclides are considered detects.

2.2.4 Subsurface Soil/Subsurface Sediment Background Analysis

Analyses were conducted to assess whether radium-228 concentrations in UWOEU subsurface soil/subsurface sediment are statistically higher than those in background subsurface soil/subsurface sediment at the 0.1 level of significance (1-p less than or equal to 0.1). The subsurface soil/subsurface sediment background data are described in detail in Appendix A, Volume 2 of the RI/FS Report.

The results of the statistical comparisons of the UWOEU data to background data indicate site concentrations for radium-228 are not statistically greater than background at the 0.1 significance level. The results are summarized in Table 2.3 and in Attachment 3. Box plots for radium-228 (both UWOEU and background data) are provided on Figure A3.2.32 in Attachment 3. Radium-228 in subsurface soil/subsurface sediment is not further evaluated in the professional judgment section.

2.2.5 Subsurface Soil/Subsurface Sediment Professional Judgment Evaluation

A professional judgment evaluation for subsurface soil/subsurface sediment at the UWOEU was not performed because no PCOCs were retained after the background analysis.

2.3 Contaminant of Concern Selection Summary

A summary of the results of the COC screening process is presented in Table 2.6. Benzo(a)pyrene and 2,3,7,8 TCDD (TEQ) were the only analytes in surface soil/surface sediment selected as COCs in the UWOEU. These COCs are further evaluated quantitatively. No analytes were selected as COCs in subsurface soil/subsurface sediment in the UWOEU.

3.0 HUMAN HEALTH EXPOSURE ASSESSMENT

The site conceptual model (SCM), presented on Figure 2.1 of the CRA Methodology and discussed in Appendix A, Volume 2 of the RI/FS Report, provides an overview of potential human exposures at RFETS for reasonably anticipated land use. Two types of receptors, the WRW and WRV, were selected for quantitative evaluation based on the SCM. Exposure point concentrations (EPCs) were calculated for the COCs identified and chemical intakes were estimated using the EPCs for the WRW and WRV receptors.

Tier 1 and Tier 2 EPCs were calculated for the COCs, benzo(a)pyrene, and 2,3,7,8-TCDD (TEQ), in surface soil/surface sediment for the UWOEU. Tier 1 EPCs are based on the UCLs of the arithmetic mean concentration for the EU data set and Tier 2 EPCs are calculated using a spatially weighted averaging approach. For 2,3,7,8 –TCDD (TEQ), Tier 2 calculations could not be calculated because all data were collected within one of the 30-acre grids. Therefore, the Tier 1 concentrations for 2,3,7,8-TCDD (TEQ) were also used for Tier 2 calculations. The methodology for these calculations is provided in Appendix A, Volume 2 of the RI/FS Report. Figure 3.1 shows the 30-acre grid used to calculate the Tier 2 EPCs. Table 3.1 presents the Tier 1 and Tier 2 EPCs for the UWOEU.

Chemical intakes for WRW and WRV exposure pathways were quantified for benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) using the exposure factors listed in Tables 3.2 and 3.3, respectively. Additional information on the estimation of chemical intake is presented in Appendix A, Volume 2 of the RI/FS Report and in the CRA Methodology.

4.0 HUMAN HEALTH TOXICITY CRITERIA

Toxicity criteria are used in the risk calculations in Section 5.0. Tables 4.1 and 4.2 present the toxicity criteria (cancer slope factors [CSFs], reference doses [RfDs], and dermal absorption factors) for COCs at the UWOEU. Toxicity criteria are presented for the oral, inhalation, and dermal exposure pathways. Additional information on the human health toxicity assessment is presented in Appendix A, Volume 2 of the RI/FS Report and in the CRA Methodology.

5.0 HUMAN HEALTH RISK CHARACTERIZATION

Information from the exposure assessment and the toxicity assessment is integrated in this section to characterize risk to the WRW and WRV receptors. Quantitative risks for cancer and noncancer effects were estimated using the toxicity factors presented in the Toxicity Assessment (Section 4.0) and pathway-specific intakes defined in the exposure assessment (Section 3.0). Details of the risk characterization methods are provided in the CRA Methodology and summarized in Appendix A, Volume 2 of the RI/FS Report.

5.1 Wildlife Refuge Worker

This section presents the risk characterization for exposure to COCs at the UWOEU. The WRW receptor was evaluated for exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment. The risk estimates for exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) are summarized in Table 5.1, while Attachment 4 contains the risk calculation tables.

5.1.1 Surface Soil/Surface Sediment

The WRW is evaluated for exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment by ingestion, inhalation, and dermal exposure. Radionuclides were not selected as COCs for surface soil/surface sediment. Therefore, radiation cancer risks and doses were not calculated. The estimated excess lifetime cancer risks are calculated and summarized in Tables 5.1 and 5.3 for Tier 1 and Tier 2 EPCs. Noncancer hazards for benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were not calculated because noncancer toxicity values are not available.

It is important to note that some of the surface soil/surface sediment samples for the UWOEU are located under the Original Landfill cover and, therefore, are not accessible for contact by the WRW. In addition, the 2,3,7,8-TCDD (TEQ) samples are actually located approximately 20 feet bgs. The effect on the HHRA results of using the samples that are located under the Original Landfill cover and below ground surface is evaluated in Section 6.4, Uncertainties Associated with Calculation of Risk.

Risk Characterization Results Based on Tier 1 EPCs

The total chemical cancer risk for potential exposure to surface soil/surface sediment by the WRW, based on the Tier 1 EPC, is 8E-06 (Table 5.1). The primary risk driver is benzo(a)pyrene, which comprises 73 percent of the total chemical cancer risk. The risk is predominantly from the ingestion exposure route.

Risk Characterization Results Based on Tier 2 EPCs

The total cancer risk for potential exposure to surface soil/surface sediment by the WRW, based on the Tier 2 EPC, is 4E-06 (Table 5.1). The primary risk driver is 2,3,7,8-TCDD (TEQ), which comprises 57 percent of the total chemical cancer risk. The risk is predominantly from the ingestion exposure route.

5.1.2 Subsurface Soil/Subsurface Sediment

No COCs were selected in subsurface soil/subsurface sediment. Therefore, it is not necessary to perform a risk characterization for subsurface soil/subsurface sediment in the UWOEU.

5.1.3 Wildlife Refuge Worker Total Risk and Hazards

Risk estimates are summed across media to develop an estimate for the total risk to a receptor. This approach is followed only if the COCs in different media exhibit comparable health effects. For the UWOEU, benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were selected as COCs for surface soil/surface sediment only. Total risk and hazards are summarized in Table 5.3. The surface soil/surface sediment risk estimates for the WRW, based on a Tier 1 EPC, result in an estimated total cancer risk of 8E-06. Because COCs were only calculated for one medium, cumulative risks from exposure to multimedia are not calculated for the UWOEU.

5.2 Wildlife Refuge Visitor

This section presents the results of the risk characterization for potential exposure of the WRV receptor to surface soil/surface sediment at the UWOEU. Exposure to subsurface soil/subsurface sediment is not evaluated for WRV.

Risks to the WRV receptor are evaluated for potential exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment by inhalation, ingestion, and dermal exposure. The risk estimates for exposure to this COC are summarized in Table 5.2. Attachment 4 contains the risk calculation tables.

5.2.1 Surface Soil/Surface Sediment

The WRV is evaluated for exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment by ingestion, inhalation, and dermal exposure (for organic COCs only). Radionuclides were not selected as COCs for surface soil/surface sediment. Therefore, radiation cancer risks and doses were not calculated. The estimated excess lifetime cancer risks are calculated and summarized in Table 5.2 for Tier 1 and Tier 2 EPCs. Noncancer hazards for benzo(a)pyrene were not calculated because noncancer toxicity values are not available for benzo(a)pyrene.

As noted above for the WRW, some of the surface soil/surface sediment samples for the UWOEU are located under the Original Landfill cover or approximately 20 feet bgs. The effect on the HHRA results of using these samples is evaluated in Section 6.4, Uncertainties Associated with Calculation of Risk.

Risk Characterization Results Based on Tier 1 EPCs

The total cancer risk for potential exposure to surface soil/surface sediment by the WRV, based on the Tier 1 EPC, is 9E-06 (Table 5.2). The primary risk driver is benzo(a)pyrene, which comprises 75 percent of the total Tier 1 cancer risk. The ingestion and dermal exposure route are the main contributors to this risk.

Risk Characterization Results Based on Tier 2 EPCs

The total chemical cancer risk for potential exposure to surface soil/surface sediment by the WRV, based on the Tier 2 EPC, is 4E-06 (Table 5.2). The primary risk driver is 2,3,7,8-TCDD (TEQ), contributing approximately 54 percent to the risk. The risk is predominantly from the ingestion exposure route.

5.3 Summary

Risks to the WRW and WRV were evaluated for potential exposure to benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment at the UWOEU. A summary of the cancer risks and noncancer hazards is presented in Table 5.3.

The results of the Tier 1 and Tier 2 risk characterizations indicate that estimated risks for the WRW and WRV are within the target risk range for COCs exhibiting carcinogenic effects (i.e., 1 x 10^{-6} to 1x 10^{-4}) (Table 5.3).

6.0 UNCERTAINTIES ASSOCIATED WITH THE HUMAN HEALTH RISK ASSESSMENT

There are various types of uncertainties associated with steps of an HHRA. General uncertainties common to the EUs are discussed in Appendix A, Volume 2 of the RI/FS Report. Uncertainties specific to the EU are described below.

6.1 Uncertainties Associated with the Data

Data adequacy for this CRA is evaluated and discussed in Appendix A, Volume 2 of the RI/FS Report. Although there are some uncertainties associated with the sampling and analyses conducted for surface soil/surface sediment and subsurface soil/subsurface sediment at the UWOEU, data are considered adequate for the characterization of risk at the EU. The environmental samples for the UWOEU were collected from 1991 through 2005. The CRA sampling and analysis requirements for the BZ (DOE 2004) specify that the minimum sampling density requirement for surface soil/surface sediment is one five-sample composite for every 30-acre grid cell. This sampling density is exceeded for most of the UWOEU given that there are up to 217 surface soil/surface sediment samples for the entire 524-acre EU. In surface soil/surface sediment, there are up to 217 samples in the UWOEU.

Another source of uncertainty in the data is the relationship of detection limits to the PRGs for analytes eliminated as COCs because they were not detected nor had a low detection frequency (i.e., less than 5 percent). The detection limits were appropriate for the analytical methods used, and this is examined in greater detail in Attachment 1.

6.2 Uncertainties Associated with Screening Values

The COC screening analyses used RFETS-specific PRGs based on a WRW scenario. The assumptions used in the development of these values were conservative. For example, it is assumed that a future WRW will consume 100 mg of surface soil/surface sediment for 230 days a year for 18.7 years. In addition, a WRW is assumed to be dermally exposed to and inhale surface soil and surface sediment particles in the air. These assumptions are likely to overestimate actual exposures to surface soil for WRWs in the UWOEU because a WRW will not spend 100 percent of his or her time in this area. Exposure to subsurface soil and subsurface sediment is assumed to occur 20 days per year. The WRW PRGs for subsurface soil/subsurface sediment are also expected to estimate conservatively potential exposures because it is unlikely a WRW will excavate extensively in the UWOEU.

6.2.1 Uncertainties Associated with Potential Contaminants of Concern without Preliminary Remediation Goals

PCOCs for the UWOEU for which PRGs are not available are listed in Table 6.1.

Uncertainties associated with the lack of PRGs for analytes listed in Table 6.1 are considered small. The listed cations/anions and inorganics are not usually included in HHRAs because they are not expected to result in significant human health impacts. The majority of the listed organics have a low detection frequency and, therefore, are not expected to affect the results of the HHRA. Radionuclide PRGs are available for all detected individual radionuclides. Therefore, the lack of PRGs for gross alpha and gross beta activities is also not expected to affect the results of the HHRA.

6.3 Uncertainties Associated with Eliminating Potential Contaminants of Concern Based on Professional Judgment

Arsenic in surface soil/surface sediment was eliminated as a COC based on professional judgment. There is no identified source or pattern of release in the UWOEU and the slightly elevated median values of the UWOEU data for these PCOCs are most likely due to natural variation. The weight of evidence presented in Attachment 3, Section 4.0 supports the conclusion that concentrations of arsenic are naturally occurring and not due to site activities. Uncertainty associated with the elimination of this chemical as a COC is low.

6.4 Uncertainties Associated with Calculation of Risk

One of the most important uncertainties in the risk calculations for the UWOEU is associated with the EPCs for benzo(a)pyrene in surface soil/surface sediment. This concentration estimate is biased by two high benzo(a)pyrene hits (one as high as 43,000 μg/kg) from locations underneath the cover of the Original Landfill. Because exposure to soil at these locations is not anticipated, the EPC for benzo(a)pyrene and the associated risks are likely overestimated.

Of the 121 surface soil/surface sediment samples in the UWOEU, 52 samples are located in areas that are now under the Original Landfill cover. As part of the uncertainty analysis, the

UCL was calculated for benzo(a)pyrene using only surface soil/surface sediment samples in the UWOEU that are located outside the Original Landfill cover. This UCL (334 µg/kg) is less than the PRG (379 µg/kg); therefore, benzo(a)pyrene would not be identified as a COC for the portion of UWOEU that is outside the Original Landfill cover. Accordingly, risks associated with exposure to benzo(a)pyrene in the UWOEU in areas outside the Original Landfill cover are less than 1E-06.

Exposure to 2,3,7,8-TCDD (TEQ) in soil is also not anticipated because these samples are located approximately 20 feet bgs. These samples were taken as confirmation samples in an excavation following an accelerated action and, therefore, were classified as surface soil samples. However, the locations are actually approximately 20 feet bgs and not accessible by the WRW or WRV. Therefore, the risks for exposure to 2,3,7,8-TCDD (TEQ) in surface soil/surface sediment are most likely to be overestimated. Another uncertainty in the risk calculations relates to the cancer slope factor (CSF) for 2,3,7,8-TCDD. EPA is currently reevaluating this CSF and, therefore, there are uncertainties related to the risk results based on the current CSF.

6.5 Uncertainties Evaluation Summary

Evaluation of the uncertainties associated with the data and the COC screening processes indicates there is reasonable confidence in the conclusions of the UWOEU risk characterization.

7.0 IDENTIFICATION OF ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN

The ECOPC identification process streamlines the ecological risk characterization for each EU by focusing the assessment on ecological contaminants of interest (ECOIs) that are present in the UWOEU. ECOIs are defined as any chemical detected in the UWOEU and are assessed for surface soils and subsurface soils. ECOIs for sediments and surface water are assessed in Appendix A, Volume 15B of the RI/FS Report. The ECOPC process is described in the CRA Methodology and additional details are provided in Appendix A, Volume 2 of the RI/FS Report. A detailed discussion of the ecological SCM, including the receptors of concern, exposure pathways, and endpoints used in the ERA for the UWOEU is also provided in Appendix A, Volume 2 of the RI/FS Report.

The SCM presents the pathways of potential exposure from documented historical source areas (IHSSs and PACs) to the receptors of concern. The most significant exposure pathways for ecological receptors at the UWOEU are the ingestion of plant, invertebrate, or animal tissue that could have accumulated ECOIs from the source areas through direct uptake or dietary routes, as well as the direct ingestion of potentially contaminated media. For terrestrial plants and invertebrates, the most significant exposure pathway is direct contact with potentially contaminated soil.

The receptors of concern that were selected for assessment are listed in Table 7.1, and discussed in detail in Appendix A, Volume 2 of the RI/FS Report, and include representative birds and mammals in addition to the general plant and terrestrial invertebrate communities. The receptors were selected based on several criteria, including their potential to be found in the various habitats present within the UWOEU, their potential to have contact with ECOIs, and the amount of life history and behavioral information available.

The ECOPC identification process consists of two separate evaluations, one for the PMJM receptor and one for non-PMJM receptors. The ECOPC identification process for the PMJM is conducted separately from non-PMJM receptors because the PMJM is a federally listed threatened species under the Endangered Species Act (63 FR 26517).

7.1 Data Used in the Ecological Risk Assessment

The following UWOEU data are used in the CRA:

- One hundred and seventy-seven surface soil samples were collected and analyzed for inorganics (135 samples), organics (121 samples), and radionuclides (177 samples) (Table 1.2).

- Two hundred and ninety-seven subsurface soil samples were collected and analyzed for inorganics (257 samples), organics (297 samples), and radionuclides (251 samples) (Table 1.2).

A data summary is provided in Table 1.5 for surface soil and Table 1.7 for subsurface soil.

Sediment and surface water data for the UWOEU also were collected (Section 1.1.5), and these data are evaluated for the ERA in Appendix A, Volume 15B of the RI/FS Report. As discussed in Section 8.0, surface water EPCs are used in the risk model to estimate exposure via the surface water ingestion pathway. Three hundred and ninety-one distinct surface water samples were collected in the UWOEU and analyzed for inorganics (391 samples), organics (166 samples), and radionuclides (342 samples).

As described in Section 1.1.4, there are 45 sample locations occurring in PMJM habitat within the UWOEU. Surface soil samples were collected and analyzed for inorganics (35 samples), organics (28 samples), and radionuclides (45 samples). A data summary is provided in Table 1.6. Sampling locations and PMJM habitat patches within the UWOEU are shown on Figure 1.5.

7.2 Identification of Surface Soil Ecological Contaminants of Potential Concern

ECOPCs for surface soil were identified for non-PMJM and PMJM receptors in accordance with the sequence presented in the CRA Methodology.

7.2.1 Comparison with No Observed Adverse Effect Level Ecological Screening Levels

In the first step of the ECOPC identification process, the MDCs of ECOIs in surface soil were compared to receptor-specific no observed adverse effect level (NOAEL) ESLs.

NOAEL ESLs for surface soil were developed in the CRA Methodology for three receptor groups: terrestrial vertebrates, terrestrial invertebrates, and terrestrial plants.

Non-PMJM Receptors

The NOAEL ESLs for non-PMJM receptors are compared to MDCs in surface soil in Table 7.1. The results of the NOAEL ESL screening analyses for all receptor types are summarized in Table 7.2. Analytes with a "Yes" in any of the "Exceedance" columns in Table 7.2 are further evaluated.

NOAEL ESLs were not available for several ECOI/receptor pairs (Tables 7.1 and 7.2). These ECOI/receptor pairs are discussed as ECOIs with uncertain toxicity (UT) in Section 10.0 along with the potential impacts to the risk assessment.

PMJM Receptors

The NOAEL ESLs for PMJM receptors were compared to the MDCs of ECOIs in surface soil collected from PMJM habitat (Table 7.3). The MDCs in surface soil that exceed the NOAEL ESLs are identified in Table 7.3 with a "Yes" in the column heading "MDC>PMJM ESL?"

Analytes for which a PMJM NOAEL ESL is not available are identified with a "N/A" in Table 7.3 under the column heading "PMJM NOAEL ESL." These analytes are discussed in the uncertainty section (Section 10.0) as ECOIs with UT.

7.2.2 Surface Soil Frequency of Detection Evaluation

The ECOPC identification process for non-PMJM receptors involves an evaluation of detection frequency for each ECOI retained after the NOAEL screening step. If the detection frequency is less than 5 percent, population-level risks are considered highly unlikely and the ECOI is not further evaluated. 4,4'-DDT, dieldrin, and endrin ketone were each detected once in 89 UWOEU surface soil samples. Detections of 4,4'-DDT, dieldrin, and endrin ketone within UWOEU are presented on Figures 7.1, 7.2, and 7.3, respectively. None of these ECOIs were carried forward in the ECOPC identification process However, because greater than 95 percent of the detection limits for these compound exceed the lowest ESL, this contributes some uncertainty to the overall risk estimates. For dieldrin and endrin ketone, the uncertainty is minimal because professional judgment suggests these chemicals are not expected to be present in UWOEU surface soil. For DDT, professional judgment indicates it may be present in UWOEU surface soil i.e., ecological risks may be underestimated because this analyte may have been included as an ECOPC had it been detected more frequently using lower detection limits (see Attachment 1 for a more detailed discussion).

7.2.3 Surface Soil Background Comparisons

ECOIs retained after the NOAEL ESL screening and the detection frequency evaluation were then compared to site-specific background concentrations where available. The background comparisons are presented in Tables 7.4 and 7.5 and discussed in

Attachment 3. The statistical methods used for the background comparison are summarized in Appendix A, Volume 2 of the RI/FS Report.

Non-PMJM Receptors

The results of the background comparisons for the non-PMJM receptors are presented in Table 7.4. The analytes listed as being retained as ECOIs in Table 7.4 are evaluated further using upper-bound EPCs in the following section.

PMJM Receptors

The background comparison for PMJM receptors is performed using the same methods as for non-PMJM receptors, but the EU data set is restricted to soil samples from within PMJM areas. Table 7.5 presents the results of the PMJM comparison to background. Attachment 3 presents further discussion of the PMJM background analysis. The analytes listed as '"yes" in Table 7.5 are further evaluated in the professional judgment evaluation.

7.2.4 Exposure Point Concentration Comparisons to Threshold ESLs

The ECOIs retained after completion of all previous evaluations for non-PMJM receptors were then compared to threshold ecological screening levels (tESLs) using EPCs specific to small and large home-range receptors. The calculation of EPCs is described in Attachment 3 and Appendix A, Volume 2 of the RI/FS Report.

Statistical concentrations for each ECOI retained for the tESL screen are presented in Table 7.6. The EPC for small home-range receptors is the 95 percent UCL of the 90th percentile (upper tolerance limit [UTL]), or the MDC in the event that the UTL is greater than the MDC. The EPC for large home-range receptors is the UCL of the mean, or the MDC in the event that the UCL is greater than the MDC.

Small home-range receptors include terrestrial plants, terrestrial invertebrates, mourning dove, American kestrel, deer mouse, and black-tailed prairie dog. These receptors are evaluated by comparing the small home-range EPC (UTL) for each ECOI to the limiting (or lowest) small home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

Large home-range receptors, such as coyote and mule deer, are evaluated by comparing the large home-range EPC (UCL) for each ECOI to the limiting large home-range receptor tESL (if available). In the event that tESLs are not available, the limiting NOAEL ESL is used in accordance with the CRA Methodology.

The upper-bound EPC comparison to limiting tESLs for small and large home-range receptors is presented in Table 7.7. Analytes that exceed the limiting tESLs are further evaluated by comparing them to the receptor-specific tESLs (if available) to identify receptors of potential concern. Analytes exceeding the limiting tESLs for small home-range receptors are compared to receptor-specific tESLs in Table 7.8, and analytes exceeding limiting tESLs for large home-range receptors are compared to receptor-specific tESLs in Table 7.9

Chemicals that exceed any tESLs (if available) are assessed in the professional judgment evaluation. Any analyte/receptor pairs that are retained through professional judgment are identified as ECOPCs and are carried forward in the risk assessment.

7.2.5 Surface Soil Professional Judgment Evaluation

Non-PMJM Receptors

Based on the weight-of-evidence, professional judgment described in Attachment 3, boron and molybdenum in surface soil at the UWOEU were not considered ECOPCs for non-PMJM receptors and are not further evaluated quantitatively.

Antimony, copper, nickel, silver, tin, uranium, vanadium, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, 2,3,7,8-TCDD (TEQ) (mammal and bird), and total PCBs were identified as ECOPCs and retained for further evaluation in the risk characterization.

PMJM Receptors

Based on the weight-of-evidence, professional judgment described in Attachment 3, all analytes exceeding screening steps for PMJM receptors were identified as ECOPCs and retained for further evaluation in the risk characterization.

Antimony, chromium, copper, manganese, molybdenum, nickel, tin, vanadium, zinc, and total PCBs were identified as ECOPCs and retained for further evaluation in the risk characterization.

7.2.6 Summary of Surface Soil Ecological Contaminants of Potential Concern

The ECOPC screening process for surface soil is summarized below for non-PMJM receptors and PMJM receptors.

Non-PMJM Receptors

Most inorganic, organic, and radionuclide surface soil ECOIs for non-PMJM receptors in the UWOEU were eliminated from further consideration in the ECOPC identification process based on one of the following: 1) the MDC of the ECOI was less than the lowest ESL; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in UWOEU surface soils was not statistically greater than those from background surface soils; 4) the upper-bound EPC did not exceed the limiting tESL; or 5) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. Chemicals that were retained are identified as ECOPCs and are presented in Table 7.10.

A summary of the ECOPC screening process for non-PMJM receptors is presented in Table 7.10. Receptors of potential concern for each ECOPC are also presented. The

ECOPC/receptor pairs are evaluated further in Section 8.0 (Ecological Exposure Assessment), Section 9.0 (Ecological Toxicity Assessment), and Section 10.0 (Ecological Risk Characterization).

PMJM Receptors

ECOIs in surface soil in PMJM habitat located within the UWOEU were evaluated in the ECOPC identification process. Most ECOIs were removed from further evaluation in the ECOPC identification process based on one of the following: 1) the MDC of the ECOI was less than the NOAEL ESL for PMJM; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the ECOI concentrations within the PMJM habitat in UWOEU were not statistically greater than those from background surface soils; or 4) the weight-of-evidence, professional judgment evaluation indicated that the ECOI was not a site-related contaminant of potential concern. Chemicals that were retained are identified as ECOPCs and are presented in Table 7.11.

A summary of the ECOPC screening process for PMJM receptors is presented in Table 7.11. The ECOPC/PMJM pairs are evaluated further in Section 8.0 (Ecological Exposure Assessment), Section 9.0 (Ecological Toxicity Assessment), and Section 10.0 (Ecological Risk Characterization).

7.3 Identification of Subsurface Soil Ecological Contaminants of Potential Concern

Subsurface soil sampling locations for soil collected at a starting depth of 0.5 to 8 feet bgs in the UWOEU are identified on Figure 1.7. A data summary is presented in Table 1.7 for subsurface soil less than 8 feet deep.

7.3.1 Comparison to No Observed Adverse Effect Level Ecological Screening Levels

The CRA Methodology indicates subsurface soil must be evaluated for those ECOIs that have greater concentrations in subsurface soil than in surface soil. As a conservative step, subsurface soil is evaluated for all EUs regardless of the presence/absence of a change in concentrations from surface soil and subsurface soil. The MDCs of ECOIs in subsurface soil were compared to NOAEL ESLs for burrowing receptors (Table 7.12). ECOIs with MDCs greater than the NOAEL ESL for the prairie dog are further evaluated in the ECOPC identification process.

NOAEL ESLs are not available for some analytes, and these are identified as “N/A” in Table 7.12. These constituents are considered ECOIs with uncertain toxicity (UT) and are discussed in the uncertainty analysis (Section 10.0).

7.3.2 Subsurface Soil Detection Frequency Evaluation

The ECOPC identification process for burrowing receptors includes an evaluation of detection frequency for each ECOI retained after the NOAEL ESL screening step. If the detection frequency is less than 5 percent, population-level risks are considered highly unlikely and the ECOI is not further evaluated. The detection frequencies for chemicals in subsurface soil are presented in Table 1.7. None of the chemicals in subsurface soil at the UWOEU that were retained after the NOAEL ESL screening step had a detection frequency of less than 5 percent. Therefore, no ECOIs were eliminated from further evaluation based on the detection frequency for subsurface soil in the UWOEU.

7.3.3 Subsurface Soil Background Comparison

The ECOIs retained after the NOAEL ESL screening and detection frequency evaluation were compared to site-specific background concentrations where available. The background comparisons are presented in Table 7.13 and discussed in Attachment 3. The statistical methods used for the background comparison are summarized in Attachment 3.

The analytes listed as being retained as ECOIs in Table 7.13 are evaluated further using upper-bound EPCs in the following section.

7.3.4 Exposure Point Concentration Comparisons to Threshold ESLs

ECOIs retained after all previous evaluations for burrowing receptors are compared to tESLs using EPCs specific to small home-range receptors. The calculation of upper-bound EPCs is discussed in the CRA Methodology (DOE 2005a).

Statistical concentrations for each remaining ECOI retained for the tESL screen are presented in Table 7.14. The EPC comparison to tESLs for burrowing receptors is presented in Table 7.15. The subsurface soil UTLs for all remaining ECOIs are lower than their respective tESLs for the prairie dog receptor; therefore, no ECOIs are evaluated further in professional judgment.

7.3.5 Subsurface Soil Professional Judgment

ECOIs with subsurface soil concentrations that exceed NOAEL ESLs, which have been detected in more than 5 percent of samples, that are statistically higher at the 0.1 level of significance compared to the background data, and which exceed tESLs are subject to a professional judgment evaluation. However, no ECOIs had subsurface soil concentrations that exceeded tESLs; therefore, no weight-of-evidence, professional judgment evaluation was needed for subsurface soil in the UWOEU.

7.3.6 Summary of Subsurface Soil Ecological Contaminants of Potential Concern

All subsurface soil ECOIs for burrowing receptors in the UWOEU were eliminated from further consideration in the ECOPC identification process based on one of the following: 1) the MDC of the ECOI was less than NOAEL ESL for the burrowing receptor; 2) no ESLs were available (these ECOIs are discussed in Section 10.0); 3) the concentration of the ECOI in UWOEU subsurface soils was not statistically greater than those in background subsurface soils; or 4) the upper-bound EPC was less than the tESL. The results of the subsurface soil ECOPC identification process for burrowing receptors are summarized in Table 7.16.

7.4 Summary of Ecological Contaminants of Potential Concern

ECOIs in surface and subsurface soil in the UWOEU were evaluated in the ECOPC identification process for non-PMJM receptors, PMJM receptors, and burrowing receptors. Antimony, copper, nickel, silver, tin, uranium, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, 2,3,7,8-TCDD (TEQ) (mammal and bird), and total PCBs were identified as ECOPCs for selected non-PMJM receptors (Table 7.10). Antimony, chromium, copper, manganese, molybdenum, nickel, tin, vanadium, zinc, and total PCBs were identified as ECOPCs for the PMJM (Table 7.11). No chemicals were identified as ECOPCs for burrowing receptors (Table 7.16). No other ECOIs were retained past the professional judgment step of the ECOPC identification process for any other receptor group (non-PMJM receptors, PMJM receptors, or burrowing receptors).

8.0 ECOLOGICAL EXPOSURE ASSESSMENT

The ECOPC identification process defined the steps necessary to identify those chemicals that could not reliably be removed from further consideration in the ERA process. The list of ECOPC/receptor pairs of potential concern (Table 8.1) represents those media, chemicals, and receptors in the UWOEU that require further assessment. The characterization of risk defines a range of potential exposures to site receptors from the ECOPCs and a parallel evaluation of the potential toxicity of each of the ECOPCs as well as the uncertainties associated with the risk characterization. This section provides the estimation of potential exposure to surface soil ECOPCs for the receptors identified in Section 7.0 and Table 8.1. Exposure to ECOPCs via the ingestion of surface water is also considered a potentially significant exposure route as presented in the CRA Methodology (DOE 2005a). Details of the two exposure models, concentration-based exposure and dosage-based exposure, are presented in Appendix A, Volume 2 of the RI/FS Report.

8.1 Exposure Point Concentrations

Surface soil EPCs for all non-PMJM receptors were calculated using both Tier 1 and Tier 2 methods as described in the CRA Methodology. Tier1 EPCs are based on the upper confidence limits of the arithmetic mean concentration for the EU data set, and Tier 2 EPCs are calculated using a spatially-weighted averaging approach. The 30-acre grid used for the Tier 2 calculations is shown on Figure 8.1. The Tier 1 and Tier 2 UTLs and UCLs are presented in Table 8.2. The methodology for the calculation of Tier 2 statistics is provided in Appendix A, Volume 2 of the RI/FS Report.

Surface soil EPCs for PMJM receptors were calculated for each PMJM habitat patch assuming that all samples were randomly located and weighted equally. The habitat patches showing sample locations exceeding the NOAEL ESL, or three times the NOAEL ESL are shown for ECOPCs on Figure 8.2 (antimony), Figure 8.3 (chromium), Figure 8.4 (copper), Figure 8.5 (manganese), Figure 8.6 (molybdenum), Figure 8.7 (nickel), Figure 8.8 (tin), Figure 8.9 (vanadium), Figure 8.10 (zinc), and Figure 8.11 (total PCBs). The UCL concentrations for each ECOPC were used as EPCs to calculate hazard quotients (HQs). The UCL was not used if there were not sufficient numbers of samples to calculate this value or if it exceeded the MDC. In either case, the MDC was used as a surrogate EPC. The surface soil EPCs for each PMJM patch are presented in Table 8.3. The ECOPCs shown in Table 8.3 represent ECOPCs with patch-specific MDCs greater than their respective ESLs. All ECOPCs that are not detected in a specific patch at concentrations less than their ESLs are excluded from the table.

The surface water EPCs were calculated for ECOIs that were identified as soil ECOPCs using the same statistical basis as determined for the soil ECOPCs. For example, if the soil EPC statistic was the UCL, then the UCL concentration in surface water (total values only) was calculated as described for soils and selected as the EPC. Surface water EPCs for all ECOPCs are presented in Table 8.4. All surface water data are provided on CD in Attachment 6.

8.2 Receptor-Specific Exposure Parameters

Receptor-specific exposure factors are needed to estimate exposure to ECOPCs for each representative species. These include body weight; food, water, and media ingestion rates; and diet composition and respective proportion of each dietary component. Daily rates for intake of forage, prey, water, and incidental ingestion of soils were developed in the CRA Methodology (DOE 2005a) and are presented in Table 8.5 for the receptors of potential concern carried forward in the ERA for the UWOEU.

8.3 Bioaccumulation Factors

The measurement or estimation of concentrations of ECOPCs in wildlife food is necessary to evaluate how much of a receptor's exposure is via food versus direct uptake of contaminated media. Conservative bioaccumulation factors (BAFs) were identified in the CRA Methodology (DOE 2005a). These BAFs are either simple ratios between chemical concentrations in biota and soil or are based on quantitative relationships such as linear, logarithmic, or exponential equations. The values reported in the CRA Methodology are used as the BAFs for purposes of risk estimation.

8.4 Intake and Exposure Estimates

Intake and exposure estimates were completed for each ECOPC/receptor pair identified in Table 8.1. The estimates use the default exposure parameters and BAFs presented in Appendix B of the CRA Methodology (DOE 2005a) and described in the previous subsection. These intake calculations represent conservative estimates of food tissue concentrations calculated from the range of upper-bound EPCs including the Tier 1 and Tier 2 UTLs and UCLs.

Non-PMJM Receptors

The intake and exposure estimates for ECOPC/non-PMJM receptor pairs are presented in Attachment 4. A summary of the exposure estimates is presented in Table 8.6.

- Antimony – Default exposure estimates for the terrestrial plant, deer mouse (insectivore), and coyote (insectivore);

- Copper – Default exposure estimates for the mourning dove (herbivore and insectivore);
- Nickel – Default exposure estimates for the mourning dove (insectivore), deer mouse (herbivore and insectivore), and coyote (generalist and insectivore);
- Nickel – Alternative exposure estimates for the deer mouse (insectivore);
- Silver – Default exposure estimates for the terrestrial plant;
- Tin – Default exposure estimates for the American kestrel, mourning dove (insectivore), and deer mouse (insectivore);
- Uranium – Default exposure estimates for the terrestrial plant;
- Vanadium – Default exposure estimates for the terrestrial plant and deer mouse (insectivore);
- Bis(2-ethylhexyl)phthalate – Default exposure estimates for the American kestrel and mourning dove (insectivore);
- Di-n-butylphthalate – Default exposure estimates for the American kestrel and mourning dove (insectivore);
- 2,3,7,8-TCDD (TEQ) (mammal and bird) – Default exposure estimates for the American kestrel, mourning dove (insectivore), deer mouse (herbivore and insectivore), and coyote (generalist and insectivore); and,
- Total PCBs – Default exposure estimates for the American kestrel and mourning dove (herbivore and insectivore).

PMJM Receptors

The intake and exposure estimates for ECOPC/PMJM receptor pairs are presented in Attachment 4 and are summarized in Table 8.7 for:

- Antimony – Default exposure estimates;
- Chromium – Default exposure estimates;
- Copper – Default exposure estimates;
- Manganese – Default exposure estimates;
- Molybdenum – Default exposure estimates
- Nickel – Default and alternative exposure estimates;
- Tin – Default exposure estimates;

- Vanadium – Default exposure estimates;
- Zinc – Default exposure estimates; and
- Total PCBs – Default exposure estimates.

9.0 ECOLOGICAL TOXICITY ASSESSMENT

Exposure to wildlife receptors was estimated for representative species of functional groups based on taxonomy and feeding behavior in Section 8.0 in the form of a daily rate of intake for each ECOPC/receptor pair. To estimate risk, soil concentrations (plants and invertebrate exposure) and calculated intakes (birds and mammals) must then be compared to the toxicological properties of each ECOPC. The laboratory-based toxicity benchmarks are termed toxicity reference values (TRVs) and are of several basic types. The NOAEL and no observed effect concentration (NOEC) TRVs are intake rates or soil concentrations below which no ecologically significant effects are expected. The NOAEL and NOEC TRVs were used to calculate the NOAEL ESLs used in screening steps of the ECOPC identification process to eliminate chemicals that have no potential to cause risk to the representative receptors. The lowest observed adverse effects level (LOAEL) TRV is a concentration above which the potential for some ecologically significant adverse effect could be elevated. The threshold TRVs represent the hypothetical dose at which the response in a group of exposed organisms may first begin to be significantly greater than in unexposed receptors and is calculated as the geometric mean of the NOAEL and LOAEL. Threshold TRVs were calculated based on specific data quality rules for use in the ECOPC identification process for a small subset of ECOIs in the CRA Methodology (DOE 2005a).

TRVs for ECOPCs identified for UWOEU were obtained from the CRA Methodology. The pertinent TRVs for the UWOEU are presented for terrestrial plants and invertebrates in Table 9.1 and for birds and mammals in Table 9.2.

10.0 ECOLOGICAL RISK CHARACTERIZATION

Risk characterization includes risk estimation and risk description. Details of these components are described in the CRA Methodology (DOE 2005a) and Appendix A, Volume 2 of the RI/FS Report. Predicted risks should be viewed in terms of the potential for the assumptions used in the risk characterization to occur in nature, the uncertainties associated with the assumptions, and in the potential for effects on the population of receptors that could inhabit the UWOEU.

Potential risks to terrestrial plants, invertebrates, birds, and mammals are evaluated using an HQ approach. An HQ is the ratio of the estimated exposure of a receptor to a TRV that is associated with a known level of toxicity, either a no effect level (NOAEL or NOEC) or an effect level (LOAEL or LOEC):

$$HQ = Exposure/TRV$$

As described in Section 8.0, the units used for exposure and TRV depend upon the type of receptor evaluated. For plants and invertebrates, exposures and TRVs are expressed as concentrations (mg/kg soil). For birds and mammals, exposures and TRVs are expressed as ingested doses (milligrams per kilogram receptor body weight per day [mg/kg BW/day]).

In general, if the NOAEL-based HQ is less than 1, then no adverse effects are predicted. If the LOAEL-based HQ is less than 1 but the NOAEL-based HQ is above 1, then some adverse effects are possible, although it is expected that the magnitude and frequency of the effects will usually be low (assuming the magnitude and severity of the response at the LOAEL are not large and the endpoint of the LOAEL accurately reflects the assessment endpoints for that receptor). If the LOAEL-based HQ is greater than or equal to 1, the risk of an adverse effect is of potential concern, with the probability and/or severity of effect tending to increase as the value of the HQ increases.

When interpreting HQ results for non-PMJM ecological receptors, it is important to remember that the assessment endpoint to non-PMJM receptors is based on the sustainability of exposed populations, and risks to some individuals in a population may be acceptable if the population is expected to remain healthy and stable. For threatened and endangered species, such as the PMJM, the interpretation of HQ results is based on potential risks to individuals rather than populations.

HQs were calculated for each ECOPC/receptor pair based on the exposures estimated and TRVs presented in the preceding sections. The NOAEL and NOEC TRVs along with default screening-level exposure assumptions are first used to calculate HQs. However, these no effects HQs are typically considered as screening level results and do not necessarily represent realistic risks for the site. EPA risk assessment guidance (EPA 1997) recommends a tiered approach to evaluation, and following the first tier of evaluation "the risk assessor should review the assumptions used (e.g., 100 percent bioavailability) against values reported in the literature (e.g., only up to 60 percent for a particular contaminant), and consider how the HQs would change if more realistic conservative assumptions were used instead." Accordingly, LOAEL and threshold TRVs are also used in this evaluation to calculate HQs. Where LOAEL HQs greater than 1 are calculated using default exposure assumptions, and the uncertainty analysis indicates that alternative BAFs and/or TRVs would be beneficial to reduce uncertainty and conservatism, alternative HQs are calculated.

10.1 Chemical Risk Characterization

Chemical risk characterization uses quantitative methods to evaluate potential risks to ecological receptors. In this risk assessment, the quantitative method used to characterize chemical risk is the HQ approach. As noted above, HQs are usually interpreted as follows:

HQ Values		**Interpretation of HQ Results**
NOAEL-based	**LOAEL-based**	
≤ 1	≤ 1	Minimal or no risk
> 1	≤ 1	Low-level risk[a]
> 1	> 1	Potential adverse effects

[a]Assuming magnitude and severity of response at LOAEL are relatively small and based on endpoints appropriate for the assessment endpoint of the receptor considered.

One potential limitation of the HQ approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, this risk assessment provides information on three potential sources of uncertainty, described below.

- **EPCs.** Because surface soil sampling programs in the EU sometimes tended to focus on areas of potential contamination (IHSS/PAC/UBCs), EPCs calculated using the Tier 1 approach (which assumes that all samples are randomly spread across the EU and are weighted equally) may tend to yield an EPC that is biased high. For this reason, a Tier 2 area-weighting approach was used to derive additional EPCs that help compensate for this potential bias. HQs were always calculated based on both Tier 1 and Tier 2 EPCs for non-PMJM receptors. No Tier 2 EPCs were calculated for PMJM receptors due to the limited size of their habitat.

- **BAFs.** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., $C_{tissue} = BAF * C_{soil}$), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. To estimate more typical tissue concentrations, where necessary, an alternative exposure scenario calculated total chemical intake using a 50th percentile (median) BAF and HQs were calculated. The use of the median BAF is consistent with the approach used in the ecological soil screening level (Eco-SSL) guidance (EPA 2005).

- **TRVs.** The CRA Methodology used an established hierarchy to identify the most appropriate default TRVs for use in the ECOPC selection process. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed in the uncertainty sections below on a chemical-by-chemical basis in the following subsections. When an alternative TRV is identified, the chemical-specific subsections provide a discussion of why the alternative TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs were calculated using both default and alternative TRVs where necessary.

The influences of each of these uncertainties on the calculated HQs were evaluated both alone and in concert in the risk description for each chemical. Uncertainties related to the BAFs, TRVs, and background risk are presented for each chemical in Attachment 5. Where uncertainties were deemed to be high, Attachment 5 provided alternative BAFs and/or TRVs that are then incorporated into the risk characterization, as appropriate.

HQs calculated using the default BAFs and HQs with the Tier 1 and Tier 2 EPCs are provided in Tables 10.1 and 10.2 for each ECOPC/receptor pair. Shaded cells represent default HQ calculations based on exposure and toxicity models specifically identified in the CRA Methodology. Where no LOAEL HQs exceed 1 using the default exposure and toxicity values, no further HQs were calculated. Since the default HQs are generally the most conservative risk estimations, if low risk is estimated using these values then further reductions of conservatism would only serve to reduce risk estimates further.

Where LOAEL HQs greater than 1 are calculated using default assumptions, and the uncertainty analysis indicates that median BAFs and/or additional TRVs would be beneficial to reduce uncertainty and conservatism, alternative HQs are calculated and presented in Tables 10.1 and 10.2 as appropriate.

The selection of which EPC (e.g., UTL or UCL) is of primary importance will depend upon the type of receptor and the relative home range size. Only the UTL EPC is provided in Table 10.1 for small home-range receptors, and only the UCL is provided for large home-range receptors. The patch-specific UCL is provided in Table 10.2 for the PMJM receptors.

All calculated exposure estimates and HQ values are also provided in Attachment 4. These include the default and refined HQs if needed. The results for each ECOPC are discussed in more detail below.

The risk description incorporates results of the risk estimates along with the uncertainties associated with the risk estimations and other lines of evidence to evaluate potential chemical effects on ecological receptors in the UWOEU following accelerated actions at RFETS. Information considered in the risk description includes receptor groups potentially affected, type of TRV exceeded (e.g., NOAEL versus LOAEL), relation of EU concentrations to other criteria such as EPA Eco-SSLs, and risk above background conditions. In addition, other site-specific and regional factors are considered, such as the use of a given ECOPC within the EU related to historical RFETS activities, comparison of ECOPC concentrations within the UWOEU to the rest of the RFETS site as it relates to background, and/or comparison to regional background concentrations.

10.1.1 Antimony

Antimony HQs for terrestrial plants, deer mouse (insectivore), and coyote (insectivore) are presented in Table 10.1. Figure 10.1 shows the spatial distribution of antimony in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Antimony was also identified as an ECOPC for PMJM receptors in Patches #19, #20, and #21.

For non-PMJM receptors, only the deer mouse (insectivore) had LOAEL HQs greater than 1 indicating a potential for adverse effects. In addition, the terrestrial plant had a LOEC HQ greater than 1 (HQ = 2) using the Tier 2 UTL indicating there may be a potential for adverse effects in plants. The uncertainty analysis presented in Attachment 5 indicates that there were considerable uncertainties associated with the antimony ESL for plants and with the upper-bound BAF and TRVs used in the deer mouse (insectivore) calculations. A refined analysis could not be performed because additional ESLs for plants were not available and a median soil-to-invertebrate BAF and additional TRVs were also not available for the deer mouse (insectivore). For PMJM receptors, a LOAEL HQ greater than 1 (HQ = 2) was calculated in Patch #20 using the default risk calculations. No additional HQs were calculated because of the lack of a median BAF or additional TRVs for a refined analysis. LOAEL HQs were less than 1 for the other two patches.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Antimony – Risk Description

Antimony was identified as an ECOPC for terrestrial plants, the deer mouse (insectivore), coyote (insectivore), and PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Terrestrial Plants

For terrestrial plants, HQs were equal to 1 and 2 using the Tier 1 and Tier 2 UTLs, respectively (Table 10.1). However, Efroymson et al. (1997a) places low confidence in the default TRV because there are no primary reference data showing toxicity to plants and the ESL is based on unspecified toxic effects. No additional TRVs were available in the literature for a refined analysis. The potential for risk to terrestrial plant populations in the UWOEU from exposure to antimony in surface soils is likely to be low to moderate but there is high uncertainty due to the lack of confidence in the toxicity information on the effects of antimony on plants.

Non-PMJM Receptors – Small Home Range

Potential risks to vertebrate non-PMJM receptors were evaluated, and HQs are presented in Table 10.1. Using the Tier 1 and Tier 2 EPCs, NOAEL HQs greater than 1 were calculated for the deer mouse (insectivore). LOAEL HQs were less than 1 using the Tier 1 EPC and greater than 1 using the Tier 2 EPC (HQs = 3). Therefore, risks to the deer mouse (insectivore) using the default HQ calculations may potentially be significant and require further evaluation.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Antimony samples were available from 26 grid cells (Figure 10.1). NOAEL HQs greater than 1 were calculated in 50 percent of the grid cells and no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to antimony.

There is considerable uncertainty associated with the use of the default upper-bound BAF and the default TRVs in the risk calculations (see Attachment 5). A median BAF and additional TRVs were unavailable for a refined analysis. The potential for adverse effects to populations of small mammals such as the deer mouse (insectivore) are likely to be low to moderate. However, no LOAEL HQs were greater than 1 in the grid analysis for the deer mouse (insectivore) and there is low confidence in the default risk model.

Non-PMJM Receptors – Large Home Range

Potential risks to vertebrate large home-range, non-PMJM receptors were evaluated and HQs are presented in Table 10.1. Using the Tier 1 and 2 EPCs, NOAEL HQs greater than 1 (HQs = 2) were calculated for the coyote (insectivore). No LOAEL HQs greater than 1 were calculated for the coyote (insectivore) under the default exposure scenario. Because no HQs greater than 1 were calculated using any effects-based TRV, the potential for adverse effects to populations of large home-range receptors are likely to be low.

PMJM Receptors

For the PMJM receptor, NOAEL HQs were greater than 1 in all three patches (Table 10.2). Figure 8.3 presents antimony sampling locations and a comparison to the PMJM ESL.

LOAEL HQs were less than 1 using the default exposure scenario in Patch #19 and #21. However, in Patch #20 the LOAEL HQ was equal to 2. Therefore, the potential for adverse effects to PMJM receptors within Patch #20 are to likely be low to moderate but somewhat elevated over the remaining patches, while risks within all other habitat patches at UWOEU are likely low. However, the LOAEL HQ is only equal to 2 and there is considerable uncertainty or low confidence in the default risk model

10.1.2 Chromium

The PMJM receptor is the only receptor of concern for chromium. Patch-specific HQs for the PMJM receptor are presented in Table 10.2. Chromium was identified as an ECOPC in Patches #19, #20, and #21.

For PMJM receptors, NOAEL HQs for all three patches were less than or equal to 1 using both chromium VI and chromium III NOAEL TRVs in the HQ calculations. The LOAEL HQs were all less than 1 using the default HQ calculations. Therefore, no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Chromium – Risk Description

Chromium was identified as an ECOPC for PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

PMJM Receptors

For the PMJM receptor, NOAEL HQs (using both chromium VI and chromium III TRVs) were less than or equal to 1 in all three patches (Table 10.2). Figure 8.3 presents chromium sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default risk model. The results indicate that risks to PMJM from exposure to chromium are likely to be low in all three patches.

10.1.3 Copper

Copper HQs for the mourning dove (herbivore and insectivore) are presented in Table 10.1. Figure 10.2 shows the spatial distribution of copper in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Copper was also identified as an ECOPC for PMJM receptors in Patch #20.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions and no additional HQs were calculated.

For PMJM receptors, the LOAEL and NOAEL HQs were less than 1 in the HQ calculations and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Copper Risk Description

Copper was identified as an ECOPC for the mourning dove (herbivore and insectivore) receptors and PMJM receptors only. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs calculated using Tier 1 EPCs were greater than 1 for the mourning dove (herbivore and insectivore). NOAEL HQs calculated using Tier 2 EPCs were less than 1 for the mourning dove (herbivore) and greater than 1 for the mourning dove (insectivore).

All LOAEL HQs were less than 1 for both receptors. Risks to populations of non-PMJM small home range receptors from exposure to copper are, therefore, likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL, threshold, and LOAEL TRVs were used in the HQ calculations. Copper samples were available from 26 grid cells (Figure 10.3). NOAEL HQs greater than 1 were calculated in 96 percent of the grid cells while no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to copper.

PMJM Receptors

Copper was identified as an ECOPC for the PMJM receptor in Patch #20 only (Table 10.2). Figure 8.4 presents copper sampling locations and a comparison to the PMJM ESL. No NOAEL or LOAEL HQs greater than 1 were calculated using the default risk model. These results indicate that risks to PMJM from exposure to copper in Patch #20 are likely to be low.

10.1.4 Manganese

The PMJM receptor is the only receptor of concern for manganese. Patch-specific HQs for the PMJM receptor are presented in Table 10.2. Manganese was identified as an ECOPC in Patches #19, #20, and #21.

For PMJM receptors, NOAEL HQs for Patches #19 and #20 were equal to 1 whereas the NOAEL HQ for Patch #21 was greater than 1 (HQ = 2). The LOAEL HQs were all less than 1 using the default HQ calculations and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Manganese – Risk Description

Manganese was identified as an ECOPC for PMJM receptors only. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

PMJM Receptors

For the PMJM receptor, NOAEL HQs were equal to 1 in Patches #19 and #20, whereas the NOAEL HQ was greater than 1 (HQ = 2) in Patch #21 (Table 10.2). Figure 8.5 presents manganese sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default risk model. The results indicate that risks to PMJM from exposure to manganese are likely to be low in all three patches.

10.1.5 Molybdenum

The PMJM receptor is the only receptor of concern for molybdenum. Patch-specific HQs for the PMJM receptor are presented in Table 10.2. Molybdenum was identified as an ECOPC in Patches #20 and #21.

For PMJM receptors, NOAEL HQs for Patches #20 and #21 were equal to 1. LOAEL HQs were all less than 1 using the default risk model and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Molybdenum – Risk Description

Molybdenum was identified as an ECOPC for PMJM receptors only. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

PMJM Receptors

For the PMJM receptor, NOAEL HQs were equal to 1 in Patches #20 and #21 (Table 10.2). Figure 8.6 presents molybdenum sampling locations and a comparison to the PMJM ESL.

All LOAEL HQs were less than 1 using the default risk model. The results indicate that risks to PMJM from exposure to molybdenum are likely to be low in both patches.

10.1.6 Nickel

Nickel HQs for the mourning dove (insectivore), deer mouse (herbivore and insectivore), and coyote (generalist and insectivore) are presented in Table 10.1. Figure 10.3 shows the spatial distribution of nickel in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Patch-specific HQs for the PMJM receptor (Patches #19, #20, and #21) are presented in Table 10.2.

For non-PMJM receptors, only the deer mouse (insectivore) had LOAEL HQs greater than 1, indicating a potential for adverse effects. The uncertainty analysis presented in

Attachment 5 indicated that there were considerable uncertainties in the nickel risk calculations based on both upper-bound BAFs and TRVs used in the deer mouse (insectivore) risk calculations. For this reason, additional HQs were calculated for the deer mouse (insectivore) using both a median soil-to-invertebrate BAF and additional TRVs. The resulting HQs are presented in Table 10.1.

For PMJM receptors, NOAEL and LOAEL HQs greater than 1 were calculated using the UCL EPC in all three patches (#19, #20, and #21) indicating a potential for adverse effects. However, as discussed above, the uncertainty analysis presented in Attachment 5 indicated that there were considerable uncertainties in the default risk model based on both the upper-bound BAFs and default TRVs. For this reason, refined HQs were calculated for the PMJM using a median BAF and additional TRVs. The resulting HQs are presented in Table 10.2.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Nickel – Risk Description

Nickel was identified as an ECOPC for the mourning dove (insectivore), deer mouse (herbivore and insectivore), PMJM, and coyote (generalist and insectivore). Refined HQs were calculated for the deer mouse (insectivore) and PMJM using a median soil-to-invertebrate BAF and additional TRVs. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs were greater than 1 for the mourning dove (insectivore) and deer mouse (insectivore) under the default risk model (Table 10.1). The NOAEL HQ using the Tier 1 EPC was equal to 1 while the NOAEL HQ was greater than 1 (HQ = 2) using the Tier 2 EPC for the deer mouse (herbivore). LOAEL HQs were less than 1 for all non-PMJM receptors except the deer mouse insectivore. Therefore, the potential for adverse effects to populations of the mourning dove (insectivore) and deer mouse (herbivore) from exposure to nickel are likely to be low. Risks to the deer mouse (insectivore) using the default HQ calculations may be low to moderate and require further evaluation.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Nickel samples were available from 26 grid cells (Figure 10.6). NOAEL HQs greater than 10 were calculated in 100 percent of the grid cells. LOAEL HQs greater than 1 but less than 5 were calculated in 96 percent of the grid cells for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that potentially significant risks from average exposure to sub-populations of insectivorous small mammals cannot be dismissed and requires further evaluation.

The uncertainty analysis discussed the potential for risks at UCL and UTL background soil concentrations. For the deer mouse (insectivore), LOAEL HQs in background (UTL and UCL HQs = 3) are similar as those calculated for UWOEU surface soils with the exception of the Tier 1 UTL (HQ = 5). These results indicate that risks to insectivorous deer mouse populations within UWOEU are similar to those offsite.

The uncertainty analysis indicated that exposure to the deer mouse (insectivore) may be overestimated based on the use of upper-bound BAFs. Alternative intake rates were calculated for those receptors ingesting invertebrates in their diet. In addition, HQs were also calculated using additional TRVs from Sample et al. (1996). Table 10.1 presents HQs calculated using the default risk model but with a median BAF rather than the conservative 90th percentile BAF. The deer mouse (insectivore) had a NOAEL HQ greater than 1 using the Tier 1 EPC (HQ = 11) and the Tier 2 EPC (HQ = 15). However, LOAEL HQs were equal to 1 using both EPCs. When the additional TRVs from Sample et al. (1996) were used instead of the default TRVs, no HQs greater than 1 were calculated using either the NOAEL or the LOAEL TRV.

The refined analysis supports the conclusion that the default HQs are likely overestimated and risks are low, not low to moderate as indicated by the default HQ results. In addition, background risk evaluations also indicated similar HQs for the deer mouse (insectivore) using the default HQ calculations. Therefore, the potential for adverse effects are expected to be low to populations of the deer mouse (insectivore).

Non-PMJM Receptors – Large Home Range

NOAEL HQs using the default risk model were greater than 1 for the coyote (generalist and insectivore) (Table 10.1). LOAEL HQs for both receptors were less than 1 for all exposure scenarios. Because risks are classified as low using the default risk model, no additional HQs were calculated and the potential for adverse effects are likely to be low for populations of large home range receptors such as the coyote.

PMJM Receptor

NOAEL HQs were greater than 1 in all three patches. LOAEL HQs were also greater than 1 (HQs = 3) in all three patches, indicating a potential for adverse effects. Therefore, risks to the PMJM using the default HQ calculations may potentially be significant and require further evaluation.

The uncertainty analysis discussed the potential for risks at UCL background soil concentrations. For the PMJM receptor, risks calculated using the background UCL as the EPC indicate potential adverse effects, with the NOAEL HQ equal to 20 for the UCL. LOAEL HQs in background using the UCL are the same as those calculated for UWOEU surface soils (HQs = 3) in all three patches. These results indicate that risks to PMJM receptors within UWOEU are similar to those offsite.

No LOAEL HQs greater than 1 were calculated using the median soil-to-invertebrate BAF in all three patches. In addition, no HQs (NOAEL or LOAEL) were greater than 1 for any of the three patches when using the additional NOAEL or LOAEL TRV coupled with the median BAF in the risk calculation. Similarly, no HQs (NOAEL or LOAEL) were greater than 1 when using the upper-bound soil-to-invertebrate BAF coupled with the additional NOAEL or LOAEL TRV in the risk calculation.

The refined analysis indicates that the potential for adverse effects to the PMJM receptor are low in all three patches because HQs calculated in those patches are similar to those calculated using background data and LOAEL HQs were less than 1 for all patches when the median soil-to-invertebrate BAF and additional TRVs were used in the risk calculations. Based on the uncertainty analysis, risks are, therefore, expected to be low for the PMJM in all three patches.

10.1.7 Silver

Silver HQs for terrestrial plants are presented in Table 10.1. Figure 10.4 shows the spatial distribution of silver in relation to the plant ESL.

The terrestrial plant receptors had a HQ greater than 1 (HQ = 2) using the Tier 1 EPC and a HQ equal to 1 using the Tier 2 EPC. However, there is low confidence in the ESL. No additional ESL without high uncertainty was available for silver; therefore, it is unclear whether there is potential for adverse effects using only the default ESL.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Silver – Risk Description

Silver was identified as an ECOPC for terrestrial plants only. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Terrestrial Plants

For terrestrial plants, the HQ was greater than 1 (HQ = 2) using the Tier 1 EPC and equal to 1 using the Tier 2 EPC (Table 10.1). Therefore, the potential for adverse effects to populations of terrestrial plants from silver in surface soils is likely to be low. However, there is high uncertainty due to the lack of confidence in the toxicity information on the effects of silver on plants.

10.1.8 Tin

Tin HQs for the mourning dove (insectivore), American kestrel, and deer mouse (insectivore) are presented in Table 10.1. Figure 10.5 shows the spatial distribution of tin in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Tin was also identified as an ECOPC for PMJM receptors in Patches #19 and #21.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default risk model, and no additional HQs were calculated.

For PMJM receptors, LOAEL HQs were less than 1 using the default risk model and no additional HQs were calculated.

Care should, however, be taken to review the chemical specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Tin – Risk Description

Tin was identified as an ECOPC for the mourning dove (insectivore), American kestrel, deer mouse (insectivore), and the PMJM receptor. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs were greater than 1 for the mourning dove (insectivore) and deer mouse (insectivore). NOAEL HQs were equal to 1 using the Tier 1 EPC and greater than 1 (HQ = 2) using the Tier 2 EPC for the American kestrel. LOAEL HQs for all three receptors were less than 1. Therefore, the potential for adverse effects to populations of the mourning dove (insectivore), American kestrel, and deer mouse (insectivore) are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Tin samples were available from 26 grid cells (Figure 10.5). NOAEL HQs greater than 1 were calculated in 43 percent of the grid cells while no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to tin.

PMJM Receptors

NOAEL HQs were greater than 1 in Patches #19 and #21 (Table 10.2). Figure 8.8 presents tin sampling locations and a comparison to the PMJM ESL. LOAEL HQs were less than 1 in both patches. Because no LOAEL HQs greater than 1 were calculated in Patches #19 and #21, risks to PMJM receptors are likely to be low in both patches.

10.1.9 Uranium

Uranium HQs for terrestrial plants are presented in Table 10.1. Figure 10.6 shows the spatial distribution of uranium in relation to the plant ESL.

The terrestrial plant receptors had a LOEC HQ greater than 1. The uncertainty analysis did not identify any additional toxicity information that could be used in a refined analysis. Therefore, no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Uranium – Risk Description

Uranium was identified as an ECOPC for terrestrial plants only. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Terrestrial Plants

For terrestrial plants, LOEC HQs were greater than 1 (Table 10.1). However, Efroymson et al. (1997a) places low confidence in the default LOEC ESL value because it is based on only one study. Although toxicity information is limited and there is low confidence in the LOEC ESL value, the potential for adverse effects to terrestrial plant populations from exposure to uranium in surface soils is likely to be low to moderate.

10.1.10 Vanadium

Vanadium HQs for terrestrial plants and the deer mouse (insectivore) are presented in Table 10.1. Figure 10.7 shows the spatial distribution of vanadium in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Vanadium was also identified as an ECOPC for PMJM receptors in Patches #19, #20, and #21. Patch-specific HQs for the PMJM receptor are presented in Table 10.2.

For terrestrial plants, HQs calculated using the default ESL were greater than 1. An additional LOEC value was available for a refined analysis. Therefore, additional HQs were calculated.

For the deer mouse (insectivore), LOAEL HQs were less than 1 using the default risk model and no additional HQs were calculated.

For PMJM receptors, NOAEL HQs for all three patches were greater than 1 (HQs = 2). LOAEL HQs were all less than 1 using the default risk model and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Vanadium – Risk Description

Vanadium was identified as an ECOPC for terrestrial plants, deer mouse (insectivore), and PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Terrestrial Plants

Tier 1 and Tier 2 HQs were greater than 1 using the default ESL. However, Efroymson et al. (1997a) places low confidence in the TRV because there are no primary reference data showing toxicity to plants and the ESL value is based on unspecified toxic effects.

The uncertainty assessment recommended the use of an alternative LOEC value (50 mg/kg). HQs based on this LOEC ESL were less than 1, indicating that the potential for adverse effects to terrestrial plant populations are likely to be low. However, there is low confidence in this alternative LOEC as well (see Attachment 5).

In addition, the default NOEC ESL (2 mg/kg) is less than all site-specific background concentrations. HQs greater than 1 were calculated using UTL and UCL background concentrations (HQ = 23 and 15, respectively). An HQ equal to 5 would be calculated using the minimum background concentration and the default ESL.

The potential for risk to terrestrial plant populations from exposure to vanadium in surface soils is likely to be low although there is high uncertainty or low confidence in both ESLs used in the risk calculations.

Non-PMJM Receptors – Small Home Range

Potential risks to vertebrate non-PMJM receptors were evaluated and HQs are presented in Table 10.1. NOAEL HQs were greater than 1 (HQ = 2) using the default risk model. LOAEL HQs were less than 1 for the deer mouse (insectivore). This indicates that risks to populations of insectivorous small mammals are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Vanadium samples were available from 26 grid cells (Figure 10.1). NOAEL HQs greater than 1 were calculated in 73 percent of the grid cells, and no LOAEL HQs greater than 1 were calculated in any grid cell for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to vanadium.

PMJM Receptors

For the PMJM receptor, NOAEL HQs were greater than 1 (HQs = 2) in all three patches (Table 10.2). Figure 8.9 presents vanadium sampling locations and a comparison to the PMJM ESL. LOAEL HQs were less than 1 in all three patches using the default risk model. The results indicate that risks to PMJM from exposure to vanadium are likely to be low in all three patches.

10.1.11 Zinc

The PMJM receptor is the only receptor of concern for zinc. Patch-specific HQs for the PMJM receptor are presented in Table 10.2. Zinc was identified as an ECOPC in Patches #19, #20, and #21.

For PMJM receptors, NOAEL HQs for all three patches were greater than 1 (HQs = 2 or 3). LOAEL HQs were all less than 1 using the default risk model and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Zinc – Risk Description

Zinc was identified as an ECOPC for PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

PMJM Receptors

For the PMJM receptor, NOAEL HQs were greater than 1 in all three patches (Table 10.2). Figure 8.10 presents zinc sampling locations and a comparison to the PMJM ESL. LOAEL HQs were less than 1 using the default exposure scenario. The results indicate that risks to PMJM from exposure to zinc are likely to be low in all three patches.

10.1.12 Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexylphthalate) HQs for the American kestrel and mourning dove (insectivore) are presented in Table 10.1. Figure 10.8 shows the spatial distribution of bis(2-ethylhexyl)phthalate in relation to the lowest ESL, and also presents the data used in the calculation of the Tier 2 EPCs.

No LOAEL HQs greater than 1 were calculated for any non-PMJM receptor and no additional HQ calculations are provided.

Care should be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Bis(2-ethylhexyl)phthalate – Risk Description

There is no identified source in the UWOEU for bis(2-ethylhexyl)phthalate, which was identified as an ECOPC for the American kestrel and mourning dove (insectivore) receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs were greater than 1 for the mourning dove (insectivore) (Table 10.1). NOAEL HQs were less than or equal to 1 for the American kestrel. All LOAEL HQs were less than 1 for both receptors. Therefore, the potential for adverse effects to populations of the mourning dove (insectivore) and American kestrel are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Bis(2-ethylhexyl)phthalate samples were available from 12 grid cells (Figure 10.8). NOAEL HQs greater than 1 were calculated in 100 percent of the grid cells, while no grids had LOAEL HQs greater than 1 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to bis(2-ethylhexyl)phthalate.

10.1.13 Di-n-butylphthalate

Di-n-butylphthalate HQs for American kestrel and mourning dove (insectivore) are presented in Table 10.1. Figure 10.9 shows the spatial distribution of di-n-butylphthalate in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

LOAEL HQs were less than 1 for the American kestrel. LOAEL HQs greater than 1 were calculated for the mourning dove (insectivore) receptor. However, as discussed in the uncertainty analysis, no median BAF or additional TRVs were available for di-n-butylphthalate for a refined risk analysis.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Di-n-butylphthalate – Risk Description

There is no identified source in the UWOEU for di-n-butylphthalate, which was identified as an ECOPC for the American kestrel and mourning dove (insectivore) receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small Home Range

NOAEL HQs were greater than 1 for the mourning dove (insectivore) and American kestrel (Table 10.1). LOAEL HQs were also greater than 1 for the mourning dove (insectivore) but were less than 1 for the American kestrel. Risks to the American kestrel are, therefore, likely to be low from exposure to di-n-butylphthalate. Risks to the mourning dove (insectivore) using the default risk model may result in potential adverse effects and require further evaluation.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Di-n-butylphthalate samples were available from 12 grid cells (Figure 10.9). NOAEL HQs greater than 1 were calculated in 100 percent of the grid cells. One hundred percent of the LOAEL HQs were between 1 and 5 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors requires further evaluation.

The uncertainty analysis discussed the low confidence in the BAFs used in the exposure model and specifically, the potential for overestimation of invertebrate tissue concentrations from soil. It is, therefore, likely that the potential for adverse effects are somewhat overestimated. The potential for adverse effects to populations of the mourning dove (insectivore) are likely to be low to moderate. However, there is no known source of di-n-butylphthalate at the UWOEU, the highest LOAEL HQ calculated equaled 3, and the possibility for overestimation of risk is high because of the uncertainties in the default risk model.

10.1.14 Total Dioxin (2,3,7,8 TCDD TEQ for mammals and birds)

HQs for 2,3,7,8-TCDD (TEQ) for mammals and birds for the mourning dove (insectivore), American kestrel, deer mouse (herbivore and insectivore), and coyote (generalist and insectivore) are presented in Table 10.1. Figure 10.10 shows the spatial distribution of 2,3,7,8-TCDD (TEQ) for mammals and birds in relation to the lowest ESL, and also presents the data used in the calculation of the Tier 2 EPCs.

For non-PMJM receptors, only the deer mouse (insectivore) had a Tier 1 LOAEL HQ greater than 1 (HQ = 3) using the default exposure assumptions. No Tier 2 NOAEL or LOAEL HQs were greater than 1. No alternative HQs were calculated in a refined analysis because of the lack of median BAFs or additional TRVs, as discussed in the uncertainty analysis (Attachment 5). Therefore, no additional risk calculations were provided.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Dioxin (Total) – Risk Description

2,3,7,8-TCDD (TEQ) were identified as an ECOPC for the mourning dove (insectivore), American kestrel, deer mouse (herbivore and insectivore), and coyote (generalist and insectivore). Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small home-range

All Tier 1 NOAEL HQs were greater than 1 for the mourning dove (insectivore), American kestrel, and deer mouse (herbivore and insectivore)(Table 10.1). All Tier 1 LOAEL HQs were less than or equal to 1 for the mourning dove (insectivore), American kestrel, and deer mouse (herbivore). The Tier 1 LOAEL for the deer mouse (insectivore) was greater than 1 (HQ = 3). All Tier 2 NOAEL or LOAEL HQs were less than 1 for all non-PMJM receptors. Risks to the deer mouse (insectivore) using the Tier 1 default risk model may result in potential adverse effects and require further evaluation.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Total PCB samples were available from 1 grid cell (Figure 10.9). A LOAEL and NOAEL HQ greater than 1 but less than 5 was calculated in the one grid cell with dioxin for the most sensitive receptor (mourning dove [insectivore]). Although the analysis is limited because of the small sample size, the results of the grid-cell analysis generally indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to total dioxin.

The uncertainty analysis discussed the low confidence in the BAFs used in the exposure models and the potential for overestimation of invertebrate tissue concentrations from soil. It is, therefore, likely that the potential for adverse effects are somewhat overestimated. The potential for adverse effects to small home-range receptors such as the deer mouse (insectivore) receptor are likely to be low to moderate. However, there are uncertainties in the default risk model and the LOAEL HQs were less than 1 using the Tier 2 EPC in the risk calculations.

Non-PMJM Receptors – Large Home-Range

NOAEL HQs were greater than 1 for the coyote (generalist and insectivore) using the Tier 1 EPC in the default risk model (Table 10.1). LOAEL HQs for both receptors were less than 1 using the Tier 1 EPC in the risk model. NOAEL and LOAEL HQs were less than 1 using the Tier 2 EPCs in the default risk model.. Because no LOAEL HQs greater than 1 were calculated for either receptor using the default exposure and toxicity assumptions, risks to large home range receptors from exposure to total dioxin are likely to be low.

10.1.15 Total PCBs

HQs for total PCBs for the mourning dove (herbivore and insectivore) and American kestrel are presented in Table 10.1. Figure 10.11 shows the spatial distribution of total PCBs in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs. Total PCBs were also identified as an ECOPC for PMJM receptors in Patch #20.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions and no additional HQs were calculated.

For PMJM receptors in Patch #20, the NOAEL and LOAEL HQ were less than 1 in the default risk model and no additional HQs were calculated.

Care should, however, be taken to review the chemical-specific uncertainties discussed in Attachment 5 when reviewing the results of all receptors, regardless of whether refined HQs were calculated to address uncertainties in the default risk model.

Total PCBs – Risk Description

Total PCBs were identified as an ECOPC for the mourning dove (herbivore and insectivore), American kestrel, and PMJM receptors. Information on the historical use and a summary of site data and background data are provided in Attachment 3.

Non-PMJM Receptors – Small home-range

NOAEL HQs were greater than 1 for the mourning dove (insectivore) and the American kestrel (Table 10.1). NOAEL HQs were less than or equal to 1 for the mourning dove (herbivore). LOAEL HQs were less than or equal to 1 for the mourning dove (herbivore and insectivore) and American kestrel. Therefore, risks to populations of the mourning dove (herbivore and insectivore) and American kestrel from total PCBs in surface soils are likely to be low.

Table 10.3 presents a summary of HQs calculated using the arithmetic mean concentration used as cell-specific EPCs for surface soil samples within each of the Tier 2 30-acre grid cells. Default NOAEL and LOAEL TRVs were used in the HQ calculations. Total PCB samples were available from 11 grid cells (Figure 10.11). NOAEL HQs greater than 1 were calculated in 27 percent of the grid cells, while no grids had LOAEL HQs greater than 1 for the most sensitive receptor (mourning dove [insectivore]). The results of the grid-cell analysis indicate that the average exposure to sub-populations of small home-range receptors results in low risk from exposure to total PCBs.

PMJM Receptors

The NOAEL and LOAEL HQs were less than 1 in Patch #20 using the default risk model (Table 10.2). Figure 8.11 presents total PCBs sampling locations and a comparison to the PMJM ESL. The HQ results indicate that risks to PMJM from exposure to total PCBs are likely to be low in Patch #20.

10.2 Ecosystem Characterization

An ecological monitoring program has been underway since 1991 when baseline data on wildlife species were gathered (Ebasco 1992). The purpose of this long-term program was to monitor specific habitats to provide a sitewide database from which to monitor trends in the wildlife populations at RFETS. Although a comprehensive compilation of monitoring results has not been presented, the annual reports of the monitoring program provide localized information and insights on the general health of the RFETS ecosystem. Permanent transects through three basic habitats were run monthly for more than a decade (K-H 2002a). Observations were recorded concerning the abundance, distribution, and diversity of wide-ranging wildlife species, including observations of migratory birds, raptors, coyotes, and deer. Small mammal monitoring occurred through several tasks in the monitoring program. The Ecological Monitoring Program (DOE 1995) established permanent transects for small mammal monitoring in three habitat types: xeric grasslands, mesic grasslands, and riparian habitats. Preble's mouse studies established small mammal trapping in nearly all riparian habitats across the site (K-H 1998a, 1998b, 1999, 2000, 2001, 2002a).

Migratory birds were tracked during all seasons, but most notably during the breeding season. Over 8 years of bird survey data were collected on 18 permanent transects. Field observations were summarized into species richness and densities by habitat type. Habitats comprised the general categories of grasslands, woodlands, and wetlands. However, summaries in annual reports are grouped by habitat types across RFETS and not within EUs because EU boundaries were determined well after the monitoring program had begun. Additionally, wide-ranging animals may use habitat in several EUs and do not recognize EU boundaries.

Summarizing songbird surveys over the breeding season, diversity indices for RFETS for all habitats combined over 8 years of observations (1991, and 1993 to 1999) show a steady state in diversity of bird communities (K-H 2000). Among habitats, results were similar with the exception of an increasing trend in species richness and a decreasing trend in bird densities in woodland habitats. Woodland bird communities consistently show the highest diversity when compared with bird communities in wetlands and grasslands. The decreasing trend can be mostly attributed to transient species (i.e., those species not usually associated with woody cover) except for red-tailed hawk (*Buteo jamaicensis*) and American goldfinch (*Carduelis tristis*). The red-tailed hawk change in density can be attributed to a loss of nesting sites in Upper Woman Creek during the survey period. Goldfinch abundance can be heavily influenced by the availability of food sources.

A subgroup of migratory birds is the neotropical migrants, which show declining populations in North America (Audubon 2005; Nature Conservancy 2005). Most of this decline is thought to be due to conversion of forest land to agriculture in the tropics, and conversion to real estate development in North America. Grassland birds that are neotropical migrants are also in decline. However, over the last 5 years at RFETS, the declining trends have not been observed and densities for this group show an increase.

Raptors, big game species, and carnivores were observed through relative abundance surveys and multi-species surveys (16 permanent transects) that provide species-specific sitewide counts. Raptors were noted on relative abundance surveys and nest sites were visited repeatedly during the nesting season to confirm nesting success. The three most common raptors at RFETS are red-tailed hawk, great horned owl (*Bubo virginianus*), and American kestrel (*Falco sparverius*) (K-H 2002a). One Swainson's hawk nest was noted in North Walnut Creek near the A-1 Pond, and one great horned owl nest was observed within South Walnut Creek. All nests generally fledged two young of each species, except kestrels, which usually fledged two to three young. Each species had a successful nesting season each year during the monitoring period from 1991 to 1999 with a single exception. This exception was the loss of the red-tailed hawk nest in Upper Woman Creek (K-H 1997a, K-H 1997b, 1998a) due to weather. The continued presence of nesting raptors at RFETS (K-H 2002a) indicates that habitat quality and protection from human disturbance have contributed to making RFETS a desirable location for raptors to reproduce. Adequate habitat provides essential seasonal requirements. RFETS is estimated to be at optimum population density for raptors given available habitat and territorial nature of these species (K-H 2000).

Two deer species inhabit RFETS: mule deer (*Odocoileus hemionus*) and white-tailed deer (*Odocoileus virginianus*). No white-tailed deer were present at RFETS in 1991 when monitoring began (K-H 2002a). In 2000 (K-H 2001), the population of white-tailed deer was estimated to be between 10 and 15 individuals. White-tailed deer frequent No Name Gulch Drainage Exposure Unit (NNEU), but spend the majority of their time in LWOEU. Mule deer frequent all parts of RFETS (14 mi^2) year-round. The RFETS population from winter counts is estimated at a mean 125 individuals ($n = 7$), with a density of 14 deer per square mile (K-H 2000, 2002a). Winter mule deer counts have varied from 100 to 160 individuals over the monitoring period (1994 to 2000), with expected age/sex class distributions (K-H 2001). The mule deer populations at RFETS have been increasing at a steady state, with good age/sex distributions (K-H 2001) over time and similar densities when compared to other "open" populations that are not hunted. This provides a good indicator that habitat quality is high and that site activities have not affected deer populations. It is unlikely that deer populations are depressed or reproduction is affected by contaminants. A recent study on actinides in deer tissue found that plutonium levels were near or below detection limits (Todd and Sattelberg 2004). This provides further support that the deer population is healthy.

Coyotes (*Canis latrans*) are the top mammalian predator at RFETS. They prey upon mule deer fawns and other smaller prey species. The number of coyotes using the site has been estimated at 14 to 16 individuals (K-H 2002a). Through surveys across the site, coyotes have been noted to have reproduction success with as many as six dens active in 1 year. Typically, at RFETS, three to six coyote dens support an estimated 14 to 16 individuals at any given time (K-H 2001). Coyotes have exhibited a steady population over time, thereby indicating their prey species continue to be abundant and healthy.

Small mammals have been trapped in the UWOEU over the last decade (Ebasco 1992; DOE 1995; K-H 1999, 2002a) under the Ecological Monitoring Program. No long-term monitoring sites were established in Woman Creek under the Ecological Monitoring Program outside of PMJM (*Zapus hudsonius preblei*) studies. Small mammal trapping was conducted initially during a NEPA baseline survey in 1991 and continued in the course of monitoring PMJM. Results from the baseline study (Ebasco 1992) revealed typical small mammal communities, with normal densities of each species in grassland, wetland, and riparian habitats (Fitzgerald et. al. 1994). PMJM have been captured in UWOEU over the last decade and were discovered during the baseline survey (Ebasco 1992). PMJM have persisted over time but apparently experienced a decrease in population density in the mid-1990s (DOE 1995; K-H

1998a, 1998b). Current populations appear to have recovered from the decline in recent years (K-H 2001, 2002a). Common species found in riparian areas have also been captured with PMJM, indicating a typical community of small mammals in the UWOEU. Results of small mammal trapping from 1991 to 2001 give indications of diverse and healthy small mammal communities in the UWOEU. PMJM monitoring has revealed abundance and species diversity of associated small mammals that would be expected in typical native riparian ecosystems on the plains of Colorado (Fitzgerald et al. 1994). Additionally, less-common riparian species include hispid pocket mouse (*Chaetodipus hispidus*), long-tailed vole (*Microtus longicaudus*), and water shrew (*Sorex palustris*). These species add to the diversity of the EU small mammal diversity. Water shrews were found in the Antelope Springs drainage and are indicative of good water quality and abundant aquatic macroinvertebrates.

The high species diversity and continued use of the site by numerous vertebrate species verify that habitat quality for these species remains acceptable and the ecosystem functions are being maintained (K-H 2000). Data collected on wildlife abundance and diversity indicate that wildlife populations are stable and species richness remains high during remediation activities at RFETS, including wildlife using the UWOEU.

10.3 General Uncertainty Analysis

Quantitative evaluation of ecological risks is limited by uncertainties regarding the assumptions used to predict risk and the data available for quantifying risk. These limitations are usually addressed by making estimates based on the data available or by making assumptions based on professional judgment when data are limited. Because of these assumptions and estimates, the results of the risk calculations themselves are uncertain, and it is important for risk managers and the public to view the results of the risk assessment with this in mind. Chemical-specific uncertainties are presented in Attachment 5 of this document and were discussed in terms of their potential effects on the risk characterization in the risk description section for each ECOPC. The following general uncertainties associated with the ERAs for all the EUs may under- or overestimate risk to an unknown degree; a full discussion of these general uncertainties is provided in Appendix A, Volume 2 of the RI/FS Report:

- Uncertainties associated with data quality and adequacy;
- Uncertainties associated with the ECOPC identification process;
- Uncertainties associated with the selection of representative receptors;
- Uncertainties associated with exposure calculations;
- Uncertainties associated with the development of NOAEL ESLs;
- Uncertainties associated with the lack of toxicity data for ECOIs; and
- Uncertainties associated with eliminating ECOIs based on professional judgment.

The following sections are potential sources of general uncertainty that are specific to the UWOEU ERA.

10.3.1 Uncertainties Associated with Data Adequacy and Quality

Sections 1.2 and 1.3 summarize the general data adequacy and data quality for the UWOEU, respectively. A more detailed discussion is presented in Appendix A, Volume 2, Attachments 2 and 3 of the RI/FS Report, and Attachment 2 of this volume. The data quality assessment indicates the data are of sufficient quality for use in the CRA. The adequacy of the UWOEU data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. The assessment indicates the number of UWOEU surface soil samples for each analyte group EU-wide and for PMJM patches #20 and #21 meet the data adequacy guideline; however, the data adequacy guideline for number of samples is not met for VOCs and SVOCs for PMJM patch #19. However, PMJM patch #19 is near the Ash Pits, and the Ash Pits are not a source for VOC and PCB contamination, and therefore, constituents in these analyte groups are not likely to be present in surface soil for this PMJM habitat patch, and risks are expected to be low for the PMJM. With respect to surface water data adequacy, the number of UWOEU surface water samples for each analyte group meet the data adequacy guideline; however, there are no current data for PCBs. Even though PCBs were not detected in surface water in the EU, there is some uncertainty in the risk assessment process because of the high detection limits associated with the PCBs. Overall, it is possible to make risk management decisions without additional surface soil or surface water sampling.

Data used in the CRA must have detection limits to allow meaningful comparison to ESLs. When these detection limits exceed the respective ESLs, this is a source of uncertainty in the risk assessment. There are 14 analytes in surface soil where some percent of the detection limits exceed the lowest ESL. However, except for 4,4' dichlorodiphenyltrichloroethane (DDT) and PCB-1260 those analytes that have detection limits that exceed the lowest ESLs contribute only minimal uncertainty to the overall risk estimates because either only a small fraction of the detection limits are greater than the lowest ESL, or professional judgment indicates they are not likely to be ECOPCs in UWOEU surface soil even if detection limits had been lower. There is some uncertainty in the overall risk estimates because of the higher detection limits for DDT and PCB-1260, i.e., overall risks to the UWOEU ecological receptors may be underestimated because DDT and PCB-1260 may have been included as ECOPCs for surface soil had the analytes been detected at a higher frequency using lower detection limits. However, DDT and PCB-1260 do not present a potential for adverse ecological effects if they were detected at their maximum detection limits (see Attachment 1 for a more detailed discussion).

10.3.2 Uncertainties Associated with the Lack of Toxicity Data for Ecological Contaminant of Interest Detected at the Upper Woman Drainage Exposure Unit

Several ECOIs detected in the UWOEU do not have adequate toxicity data for the derivation of ESLs (CRA Methodology). These ECOIs are listed in Tables 7.1, 7.3, and 7.12 with a "UT" designation. Included as a subset of the ECOIs with a "UT" designation are the essential nutrients (calcium, iron, magnesium, potassium, and sodium). Although these nutrients may be potentially toxic to certain ecological receptors at high concentrations, the uncertainty associated with the toxicity of these nutrients is expected to be low. Appendix B of the CRA Methodology outlines a detailed search process that was intended to provide high-quality toxicological information for a large proportion of the chemicals detected at RFETS. Although the toxicity is uncertain for those ECOIs that do not have ESLs calculated due to a lack of identified toxicity data, the overall effect on the risk assessment is small because the primary chemicals historically used at RFETS have adequate toxicity data for use in the CRA. Therefore, while the potential for risk from these ECOPCs is uncertain and will tend to underestimate the overall risk calculated, the magnitude of underestimation is likely to be low.

ESLs and/or TRVs were not available for several of the ECOPC/receptor pairs identified in Section 7.0. These include antimony (birds), manganese (invertebrates), molybdenum (invertebrates), silver (invertebrates, birds and mammals), tin (invertebrates), uranium (invertebrates), vanadium (invertebrates), bis(2-ethylhexyl)phthalate (invertebrates), di-n-butylphthalate (invertebrates), total dioxin (plants and invertebrates), and total PCBs (invertebrates). The risks to these ECOPC/receptor pairs are uncertain. However, because risks to all of the ECOPCs mentioned above is considered to be low for those receptors where toxicity information is available, this source of uncertainty is not expected to be significant.

10.3.3 Uncertainties Associated with Eliminating Ecological Contaminants of Interest Based on Professional Judgment

Several analytes in surface soil and subsurface soil were eliminated as ECOIs based on professional judgment. The professional judgment evaluation is intended to identify those ECOIs that have a limited potential for contamination in the UWOEU. The weight-of-evidence approach indicates that there is no identified source or pattern of release in the UWOEU, and the slightly elevated values of the UWOEU data for these ECOIs are most likely due to natural variation. The professional judgment evaluation is unlikely to have significant effect on the overall risk calculations because the ECOIs eliminated from further consideration are found at concentrations in UWOEU that are at levels that are unlikely to result in risk concerns for ecological receptors and are well within regional background levels. In addition, these ECOIs are not related to site-activities in the UWOEU and have very low potential to be transported from historical sources to the UWOEU.

10.4 Summary of Significant Sources of Uncertainty

The preceding discussion outlined the significant sources of uncertainty in the CRA process for assessing ecological risk. While some of the general sources of uncertainty discussed tend to either underestimate risk or overestimate risk, many result in an unknown effect on the potential risks. However, the CRA Methodology outlines a tiered process of risk evaluation that includes conservative assumptions for the ECOPC identification process and more realistic assumptions, as appropriate, for risk characterization.

11.0 SUMMARY AND CONCLUSIONS

A summary of the results of this CRA for human health and ecological receptors in the UWOEU is presented below.

11.1 Data Adequacy

The adequacy of the UWOEU data was assessed by comparing the number of samples for each analyte group in each medium as well as the spatial and temporal distributions of the data to data adequacy guidelines. The assessment indicates the total number of UWOEU surface soil and sediment samples for each analyte group meet the data adequacy guideline; however, for one of the three PMJM patches, the data adequacy guideline for number of surface soil samples for all analyte groups is not met. However, other lines of evidence (e.g., information on potential historical sources of contamination, migration pathways, and the concentration levels in the media) indicate that the analytes for which there is insufficient data in the one PMJM patch are not expected to be present in the surface soil. With regard to surface water data, the number of UWOEU surface water samples for each analyte group meet the data adequacy guideline, although there is no current data for PCBs. Even though PCBs were not detected in surface water in the EU, there is some uncertainty in the risk assessment process because of the high detection limits associated with the PCBs. Overall, it is possible to make risk management decisions using the existing data. In addition, for analytes that are not detected or detected at a frequency less than 5 percent, there are several analytes in surface soil that have detection limits that exceed the lowest ESLs. However, except for DDT and PCB-1260, these higher detection limits contribute only minimal uncertainty to the overall risk assessment process because either only a small fraction of the detection limits are greater than the lowest ESL, or professional judgment indicates they are not likely to be ECOPCs in UWOEU surface soil even if detection limits had been lower. There is some uncertainty in the overall risk estimates because of the higher detection limits for DDT and PCB-1260; however, DDT and PCB-1260 do not present a potential for adverse ecological effects if they were detected at their maximum detection limits.

11.2 Human Health Risk

An HHRA was performed for the UWOEU for analytes identified as COCs. In the COC screening analyses, MDCs and UCLs of analytes in UWOEU media were compared to PRGs for the WRW receptor. Inorganic and radionuclide analytes with UCLs greater than the PRGs were statistically compared to the background concentration data set. Inorganic analytes that were statistically greater than background at the 0.1 significance level, and organics with UCL concentrations greater than the PRG were carried forward to professional judgment evaluation. Based on the COC selection process, benzo(a)pyrene and 2,3,7,8-TCDD (TEQ) were retained as COCs for surface soil/surface sediment. No COCs were identified for subsurface soil. The estimated Tier 1 total excess lifetime cancer risk for potential exposure of the WRW to surface soil/surface sediment at the UWOEU is 8E-06 and the Tier 2 risk is 4E-06. The estimated total Tier 1 cancer risk for potential exposure of the WRV to surface soil/surface sediment based on the Tier 1 EPC is 9E-06, and the Tier 2 risk is 4E-06.

It is important to note that two locations, including those with the highest benzo(a)pyrene concentrations, are located underneath the Original Landfill cover. Therefore, exposure to soil at these locations is not anticipated, and the benzo(a)pyrene concentration estimate for the UWOEU and the associated risk are likely overestimated. In addition, although selected as a COC for the HHRA, benzo(a)pyrene has not been directly associated with historical IHSSs, but could be associated with traffic, pavement degradation, or pavement operations within parts of the UWOEU or the nearby IAEU. Polynuclear aromatic hydrocarbons (PAHs) are ubiquitous in the environment.

As part of the uncertainty analysis, the UCL was calculated for benzo(a)pyrene using only surface soil/surface sediment samples in the UWOEU that are located outside the Original Landfill cover. This UCL (334 µg/kg) is less than the PRG (379 µg/kg); therefore, benzo(a)pyrene would not be identified as a COC for the portion of UWOEU that is outside the Original Landfill cover. Accordingly, risks associated with exposure to benzo(a)pyrene in the UWOEU in areas outside the Original Landfill cover are less than 1E-06.

Exposure to the 2,3,7,8-TCDD (TEQ) in soil is also not anticipated because these samples are located approximately 20 feet bgs. These samples were taken as confirmation samples in an excavation following an accelerated action and, therefore, were classified as surface soil samples. However, the locations are actually approximately 20 feet bgs and not accessible by the WRW or WRV.

In summary, the risk characterization for exposure of the WRW and WRV to surface soil/surface sediment indicated that the estimated cancer risks for both receptor populations were within the 10^{-6} to 10^{-4} risk range. Noncancer risks were not estimated because noncancer toxicity criteria are not available for benzo(a)pyrene and 2,3,7,8-TCDD (TEQ).

11.3 Ecological Risk

The ECOPC identification process streamlines the ecological risk characterization by focusing the assessment on ECOIs that are present in the UWOEU. The ECOPC identification process is described in the CRA Methodology (DOE 2005a) and additional details are provided in Appendix A, Volume 2 of the RI/FS Report. Antimony, copper, nickel, silver, tin, uranium, vanadium, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, total dioxins and total PCBs were identified as ECOPCs for representative populations of non-PMJM receptors in surface soil. ECOPCs for individual PMJM receptors included antimony, chromium, copper, manganese, molybdenum, nickel, tin, vanadium, zinc, and total PCBs. No ECOPCs were identified in subsurface soil for burrowing receptors.

ECOPC/receptor pairs were evaluated in the risk characterization using conservative default exposure and risk assumptions as defined in the CRA Methodology. Tier 1 and Tier 2 EPCs were used in the risk characterization: Tier 1 EPCs are based on the upper confidence limits of the arithmetic mean concentration for the EU data set and Tier 2 EPCs are calculated using a spatially-weighted averaging approach. In addition, a refinement of the exposure and risk models based on chemical-specific uncertainties associated with the initial default exposure models were completed for several ECOPC/receptor pairs to provide a refined estimate of potential risk. Using Tier 1 EPCs and default exposure and risk assumptions, NOAEL or NOEC HQs ranged from 49 (nickel/deer mouse - insectivore) to 1 (several ECOPC/receptor pairs). NOAEL or NOEC HQs ranged from 65 (nickel/deer mouse - insectivore) to less than 1 several ECOPC/receptor pairs) using Tier 2 EPCs and default exposure and risk assumptions (Table 10.1).

For terrestrial plants, antimony, silver, uranium, and vanadium all had HQs greater than or equal to 1 using Tier 1 and Tier 2 EPCs. However, there is low confidence placed in the ESLs for terrestrial plants for all four of these ECOPCs. As discussed in Attachment 5, additional NOEC or LOEC values for antimony, silver and uranium were either not acceptable for use in the CRA (low confidence in the additional values) or not available in the literature. For vanadium, an additional LOEC value was available for refined risk calculations.

For antimony, the HQ was equal to 1 using the Tier 1 UTL and equal to 2 using the Tier 2 UTL. For silver, the HQ was equal to 2 using the Tier 1 UTL and equal to 1 using the Tier 2 UTL. Therefore, risks to populations of terrestrial plants from exposure to antimony and silver in surface soils are likely to be low but with a high level of uncertainty due to low confidence in the ESLs. For uranium, HQs were greater than 1 using both the Tier 1 and Tier 2 UTLs. Therefore, risks to populations of terrestrial plants from exposure to uranium in surface soils is likely to be low to moderate but there is a high level of uncertainty in this risk calculation because of the low confidence in the ESL.

For vanadium, HQs based on the default ESL (2 mg/kg) were greater than 1 using both the Tier 1 and Tier 2 UTLs. The uncertainty assessment recommended using an additional LOEC value (50 mg/kg) in a refined risk calculation. HQs were less than 1 using both the Tier 1 and Tier 2 EPCs in the refined analysis. The potential for risk to terrestrial plant populations in the UWOEU from exposure to vanadium in surface soils is likely to be low although there is high uncertainty or low confidence in both ESLs used in the risk calculations. In addition, the HQ based on the default ESL and the background UTL (HQ = 23) is similar to the HQ based on the default ESL and the UWOEU UTL (HQ = 24).

Most of the ECOPC/receptor pairs for birds and mammals had LOAEL HQs less than or equal to 1 using the default assumptions used in the risk calculations. However, the following ECOPC/receptor pairs had LOAEL HQs greater than 1 using the default exposure and toxicity assumptions:

- Antimony/deer mouse (insectivore) – The LOAEL HQ was equal to 3 using the Tier 2 EPC in the default risk model. There is a high level of uncertainty associated with the use of the default upper-bound BAF and the default TRV in the risk calculations (see Attachment 5). Additional BAFs and TRVs for antimony are unavailable for a refined analysis. Given that no LOAEL HQs were greater than 1 in the grid analysis, the potential for risks to populations of small mammals such as the deer mouse (insectivore) are likely to be low. However, there is considerable uncertainty or low confidence in the default risk model.

- Antimony/PMJM – The LOAEL HQ was equal to 2 in Patch #20 using the default risk model. There is a high level of uncertainty associated with the use of the default upper-bound BAF and the default TRV in the risk calculations (see Attachment 5). Additional BAFs and TRVs for antimony are unavailable for a refined analysis. Given that the LOAEL HQ is only equal to 2, risks to PMJM receptors within Patch #20 are likely to be low but somewhat elevated over the remaining patches, while risks within all other habitat patches at UWOEU are likely low. However, there is considerable uncertainty or low confidence in the default risk model.

- Nickel/deer mouse (insectivore) – The default LOAEL HQs were equal to 5 and 7 using the Tier 1 and Tier 2 EPCs, respectively. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, no LOAEL HQs greater than 1 were calculated. In addition, HQs were also calculated using additional TRVs from Sample et al. (1996). No HQs greater than 1 were calculated using either the NOAEL or the LOAEL TRV in the refined analysis. Based on these additional risk calculations using the median BAF or the additional NOAEL or LOAEL TRVs, risks to populations of small mammals such as the deer mouse (insectivore) receptor are likely to be low.

- Nickel/PMJM - LOAEL HQs were greater than 1 in Patches #19, #20, and #21 using default exposure and toxicity assumptions. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, LOAEL HQs were less than 1 in all three patches. Using additional TRVs for nickel resulted in NOAEL and LOAEL HQs less than 1 with either BAF in the calculations in all three patches. Based on the additional risk calculations using either the median BAF or the additional TRVs in the refined analysis, risks to the PMJM receptor from exposure to nickel are likely to be low.

- Di-n-butylphthalate/mourning dove (insectivore) – – LOAEL HQs were equal to 3 using the Tier 1 EPC and equal to 2 using the Tier 2 EPC. No median BAF or additional TRVs were available for refined risk calculations. Therefore, the risk of potential adverse effects to populations of small birds such as the mourning dove (insectivore) receptor are likely to be low to moderate although there is considerable uncertainty or low confidence in the default risk model. In addition, there is no known source of di-n-butylphthalate at UWOEU.

- Total dioxins/deer mouse (insectivore) - The LOAEL HQ was equal to 3 using the Tier 1 EPC and less than 1 using the Tier 2 EPC. No median BAF or additional TRVs were available for refined risk calculations. Therefore, the risk of potential adverse effects to populations of small mammals such as the deer mouse (insectivore) receptor are likely to be low to moderate. However, there are uncertainties in the default risk model as discussed in Attachment 5 and the LOAEL HQs were less than 1 using the Tier 2 EPC in the risk calculations.

Based on default and refined calculations, site-related risks are likely to be low to moderate with some high levels of uncertainty for the ecological receptors evaluated in the UWOEU (Table 11.1). In addition, data collected on wildlife abundance and diversity indicate that wildlife species richness remains high at RFETS. There are no significant risks to ecological receptors or high levels of uncertainty with the data, and therefore, there are no ecological contaminants of concern (ECOCs) for the UWOEU.

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TABLES

Table 1.1

UWOEU IHSSs

IHSS	PAC/UBC	Name	Description	Disposition
102	800-102	Oil Sludge Pit	The Oil Sludge Pit was a pit where drums of non-radioactive oil sludge were emptied in 1958. The sludge reportedly was collected during cleaning of two No. 6 fuel oil tanks (IHSS 105.1 and 105.2) south of Building 881. No action required.	OU 1 CAD/ROD
106	800-106	Bldg. 881, Outfall	At the Building 881Outfall Site there was a six-inch-diameter, vitrified-clay-pipe outfall, which existed south of Building 881 and discharged water until December 1977. The pipe was an overflow line from the sanitary sewer sump in Building 887. The pipe has been removed. No action required.	OU 1 CAD/ROD
107	800-107	Bldg. 881, Hillside Oil Leak	The Building 881 Hillside Oil Leak site was the location of an oil leak discovered in 1973 on the hillside south of Building 881. The oil spill was contained with straw, and the straw and soil were removed. No action required.	OU 1 CAD/ROD
145	800-145	Sanitary Waste Line Leak	In 1981, a portion of a six-inch, cast-iron sanitary sewer line located south of Building 881 leaked. The line conveyed sanitary wastes and did not carry hazardous or radioactive materials. The pipe has been removed. No action required.	OU 1 CAD/ROD
115	SW-115	Original Landfill	The Original Landfill operated from 1952 to 1968 and was used to dispose of general wastes but potentially including solvents, paint thinners, paints, pesticides and depleted uranium. Depleted uranium "hot spots" were removed from the surface of the landfill, and the landfill was regraded and a soil cover placed on it as a final closure measure.	NFA-2005, HRR
133.1	SW-133.1	Ash Pit 1	Four ash pits, each about 8 feet by 3 feet by 150 feet, were used to dispose of the ash from the Plant incinerator, which burned general wastes and may have burned depleted uranium. Following the shutdown of the incinerator, the Ash Pits were covered with fill. No action required.	NFA-2003, HRR
133.2	SW-133.2	Ash Pit 2	Four ash pits, each about 8 feet by 3 feet by 150 feet, were used to dispose of the ash from the Plant incinerator, which burned general wastes and may have burned depleted uranium. Following the shutdown of the incinerator, the Ash Pits were covered with fill. No action required.	NFA-2003, HRR
133.3	SW-133.3	Ash Pit 3	Four ash pits, each about 8 feet by 3 feet by 150 feet, were used to dispose of the ash from the Plant incinerator, which burned general wastes and may have burned depleted uranium. Following the shutdown of the incinerator, the Ash Pits were covered with fill. No action required.	NFA-2002, HRR
133.4	SW-133.4	Ash Pit 4	Four ash pits, each about 8 feet by 3 feet by 150 feet, were used to dispose of the ash from the Plant incinerator, which burned general wastes and may have burned depleted uranium. Following the shutdown of the incinerator, the Ash Pits were covered with fill. No action required.	NFA-2003, HRR

Table 1.1
UWOEU IHSSs

IHSS	PAC/UBC	Name	Description	Disposition
133.5	SW-133.5	Incinerator Facility	The incinerator was used to burn general RFETS' waste and possibly depleted uranium between the 1950s and 1968. The incinerator facility was removed per ER RSOP Notification #03-09	NFA-2003, HRR
133.6	SW-133.6	Concrete Wash Pad	This area was used to dispose of waste concrete from concrete trucks used during construction of plant facilities. It is also likely the trucks were washed down in this area after delivering concrete. 3000 cubic yards uncontaminated concrete were removed and recycled as a BMP.	NFA-2003, HRR
196	SW-196	Water Treatment Plant Backwash Pond	During the early 1970s, backwash from the raw water treatment plant was collected in an unlined pond located on the south side of Building 124. Reportedly, the pond dried up and was destroyed in the late 1970s. This area was regraded and soil cover installed as part of IM/IRA for Original Landfill.	NFA-2005, HRR
N/A	SE-1600	Pond 7-Steam Condensate Releases	Pond 7 was constructed in March 1955 as a retention pond for steam condensate releases from Building 881 and likely received other routine discharges from Building 881. Pond 7 was abandoned prior to October 1964. No action required.	NFA-2002, HRR
N/A	SE-1601.1	Pond 8 - North [Original Pond 8] (Cooling Tower Discharge Releases)	Pond 8 North was constructed in March 1955 as a retention pond for cooling tower overflow and blowdown. Pond 8 North was abandoned prior to October 1964. No action required.	NFA-2002, HRR
N/A	SE-1601.2	Pond 8 - South (Cooling Tower Discharge Releases)	Pond 8 South was constructed prior to October 1964 and appears to have been used as a retention pond both for the flows that formerly flowed into Ponds 7 and 8 North, which had both been abandoned by that date. No action required.	NFA-2002, HRR
N/A	SW-1700	Fuel Spill into Woman Creek Drainage	An armored vehicle turned over into Woman Creek upstream of Pond C-1 on October 19, 1975. No action required.	NFA-2002, HRR
N/A	SW-1701	Recently Identified Ash Pit (Also referred to as TDEM-1)	PAC SW-1701 is a suspected ash pit for disposing ash from the plant incinerator that operated prior to 1968. Drilling of the area turned up small shavings of metallic debris. No action required.	NFA-2002, HRR
N/A	SW-1702	Recently Identified Ash Pit (Also referred to as TDEM-2)	PAC SW-1702 is a suspected ash pit for disposing ash from the plant incinerator that operated prior to 1968. Magnetometer surveys indicated buried metals at this location. The anomalies in both areas are similar. No action required.	NFA-2003, HRR

Table 1.2
Number of Samples in Each Medium by Analyte Suite

Analyte Suite	Surface Soil/ Surface Sediment[a]	SubSurface Soil/ Subsurface Sediment[a]	Surface Soil[b]	Surface Soil within PMJM[b]	Subsurface Soil[b]
Inorganics	166	258	135	35	257
Organics	148	298	121	28	297
Radionuclides	217	252	177	45	251

[a] Used in the HHRA.

[b] Used in the ERA.

Note: The total number of results (analyses in Tables 1.3 through 1.7 may differ from the total number of samples presented in Table 1.2 because not all analyses are necessarily performed for each sample.

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		161	100	1,140	30,200	10,799	5,267
Ammonia[c]	0.338 - 0.350	5	60	0.684	4.40	1.90	2.14
Antimony[c]	0.280 - 39.1	148	8.78	0.330	51.3	5.68	8.25
Arsenic	0.530 - 0.741	161	98.8	0.290	27.9	5.07	3.05
Barium		161	100	14.6	464	123	59.1
Beryllium	0.19 - 1.1	164	75	0.180	4.40	0.739	0.464
Boron	2.4 - 4.50	18	72.2	3.90	11	5.21	2.79
Cadmium	0.0680 - 2.8	148	31.8	0.270	30	0.796	2.50
Calcium		161	100	833	69,700	8,279	9,999
Cesium	0.52 - 164	124	11.3	2	16.4	8.63	15.3
Chromium	1.2 - 6.3	161	98.8	1.50	70.1	13.0	8.22
Chromium (VI)	0.005 - 0.005	4	25	0.0120	0.0120	0.00488	0.00475
Cobalt	1.73 - 10.6	160	88.1	2	13.7	7.23	2.53
Copper	4.7 - 8.1	161	97.5	2.20	330	24.7	37.1
Fluoride[c]	1.86 - 2.50	4	25	20.3	20.3	5.93	9.58
Iron		161	100	2,660	38,800	14,077	5,227
Lead		166	100	2.60	220	26.3	22.8
Lithium	2.9 - 16.9	156	90.4	1.70	20	7.79	3.63
Magnesium		161	100	448	6,600	2,391	1,050
Manganese		161	100	45.2	829	258	116
Mercury	0.049 - 0.26	157	40.1	0.0170	3.80	0.120	0.378
Molybdenum	0.31 - 7.8	158	19.0	0.310	11.7	1.42	1.48
Nickel	2.2 - 19.5	160	91.3	2.20	48	13.1	6.52
Nitrate / Nitrite	0.98 - 7.40	33	72.7	0.414	32	2.92	5.59
Potassium	718 - 4,180	160	96.3	276	4,460	1,939	822
Selenium	0.210 - 1.9	146	34.9	0.220	3.80	0.335	0.366
Silica[c]		18	100	540	1,200	785	142
Silicon[c]		27	100	83.8	1,890	575	461
Silver	0.082 - 7	145	23.4	0.0950	98	2.24	11.3
Sodium	40.30 - 210	159	79.2	36.6	2,060	137	198
Strontium	13.6 - 13.6	160	99.4	4.80	150	38.8	28.3
Thallium	0.210 - 1.9	156	16.0	0.210	0.990	0.237	0.175
Tin	0.850 - 127	160	13.8	1.20	66.9	7.59	12.8
Titanium		18	100	170	410	257	59.5

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Uranium	1.40 - 1.70	18	38.9	1.80	85	8.60	20.1
Vanadium		161	100	4.90	68.6	29.6	10.5
Zinc		161	100	10.6	2,080	93.0	197
Organics (mg/kg)							
1,2,3,4,6,7,8-HpCDF	0.986 - 1,000	10	90	2.35E-04	0.240	0.0349	0.0735
1,2,3,4,7,8,9-HpCDF	1.035 - 5.9	10	80	4.40E-04	0.0250	0.00366	0.00753
1,2,3,4,7,8-HxCDD	0.00264 - 0.00264	10	70	3.40E-04	0.00730	0.00140	0.00212
1,2,3,4,7,8-HxCDF	0.00264 - 0.00269	10	80	0.00120	0.140	0.0197	0.0429
1,2,3,6,7,8-HxCDD	0.00017 - 0.00269	10	80	4.10E-04	0.0120	0.00233	0.00342
1,2,3,6,7,8-HxCDF	0.00264 - 0.00269	10	80	4.40E-04	0.0430	0.00660	0.0131
1,2,3,7,8,9-HxCDD	0.00264 - 0.00269	10	90	2.20E-04	0.0210	0.00318	0.00630
1,2,3,7,8,9-HxCDF	0.00264 - 0.00269	10	40	1.90E-04	0.00250	6.55E-04	8.10E-04
1,2,3,7,8-PeCDF	0.00264 - 0.00264	10	80	2.90E-04	0.0280	0.00434	0.00843
1,2,4-Trichlorobenzene	0.00011 - 0.00269	118	0.847	0.950	0.950	251	116
1,2,4-Trimethylbenzene	0.00264 - 0.00269	8	12.5	1.50	1.50	0.957	0.874
2,3,4,6,7,8-HxCDF	0.00264 - 0.00269	10	80	5.50E-04	0.0630	0.00862	0.0192
2,3,4,7,8-PeCDF	0.00264 - 0.00269	10	80	6.40E-04	0.0560	0.00786	0.0170
2,3,7,8-TCDD	0.00022 - 0.00106	10	70	2.59E-05	0.00190	4.76E-04	5.38E-04
2,3,7,8-TCDF	0.00106 - 0.00108	10	80	8.70E-04	0.0280	0.00431	0.00842
2-Butanone	10.13 - 57	34	14.7	3	380	23.4	69.0
2-Methylnaphthalene	340 - 1,000	111	4.50	57	12,000	376	1,119
4,4'-DDT	3.60 - 170	112	0.893	21	21	13.9	9.54
4-Methyl-2-pentanone	6.859 - 57.0	32	3.13	4	4	7.15	4.45
4-Methylphenol	340 - 1,000	79	2.53	68	510	224	79.0
Acenaphthene	350 - 1,800	124	16.9	51	44,000	671	3,932
Acenaphthylene	340 - 2,300	126	0.794	600	600	338	218
Acetone	10.16 - 120	36	33.3	5.80	890	57.9	159
Aldrin[c]	1.80 - 85	112	0.893	17	17	7.50	5.66
Anthracene	350 - 1,000	130	16.9	67	47,000	645	4,106
Aroclor-1254	0.828 - 28	115	16.5	19	3,900	282	541
Aroclor-1260	350 - 1,000	114	1.75	48	600	140	105
Benzene[c]	19 - 2,000	32	6.25	1.10	1.20	3.66	2.55
Benzo(a)anthracene	13 - 1,000	111	35.1	22	45,000	755	4,269
Benzo(a)pyrene	52 - 1,000	121	25.6	37	43,000	702	3,904
Benzo(b)fluoranthene	350 - 1,000	117	27.4	73	49,000	829	4,536
Benzo(g,h,i)perylene	1,600 - 4,900	104	19.2	45	28,000	513	2,740

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Benzo(k)fluoranthene	340 - 1,500	111	18.0	59	25,000	533	2,355
Benzoic Acid	350 - 1,000	74	28.4	44	770	930	509
Benzyl Alcohol	340 - 1,000	68	1.47	270	270	239	114
bis(2-ethylhexyl)phthalate	360 - 480	113	31.9	48	3,500	285	396
Butylbenzylphthalate	100 - 1,000	113	3.54	75	220	268	100
Carbazole	21 - 1,000	5	20	39	39	170	76.6
Chrysene	340 - 1,000	126	33.3	40	46,000	696	4,104
Dibenz(a,h)anthracene	3.6 - 170	104	4.81	60	9,200	329	889
Dibenzofuran	340 - 1,000	112	8.93	36	20,000	447	1,870
Dieldrin	350 - 1,000	112	0.893	34	34	14.2	9.76
Diethylphthalate	340 - 1,000	113	0.885	79	79	270	99.4
Di-n-butylphthalate	3.6 - 170	113	12.4	39	390	251	111
Di-n-octylphthalate	3.6 - 170	112	2.68	21	96	267	103
Endosulfan sulfate	140 - 1,000	112	0.893	24	24	13.9	9.56
Endrin ketone[c]	140 - 1,000	112	0.893	36	36	14.0	9.74
Fluoranthene	1.8 - 85	121	48.8	31	140,000	1,689	12,744
Fluorene	0.00264 - 0.00264	129	14.0	39	39,000	552	3,419
Heptachlor epoxide	29 - 1,000	112	0.893	10	10	7.08	4.93
Heptachlorodibenzo-p-dioxin	270 - 1,000	10	90	2.48E-04	0.110	0.0221	0.0317
Indeno(1,2,3-cd)pyrene	18 - 850	106	17.9	24	32,000	575	3,097
Isophorone	1.133 - 41	112	0.893	96	96	269	100
Methoxychlor[c]	0.834 - 1,800	112	0.893	450	450	72.5	59.6
Methylene Chloride		36	27.8	0.950	220	14.5	41.2
Naphthalene		136	8.09	0.950	41,000	623	3,500
OCDD	34 - 920	10	100	4.15E-04	0.390	0.120	0.111
OCDF	36 - 1,700	10	100	7.19E-05	0.140	0.0223	0.0418
Pentachlorodibenzo-p-dioxin[c]	0.00014 - 0.00269	10	70	3.20E-04	0.00710	0.00129	0.00208
Phenanthrene	350 - 1,000	131	39.7	24	170,000	1,750	14,855
Phenol	340 - 1,000	79	2.53	56	80	221	74.1
Pyrene	180 - 1,000	127	48.0	41	120,000	1,438	10,670
Tetrachloroethene	1.283 - 28	32	9.38	1	6	3.56	2.64
Toluene	1.328 - 15	34	20.6	2.90	310	12.9	52.5
Trichloroethene	0.670 - 28	33	3.03	23	23	4.19	4.25
Xylene[c,d]	2.639 - 28	32	6.25	2.90	5	3.92	2.36
Radionuclides (pCi/g)[e]							

Table 1.3
Summary of Detected Analytes in Surface Soil/Surface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Americium-241		189	N/A	-0.0288	0.802	0.0358	0.0727
Cesium-134		13	N/A	0.00100	0.300	0.0931	0.0913
Cesium-137		22	N/A	0.0300	1	0.173	0.201
Gross Alpha		126	N/A	-6.30	320	21.1	31.2
Gross Beta		130	N/A	6.60	305	34.5	41.6
Neptunium-237		2	N/A	0.00222	0.00224	0.00223	1.06E-05
Plutonium-238		14	N/A	-0.00200	0.0253	0.00236	0.00671
Plutonium-239/240		214	N/A	-0.0126	17.1	0.230	1.23
Radium-226		10	N/A	0.240	1.09	0.722	0.300
Radium-228		8	N/A	0.880	2.29	1.41	0.483
Strontium-89/90		20	N/A	-0.0400	4.86	0.446	1.14
Uranium-233/234		188	N/A	0.191	47.5	1.43	3.55
Uranium-235		188	N/A	-0.0230	2.24	0.0863	0.228
Uranium-238		188	N/A	0.283	209	3.11	16.5

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] The value for total xylene is used.

[e] All radionuclide values are considered detects.

N/A = Not applicable.

Table 1.4
Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		253	100	1,740	32,800	12,143	6,020
Antimony	0.290 - 29.3	230	20.9	0.340	149	6.98	11.8
Arsenic	0.230 - 0.230	253	99.6	0.470	24.3	4.66	2.82
Barium		253	100	21.5	1,610	160	141
Beryllium	0.100 - 1.90	258	76.0	0.280	446	3.60	29.3
Boron	1.90 - 1.90	8	87.5	2.10	4.70	3.29	1.29
Cadmium	0.068 - 1.20	247	16.6	0.0750	71	2.10	8.60
Calcium	895 - 895	253	99.6	1,140	60,000	7,340	7,307
Cesium	2.50 - 294	224	8.48	1.90	29.6	7.04	13.7
Chromium	1.10 - 1.10	253	99.6	4.30	8,310	52.8	522
Cobalt	2.80 - 9.70	253	96.4	1.90	701	11.7	44.0
Copper	4.60 - 20.9	253	96.8	3.60	8,850	140	760
Iron		253	100	2,340	107,000	18,370	14,237
Lead		258	100	2.90	5,200	60.7	343
Lithium	2.90 - 18.4	250	87.6	1.40	29	8.69	5.33
Magnesium		253	100	392	9,480	3,096	1,484
Manganese		253	100	14.3	2,150	278	252
Mercury	0.015 - 0.190	229	28.4	0.00620	1.40	0.0900	0.166
Molybdenum	0.310 - 5.20	252	23.8	0.320	470	5.06	33.1
Nickel	4.60 - 24.3	253	96.4	2.70	4,750	40.2	298
Phosphorus		1	100	975	975	975	N/A
Potassium	622 - 2,140	252	91.7	327	4,190	1,426	727
Selenium	0.180 - 1.90	248	14.1	0.150	80.8	0.569	5.13
Silica[c]		8	100	550	850	703	105
Silicon		18	100	22.7	1,120	379	273
Silver	0.089 - 3.10	235	17.9	0.230	311	7.11	31.9
Sodium	38.6 - 226	252	93.3	42	3,360	330	396
Strontium	54.2 - 54.2	253	99.6	6.40	170	46.0	26.3
Thallium	0.200 - 29.3	252	27.8	0.210	6.30	0.304	0.998
Tin	0.970 - 41.2	252	8.73	1.50	579	8.71	38.7
Titanium		9	100	34	283	155	78.4
Total Petroleum Hydrocarbons	18.0 - 37.0	29	6.90	21	62	12.7	9.93
Uranium	1.50 - 1.70	8	12.5	5.50	5.50	1.38	1.66
Vanadium		253	100	9.80	74.4	32.3	12.3

Table 1.4
Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Zinc		253	100	7.60	6,920	137	509
Organics (ug/kg)							
1,1,1-Trichloroethane	1.13 - 31.0	197	0.508	2	2	3.10	1.76
1,2,3,4,6,7,8-HpCDF	1.00 - 7,700	1	100	0.00480	0.00480	0.00480	N/A
1,2,3,4,7,8,9-HpCDF[c]	0.755 - 7,700	1	100	6.00E-04	6.00E-04	6.00E-04	N/A
1,2,3,4,7,8-HxCDD	1.05 - 7,700	1	100	3.40E-04	3.40E-04	3.40E-04	N/A
1,2,3,4,7,8-HxCDF[c]	1.14 - 7,700	1	100	0.00290	0.00290	0.00290	N/A
1,2,3,6,7,8-HxCDD[c]		1	100	6.10E-04	6.10E-04	6.10E-04	N/A
1,2,3,6,7,8-HxCDF[c]		1	100	0.00120	0.00120	0.00120	N/A
1,2,3,7,8,9-HxCDD[c]		1	100	8.40E-04	8.40E-04	8.40E-04	N/A
1,2,3,7,8,9-HxCDF[c]		1	100	1.40E-04	1.40E-04	1.40E-04	N/A
1,2,3,7,8-PeCDF[c]		1	100	9.30E-04	9.30E-04	9.30E-04	N/A
1,2,4-Trichlorobenzene		112	0.893	60	60	271	360
1,2-Dichlorobenzene		112	0.893	30	30	271	360
1,3-Dichlorobenzene		112	0.893	20	20	271	360
1,4-Dichlorobenzene[c]		112	0.893	10	10	271	360
2,3,4,6,7,8-HxCDF[c]		1	100	0.00120	0.00120	0.00120	N/A
2,3,4,7,8-PeCDF[c]		1	100	0.00160	0.00160	0.00160	N/A
2,3,7,8-TCDD		1	100	2.40E-04	2.40E-04	2.40E-04	N/A
2,3,7,8-TCDF		1	100	0.00110	0.00110	0.00110	N/A
2-Butanone	10.0 - 62.0	176	2.84	2	8	6.36	3.59
2-Chlorophenol	340 - 7,700	108	0.926	10	10	296	359
2-Methylnaphthalene	340 - 870	108	8.33	10	15,000	399	1,422
3,3'-Dichlorobenzidine	690 - 15,000	107	0.935	160	160	587	702
4-Chloro-3-methylphenol	340 - 7,700	108	0.926	10	10	310	371
4-Methyl-2-pentanone	6.96 - 62.0	190	0.526	2	2	6.24	3.44
Acenaphthene	350 - 1,000	108	13.0	56	31,000	569	2,960
Acenaphthylene	340 - 7,700	108	0.926	47	47	292	359
Acetone	10.0 - 150	182	17.0	2	330	19.2	27.1
alpha-BHC	4.70 - 21.0	100	1	15	15	6.32	2.54
Anthracene	350 - 1,000	108	13.0	61	46,000	738	4,403
Aroclor-1254	350 - 1,000	99	10.1	210	960	172	162
Aroclor-1260	350 - 870	100	3	450	1,300	148	151

Table 1.4
Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Benzo(a)anthracene	350 - 1,000	108	16.7	44	48,000	810	4,610
Benzo(a)pyrene	340 - 1,000	108	15.7	10	43,000	751	4,127
Benzo(b)fluoranthene	350 - 1,000	106	17.0	53	48,000	818	4,648
Benzo(g,h,i)perylene	1,700 - 37,000	108	12.0	86	19,000	480	1,812
Benzo(k)fluoranthene	340 - 7,700	106	15.1	48	19,000	492	1,850
Benzoic Acid	1.14 - 31.0	103	17.5	42	260	1,275	1,827
bis(2-ethylhexyl)phthalate	340 - 7,700	108	19.4	42	540	279	367
Bromoform	350 - 1,000	194	0.515	2	2	3.10	1.77
Butylbenzylphthalate	1.09 - 1.45	108	4.63	50	1,400	322	389
Chrysene	340 - 7,700	108	16.7	52	53,000	864	5,093
cis-1,2-Dichloroethene	340 - 870	8	37.5	1.48	10.1	2.11	3.27
Dibenz(a,h)anthracene	340 - 7,700	108	7.41	53	890	305	363
Dibenzofuran	340 - 7,700	108	9.26	10	20,000	449	1,902
Diethylphthalate	340 - 7,700	108	1.85	40	250	297	359
Di-n-butylphthalate	350 - 870	108	10.2	88	2,700	319	429
Di-n-octylphthalate	350 - 1,000	108	1.85	39	50	298	360
Fluoranthene	4.70 - 21.0	108	21.3	10	160,000	2,036	15,396
Fluorene	4.70 - 21.0	108	13.0	42	35,000	610	3,344
Heptachlor		100	1	3.10	3.10	6.16	2.40
Heptachlor epoxide	340 - 7,700	100	1	11	11	6.28	2.43
Heptachlorodibenzo-p-dioxin	340 - 1,000	1	100	0.00960	0.00960	0.00960	N/A
Hexachlorobenzene	340 - 7,700	108	0.926	30	30	296	359
Indeno(1,2,3-cd)pyrene	1.15 - 45.0	108	10.2	98	22,000	518	2,099
Isophorone	0.847 - 870	108	0.926	82	82	299	359
Methylene Chloride		199	19.1	1	67	5.30	7.26
Naphthalene		112	8.04	30	61,000	803	5,741
OCDD	94.0 - 420	1	100	0.0750	0.0750	0.0750	N/A
OCDF	94.0 - 420	1	100	0.00620	0.00620	0.00620	N/A
Pentachlorodibenzo-p-dioxin[c]		1	100	3.50E-04	3.50E-04	3.50E-04	N/A
Pentachlorophenol	1,700 - 37,000	108	0.926	160	160	1,434	1,726
Phenanthrene	350 - 870	108	21.3	20	220,000	2,568	21,145
Phenol	340 - 7,700	108	3.70	30	140	293	360
Pyrene	350 - 870	108	21.3	10	150,000	1,894	14,426
Tetrachloroethene	1.30 - 12.0	199	10.1	1	920	16.5	84.1
Toluene	1.36 - 64.0	199	51.3	1	420	31.1	60.9

Table 1.4
Summary of Detected Analytes in Subsurface Soil/Subsurface Sediment

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Trichloroethene	0.680 - 12.0	199	6.53	1	440	6.69	33.2
Radionuclides (pCi/g)[d]							
Americium-241		237	N/A	-0.0170	2.97	0.0311	0.200
Cesium-134		3	N/A	-0.103	-0.0657	-0.0839	0.0187
Cesium-137		23	N/A	-0.0527	0.176	0.0194	0.0447
Gross Alpha		245	N/A	3.58	742	33.3	75.0
Gross Beta		245	N/A	7.50	1,580	54.8	141
Plutonium-238		25	N/A	-0.00340	9.84	0.419	1.96
Plutonium-239/240		244	N/A	-0.00710	5.16	0.0835	0.413
Radium-226		17	N/A	0.728	2.09	0.999	0.318
Radium-228		26	N/A	0	2.79	1.55	0.577
Strontium-89/90		43	N/A	-0.0144	0.969	0.249	0.254
Uranium-233/234		245	N/A	0.0475	288	6.53	28.6
Uranium-235		245	N/A	-0.0193	37.7	0.710	3.90
Uranium-238		245	N/A	0.238	1,160	24.5	136

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A - Not available or not applicable.

Table 1.5
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		130	100	1,950	30,000	11,069	4,969
Ammonia	0.338 - 0.350	5	60	0.684	4.40	1.90	2.14
Antimony[c]	0.280 - 17.6	120	6.67	0.330	49.8	4.53	5.84
Arsenic		130	100	0.290	10	5.06	2.11
Barium		130	100	40.1	464	122	51.2
Beryllium	0.240 - 1.10	135	77.8	0.180	4.40	0.758	0.462
Boron	2.40 - 4.50	18	72.2	3.90	11	5.21	2.79
Cadmium	0.068 - 1.10	120	30.8	0.270	30	0.777	2.76
Calcium		130	100	1,940	69,700	8,069	10,123
Cesium	4.00 - 30.5	96	10.4	2	16.4	4.52	2.91
Chromium	6.30 - 6.30	130	99.2	2.60	61	13.1	6.91
Cobalt	4.30 - 10.2	130	87.7	2.40	13.7	7.39	2.31
Copper	4.70 - 4.70	130	99.2	5.10	330	24.6	36.3
Iron		130	100	4,700	29,000	14,052	3,987
Lead		135	100	5.80	220	26.4	22.7
Lithium	3.20 - 12.7	128	92.2	2.40	20	7.93	3.52
Magnesium		130	100	663	5,610	2,376	878
Manganese		130	100	45.2	829	261	112
Mercury	0.049 - 0.140	128	46.9	0.0170	2.40	0.0905	0.217
Molybdenum	0.310 - 4.50	128	18.8	0.310	5.90	1.14	0.920
Nickel	4.60 - 9.20	129	96.1	4.70	48	13.2	5.71
Nitrate / Nitrite		7	100	0.414	3.63	1.93	1.12
Potassium	718 - 718	130	98.5	736	4,460	2,049	768
Selenium	0.210 - 1.10	120	35.8	0.220	1	0.283	0.194
Silica[c]		18	100	540	1,200	785	142
Silicon[c]		9	100	90.5	1,560	552	466
Silver	0.082 - 7.00	117	23.9	0.0950	98	2.47	12.5
Sodium	40.3 - 210	130	75.4	48.4	474	102	81.7
Strontium		129	100	11.8	150	36.1	24.5
Thallium	0.210 - 1.10	129	14.7	0.210	0.960	0.214	0.152
Tin	0.850 - 42.2	129	12.4	1.20	66.9	6.28	11.7
Titanium		18	100	170	410	257	59.5
Uranium	1.40 - 1.70	18	38.9	1.80	85	8.60	20.1
Vanadium		130	100	9.90	54.8	30.7	8.87

Table 1.5
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Zinc		130	100	11.8	650	65.5	71.0
Organic (ug/kg)							
1,2,3,4,6,7,8-HpCDF	0.986 - 960	10	90	2.35E-04	0.240	0.0349	0.0735
1,2,3,4,7,8,9-HpCDF	1.04 - 5.90	10	80	4.40E-04	0.0250	0.00366	0.00753
1,2,3,4,7,8-HxCDD	0.003 - 0.003	10	70	3.40E-04	0.00730	0.00140	0.00212
1,2,3,4,7,8-HxCDF	0.003 - 0.003	10	80	0.00120	0.140	0.0197	0.0429
1,2,3,6,7,8-HxCDD	1.70E-04 - 0.003	10	80	4.10E-04	0.0120	0.00233	0.00342
1,2,3,6,7,8-HxCDF	0.003 - 0.003	10	80	4.40E-04	0.0430	0.00660	0.0131
1,2,3,7,8,9-HxCDD	0.003 - 0.003	10	90	2.20E-04	0.0210	0.00318	0.00630
1,2,3,7,8,9-HxCDF	0.003 - 0.003	10	40	1.90E-04	0.00250	6.55E-04	8.10E-04
1,2,3,7,8-PeCDF	0.003 - 0.003	10	80	2.90E-04	0.0280	0.00434	0.00843
1,2,4-Trichlorobenzene	1.10E-04 - 0.003	95	1.05	0.950	0.950	248	123
1,2,4-Trimethylbenzene	0.003 - 0.003	8	12.5	1.50	1.50	0.957	0.874
2,3,4,6,7,8-HxCDF	0.003 - 0.003	10	80	5.50E-04	0.0630	0.00862	0.0192
2,3,4,7,8-PeCDF	0.003 - 0.003	10	80	6.40E-04	0.0560	0.00786	0.0170
2,3,7,8-TCDD	2.20E-04 - 0.001	10	70	2.59E-05	0.00190	4.76E-04	5.38E-04
2,3,7,8-TCDF	0.001 - 0.001	10	80	8.70E-04	0.0280	0.00431	0.00842
2-Butanone	10.1 - 57.0	11	9.09	3	3	8.21	7.18
2-Methylnaphthalene	340 - 960	88	5.68	57	12,000	406	1,256
4,4'-DDT	3.60 - 170	89	1.12	21	21	14.5	10.2
4-Methyl-2-pentanone	6.86 - 57.0	11	9.09	4	4	7.38	7.59
Acenaphthene	350 - 1,800	101	20.8	51	44,000	765	4,355
Acenaphthylene	340 - 2,300	103	0.971	600	600	355	235
Acetone	10.2 - 93.0	11	18.2	5.80	11	14.9	15.8
Aldrin[c]	1.80 - 85.0	89	1.12	17	17	7.96	6.11
Anthracene	350 - 960	107	20.6	67	47,000	727	4,525
Aroclor-1254	0.828 - 28.0	90	15.6	220	3,900	331	602
Aroclor-1260	350 - 940	90	2.22	48	600	148	113
Benzene[c]	19.0 - 2,000	11	18.2	1.10	1.20	3.15	4.08
Benzo(a)anthracene	13.0 - 960	88	39.8	40	45,000	890	4,790
Benzo(a)pyrene	52.0 - 940	98	28.6	60	43,000	810	4,334
Benzo(b)fluoranthene	350 - 960	94	31.9	73	49,000	971	5,055
Benzo(g,h,i)perylene	1,600 - 4,100	81	22.2	50	28,000	588	3,104
Benzo(k)fluoranthene	340 - 1,500	88	20.5	59	25,000	609	2,642
Benzoic Acid	350 - 960	54	35.2	44	770	807	456

Table 1.5
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Benzyl Alcohol	340 - 960	48	2.08	270	270	225	120
bis(2-ethylhexyl)phthalate	360 - 360	89	27.0	48	3,500	273	367
Butylbenzylphthalate	100 - 940	89	2.25	120	220	273	102
Carbazole	21.0 - 940	2	50	39	39	110	99.7
Chrysene	340 - 960	102	34.3	40	46,000	806	4,558
Dibenz(a,h)anthracene	3.60 - 170	81	6.17	60	9,200	348	1,007
Dibenzofuran	350 - 960	89	11.2	36	20,000	494	2,097
Dieldrin	340 - 960	89	1.12	34	34	14.9	10.5
Di-n-butylphthalate	3.60 - 170	89	11.2	40	200	250	111
Di-n-octylphthalate	3.60 - 170	88	1.14	83	83	271	102
Endosulfan sulfate	140 - 940	89	1.12	24	24	14.5	10.3
Endrin ketone[c]	140 - 960	89	1.12	36	36	14.7	10.5
Fluoranthene	1.80 - 85.0	97	50.5	49	140,000	2,052	14,224
Fluorene	0.003 - 0.003	106	17.0	39	39,000	614	3,771
Heptachlor epoxide	29.0 - 940	89	1.12	10	10	7.43	5.29
Heptachlorodibenzo-p-dioxin	340 - 960	10	90	2.48E-04	0.110	0.0221	0.0317
Indeno(1,2,3-cd)pyrene	18.0 - 850	83	21.7	52	32,000	664	3,499
Isophorone	1.13 - 28.0	89	1.12	96	96	272	102
Methoxychlor[c]	0.834 - 1,800	89	1.12	450	450	76.4	64.9
Methylene Chloride		11	27.3	0.950	2	2.22	3.98
Naphthalene		113	9.73	0.950	41,000	696	3,839
OCDD	34.0 - 920	10	100	4.15E-04	0.390	0.120	0.111
OCDF	36.0 - 1,700	10	100	7.19E-05	0.140	0.0223	0.0418
Pentachlorodibenzo-p-dioxin	1.40E-04 - 0.003	10	70	3.20E-04	0.00710	0.00129	0.00208
Phenanthrene	350 - 940	107	41.1	43	170,000	2,095	16,431
Phenol	340 - 820	56	3.57	56	80	203	60.1
Pyrene	180 - 940	103	50.5	41	120,000	1,721	11,841
Tetrachloroethene	1.28 - 28.0	11	18.2	1	6	3.04	4.16
Toluene	1.33 - 11.0	11	36.4	2.90	310	30.7	92.6
Xylene[c]	2.64 - 28.0	11	9.09	2.90	2.90	3.66	3.77
Radionuclides (pCi/g)[d]							
Americium-241		152	N/A	-0.0288	0.802	0.0366	0.0763
Cesium-137		1	N/A	1	1	1	N/A
Gross Alpha		95	N/A	1.47	113	19.0	17.6
Gross Beta		99	N/A	6.60	305	36.2	47.4

Table 1.5
Summary of Detected Analytes in Surface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Neptunium-237		2	N/A	0.00222	0.00224	0.00223	1.06E-05
Plutonium-238		14	N/A	-0.00200	0.0253	0.00236	0.00671
Plutonium-239/240		175	N/A	-0.0126	5.01	0.147	0.421
Radium-226		4	N/A	0.813	1.09	0.962	0.115
Radium-228		4	N/A	1.57	2.29	1.80	0.336
Uranium-233/234		154	N/A	0.191	47.5	1.49	3.90
Uranium-235		154	N/A	-0.0230	2.24	0.0920	0.250
Uranium-238		154	N/A	0.283	209	3.54	18.2

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A - Not applicable.

Table 1.6
Summary of Detected Analytes in Surface Soil (PMJM Habitat)

Analyte	Range of Reported Detection Limits[a]	Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		34	100	1,950	22,000	11,924	4,724
Ammonia[c]		3	66.7	4.06	4.40	2.88	2.35
Antimony[c]		29	13.8	0.330	49.8	7.06	10.8
Arsenic		34	100	1.90	9.90	5.25	1.60
Barium		34	100	40.1	209	135	36.5
Beryllium		35	80	0.440	1.70	0.818	0.404
Boron		4	100	5.30	8.50	6.83	1.45
Cadmium		32	34.4	0.420	4.10	0.734	0.834
Calcium		34	100	1,960	27,000	6,523	5,412
Cesium		26	19.2	2	16.4	5.72	3.97
Chromium		34	100	2.60	26	15.1	5.52
Cobalt		34	88.2	2.40	12.4	7.87	2.55
Copper		34	100	5.10	112	26.4	25.5
Iron		34	100	4,700	23,400	15,750	4,233
Lead		35	100	12.8	40.2	27.5	8.03
Lithium		33	75.8	5.40	18.5	9.31	4.16
Magnesium		34	100	663	5,610	2,686	937
Manganese		34	100	134	829	319	141
Mercury		33	57.6	0.0270	0.370	0.0924	0.0918
Molybdenum		33	18.2	0.840	4.40	1.18	0.784
Nickel		33	90.9	5.70	26.3	13.6	5.03
Nitrate / Nitrite		3	100	1.62	3.63	2.80	1.05
Potassium		34	100	781	4,460	2,470	891
Selenium		33	39.4	0.220	1	0.277	0.204
Silica[c]		4	100	540	1,200	835	274
Silicon[c]		4	100	90.5	798	584	331
Silver		32	12.5	0.160	12.6	0.920	2.17
Sodium		34	70.6	52.6	403	93.5	66.1
Strontium		34	100	14	94	40.1	18.2
Thallium		34	35.3	0.210	0.960	0.243	0.187
Tin		34	17.6	1.60	66.9	10.3	16.1
Titanium[c]		4	100	290	410	343	51.2
Uranium		4	50	9	26	9.13	11.9
Vanadium[c]		34	100	9.90	53	33.6	10.5

Table 1.6
Summary of Detected Analytes in Surface Soil (PMJM Habitat)

Analyte	Range of Reported Detection Limits[a]	Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Zinc		34	100	21.2	199	73.4	41.1
Organics (ug/kg)							
Acenaphthene		21	19.0	56	210	353	236
Anthracene		25	20	92	280	242	93.4
Aroclor-1254		19	26.3	560	3,900	640	1,063
Aroclor-1260		19	5.26	48	48	143	85.5
Benzo(a)anthracene		16	50	64	780	272	182
Benzo(a)pyrene		21	33.3	73	790	306	238
Benzo(b)fluoranthene		18	44.4	110	1,300	306	299
Benzo(g,h,i)perylene		24	8.33	69	83	189	155
Benzo(k)fluoranthene		16	18.8	59	150	269	128
bis(2-ethylhexyl)phthalate		16	37.5	66	210	211	127
Butylbenzylphthalate		16	6.25	220	220	284	110
Chrysene		22	36.4	68	820	215	192
Di-n-butylphthalate		16	6.25	40	40	274	125
Fluoranthene		20	60.0	110	2,100	407	482
Fluorene		24	16.7	39	160	183	127
Indeno(1,2,3-cd)pyrene		21	19.0	52	140	200	160
Phenanthrene		25	48	79	1,300	323	272
Pyrene		22	54.5	59	1,600	314	362
Radionuclides (pCi/g)[d]							
Americium-241		42	N/A	6.00E-04	0.139	0.0290	0.0300
Gross Alpha		33	N/A	2.41	113	25.4	26.5
Gross Beta		36	N/A	6.60	305	52.9	74.8
Plutonium-239/240		45	N/A	0.00230	1.31	0.121	0.232
Uranium-233/234		40	N/A	0.408	47.5	2.58	7.31
Uranium-235		40	N/A	-0.0230	2.24	0.117	0.348
Uranium-238		40	N/A	0.394	209	6.99	32.8

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A - Not applicable.

Table 1.7
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Inorganics (mg/kg)							
Aluminum		252	100	1,740	32,800	12,169	6,017
Antimony	0.290 - 29.3	229	21.0	0.340	149	7.00	11.9
Arsenic	0.230 - 0.230	252	99.6	0.470	24.3	4.68	2.82
Barium		252	100	21.5	1,610	160	141
Beryllium	0.100 - 1.90	257	76.3	0.280	446	3.61	29.3
Boron	1.90 - 1.90	8	87.5	2.10	4.70	3.29	1.29
Cadmium	0.068 - 1.20	246	16.7	0.0750	71	2.11	8.62
Calcium	895 - 895	252	99.6	1,140	60,000	7,360	7,314
Cesium	2.50 - 294	223	8.52	1.90	29.6	6.60	12.1
Chromium	1.10 - 1.10	252	99.6	4.30	8,310	53.0	523
Cobalt	2.80 - 9.70	252	96.4	1.90	701	11.7	44.0
Copper	4.60 - 20.9	252	96.8	3.60	8,850	140	761
Iron		252	100	2,340	107,000	18,415	14,247
Lead		257	100	2.90	5,200	60.9	344
Lithium	2.90 - 18.4	249	87.6	1.40	29	8.70	5.34
Magnesium		252	100	392	9,480	3,102	1,484
Manganese		252	100	14.3	2,150	279	253
Mercury	0.015 - 0.190	228	28.5	0.00620	1.40	0.0901	0.167
Molybdenum	0.310 - 5.20	251	23.5	0.320	470	5.06	33.2
Nickel	4.60 - 24.3	252	96.4	2.70	4,750	40.3	299
Phosphorus		1	100	975	975	975	N/A
Potassium	622 - 2,140	251	91.6	327	4,190	1,428	728
Selenium	0.180 - 1.90	247	13.8	0.150	80.8	0.569	5.15
Silica[c]		8	100	550	850	703	105
Silicon		17	100	22.7	1,120	392	276
Silver	0.089 - 3.10	234	17.9	0.230	311	7.14	31.9
Sodium	38.6 - 226	251	93.2	42	3,360	331	397
Strontium	54.2 - 54.2	252	99.6	6.40	170	46.1	26.3
Thallium	0.200 - 29.3	251	27.9	0.210	6.30	0.304	1.000
Tin	0.970 - 41.2	251	8.76	1.50	579	8.73	38.7
Titanium		9	100	34	283	155	78.4
Total Petroleum Hydrocarbons	18.0 - 37.0	29	6.90	21	62	12.7	9.93
Uranium	1.50 - 1.70	8	12.5	5.50	5.50	1.38	1.66
Vanadium		252	100	9.80	74.4	32.3	12.3

Table 1.7
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Zinc		252	100	7.60	6,920	137	510
Organics (ug/kg)							
1,1,1-Trichloroethane	1.13 - 31.0	196	0.510	2	2	3.09	1.75
1,2,4-Trichlorobenzene	1.00 - 7,700	111	0.901	60	60	270	361
1,2-Dichlorobenzene	0.755 - 7,700	111	0.901	30	30	270	361
1,3-Dichlorobenzene	1.05 - 7,700	111	0.901	20	20	270	361
1,4-Dichlorobenzene[c]	1.14 - 7,700	111	0.901	10	10	270	361
1,2,3,4,6,7,8-HpCDF		1	100	0.00480	0.00480	0.00480	N/A
1,2,3,4,7,8,9-HpCDF[c]		1	100	6.00E-04	6.00E-04	6.00E-04	N/A
1,2,3,4,7,8-HxCDD		1	100	3.40E-04	3.40E-04	3.40E-04	N/A
1,2,3,4,7,8-HxCDF[c]		1	100	0.00290	0.00290	0.00290	N/A
1,2,3,6,7,8-HxCDD		1	100	6.10E-04	6.10E-04	6.10E-04	N/A
1,2,3,6,7,8-HxCDF[c]		1	100	0.00120	0.00120	0.00120	N/A
1,2,3,7,8,9-HxCDD[c]		1	100	8.40E-04	8.40E-04	8.40E-04	N/A
1,2,3,7,8,9-HxCDF[c]		1	100	1.40E-04	1.40E-04	1.40E-04	N/A
12,3,7,8-PeCDF[c]		1	100	9.30E-04	9.30E-04	9.30E-04	N/A
2,3,4,6,7,8-HxCDF[c]		1	100	0.00120	0.00120	0.00120	N/A
2,3,4,7,8-PeCDF		1	100	0.00160	0.00160	0.00160	N/A
2,3,7,8-TCDD[c]		1	100	2.40E-04	2.40E-04	2.40E-04	N/A
2,3,7,8-TCDF		1	100	0.00110	0.00110	0.00110	N/A
2-Butanone	10.0 - 62.0	175	2.86	2	8	6.33	3.58
2-Chlorophenol	340 - 7,700	107	0.935	10	10	295	361
2-Methylnaphthalene	340 - 870	107	8.41	10	15,000	399	1,428
3,3'-Dichlorobenzidine	690 - 15,000	106	0.943	160	160	585	705
4-Chloro-3-methylphenol	340 - 7,700	107	0.935	10	10	309	372
4-Methyl-2-pentanone	6.96 - 62.0	189	0.529	2	2	6.21	3.42
Acenaphthene	350 - 1,000	107	13.1	56	31,000	570	2,974
Acenaphthylene	340 - 7,700	107	0.935	47	47	291	361
Acetone	10.0 - 150	181	17.1	2	330	19.1	27.1
alpha-BHC	4.70 - 21.0	99	1.01	15	15	6.29	2.54
Anthracene	350 - 1,000	107	13.1	61	46,000	742	4,423
Aroclor-1254	350 - 1,000	98	10.2	210	960	172	162
Aroclor-1260	350 - 870	99	3.03	450	1,300	147	152

Table 1.7
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Benzo(a)anthracene	350 - 1,000	107	16.8	44	48,000	813	4,632
Benzo(a)pyrene	340 - 1,000	107	15.9	10	43,000	754	4,146
Benzo(b)fluoranthene	350 - 1,000	105	17.1	53	48,000	822	4,670
Benzo(g,h,i)perylene	1,700 - 37,000	107	12.1	86	19,000	481	1,821
Benzo(k)fluoranthene	340 - 7,700	105	15.2	48	19,000	493	1,859
Benzoic Acid	1.14 - 31.0	102	17.6	42	260	1,269	1,835
bis(2-ethylhexyl)phthalate	340 - 7,700	107	18.7	42	540	281	369
Bromoform	350 - 1,000	193	0.518	2	2	3.08	1.76
Butylbenzylphthalate	1.09 - 1.45	107	4.67	50	1,400	322	391
Chrysene	340 - 7,700	107	16.8	52	53,000	868	5,117
cis-1,2-Dichloroethene	340 - 870	8	37.5	1.48	10.1	2.11	3.27
Dibenz(a,h)anthracene	340 - 7,700	107	7.48	53	890	305	365
Dibenzofuran	340 - 7,700	107	9.35	10	20,000	449	1,911
Diethylphthalate	340 - 7,700	107	1.87	40	250	296	360
Di-n-butylphthalate	350 - 870	107	10.3	88	2,700	318	431
Di-n-octylphthalate	350 - 1,000	107	1.87	39	50	297	362
Fluoranthene	4.70 - 21.0	107	21.5	10	160,000	2,052	15,467
Fluorene		107	13.1	42	35,000	612	3,360
Heptachlor epoxide	340 - 7,700	99	1.01	11	11	6.25	2.43
Heptachlorodibenzo-p-dioxin	340 - 1,000	1	100	0.00960	0.00960	0.00960	
Hexachlorobenzene	340 - 7,700	107	0.935	30	30	295	361
Indeno(1,2,3-cd)pyrene	1.15 - 45.0	107	10.3	98	22,000	519	2,109
Isophorone	0.847 - 870	107	0.935	82	82	299	361
Methylene Chloride		198	19.2	1	67	5.27	7.26
Naphthalene		111	8.11	30	61,000	807	5,767
OCDD	94.0 - 420	1	100	0.0750	0.0750	0.0750	
OCDF	94.0 - 420	1	100	0.00620	0.00620	0.00620	
Pentachlorodibenzo-p-dioxin[c]		1	100	3.50E-04	3.50E-04	3.50E-04	
Pentachlorophenol	1,700 - 37,000	107	0.935	160	160	1,430	1,733
Phenanthrene	350 - 870	107	21.5	20	220,000	2,589	21,243
Phenol	340 - 7,700	107	3.74	30	140	292	362
Pyrene	350 - 870	107	21.5	10	150,000	1,908	14,493
Tetrachloroethene	1.30 - 7.00	198	10.1	1	920	16.6	84.3
Toluene	1.36 - 64.0	198	51.5	1	420	31.3	61.0
Trichloroethene	0.680 - 7.00	198	6.57	1	440	6.69	33.3

Table 1.7
Summary of Detected Analytes in Subsurface Soil

Analyte	Range of Reported Detection Limits[a]	Total Number of Results	Detection Frequency (%)	Minimum Detected Concentration	Maximum Detected Concentration	Arithmetic Mean Concentration[b]	Standard Deviation[b]
Radionuclides (pCi/g)[d]							
Americium-241		236	N/A	-0.0170	2.97	0.0312	0.200
Cesium-134		3	N/A	-0.103	-0.0657	-0.0839	0.0187
Cesium-137		22	N/A	-0.0527	0.0720	0.0123	0.0297
Gross Alpha		245	N/A	3.58	742	33.3	75.0
Gross Beta		244	N/A	7.50	1,580	54.8	142
Plutonium-238		25	N/A	-0.00340	9.84	0.419	1.96
Plutonium-239/240		243	N/A	-0.00710	5.16	0.0838	0.414
Radium-226		17	N/A	0.728	2.09	0.999	0.318
Radium-228		26	N/A	0	2.79	1.55	0.577
Strontium-89/90		42	N/A	-0.0144	0.969	0.254	0.255
Uranium-233/234		244	N/A	0.0475	288	6.54	28.6
Uranium-235		244	N/A	-0.0193	37.7	0.713	3.91
Uranium-238		244	N/A	0.238	1,160	24.6	136

[a] Values in this column are reported results for nondetects (i.e., U-qualified results).

[b] For inorganics and organics, statistics are computed using one-half the reported value for nondetects.

[c] All detections are "J" qualified, signifying that the reported result is below the detection limit, but above the instrument detection limit.

[d] All radionuclide values are considered detects.

N/A - Not available or not applicable.

Table 1.8
Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
Surface Soil/Surface Sediment (ug/kg)							
BI31-008	03F0329-006	1,2,3,4,6,7,8-HpCDF	0.00920	Yes	V	0.0100	9.20E-05
BI31-008	03F0329-006	1,2,3,4,7,8-HxCDD	5.00E-04	Yes	JB	0.100	5.00E-05
BI31-008	03F0329-006	1,2,3,4,7,8-HxCDF	0.00520	Yes	V	0.100	5.20E-04
BI31-008	03F0329-006	1,2,3,4,7,8,9-HpCDF	0.00120	Yes	JB	0.0100	1.20E-05
BI31-008	03F0329-006	1,2,3,6,7,8-HxCDD	0.00110	Yes	JB	0.100	1.10E-04
BI31-008	03F0329-006	1,2,3,6,7,8-HxCDF	0.00180	Yes	JB	0.100	1.80E-04
BI31-008	03F0329-006	1,2,3,7,8-PeCDF	0.00180	Yes	JB	0.0500	9.00E-05
BI31-008	03F0329-006	1,2,3,7,8,9-HxCDD	0.00120	Yes	JB	0.100	1.20E-04
BI31-008	03F0329-006	1,2,3,7,8,9-HxCDF	1.90E-04	Yes	JB	0.100	1.90E-05
BI31-008	03F0329-006	2,3,4,6,7,8-HxCDF	0.00200	Yes	JB	0.100	2.00E-04
BI31-008	03F0329-006	2,3,4,7,8-PeCDF	0.00330	Yes	JB	0.500	0.00165
BI31-008	03F0329-006	2,3,7,8-TCDD	3.80E-04	Yes	V	1	3.80E-04
BI31-008	03F0329-006	2,3,7,8-TCDF	0.00290	Yes	V	0.100	2.90E-04
BI31-008	03F0329-006	Heptachlorodibenzo-p-dioxin	0.0170	Yes	V	0.0100	1.70E-04
BI31-008	03F0329-006	OCDD	0.130	Yes	V	1.00E-04	1.30E-05
BI31-008	03F0329-006	OCDF	0.0120	Yes	V	1.00E-04	1.20E-06
BI31-008	03F0329-006	Pentachlorodibenzo-p-dioxin	4.00E-04	Yes	JB	1	4.00E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-006:							**0.00430**
BI31-009-01	03F0329-004	1,2,3,4,6,7,8-HpCDF	0.00260	Yes	V	0.0100	2.60E-05
BI31-009-01	03F0329-004	1,2,3,4,7,8-HxCDD	1.70E-04	No	V	0.100	0
BI31-009-01	03F0329-004	1,2,3,4,7,8-HxCDF	0.00120	Yes	V	0.100	1.20E-04
BI31-009-01	03F0329-004	1,2,3,4,7,8,9-HpCDF	4.40E-04	Yes	JB	0.0100	4.40E-06
BI31-009-01	03F0329-004	1,2,3,6,7,8-HxCDD	4.10E-04	Yes	JB	0.100	4.10E-05
BI31-009-01	03F0329-004	1,2,3,6,7,8-HxCDF	4.40E-04	Yes	JB	0.100	4.40E-05
BI31-009-01	03F0329-004	1,2,3,7,8-PeCDF	2.90E-04	Yes	JB	0.0500	1.45E-05
BI31-009-01	03F0329-004	1,2,3,7,8,9-HxCDD	3.90E-04	Yes	JB	0.100	3.90E-05
BI31-009-01	03F0329-004	1,2,3,7,8,9-HxCDF	1.10E-04	No	V	0.100	0
BI31-009-01	03F0329-004	2,3,4,6,7,8-HxCDF	5.50E-04	Yes	JB	0.100	5.50E-05
BI31-009-01	03F0329-004	2,3,4,7,8-PeCDF	6.40E-04	Yes	JB	0.500	3.20E-04
BI31-009-01	03F0329-004	2,3,7,8-TCDD	2.90E-04	No	V	1	0
BI31-009-01	03F0329-004	2,3,7,8-TCDF	8.70E-04	Yes	V	0.100	8.70E-05
BI31-009-01	03F0329-004	Heptachlorodibenzo-p-dioxin	0.00680	Yes	V	0.0100	6.80E-05
BI31-009-01	03F0329-004	OCDD	0.0540	Yes	V	1.00E-04	5.40E-06
BI31-009-01	03F0329-004	OCDF	0.00450	Yes	V	1.00E-04	4.50E-07
BI31-009-01	03F0329-004	Pentachlorodibenzo-p-dioxin	1.40E-04	No	V	1	0

Table 1.8
Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-004:							**8.25E-04**
BI31-010	03F0329-002	1,2,3,4,6,7,8-HpCDF	0.0510	Yes	V	0.0100	5.10E-04
BI31-010	03F0329-002	1,2,3,4,7,8-HxCDD	0.00120	Yes	JB	0.100	1.20E-04
BI31-010	03F0329-002	1,2,3,4,7,8-HxCDF	0.0270	Yes	V	0.100	0.00270
BI31-010	03F0329-002	1,2,3,4,7,8,9-HpCDF	0.00300	Yes	V	0.0100	3.00E-05
BI31-010	03F0329-002	1,2,3,6,7,8-HxCDD	0.00190	Yes	V	0.100	1.90E-04
BI31-010	03F0329-002	1,2,3,6,7,8-HxCDF	0.0100	Yes	V	0.100	0.00100
BI31-010	03F0329-002	1,2,3,7,8-PeCDF	0.00540	Yes	V	0.0500	2.70E-04
BI31-010	03F0329-002	1,2,3,7,8,9-HxCDD	0.00270	Yes	V	0.100	2.70E-04
BI31-010	03F0329-002	1,2,3,7,8,9-HxCDF	4.70E-04	Yes	JB	0.100	4.70E-05
BI31-010	03F0329-002	2,3,4,6,7,8-HxCDF	0.00810	Yes	V	0.100	8.10E-04
BI31-010	03F0329-002	2,3,4,7,8-PeCDF	0.00760	Yes	V	0.500	0.00380
BI31-010	03F0329-002	2,3,7,8-TCDD	2.30E-04	Yes	V	1	2.30E-04
BI31-010	03F0329-002	2,3,7,8-TCDF	0.00460	Yes	V	0.100	4.60E-04
BI31-010	03F0329-002	Heptachlorodibenzo-p-dioxin	0.0160	Yes	V	0.0100	1.60E-04
BI31-010	03F0329-002	OCDD	0.0900	Yes	V	1.00E-04	9.00E-06
BI31-010	03F0329-002	OCDF	0.0200	Yes	V	1.00E-04	2.00E-06
BI31-010	03F0329-002	Pentachlorodibenzo-p-dioxin	7.60E-04	Yes	JB	1	7.60E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-002:							**0.0114**
BI31-011	03F0329-003	1,2,3,4,6,7,8-HpCDF	0.240	Yes	V	0.0100	0.00240
BI31-011	03F0329-003	1,2,3,4,7,8-HxCDD	0.00730	Yes	V	0.100	7.30E-04
BI31-011	03F0329-003	1,2,3,4,7,8-HxCDF	0.140	Yes	V	0.100	0.0140
BI31-011	03F0329-003	1,2,3,4,7,8,9-HpCDF	0.0250	Yes	V	0.0100	2.50E-04
BI31-011	03F0329-003	1,2,3,6,7,8-HxCDD	0.0120	Yes	V	0.100	0.00120
BI31-011	03F0329-003	1,2,3,6,7,8-HxCDF	0.0430	Yes	V	0.100	0.00430
BI31-011	03F0329-003	1,2,3,7,8-PeCDF	0.0280	Yes	V	0.0500	0.00140
BI31-011	03F0329-003	1,2,3,7,8,9-HxCDD	0.0210	Yes	V	0.100	0.00210
BI31-011	03F0329-003	1,2,3,7,8,9-HxCDF	0.00250	Yes	V	0.100	2.50E-04
BI31-011	03F0329-003	2,3,4,6,7,8-HxCDF	0.0630	Yes	V	0.100	0.00630
BI31-011	03F0329-003	2,3,4,7,8-PeCDF	0.0560	Yes	V	0.500	0.0280
BI31-011	03F0329-003	2,3,7,8-TCDD	0.00190	Yes	V	1	0.00190
BI31-011	03F0329-003	2,3,7,8-TCDF	0.0280	Yes	V	0.100	0.00280
BI31-011	03F0329-003	Heptachlorodibenzo-p-dioxin	0.110	Yes	V	0.0100	0.00110
BI31-011	03F0329-003	OCDD	0.390	Yes	V	1.00E-04	3.90E-05
BI31-011	03F0329-003	OCDF	0.140	Yes	V	1.00E-04	1.40E-05
BI31-011	03F0329-003	Pentachlorodibenzo-p-dioxin	0.00710	Yes	V	1	0.00710

Table 1.8

Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-003:							**0.0739**
BI31-012	03F2087-001	1,2,3,4,6,7,8-HpCDF	0.00610	Yes	V	0.0100	6.10E-05
BI31-012	03F2087-001	1,2,3,4,7,8-HxCDD	3.40E-04	Yes	V	0.100	3.40E-05
BI31-012	03F2087-001	1,2,3,4,7,8-HxCDF	0.00270	Yes	V	0.100	2.70E-04
BI31-012	03F2087-001	1,2,3,4,7,8,9-HpCDF	8.80E-04	Yes	V	0.0100	8.80E-06
BI31-012	03F2087-001	1,2,3,6,7,8-HxCDD	0.00100	Yes	V	0.100	1.00E-04
BI31-012	03F2087-001	1,2,3,6,7,8-HxCDF	9.20E-04	Yes	V	0.100	9.20E-05
BI31-012	03F2087-001	1,2,3,7,8-PeCDF	6.20E-04	Yes	V	0.0500	3.10E-05
BI31-012	03F2087-001	1,2,3,7,8,9-HxCDD	0.00100	Yes	V	0.100	1.00E-04
BI31-012	03F2087-001	1,2,3,7,8,9-HxCDF	1.40E-04	No	V	0.100	0
BI31-012	03F2087-001	2,3,4,6,7,8-HxCDF	0.00120	Yes	V	0.100	1.20E-04
BI31-012	03F2087-001	2,3,4,7,8-PeCDF	0.00100	Yes	V	0.500	5.00E-04
BI31-012	03F2087-001	2,3,7,8-TCDD	5.50E-04	Yes	V	1	5.50E-04
BI31-012	03F2087-001	2,3,7,8-TCDF	0.00100	Yes	V	0.100	1.00E-04
BI31-012	03F2087-001	Heptachlorodibenzo-p-dioxin	0.0150	Yes	V	0.0100	1.50E-04
BI31-012	03F2087-001	OCDD	0.130	Yes	V	1.00E-04	1.30E-05
BI31-012	03F2087-001	OCDF	0.0110	Yes	V	1.00E-04	1.10E-06
BI31-012	03F2087-001	Pentachlorodibenzo-p-dioxin	3.20E-04	Yes	V	1	3.20E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-001:							**0.00245**
BI31-013	03F2087-002	1,2,3,4,6,7,8-HpCDF	0.0160	Yes	V	0.0100	1.60E-04
BI31-013	03F2087-002	1,2,3,4,7,8-HxCDD	5.90E-04	Yes	V	0.100	5.90E-05
BI31-013	03F2087-002	1,2,3,4,7,8-HxCDF	0.00850	Yes	V	0.100	8.50E-04
BI31-013	03F2087-002	1,2,3,4,7,8,9-HpCDF	0.00140	Yes	V	0.0100	1.40E-05
BI31-013	03F2087-002	1,2,3,6,7,8-HxCDD	0.00120	Yes	V	0.100	1.20E-04
BI31-013	03F2087-002	1,2,3,6,7,8-HxCDF	0.00330	Yes	V	0.100	3.30E-04
BI31-013	03F2087-002	1,2,3,7,8-PeCDF	0.00220	Yes	V	0.0500	1.10E-04
BI31-013	03F2087-002	1,2,3,7,8,9-HxCDD	0.00160	Yes	V	0.100	1.60E-04
BI31-013	03F2087-002	1,2,3,7,8,9-HxCDF	2.90E-04	Yes	V	0.100	2.90E-05
BI31-013	03F2087-002	2,3,4,6,7,8-HxCDF	0.00400	Yes	V	0.100	4.00E-04
BI31-013	03F2087-002	2,3,4,7,8-PeCDF	0.00370	Yes	V	0.500	0.00185
BI31-013	03F2087-002	2,3,7,8-TCDD	6.10E-04	Yes	V	1	6.10E-04
BI31-013	03F2087-002	2,3,7,8-TCDF	0.00220	Yes	V	0.100	2.20E-04
BI31-013	03F2087-002	Heptachlorodibenzo-p-dioxin	0.0150	Yes	V	0.0100	1.50E-04
BI31-013	03F2087-002	OCDD	0.0850	Yes	V	1.00E-04	8.50E-06
BI31-013	03F2087-002	OCDF	0.0120	Yes	V	1.00E-04	1.20E-06
BI31-013	03F2087-002	Pentachlorodibenzo-p-dioxin	5.60E-04	Yes	V	1	5.60E-04

Table 1.8
Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-002:							**0.00563**
BI31-015	04F0058-001	1,2,3,4,6,7,8-HpCDF	0.00264	No	V	0.0100	0
BI31-015	04F0058-001	1,2,3,4,7,8-HxCDD	0.00264	No	V	0.100	0
BI31-015	04F0058-001	1,2,3,4,7,8-HxCDF	0.00264	No	V	0.100	0
BI31-015	04F0058-001	1,2,3,4,7,8,9-HpCDF	0.00264	No	V	0.0100	0
BI31-015	04F0058-001	1,2,3,6,7,8-HxCDD	0.00264	No	V	0.100	0
BI31-015	04F0058-001	1,2,3,6,7,8-HxCDF	0.00264	No	V	0.100	0
BI31-015	04F0058-001	1,2,3,7,8-PeCDF	0.00264	No	V	0.0500	0
BI31-015	04F0058-001	1,2,3,7,8,9-HxCDD	0.00264	No	V	0.100	0
BI31-015	04F0058-001	1,2,3,7,8,9-HxCDF	0.00264	No	V	0.100	0
BI31-015	04F0058-001	2,3,4,6,7,8-HxCDF	0.00264	No	V	0.100	0
BI31-015	04F0058-001	2,3,4,7,8-PeCDF	0.00264	No	V	0.500	0
BI31-015	04F0058-001	2,3,7,8-TCDD	0.00106	No	V	1	0
BI31-015	04F0058-001	2,3,7,8-TCDF	0.00106	No	V	0.100	0
BI31-015	04F0058-001	Heptachlorodibenzo-p-dioxin	0.00264	No	V	0.0100	0
BI31-015	04F0058-001	OCDD	4.15E-04	Yes	JB	1.00E-04	4.15E-08
BI31-015	04F0058-001	OCDF	7.19E-05	Yes	V	1.00E-04	7.19E-09
BI31-015	04F0058-001	Pentachlorodibenzo-p-dioxin	0.00264	No	V	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F0058-001:							**4.87E-08**
BI31-016	04F0058-002	1,2,3,4,6,7,8-HpCDF	2.35E-04	Yes	V	0.0100	2.35E-06
BI31-016	04F0058-002	1,2,3,4,7,8-HxCDD	0.00269	No	V	0.100	0
BI31-016	04F0058-002	1,2,3,4,7,8-HxCDF	0.00269	No	V	0.100	0
BI31-016	04F0058-002	1,2,3,4,7,8,9-HpCDF	0.00269	No	V	0.0100	0
BI31-016	04F0058-002	1,2,3,6,7,8-HxCDD	0.00269	No	V	0.100	0
BI31-016	04F0058-002	1,2,3,6,7,8-HxCDF	0.00269	No	V	0.100	0
BI31-016	04F0058-002	1,2,3,7,8-PeCDF	0.00269	No	V	0.0500	0
BI31-016	04F0058-002	1,2,3,7,8,9-HxCDD	2.20E-04	Yes	V	0.100	2.20E-05
BI31-016	04F0058-002	1,2,3,7,8,9-HxCDF	0.00269	No	V	0.100	0
BI31-016	04F0058-002	2,3,4,6,7,8-HxCDF	0.00269	No	V	0.100	0
BI31-016	04F0058-002	2,3,4,7,8-PeCDF	0.00269	No	V	0.500	0
BI31-016	04F0058-002	2,3,7,8-TCDD	2.59E-05	Yes	V	1	2.59E-05
BI31-016	04F0058-002	2,3,7,8-TCDF	0.00108	No	V	0.100	0
BI31-016	04F0058-002	Heptachlorodibenzo-p-dioxin	2.48E-04	Yes	V	0.0100	2.48E-06
BI31-016	04F0058-002	OCDD	0.00208	Yes	JB	1.00E-04	2.08E-07
BI31-016	04F0058-002	OCDF	3.58E-04	Yes	V	1.00E-04	3.58E-08
BI31-016	04F0058-002	Pentachlorodibenzo-p-dioxin	0.00269	No	V	1	0

Table 1.8
Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F0058-002:							**5.30E-05**
BJ31-005	03F2087-004	1,2,3,4,6,7,8-HpCDF	0.00990	Yes	V	0.0100	9.90E-05
BJ31-005	03F2087-004	1,2,3,4,7,8-HxCDD	7.20E-04	Yes	V	0.100	7.20E-05
BJ31-005	03F2087-004	1,2,3,4,7,8-HxCDF	0.00480	Yes	V	0.100	4.80E-04
BJ31-005	03F2087-004	1,2,3,4,7,8,9-HpCDF	7.10E-04	Yes	V	0.0100	7.10E-06
BJ31-005	03F2087-004	1,2,3,6,7,8-HxCDD	0.00140	Yes	V	0.100	1.40E-04
BJ31-005	03F2087-004	1,2,3,6,7,8-HxCDF	0.00180	Yes	V	0.100	1.80E-04
BJ31-005	03F2087-004	1,2,3,7,8-PeCDF	0.00110	Yes	V	0.0500	5.50E-05
BJ31-005	03F2087-004	1,2,3,7,8,9-HxCDD	0.00120	Yes	V	0.100	1.20E-04
BJ31-005	03F2087-004	1,2,3,7,8,9-HxCDF	2.60E-04	No	V	0.100	0
BJ31-005	03F2087-004	2,3,4,6,7,8-HxCDF	0.00220	Yes	V	0.100	2.20E-04
BJ31-005	03F2087-004	2,3,4,7,8-PeCDF	0.00170	Yes	V	0.500	8.50E-04
BJ31-005	03F2087-004	2,3,7,8-TCDD	2.80E-04	Yes	V	1	2.80E-04
BJ31-005	03F2087-004	2,3,7,8-TCDF	0.00120	Yes	V	0.100	1.20E-04
BJ31-005	03F2087-004	Heptachlorodibenzo-p-dioxin	0.0200	Yes	V	0.0100	2.00E-04
BJ31-005	03F2087-004	OCDD	0.170	Yes	J	1.00E-04	1.70E-05
BJ31-005	03F2087-004	OCDF	0.0110	Yes	V	1.00E-04	1.10E-06
BJ31-005	03F2087-004	Pentachlorodibenzo-p-dioxin	4.50E-04	Yes	V	1	4.50E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-004:							**0.00329**
BJ31-006	03F2087-005	1,2,3,4,6,7,8-HpCDF	0.0130	Yes	V	0.0100	1.30E-04
BJ31-006	03F2087-005	1,2,3,4,7,8-HxCDD	5.50E-04	Yes	V	0.100	5.50E-05
BJ31-006	03F2087-005	1,2,3,4,7,8-HxCDF	0.00540	Yes	V	0.100	5.40E-04
BJ31-006	03F2087-005	1,2,3,4,7,8,9-HpCDF	0.00130	Yes	V	0.0100	1.30E-05
BJ31-006	03F2087-005	1,2,3,6,7,8-HxCDD	0.00160	Yes	V	0.100	1.60E-04
BJ31-006	03F2087-005	1,2,3,6,7,8-HxCDF	0.00210	Yes	V	0.100	2.10E-04
BJ31-006	03F2087-005	1,2,3,7,8-PeCDF	0.00130	Yes	V	0.0500	6.50E-05
BJ31-006	03F2087-005	1,2,3,7,8,9-HxCDD	0.00120	Yes	V	0.100	1.20E-04
BJ31-006	03F2087-005	1,2,3,7,8,9-HxCDF	3.60E-04	No	V	0.100	0
BJ31-006	03F2087-005	2,3,4,6,7,8-HxCDF	0.00250	Yes	V	0.100	2.50E-04
BJ31-006	03F2087-005	2,3,4,7,8-PeCDF	0.00200	Yes	V	0.500	0.00100
BJ31-006	03F2087-005	2,3,7,8-TCDD	2.20E-04	No	V	1	0
BJ31-006	03F2087-005	2,3,7,8-TCDF	0.00130	Yes	V	0.100	1.30E-04
BJ31-006	03F2087-005	Heptachlorodibenzo-p-dioxin	0.0200	Yes	V	0.0100	2.00E-04
BJ31-006	03F2087-005	OCDD	0.150	Yes	J	1.00E-04	1.50E-05
BJ31-006	03F2087-005	OCDF	0.0120	Yes	V	1.00E-04	1.20E-06
BJ31-006	03F2087-005	Pentachlorodibenzo-p-dioxin	6.20E-04	Yes	V	1	6.20E-04

Table 1.8

Toxicity Equivalence Calculation for Dioxins/Furans - Human Health Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	TEF [a]	TEQ Concentration[b]
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-005:							**0.00351**
2,3,7,8-TCDD TEQ Concentration used in Surface Soil/Surface Sediment PRG Screen[c]:							**0.0739**
Subsurface Soil/Subsurface Sediment (ug/kg)							
BI31-009	03F0329-005	1,2,3,4,6,7,8-HpCDF	0.00480	Yes	V	0.0100	4.80E-05
BI31-009	03F0329-005	1,2,3,4,7,8-HxCDD	3.40E-04	Yes	JB	0.100	3.40E-05
BI31-009	03F0329-005	1,2,3,4,7,8-HxCDF	0.00290	Yes	V	0.100	2.90E-04
BI31-009	03F0329-005	1,2,3,4,7,8,9-HpCDF	6.00E-04	Yes	JB	0.0100	6.00E-06
BI31-009	03F0329-005	1,2,3,6,7,8-HxCDD	6.10E-04	Yes	JB	0.100	6.10E-05
BI31-009	03F0329-005	1,2,3,6,7,8-HxCDF	0.00120	Yes	JB	0.100	1.20E-04
BI31-009	03F0329-005	1,2,3,7,8-PeCDF	9.30E-04	Yes	JB	0.0500	4.65E-05
BI31-009	03F0329-005	1,2,3,7,8,9-HxCDD	8.40E-04	Yes	JB	0.100	8.40E-05
BI31-009	03F0329-005	1,2,3,7,8,9-HxCDF	1.40E-04	Yes	JB	0.100	1.40E-05
BI31-009	03F0329-005	2,3,4,6,7,8-HxCDF	0.00120	Yes	JB	0.100	1.20E-04
BI31-009	03F0329-005	2,3,4,7,8-PeCDF	0.00160	Yes	JB	0.500	8.00E-04
BI31-009	03F0329-005	2,3,7,8-TCDD	2.40E-04	Yes	V	1	2.40E-04
BI31-009	03F0329-005	2,3,7,8-TCDF	0.00110	Yes	V	0.100	1.10E-04
BI31-009	03F0329-005	Heptachlorodibenzo-p-dioxin	0.00960	Yes	V	0.0100	9.60E-05
BI31-009	03F0329-005	OCDD	0.0750	Yes	V	1.00E-04	7.50E-06
BI31-009	03F0329-005	OCDF	0.00620	Yes	V	1.00E-04	6.20E-07
BI31-009	03F0329-005	Pentachlorodibenzo-p-dioxin	3.50E-04	Yes	JB	1	3.50E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-005:							**0.00243**
2,3,7,8-TCDD TEQ Concentration used in Subsurface Soil/Subsurface Sediment PRG Screen[c]:							**0.00243**

a : Toxicity Equivalency Factor (WHO, 1997).

b : TEQ (Toxicity Equivalence) concentration = Soil Concentration x TEF. For non-detects, the TEQ concentration equals zero.

[c] The 2,3,7,8-TCDD TEQ concentration used in the PRG screen is the maximum of all sampling locations for the medium.

Table 1.9

Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals		Birds	
						TEF [a]	TEQ Concentration[b]	TEF [a]	TEQ Concentration[b]
Surface Soil (ug/kg)									
BI31-008	03F0329-006	1,2,3,4,6,7,8-HpCDF	0.00920	Yes	V	0.0100	9.20E-05	0.0100	9.20E-05
BI31-008	03F0329-006	1,2,3,4,7,8,9-HpCDF	0.00120	Yes	JB	0.0100	1.20E-05	0.0100	1.20E-05
BI31-008	03F0329-006	1,2,3,4,7,8-HxCDD	5.00E-04	Yes	JB	0.100	5.00E-05	0.0500	2.50E-05
BI31-008	03F0329-006	1,2,3,4,7,8-HxCDF	0.00520	Yes	V	0.100	5.20E-04	0.100	5.20E-04
BI31-008	03F0329-006	1,2,3,6,7,8-HxCDD	0.00110	Yes	JB	0.100	1.10E-04	0.0100	1.10E-05
BI31-008	03F0329-006	1,2,3,6,7,8-HxCDF	0.00180	Yes	JB	0.100	1.80E-04	0.100	1.80E-04
BI31-008	03F0329-006	1,2,3,7,8,9-HxCDD	0.00120	Yes	JB	0.100	1.20E-04	0.100	1.20E-04
BI31-008	03F0329-006	1,2,3,7,8,9-HxCDF	1.90E-04	Yes	JB	0.100	1.90E-05	0.100	1.90E-05
BI31-008	03F0329-006	1,2,3,7,8-PeCDF	0.00180	Yes	JB	0.0500	9.00E-05	0.100	1.80E-04
BI31-008	03F0329-006	2,3,4,6,7,8-HxCDF	0.00200	Yes	JB	0.100	2.00E-04	0.100	2.00E-04
BI31-008	03F0329-006	2,3,4,7,8-PeCDF	0.00330	Yes	JB	0.500	0.00165	1	0.00330
BI31-008	03F0329-006	2,3,7,8-TCDD	3.80E-04	Yes	V	1	3.80E-04	1	3.80E-04
BI31-008	03F0329-006	2,3,7,8-TCDF	0.00290	Yes	V	0.100	2.90E-04	1	0.00290
BI31-008	03F0329-006	Heptachlorodibenzo-p-dioxin	0.0170	Yes	V	0.0100	1.70E-04	0.00100	1.70E-05
BI31-008	03F0329-006	OCDD	0.130	Yes	V	1.00E-04	1.30E-05	1.00E-04	1.30E-05
BI31-008	03F0329-006	OCDF	0.0120	Yes	V	1.00E-04	1.20E-06	1.00E-04	1.20E-06
BI31-008	03F0329-006	Pentachlorodibenzo-p-dioxin	4.00E-04	Yes	JB	1	4.00E-04	1	4.00E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-006:							**0.00430**		**0.00837**
BI31-009-01	03F0329-004	1,2,3,4,6,7,8-HpCDF	0.00260	Yes	V	0.0100	2.60E-05	0.0100	2.60E-05
BI31-009-01	03F0329-004	1,2,3,4,7,8,9-HpCDF	4.40E-04	Yes	JB	0.0100	4.40E-06	0.0100	4.40E-06
BI31-009-01	03F0329-004	1,2,3,4,7,8-HxCDD	1.70E-04	No	V	0.100	0	0.0500	0
BI31-009-01	03F0329-004	1,2,3,4,7,8-HxCDF	0.00120	Yes	V	0.100	1.20E-04	0.100	1.20E-04
BI31-009-01	03F0329-004	1,2,3,6,7,8-HxCDD	4.10E-04	Yes	JB	0.100	4.10E-05	0.0100	4.10E-06
BI31-009-01	03F0329-004	1,2,3,6,7,8-HxCDF	4.40E-04	Yes	JB	0.100	4.40E-05	0.100	4.40E-05
BI31-009-01	03F0329-004	1,2,3,7,8,9-HxCDD	3.90E-04	Yes	JB	0.100	3.90E-05	0.100	3.90E-05
BI31-009-01	03F0329-004	1,2,3,7,8,9-HxCDF	1.10E-04	No	V	0.100	0	0.100	0
BI31-009-01	03F0329-004	1,2,3,7,8-PeCDF	2.90E-04	Yes	JB	0.0500	1.45E-05	0.100	2.90E-05
BI31-009-01	03F0329-004	2,3,4,6,7,8-HxCDF	5.50E-04	Yes	JB	0.100	5.50E-05	0.100	5.50E-05
BI31-009-01	03F0329-004	2,3,4,7,8-PeCDF	6.40E-04	Yes	JB	0.500	3.20E-04	1	6.40E-04
BI31-009-01	03F0329-004	2,3,7,8-TCDD	2.90E-04	No	V	1	0	1	0
BI31-009-01	03F0329-004	2,3,7,8-TCDF	8.70E-04	Yes	V	0.100	8.70E-05	1	8.70E-04
BI31-009-01	03F0329-004	Heptachlorodibenzo-p-dioxin	0.00680	Yes	V	0.0100	6.80E-05	0.00100	6.80E-06
BI31-009-01	03F0329-004	OCDD	0.0540	Yes	V	1.00E-04	5.40E-06	1.00E-04	5.40E-06
BI31-009-01	03F0329-004	OCDF	0.00450	Yes	V	1.00E-04	4.50E-07	1.00E-04	4.50E-07

Table 1.9

Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals		Birds	
						TEF [a]	TEQ Concentration[b]	TEF [a]	TEQ Concentration[b]
BI31-009-01	03F0329-004	Pentachlorodibenzo-p-dioxin	1.40E-04	No	V	1	0	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-004:							**8.25E-04**		**0.00184**
BI31-010	03F0329-002	1,2,3,4,6,7,8-HpCDF	0.0510	Yes	V	0.0100	5.10E-04	0.0100	5.10E-04
BI31-010	03F0329-002	1,2,3,4,7,8,9-HpCDF	0.00300	Yes	V	0.0100	3.00E-05	0.0100	3.00E-05
BI31-010	03F0329-002	1,2,3,4,7,8-HxCDD	0.00120	Yes	JB	0.100	1.20E-04	0.0500	6.00E-05
BI31-010	03F0329-002	1,2,3,4,7,8-HxCDF	0.0270	Yes	V	0.100	0.00270	0.100	0.00270
BI31-010	03F0329-002	1,2,3,6,7,8-HxCDD	0.00190	Yes	V	0.100	1.90E-04	0.0100	1.90E-05
BI31-010	03F0329-002	1,2,3,6,7,8-HxCDF	0.0100	Yes	V	0.100	0.00100	0.100	0.00100
BI31-010	03F0329-002	1,2,3,7,8,9-HxCDD	0.00270	Yes	V	0.100	2.70E-04	0.100	2.70E-04
BI31-010	03F0329-002	1,2,3,7,8,9-HxCDF	4.70E-04	Yes	JB	0.100	4.70E-05	0.100	4.70E-05
BI31-010	03F0329-002	1,2,3,7,8-PeCDF	0.00540	Yes	V	0.0500	2.70E-04	0.100	5.40E-04
BI31-010	03F0329-002	2,3,4,6,7,8-HxCDF	0.00810	Yes	V	0.100	8.10E-04	0.100	8.10E-04
BI31-010	03F0329-002	2,3,4,7,8-PeCDF	0.00760	Yes	V	0.500	0.00380	1	0.00760
BI31-010	03F0329-002	2,3,7,8-TCDD	2.30E-04	Yes	V	1	2.30E-04	1	2.30E-04
BI31-010	03F0329-002	2,3,7,8-TCDF	0.00460	Yes	V	0.100	4.60E-04	1	0.00460
BI31-010	03F0329-002	Heptachlorodibenzo-p-dioxin	0.0160	Yes	V	0.0100	1.60E-04	0.00100	1.60E-05
BI31-010	03F0329-002	OCDD	0.0900	Yes	V	1.00E-04	9.00E-06	1.00E-04	9.00E-06
BI31-010	03F0329-002	OCDF	0.0200	Yes	V	1.00E-04	2.00E-06	1.00E-04	2.00E-06
BI31-010	03F0329-002	Pentachlorodibenzo-p-dioxin	7.60E-04	Yes	JB	1	7.60E-04	1	7.60E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-002:							**0.0114**		**0.0192**
BI31-011	03F0329-003	1,2,3,4,6,7,8-HpCDF	0.240	Yes	V	0.0100	0.00240	0.0100	0.00240
BI31-011	03F0329-003	1,2,3,4,7,8,9-HpCDF	0.0250	Yes	V	0.0100	2.50E-04	0.0100	2.50E-04
BI31-011	03F0329-003	1,2,3,4,7,8-HxCDD	0.00730	Yes	V	0.100	7.30E-04	0.0500	3.65E-04
BI31-011	03F0329-003	1,2,3,4,7,8-HxCDF	0.140	Yes	V	0.100	0.0140	0.100	0.0140
BI31-011	03F0329-003	1,2,3,6,7,8-HxCDD	0.0120	Yes	V	0.100	0.00120	0.0100	1.20E-04
BI31-011	03F0329-003	1,2,3,6,7,8-HxCDF	0.0430	Yes	V	0.100	0.00430	0.100	0.00430
BI31-011	03F0329-003	1,2,3,7,8,9-HxCDD	0.0210	Yes	V	0.100	0.00210	0.100	0.00210
BI31-011	03F0329-003	1,2,3,7,8,9-HxCDF	0.00250	Yes	V	0.100	2.50E-04	0.100	2.50E-04
BI31-011	03F0329-003	1,2,3,7,8-PeCDF	0.0280	Yes	V	0.0500	0.00140	0.100	0.00280
BI31-011	03F0329-003	2,3,4,6,7,8-HxCDF	0.0630	Yes	V	0.100	0.00630	0.100	0.00630
BI31-011	03F0329-003	2,3,4,7,8-PeCDF	0.0560	Yes	V	0.500	0.0280	1	0.0560
BI31-011	03F0329-003	2,3,7,8-TCDD	0.00190	Yes	V	1	0.00190	1	0.00190
BI31-011	03F0329-003	2,3,7,8-TCDF	0.0280	Yes	V	0.100	0.00280	1	0.0280
BI31-011	03F0329-003	Heptachlorodibenzo-p-dioxin	0.110	Yes	V	0.0100	0.00110	0.00100	1.10E-04
BI31-011	03F0329-003	OCDD	0.390	Yes	V	1.00E-04	3.90E-05	1.00E-04	3.90E-05

Table 1.9

Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals		Birds	
						TEF [a]	TEQ Concentration[b]	TEF [a]	TEQ Concentration[b]
BI31-011	03F0329-003	OCDF	0.140	Yes	V	1.00E-04	1.40E-05	1.00E-04	1.40E-05
BI31-011	03F0329-003	Pentachlorodibenzo-p-dioxin	0.00710	Yes	V	1	0.00710	1	0.00710
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-003:							**0.0739**		**0.126**
BI31-012	03F2087-001	1,2,3,4,6,7,8-HpCDF	0.00610	Yes	V1	0.0100	6.10E-05	0.0100	6.10E-05
BI31-012	03F2087-001	1,2,3,4,7,8,9-HpCDF	8.80E-04	Yes	V1	0.0100	8.80E-06	0.0100	8.80E-06
BI31-012	03F2087-001	1,2,3,4,7,8-HxCDD	3.40E-04	Yes	V1	0.100	3.40E-05	0.0500	1.70E-05
BI31-012	03F2087-001	1,2,3,4,7,8-HxCDF	0.00270	Yes	V1	0.100	2.70E-04	0.100	2.70E-04
BI31-012	03F2087-001	1,2,3,6,7,8-HxCDD	0.00100	Yes	V1	0.100	1.00E-04	0.0100	1.00E-05
BI31-012	03F2087-001	1,2,3,6,7,8-HxCDF	9.20E-04	Yes	V1	0.100	9.20E-05	0.100	9.20E-05
BI31-012	03F2087-001	1,2,3,7,8,9-HxCDD	0.00100	Yes	V1	0.100	1.00E-04	0.100	1.00E-04
BI31-012	03F2087-001	1,2,3,7,8,9-HxCDF	1.40E-04	No	V1	0.100	0	0.100	0
BI31-012	03F2087-001	1,2,3,7,8-PeCDF	6.20E-04	Yes	V1	0.0500	3.10E-05	0.100	6.20E-05
BI31-012	03F2087-001	2,3,4,6,7,8-HxCDF	0.00120	Yes	V1	0.100	1.20E-04	0.100	1.20E-04
BI31-012	03F2087-001	2,3,4,7,8-PeCDF	0.00100	Yes	V1	0.500	5.00E-04	1	0.00100
BI31-012	03F2087-001	2,3,7,8-TCDD	5.50E-04	Yes	V1	1	5.50E-04	1	5.50E-04
BI31-012	03F2087-001	2,3,7,8-TCDF	0.00100	Yes	V1	0.100	1.00E-04	1	0.00100
BI31-012	03F2087-001	Heptachlorodibenzo-p-dioxin	0.0150	Yes	V1	0.0100	1.50E-04	0.00100	1.50E-05
BI31-012	03F2087-001	OCDD	0.130	Yes	V1	1.00E-04	1.30E-05	1.00E-04	1.30E-05
BI31-012	03F2087-001	OCDF	0.0110	Yes	V1	1.00E-04	1.10E-06	1.00E-04	1.10E-06
BI31-012	03F2087-001	Pentachlorodibenzo-p-dioxin	3.20E-04	Yes	V1	1	3.20E-04	1	3.20E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-001:							**0.00245**		**0.00364**
BI31-013	03F2087-002	1,2,3,4,6,7,8-HpCDF	0.0160	Yes	V1	0.0100	1.60E-04	0.0100	1.60E-04
BI31-013	03F2087-002	1,2,3,4,7,8,9-HpCDF	0.00140	Yes	V1	0.0100	1.40E-05	0.0100	1.40E-05
BI31-013	03F2087-002	1,2,3,4,7,8-HxCDD	5.90E-04	Yes	V1	0.100	5.90E-05	0.0500	2.95E-05
BI31-013	03F2087-002	1,2,3,4,7,8-HxCDF	0.00850	Yes	V1	0.100	8.50E-04	0.100	8.50E-04
BI31-013	03F2087-002	1,2,3,6,7,8-HxCDD	0.00120	Yes	V1	0.100	1.20E-04	0.0100	1.20E-05
BI31-013	03F2087-002	1,2,3,6,7,8-HxCDF	0.00330	Yes	V1	0.100	3.30E-04	0.100	3.30E-04
BI31-013	03F2087-002	1,2,3,7,8,9-HxCDD	0.00160	Yes	V1	0.100	1.60E-04	0.100	1.60E-04
BI31-013	03F2087-002	1,2,3,7,8,9-HxCDF	2.90E-04	Yes	V1	0.100	2.90E-05	0.100	2.90E-05
BI31-013	03F2087-002	1,2,3,7,8-PeCDF	0.00220	Yes	V1	0.0500	1.10E-04	0.100	2.20E-04
BI31-013	03F2087-002	2,3,4,6,7,8-HxCDF	0.00400	Yes	V1	0.100	4.00E-04	0.100	4.00E-04
BI31-013	03F2087-002	2,3,4,7,8-PeCDF	0.00370	Yes	V1	0.500	0.00185	1	0.00370
BI31-013	03F2087-002	2,3,7,8-TCDD	6.10E-04	Yes	V1	1	6.10E-04	1	6.10E-04
BI31-013	03F2087-002	2,3,7,8-TCDF	0.00220	Yes	V1	0.100	2.20E-04	1	0.00220
BI31-013	03F2087-002	Heptachlorodibenzo-p-dioxin	0.0150	Yes	V1	0.0100	1.50E-04	0.00100	1.50E-05

Table 1.9

Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals		Birds	
						TEF [a]	TEQ Concentration[b]	TEF [a]	TEQ Concentration[b]
BI31-013	03F2087-002	OCDD	0.0850	Yes	V1	1.00E-04	8.50E-06	1.00E-04	8.50E-06
BI31-013	03F2087-002	OCDF	0.0120	Yes	V1	1.00E-04	1.20E-06	1.00E-04	1.20E-06
BI31-013	03F2087-002	Pentachlorodibenzo-p-dioxin	5.60E-04	Yes	V1	1	5.60E-04	1	5.60E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-002:							**0.00563**		**0.00930**
BI31-015	04F0058-001	1,2,3,4,6,7,8-HpCDF	0.00264	No	V	0.0100	0	0.0100	0
BI31-015	04F0058-001	1,2,3,4,7,8,9-HpCDF	0.00264	No	V	0.0100	0	0.0100	0
BI31-015	04F0058-001	1,2,3,4,7,8-HxCDD	0.00264	No	V	0.100	0	0.0500	0
BI31-015	04F0058-001	1,2,3,4,7,8-HxCDF	0.00264	No	V	0.100	0	0.100	0
BI31-015	04F0058-001	1,2,3,6,7,8-HxCDD	0.00264	No	V	0.100	0	0.0100	0
BI31-015	04F0058-001	1,2,3,6,7,8-HxCDF	0.00264	No	V	0.100	0	0.100	0
BI31-015	04F0058-001	1,2,3,7,8,9-HxCDD	0.00264	No	V	0.100	0	0.100	0
BI31-015	04F0058-001	1,2,3,7,8,9-HxCDF	0.00264	No	V	0.100	0	0.100	0
BI31-015	04F0058-001	1,2,3,7,8-PeCDF	0.00264	No	V	0.0500	0	0.100	0
BI31-015	04F0058-001	2,3,4,6,7,8-HxCDF	0.00264	No	V	0.100	0	0.100	0
BI31-015	04F0058-001	2,3,4,7,8-PeCDF	0.00264	No	V	0.500	0	1	0
BI31-015	04F0058-001	2,3,7,8-TCDD	0.00106	No	V	1	0	1	0
BI31-015	04F0058-001	2,3,7,8-TCDF	0.00106	No	V	0.100	0	1	0
BI31-015	04F0058-001	Heptachlorodibenzo-p-dioxin	0.00264	No	V	0.0100	0	0.00100	0
BI31-015	04F0058-001	OCDD	4.15E-04	Yes	JB	1.00E-04	4.15E-08	1.00E-04	4.15E-08
BI31-015	04F0058-001	OCDF	7.19E-05	Yes	V	1.00E-04	7.19E-09	1.00E-04	7.19E-09
BI31-015	04F0058-001	Pentachlorodibenzo-p-dioxin	0.00264	No	V	1	0	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample 04F0058-001:							**4.87E-08**		**4.87E-08**
BI31-016	04F0058-002	1,2,3,4,6,7,8-HpCDF	2.35E-04	Yes	V	0.0100	2.35E-06	0.0100	2.35E-06
BI31-016	04F0058-002	1,2,3,4,7,8,9-HpCDF	0.00269	No	V	0.0100	0	0.0100	0
BI31-016	04F0058-002	1,2,3,4,7,8-HxCDD	0.00269	No	V	0.100	0	0.0500	0
BI31-016	04F0058-002	1,2,3,4,7,8-HxCDF	0.00269	No	V	0.100	0	0.100	0
BI31-016	04F0058-002	1,2,3,6,7,8-HxCDD	0.00269	No	V	0.100	0	0.0100	0
BI31-016	04F0058-002	1,2,3,6,7,8-HxCDF	0.00269	No	V	0.100	0	0.100	0
BI31-016	04F0058-002	1,2,3,7,8,9-HxCDD	2.20E-04	Yes	V	0.100	2.20E-05	0.100	2.20E-05
BI31-016	04F0058-002	1,2,3,7,8,9-HxCDF	0.00269	No	V	0.100	0	0.100	0
BI31-016	04F0058-002	1,2,3,7,8-PeCDF	0.00269	No	V	0.0500	0	0.100	0
BI31-016	04F0058-002	2,3,4,6,7,8-HxCDF	0.00269	No	V	0.100	0	0.100	0
BI31-016	04F0058-002	2,3,4,7,8-PeCDF	0.00269	No	V	0.500	0	1	0
BI31-016	04F0058-002	2,3,7,8-TCDD	2.59E-05	Yes	V	1	2.59E-05	1	2.59E-05
BI31-016	04F0058-002	2,3,7,8-TCDF	0.00108	No	V	0.100	0	1	0

Table 1.9

Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals		Birds	
						TEF [a]	TEQ Concentration [b]	TEF [a]	TEQ Concentration [b]
BI31-016	04F0058-002	Heptachlorodibenzo-p-dioxin	2.48E-04	Yes	V	0.0100	2.48E-06	0.00100	2.48E-07
BI31-016	04F0058-002	OCDD	0.00208	Yes	JB	1.00E-04	2.08E-07	1.00E-04	2.08E-07
BI31-016	04F0058-002	OCDF	3.58E-04	Yes	V	1.00E-04	3.58E-08	1.00E-04	3.58E-08
BI31-016	04F0058-002	Pentachlorodibenzo-p-dioxin	0.00269	No	V	1	0	1	0
Total 2,3,7,8-TCDD TEQ Concentration for Sample04F0058-002:							**5.30E-05**		**5.07E-05**
BJ31-005	03F2087-004	1,2,3,4,6,7,8-HpCDF	0.00990	Yes	V1	0.0100	9.90E-05	0.0100	9.90E-05
BJ31-005	03F2087-004	1,2,3,4,7,8,9-HpCDF	7.10E-04	Yes	V1	0.0100	7.10E-06	0.0100	7.10E-06
BJ31-005	03F2087-004	1,2,3,4,7,8-HxCDD	7.20E-04	Yes	V1	0.100	7.20E-05	0.0500	3.60E-05
BJ31-005	03F2087-004	1,2,3,4,7,8-HxCDF	0.00480	Yes	V1	0.100	4.80E-04	0.100	4.80E-04
BJ31-005	03F2087-004	1,2,3,6,7,8-HxCDD	0.00140	Yes	V1	0.100	1.40E-04	0.0100	1.40E-05
BJ31-005	03F2087-004	1,2,3,6,7,8-HxCDF	0.00180	Yes	V1	0.100	1.80E-04	0.100	1.80E-04
BJ31-005	03F2087-004	1,2,3,7,8,9-HxCDD	0.00120	Yes	V1	0.100	1.20E-04	0.100	1.20E-04
BJ31-005	03F2087-004	1,2,3,7,8,9-HxCDF	2.60E-04	No	V1	0.100	0	0.100	0
BJ31-005	03F2087-004	1,2,3,7,8-PeCDF	0.00110	Yes	V1	0.0500	5.50E-05	0.100	1.10E-04
BJ31-005	03F2087-004	2,3,4,6,7,8-HxCDF	0.00220	Yes	V1	0.100	2.20E-04	0.100	2.20E-04
BJ31-005	03F2087-004	2,3,4,7,8-PeCDF	0.00170	Yes	V1	0.500	8.50E-04	1	0.00170
BJ31-005	03F2087-004	2,3,7,8-TCDD	2.80E-04	Yes	V1	1	2.80E-04	1	2.80E-04
BJ31-005	03F2087-004	2,3,7,8-TCDF	0.00120	Yes	V1	0.100	1.20E-04	1	0.00120
BJ31-005	03F2087-004	Heptachlorodibenzo-p-dioxin	0.0200	Yes	V1	0.0100	2.00E-04	0.00100	2.00E-05
BJ31-005	03F2087-004	OCDD	0.170	Yes	J1	1.00E-04	1.70E-05	1.00E-04	1.70E-05
BJ31-005	03F2087-004	OCDF	0.0110	Yes	V1	1.00E-04	1.10E-06	1.00E-04	1.10E-06
BJ31-005	03F2087-004	Pentachlorodibenzo-p-dioxin	4.50E-04	Yes	V1	1	4.50E-04	1	4.50E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-004:							**0.00329**		**0.00493**
BJ31-006	03F2087-005	1,2,3,4,6,7,8-HpCDF	0.0130	Yes	V1	0.0100	1.30E-04	0.0100	1.30E-04
BJ31-006	03F2087-005	1,2,3,4,7,8,9-HpCDF	0.00130	Yes	V1	0.0100	1.30E-05	0.0100	1.30E-05
BJ31-006	03F2087-005	1,2,3,4,7,8-HxCDD	5.50E-04	Yes	V1	0.100	5.50E-05	0.0500	2.75E-05
BJ31-006	03F2087-005	1,2,3,4,7,8-HxCDF	0.00540	Yes	V1	0.100	5.40E-04	0.100	5.40E-04
BJ31-006	03F2087-005	1,2,3,6,7,8-HxCDD	0.00160	Yes	V1	0.100	1.60E-04	0.0100	1.60E-05
BJ31-006	03F2087-005	1,2,3,6,7,8-HxCDF	0.00210	Yes	V1	0.100	2.10E-04	0.100	2.10E-04
BJ31-006	03F2087-005	1,2,3,7,8,9-HxCDD	0.00120	Yes	V1	0.100	1.20E-04	0.100	1.20E-04
BJ31-006	03F2087-005	1,2,3,7,8,9-HxCDF	3.60E-04	No	V1	0.100	0	0.100	0
BJ31-006	03F2087-005	1,2,3,7,8-PeCDF	0.00130	Yes	V1	0.0500	6.50E-05	0.100	1.30E-04
BJ31-006	03F2087-005	2,3,4,6,7,8-HxCDF	0.00250	Yes	V1	0.100	2.50E-04	0.100	2.50E-04
BJ31-006	03F2087-005	2,3,4,7,8-PeCDF	0.00200	Yes	V1	0.500	0.00100	1	0.00200
BJ31-006	03F2087-005	2,3,7,8-TCDD	2.20E-04	No	V1	1	0	1	0

Table 1.9

Toxicity Equivalence Calculations for Dioxins/Furans - Ecological Receptors

Sampling Location	Sample Number	Congener	Result	Detect?	Validation Qualifier	Mammals		Birds	
						TEF [a]	TEQ Concentration[b]	TEF [a]	TEQ Concentration[b]
BJ31-006	03F2087-005	2,3,7,8-TCDF	0.00130	Yes	V1	0.100	1.30E-04	1	0.00130
BJ31-006	03F2087-005	Heptachlorodibenzo-p-dioxin	0.0200	Yes	V1	0.0100	2.00E-04	0.00100	2.00E-05
BJ31-006	03F2087-005	OCDD	0.150	Yes	J1	1.00E-04	1.50E-05	1.00E-04	1.50E-05
BJ31-006	03F2087-005	OCDF	0.0120	Yes	V1	1.00E-04	1.20E-06	1.00E-04	1.20E-06
BJ31-006	03F2087-005	Pentachlorodibenzo-p-dioxin	6.20E-04	Yes	V1	1	6.20E-04	1	6.20E-04
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F2087-005:							**0.004**		**0.00539**
2,3,7,8-TCDD TEQ Concentration used in Surface Soil ESL Screen[c]:							**0.074**		**0.126**
Subsurface Soil (ug/kg)									
BI31-009	03F0329-005	1,2,3,4,6,7,8-HpCDF	0.00480	Yes	V	0.0100	4.80E-05	N/A	N/A
BI31-009	03F0329-005	1,2,3,4,7,8,9-HpCDF	6.00E-04	Yes	JB	0.0100	6.00E-06	N/A	N/A
BI31-009	03F0329-005	1,2,3,4,7,8-HxCDD	3.40E-04	Yes	JB	0.100	3.40E-05	N/A	N/A
BI31-009	03F0329-005	1,2,3,4,7,8-HxCDF	0.00290	Yes	V	0.100	2.90E-04	N/A	N/A
BI31-009	03F0329-005	1,2,3,6,7,8-HxCDD	6.10E-04	Yes	JB	0.100	6.10E-05	N/A	N/A
BI31-009	03F0329-005	1,2,3,6,7,8-HxCDF	0.00120	Yes	JB	0.100	1.20E-04	N/A	N/A
BI31-009	03F0329-005	1,2,3,7,8,9-HxCDD	8.40E-04	Yes	JB	0.100	8.40E-05	N/A	N/A
BI31-009	03F0329-005	1,2,3,7,8,9-HxCDF	1.40E-04	Yes	JB	0.100	1.40E-05	N/A	N/A
BI31-009	03F0329-005	1,2,3,7,8-PeCDF	9.30E-04	Yes	JB	0.0500	4.65E-05	N/A	N/A
BI31-009	03F0329-005	2,3,4,6,7,8-HxCDF	0.00120	Yes	JB	0.100	1.20E-04	N/A	N/A
BI31-009	03F0329-005	2,3,4,7,8-PeCDF	0.00160	Yes	JB	0.500	8.00E-04	N/A	N/A
BI31-009	03F0329-005	2,3,7,8-TCDD	2.40E-04	Yes	V	1	2.40E-04	N/A	N/A
BI31-009	03F0329-005	2,3,7,8-TCDF	0.00110	Yes	V	0.100	1.10E-04	N/A	N/A
BI31-009	03F0329-005	Heptachlorodibenzo-p-dioxin	0.00960	Yes	V	0.0100	9.60E-05	N/A	N/A
BI31-009	03F0329-005	OCDD	0.0750	Yes	V	1.00E-04	7.50E-06	N/A	N/A
BI31-009	03F0329-005	OCDF	0.00620	Yes	V	1.00E-04	6.20E-07	N/A	N/A
BI31-009	03F0329-005	Pentachlorodibenzo-p-dioxin	3.50E-04	Yes	JB	1	3.50E-04	N/A	N/A
Total 2,3,7,8-TCDD TEQ Concentration for Sample 03F0329-005:							**0.00243**		N/A
2,3,7,8-TCDD TEQ Concentration used in Subsurface Soil ESL Screen[c]:							**0.00243**		N/A

[a] Toxicity Equivalency Factor (WHO, 1997).

[b] TEQ (Toxicity Equivalence) concentration = Soil Concentration x TEF. For non-detects, the TEQ concentration equals zero.

[c] The 2,3,7,8-TCDD TEQ concentration used in the ESL screen is the maximum of all sampling locations for the medium.

N/A = Not applicable.

Table 2.1
Essential Nutrient Screen for Surface Soil/Surface Sediment

Analyte	MDC (mg/kg)	Estimated Maximum Daily Intake[a] (mg/day)	RDA/RDI/AI[b] (mg/day)	UL[b] (mg/day)	Retain for PRG Screen?
Calcium	69,700	6.97	500-1,200	2,500	No
Magnesium	6,600	0.660	80-420	65-110	No
Potassium	4,460	0.446	2,000-3,500	N/A	No
Sodium	2,060	0.206	500-2,400	N/A	No

[a] Based on the MDC and a 100-mg/day soil ingestion rate for a WRW.

[b] RDA/RDI/AI/UL taken from NAS 2000 and 2002.

N/A = Not available.

Table 2.2
PRG Screen for Surface Soil/Surface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Inorganics (mg/kg)						
Aluminum	24,774	30,200	Yes	11,533	No	No
Ammonia	910,997	4.40	No	--	--	No
Antimony	44.4	51.3	Yes	9.91	No	No
Arsenic	**2.41**	**27.9**	**Yes**	**6.11**	**Yes**	**Yes**
Barium	2,872	464	No	--	--	No
Beryllium	100	4.40	No	--	--	No
Boron	9,477	11	No	--	--	No
Cadmium	91.4	30	No	--	--	No
Cesium	N/A	16.4	UT	--	--	No
Chromium[c]	28.4	70.1	Yes	15.8	No	No
Chromium VI	28.4	0.0120	No	--	--	No
Cobalt	122	13.7	No	--	--	No
Copper	4,443	330	No	--	--	No
Fluoride	6,665	20.3	No	--	--	No
Iron	33,326	38,800	Yes	14,758	No	No
Lead	1,000	220	No	--	--	No
Lithium	2,222	20	No	--	--	No
Manganese	419	829	Yes	273	No	No
Mercury	32.9	3.80	No	--	--	No
Molybdenum	555	11.7	No	--	--	No
Nickel	2,222	48	No	--	--	No
Nitrate / Nitrite[d]	177,739	32	No	--	--	No
Selenium	555	3.80	No	--	--	No
Silica	N/A	1,200	UT	--	--	No
Silicon	N/A	1,890	UT	--	--	No
Silver	555	98	No	--	--	No
Strontium	66,652	150	No	--	--	No
Thallium	7.78	0.990	No	--	--	No
Tin	66,652	66.9	No	--	--	No
Titanium	169,568	410	No	--	--	No
Uranium	333	85	No	--	--	No
Vanadium	111	68.6	No	--	--	No
Zinc	33,326	2,080	No	--	--	No
Organics (ug/kg)						
1,2,4-Trichlorobenzene	151,360	0.950	No	--	--	No
1,2,4-Trimethylbenzene	132,620	1.50	No	--	--	No
2,3,7,8-TCDD TEQ[e]	**0.0248**	**0.0739**	**Yes**	**0.0546**	**Yes**	**Yes**
2-Butanone	4.64E+07	380	No	--	--	No
2-Methylnaphthalene	320,574	12,000	No	--	--	No
4,4'-DDT	10,927	21	No	--	--	No
4-Methyl-2-pentanone	8.32E+07	4	No	--	--	No
4-Methylphenol	400,718	510	No	--	--	No
Acenaphthene	4.44E+06	44,000	No	--	--	No
Acenaphthylene	N/A	600	UT	--	--	No
Acetone	1.00E+08	890	No	--	--	No
Aldrin	176	17	No	--	--	No
Anthracene	2.22E+07	47,000	No	--	--	No
Aroclor-1254	1,349	3,900	Yes	597	No	No
Aroclor-1260	1,349	600	No	--	--	No
Benzene	23,563	1.20	No	--	--	No
Benzo(a)anthracene	3,793	45,000	Yes	2,521	No	No
Benzo(a)pyrene	**379**	**43,000**	**Yes**	**2,249**	**Yes**	**Yes**
Benzo(b)fluoranthene	3,793	49,000	Yes	3,448	No	No
Benzo(g,h,i)perylene	N/A	28,000	UT	--	--	No
Benzo(k)fluoranthene	37,927	25,000	No	--	--	No

Table 2.2
PRG Screen for Surface Soil/Surface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Benzoic Acid	3.21E+08	770	No	--	--	No
Benzyl Alcohol	2.40E+07	270	No	--	--	No
bis(2-ethylhexyl)phthalate	213,750	3,500	No	--	--	No
Butylbenzylphthalate	1.60E+07	220	No	--	--	No
Carbazole	150,001	39	No	--	--	No
Chrysene	379,269	46,000	No	--	--	No
Dibenz(a,h)anthracene	**379**	**9,200**	**Yes**	**709**	**Yes**	**Yes**
Dibenzofuran	222,174	20,000	No	--	--	No
Dieldrin	187	34	No	--	--	No
Diethylphthalate	6.41E+07	79	No	--	--	No
Di-n-butylphthalate	8.01E+06	390	No	--	--	No
Di-n-octylphthalate	3.21E+06	96	No	--	--	No
Endosulfan sulfate	480,861	24	No	--	--	No
Endrin ketone	33,326	36	No	--	--	No
Fluoranthene	2.96E+06	140,000	No	--	--	No
Fluorene	3.21E+06	39,000	No	--	--	No
Heptachlor epoxide	329	10	No	--	--	No
Indeno(1,2,3-cd)pyrene	3,793	32,000	Yes	2,445	No	No
Isophorone	3.16E+06	96	No	--	--	No
Methoxychlor	400,718	450	No	--	--	No
Methylene Chloride	271,792	220	No	--	--	No
Naphthalene	1.40E+06	41,000	No	--	--	No
Phenanthrene	N/A	170,000	UT	--	--	No
Phenol	2.40E+07	80	No	--	--	No
Pyrene	2.22E+06	120,000	No	--	--	No
Tetrachloroethene	6,705	6	No	--	--	No
Toluene	3.09E+06	310	No	--	--	No
Trichloroethene	1,770	23	No	--	--	No
Xylene[f]	1.06E+06	5	No	--	--	No
Radionuclides (pCi/g)						
Americium-241	7.69	0.802	No	--	--	No
Cesium-134	**0.0800**	**0.300**	**Yes**	**0.138**	**Yes**	**Yes**
Cesium-137	**0.221**	**1**	**Yes**	**0.238**	**Yes**	**Yes**
Gross Alpha	N/A	320	UT	--	--	No
Gross Beta	N/A	305	UT	--	--	No
Neptunium-237	5.43	0.00224	No	--	--	No
Plutonium-238	5.97	0.0253	No	--	--	No
Plutonium-239/240	9.80	17.1	Yes	0.147	No	No
Radium-226	2.69	1.09	No	--	--	No
Radium-228	**0.111**	**2.29**	**Yes**	**1.73**	**Yes**	**Yes**
Strontium-89/90	13.2	4.86	No	--	--	No
Uranium-233/234	25.3	47.5	Yes	2.56	No	No
Uranium-235	1.05	2.24	Yes	0.159	No	No
Uranium-238	29.3	209	Yes	8.34	No	No

[a] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.

[b] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.

[c] The PRG for chromium (VI) is used.

[d] The PRG for nitrate is used.

[e] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8 and the PRG for 2,3,7,8-TCDD is used in the PRG screen.

[f] The value for total xylene is used.

N/A = Not available.

UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).

-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

Bold = Analyte retained for further consideration in the next COC selection step.

Table 2.3
Statistical Distributions and Comparison to Background for UWOEU[a]

Analyte	Statistical Distribution Testing Results						Background Comparison		
	Background			UWOEU					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1-p	Retain as PCOC?
Surface Soil/Surface Sediment									
Arsenic	**20**	**NORMAL**	**91.8**	**130**	**NORMAL**	**99.4**	**t-Test_N**	**1.38E-05**	**Yes**
Cesium-134	70	NON-PARAMETRIC	N/A	N/A	N/A	N/A	WRS	0.900	No
Cesium-137	70	NORMAL	N/A	1	N/A	N/A	WRS	1.000	No
Radium-228	20	NORMAL	N/A	4	NORMAL	N/A	t-Test_N	0.651	No
Uranium-235	20	GAMMA	N/A	154	NON-PARAMETRIC	N/A	WRS	0.554	No
Subsurface Soil/Subsurface Sediment									
Radium-228	31	GAMMA	N/A	26	NORMAL	N/A	WRS	0.170	No

[a] EU data for background comparison do not include data from background locations.
t-Test_N = Student's t-test using normal data

Table 2.4
Essential Nutrient Screen for Subsurface Soil/Subsurface Sediment

Analyte	MDC (mg/kg)	Estimated Maximum Daily Intake[a] (mg/day)	RDA/RDI/AI[b] (mg/day)	UL[b] (mg/day)	Retain for PRG Screen?
Calcium	60,000	6	500-1,200	2,500	No
Magnesium	9,480	0.948	80-420	65-110	No
Potassium	4,190	0.419	2,000-3,500	N/A	No
Sodium	3,360	0.336	500-2,400	N/A	No

[a] Based on the MDC and a 100-mg/day soil ingestion rate for a WRW.

[b] RDA/RDI/AI/UL taken from NAS 2000 and 2002.

N/A = Not available.

Table 2.5
PRG Screen for Subsurface Soil/Subsurface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Inorganics (mg/kg)						
Aluminum	284,902	32,800	No	--	--	No
Antimony	511	149	No	--	--	No
Arsenic	27.7	24.3	No	--	--	No
Barium	33,033	1,610	No	--	--	No
Beryllium	1,151	446	No	--	--	No
Boron	108,980	4.70	No	--	--	No
Cadmium	1,051	71	No	--	--	No
Cesium	N/A	29.6	UT	--	--	No
Chromium[c]	327	8,310	Yes	196	No	No
Cobalt	1,401	701	No	--	--	No
Copper	51,100	8,850	No	--	--	No
Iron	383,250	107,000	No	--	--	No
Lead	1,000	5,200	Yes	73.4	No	No
Lithium	25,550	29	No	--	--	No
Manganese	4,815	2,150	No	--	--	No
Mercury	379	1.40	No	--	--	No
Molybdenum	6,388	470	No	--	--	No
Nickel	25,550	4,750	No	--	--	No
Phosphorus	N/A	975	UT	--	--	No
Selenium	6,388	80.8	No	--	--	No
Silica	N/A	850	UT	--	--	No
Silicon	N/A	1,120	UT	--	--	No
Silver	6,388	311	No	--	--	No
Strontium	766,500	170	No	--	--	No
Thallium	89.4	6.30	No	--	--	No
Tin	766,500	579	No	--	--	No
Titanium	1.95E+06	283	No	--	--	No
Total Petroleum Hydrocarbons	N/A	62	UT	--	--	No
Uranium	3,833	5.50	No	--	--	No
Vanadium	1,278	74.4	No	--	--	No
Zinc	383,250	6,920	No	--	--	No
Organics (ug/kg)						
1,1,1-Trichloroethane	1.06E+08	2	No	--	--	No
1,2,4-Trichlorobenzene	1.74E+06	60	No	--	--	No
1,2-Dichlorobenzene	3.32E+07	30	No	--	--	No
1,3-Dichlorobenzene	3.83E+07	20	No	--	--	No
1,4-Dichlorobenzene	1.05E+06	10	No	--	--	No
2,3,7,8-TCDD TEQ[d]	0.285	0.00243	No	--	--	No
2-Butanone	5.33E+08	8	No	--	--	No
2-Chlorophenol	6.39E+06	10	No	--	--	No
2-Methylnaphthalene	3.69E+06	15,000	No	--	--	No
3,3'-Dichlorobenzidine	76,667	160	No	--	--	No
4-Chloro-3-methylphenol	N/A	10	UT	--	--	No
4-Methyl-2-pentanone	9.57E+08	2	No	--	--	No

Table 2.5
PRG Screen for Subsurface Soil/Subsurface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Acenaphthene	5.10E+07	31,000	No	--	--	No
Acenaphthylene	N/A	47	UT	--	--	No
Acetone	1.15E+09	330	No	--	--	No
alpha-BHC	6,555	15	No	--	--	No
Anthracene	2.55E+08	46,000	No	--	--	No
Aroclor-1254	15,514	960	No	--	--	No
Aroclor-1260	15,514	1,300	No	--	--	No
Benzo(a)anthracene	43,616	48,000	Yes	2,743	No	No
Benzo(a)pyrene	4,357	43,000	Yes	2,482	No	No
Benzo(b)fluoranthene	43,616	48,000	Yes	2,785	No	No
Benzo(g,h,i)perylene	N/A	19,000	UT	--	--	No
Benzo(k)fluoranthene	436,159	19,000	No	--	--	No
Benzoic Acid	3.69E+09	260	No	--	--	No
bis(2-ethylhexyl)phthalate	2.46E+06	540	No	--	--	No
Bromoform	4.83E+06	2	No	--	--	No
Butylbenzylphthalate	1.84E+08	1,400	No	--	--	No
Chrysene	4.36E+06	53,000	No	--	--	No
cis-1,2-Dichloroethene	1.28E+07	10.1	No	--	--	No
Dibenz(a,h)anthracene	4,362	890	No	--	--	No
Dibenzofuran	2.56E+06	20,000	No	--	--	No
Diethylphthalate	7.37E+08	250	No	--	--	No
Di-n-butylphthalate	9.22E+07	2,700	No	--	--	No
Di-n-octylphthalate	3.69E+07	50	No	--	--	No
Fluoranthene	3.40E+07	160,000	No	--	--	No
Fluorene	3.69E+07	35,000	No	--	--	No
Heptachlor	7,647	3.10	No	--	--	No
Heptachlor epoxide	3,782	11	No	--	--	No
Hexachlorobenzene	21,508	30	No	--	--	No
Indeno(1,2,3-cd)pyrene	43,616	22,000	No	--	--	No
Isophorone	3.63E+07	82	No	--	--	No
Methylene Chloride	3.13E+06	67	No	--	--	No
Naphthalene	1.61E+07	61,000	No	--	--	No
Pentachlorophenol	202,777	160	No	--	--	No
Phenanthrene	N/A	220,000	UT	--	--	No
Phenol	2.76E+08	140	No	--	--	No
Pyrene	2.55E+07	150,000	No	--	--	No
Tetrachloroethene	77,111	920	No	--	--	No
Toluene	3.56E+07	420	No	--	--	No
Trichloroethene	20,354	440	No	--	--	No
Radionuclides (pCi/g)						
Americium-241	88.4	2.97	No	--	--	No
Cesium-134	0.910	-0.0657	No	--	--	No
Cesium-137	2.54	0.176	No	--	--	No
Gross Alpha	N/A	742	UT	--	--	No
Gross Beta	N/A	1,580	UT	--	--	No
Plutonium-238	68.7	9.84	No	--	--	No

Table 2.5
PRG Screen for Subsurface Soil/Subsurface Sediment

Analyte	PRG[a]	MDC	MDC Exceeds PRG?	UCL[b]	UCL Exceeds PRG?	Retain for Detection Frequency Screen?
Plutonium-239/240	112	5.16	No	--	--	No
Radium-226	31	2.09	No	--	--	No
Radium-228	**1.28**	**2.79**	**Yes**	**1.74**	**Yes**	**Yes**
Strontium-89/90	152	0.969	No	--	--	No
Uranium-233/234	291	288	No	--	--	No
Uranium-235	12.1	37.7	Yes	1.80	No	No
Uranium-238	337	1,160	Yes	78.7	No	No

[a] The value shown is equal to the most stringent of the PRGs based on a risk of 1E-06 or an HQ of 0.1.
[b] UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then the MDC is used as the UCL.
[c] The PRG for chromium (VI) is used.
[d] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8 and the PRG for 2,3,7,8-TCDD is used in the PRG screen.
N/A = Not available.
UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).
-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.
Bold = Analyte retained for further consideration in the next COC selection step.

Table 2.6
Summary of the COC Selection Process

Analyte	MDC Exceeds PRG?	UCL Exceeds PRG?	Detection Frequency > 5%[a]	Exceeds 30X the PRG?	Exceeds Background?	Professional Judgment-Retain?	Retain as COC?
Surface Soil/Surface Sediment							
2,3,7,8-TCDD TEQ	**Yes**	**Yes**	**Yes**	**N/A**	**N/A**	**Yes**	**Yes**
Aluminum	Yes	No	--	--	--	--	No
Antimony	Yes	No	--	--	--	--	No
Aroclor-1254	Yes	No	--	--	--	--	No
Arsenic	Yes	Yes	Yes	N/A	Yes	No	No
Benzo(a)anthracene	Yes	No	--	--	--	--	No
Benzo(a)pyrene	**Yes**	**Yes**	**Yes**	**N/A**	**N/A**	**Yes**	**Yes**
Benzo(b)fluoranthene	Yes	No	--	--	--	--	No
Cesium-134	Yes	Yes	N/A	N/A	No	--	No
Cesium-137	Yes	Yes	N/A	N/A	No	--	No
Chromium	Yes	No	--	--	--	--	No
Dibenz(a,h)anthracene	Yes	Yes	No	No	--	--	No
Indeno(1,2,3-cd)pyrene	Yes	No	--	--	--	--	No
Iron	Yes	No	--	--	--	--	No
Manganese	Yes	No	--	--	--	--	No
Plutonium 239/240	Yes	No	--	--	--	--	No
Radium-228	Yes	Yes	N/A	N/A	No	--	No
Uranium-233/234	Yes	No	--	--	--	--	No
Uranium-235	Yes	No	--	--	--	--	No
Uranium-238	Yes	No	--	--	--	--	No
Subsurface Soil/ Subsurface Sediment							
Chromium	Yes	No	--	--	--	--	No
Lead	Yes	No	--	--	--	--	No
Benzo(a)pyrene	Yes	No	--	--	--	--	No
Benzo(a)anthracene	Yes	No	--	--	--	--	No
Benzo(b)fluoranthene	Yes	No	--	--	--	--	No
Radium-228	Yes	Yes	N/A	N/A	No	--	No
Uranium-235	Yes	No	--	--	--	--	No
Uranium-238	Yes	No	--	--	--	--	No

[a] All radionuclide values are considered detects.
N/A = Not applicable.
-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.
Bold = Analyte retained as a COC for risk characterization.

Table 3.1
Exposure Point Concentrations

Analyte[f]	Unit	MDC[a]	UCL Value[b]	UCL Type[c]	Distribution[d]	EPC[e]
Tier 1						
Surface Soil/Surface Sediment						
Benzo(a)pyrene	mg/kg	43	2.25	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	2.25
2,3,7,8-TCDD TEQ	mg/kg	7.39E-05	5.46E-05	95% Adjusted Gamma UCL	GAMMA	5.46E-05
Tier 2						
Surface Soil/Surface Sediment						
Benzo(a)pyrene	mg/kg	1.35	0.62	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	0.624
2,3,7,8-TCDD TEQ	mg/kg	3.98E-07	NA	Too Few Observations To Calculate UCLs	NA	5.46E-05

[a] The MDC for Tier 1 is the maximum detected concentration of all samples and the MDC for Tier 2 is the maximum of the average concentration of the samples in each of the 30-acre grids in the EU, NA = not applicable or calculable.

[b] UCL = 95% upper confidence limit, NA = not applicable or calculable.

[c] The Tier 1 UCL type is recommended by ProUCL.

[d] The Tier 1 distribution is recommended by ProUCL.

[e] The UCL is used as the EPC, unless the UCL exceeds the MDC, then the MDC is used for the EPC. Tier 1 EPC for 2,3,7,8-TCDD TEQ is used as the Tier 2 EPC, because all dioxin/furan samples were collected from one 30-acre grid..

[f] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8.

NA = The Tier 2 UCL could not be calculated for 2,3,7,8-TCDD TEQ, because all dioxin/furan samples were collected from one 30-acre grid.

Table 3.2
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Worker

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Ingestion				
CI = (Cs x IRwss x EFwss x EDw x CF_3) / (BW x [ATc_wss or ATn_wss]b)				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Ingestion Rate of soil/sediment	IRwss	100	mg/day	EPA et al. 2002
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Conversion Factor	CF_3	1.00E-06	kg/mg	1 kg = 1.0E6 mg
Adult Body Weight	BW	70	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated
Outdoor Inhalation of Suspended Particulates				
CI = (Cs x IRawss x EFwss x EDw x ETwss x ETFo x MLF) / (BW x [ATc_wss or ATn_wss] [b])				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Inhalation Rate	IRawss	1.30	m^3/hr	EPA et al. 2002
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Exposure Time	ETwss	8	hr/day	EPA et al. 2002
Exposure Time Fraction, outdoor	ETFo	0.500	--	EPA et al. 2002
Mass loading, (PM 10) for inhalation[a]	MLF	6.70E-08	kg/m^3	EPA et al. 2002
Adult Body Weight	BW	70	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated
Indoor Inhalation of Suspended Particulates				
CI = (Cs x IRawss x EFwss x EDw x ETwss x ETFi x DFi x MLF) / (BW x [ATc_wss or ATn_wss] [b])				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Inhalation Rate	IRawss	1.30	m^3/hr	EPA et al. 2002
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Exposure Time	ETwss	8	hr/day	EPA et al. 2002

Table 3.2
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Worker

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Exposure Time Fraction, indoor	ETFi	0.500	--	EPA et al. 2002
Dilution Factor, indoor inhalation	DFi	0.700	--	EPA et al. 2002
Mass Loading, (PM 10) for inhalation[a]	MLF	6.70E-08	kg/m^3	EPA et al. 2002
Adult Body Weight	BW	70	kg/m3	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated
Dermal Contact				
CI = (Cs x SAw x AFw x EFwss x EDw x ABS x EVw x CF) / (BW x [Atc_wss or Atn_wss] [b])				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Skin Surface Area[c]	SAw	3,300	cm^2	EPA 2001
Skin-soil adherence factor	AFw	0.117	mg/cm^2-event	EPA 2001
Exposure Frequency	EFwss	230	days/year	EPA et al. 2002
Exposure Duration	EDw	18.7	yr	EPA et al. 2002
Conversion Factor	CF_3	1.00E-06	kg/mg	1 kg = 1.0E6 mg
Absorption Fraction	ABS	chemical-specific		EPA 2001[c]
Event frequency	EVw	1	events/day	EPA 2001
Adult Body Weight	BW	70	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_wss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATnc_wss	6,826	day	calculated

[a] The mass loading value is the 95th percentile of the estimated mass loading distribution estimated in the RSALs Task 3 Report (EPA et al. 2002).

[b] Carcinogenic or noncarcinogenic averaging times (Atc and Atnc, respectively) are used in equations, depending on whether carcinogenic or noncarcinogenic intakes are being calculated.

[c] The skin surface area value is the EPA default for commercial/industrial exposures and is the average of the 50th percentile for men and women > 18 years old wearing a short-sleeved shirt, long pants, and shoes. The value was recommended by CDPHE for use in the WRW PRGs.

Table 3.3
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Visitor

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Ingestion				
CI = (Cs x IRagevss x EFvss x CF_3) / [Atc_vss or Atnc] [a] **where, IRageav = ((IRvss x EDav) / BW) + ((IRcvss x EDcv) / BWc)**				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Age-adjusted Soil Ingestion Rate for chemicals	IRagevss	57.1	mg-yr/kg-day	calculated
Exposure Frequency	EFvss	100	days/year	EPA et al. 2002[b]
Exposure Duration - adult	EDav	24	yr	EPA et al. 2002
Exposure Duration - child	EDcv	6	yr	EPA et al. 2002
Conversion Factor	CF_3	1.00E-06	kg/mg	1 kg = 1.0E6 mg
Soil Ingestion Rate - adult	IRvss	50	mg/day	EPA et al. 2002
Soil Ingestion Rate - child	IRcvss	100	mg/day	EPA et al. 2002
Adult Body Weight	BW	70	kg	EPA 1991
Child Body Weight	BWc	15	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_vss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATn_vss	8,760	day	calculated
Averaging Time-Noncarcinogenic (child)	ATn_c_vss	2,190	day	calculated
Averaging Time-Noncarcinogenic (child+adult)	ATnc	10,950	day	calculated
Outdoor Inhalation of Suspended Particulates				
CI = (Cs x IRa_agevss x EFvss x MLF) / [Atc_vss or Atnc] [a] **where, IRa_agevss = (((Ira_vss x EDav) / BW) + ((IRa_cvss x EDcv) / BWc)) x ET**				
Chemical Intake	NRI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	EPC
Age-averaged Inhalation Rate for chemicals	IRa_agevss	3.66	m^3-yr/kg-day	EPA et al. 2002[b]
Exposure Frequency	EFvss	100	days/year	EPA et al. 2002[b]
Mass loading, (PM 10) for inhalation	MLF	6.70E-08	kg/m^3	EPA et al. 2002
Exposure Duration - adult	EDav	24	yr	EPA et al. 2002
Exposure Duration - child	EDcv	6	yr	EPA et al. 2002
Adult Body Weight	BW	70	kg	EPA 1991
Child Body Weight	BWc	15	kg	EPA 1991
Air Inhalation Rate - adult	IRavss	2.40	m^3/hr	EPA et al. 2002
Air Inhalation Rate - child	IRa_cvss	1.60	m^3/hr	EPA et al. 2002
Exposure Time	Etvss	2.50	hr/day	EPA et al. 2002[b]
Averaging Time-Carcinogenic	ATc_vss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATn_vss	8,760	day	calculated

Table 3.3
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Visitor

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source
Averaging Time-Noncarcinogenic (child)	ATn_c_vss	2,190	day	calculated
Averaging Time-Noncarcinogenic (child+adult)	ATnc	10,950	day	calculated
Dermal Contact				
CI = (Cs x SFSagav x EFvss x ABS x EVv x CF_3) /[Atc_vss or ATnc][a] **where, SFSagav = ((Saav x Afav xEDav) / BW) + ((Sacv x Afcv x EDcv) / BWc)**				
Chemical Intake	CI	chemical-specific	mg/kg-day	calculated
Chemical concentration in soil	Cs	chemical-specific	mg/kg	Tier 1 or 2 EPC
Exposure Frequency	EFvss	100	days/year	EPA et al. 2002[b]
Exposure Duration - adult	EDav	24	yr	EPA et al. 2002
Exposure Duration - child	EDcv	6	yr	EPA et al. 2002
Adult skin-soil adherence factor	Afav	0.0700	mg/cm^2-event	EPA 2001b[c]
Child skin-soil adherence factor	Afcv	0.200	mg/cm^2-event	EPA 2001b[d]
Adult skin surface area (exposed)	Saav	5,700	cm^2	EPA 2001b[e]
Child skin surface area (exposed)	Sacv	2,800	cm^2	EPA 2001b[f]
Age-averaged surface area/adherence factor	SFSagav	361	mg-yr/kg-event	EPA 2001b
Absorption Fraction	ABS	chemical-specific		EPA 2001b
Event frequency	EVv	1	events/day	EPA 2001
Conversion Factor	CF_3	1.00E-06	kg/mg	1 kg = 1.0E6 mg
Adult Body Weight	Bw	70	kg	EPA 1991
Child Body Weight	BWc	15	kg	EPA 1991
Averaging Time-Carcinogenic	ATc_vss	25,550	day	calculated
Averaging Time-Noncarcinogenic	ATn_vss	8,760	day	calculated
Averaging Time-Noncarcinogenic (child)	ATn_c_vss	2,190	day	calculated
Averaging Time-Noncarcinogenic (child+adult)	ATnc	10,950	day	calculated

[a] Carcinogenic or noncarcinogenic averaging times (Atc and Atnc, respectively) are used in equations, depending on whether carcinogenic or noncarcinogenic intakes are being calculated.

[b] Value is the 50th percentile of time spent for open space users (Jefferson County 1996).

[c] The adult skin-soil adherence factor is the EPA residential default and the 50th percentile for gardeners. This is the value recommended by CDPHE for use in the WRW PRGs.

[d] The child skin-soil adherence factor is the EPA residential default and the 95th percentile for children playing in wet soil. This is the value recommended by CDPHE for use in the open space user PRGs.

[e] The adult skin-surface area value is the EPA default for residential exposures and the average of the 50th percentile for males and females > 18 years old wearing short-sleeved shirts, shorts, and shoes. The value was recommended by CDPHE for use in the WRW PRGs.

Table 3.3
Chemical Exposure Factors Used in Surface Soil Intake Calculations for the Wildlife Refuge Visitor

Exposure Route/Exposure Factor	Abbreviation	Value	Units	Source

[f] The child skin-surface area value is the EPA default for residential exposures and the average of the 50th percentiles for males and females from <1 to <6 years old wearing short-sleeved shirts, shorts, and no shoes. The value was recommended by CDPHE for use in the WRW PRGs.

Table 4.1
Chemical Cancer Slope Factors, Weight of Evidence, and Target Organs for COCs

Contaminant of Concern[c]	CAS Number	Oral Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Dermal Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Inhalation Slope Factor $(mg/kg\text{-}day)^{-1}$	Source	Weight of Evidence[a]	Dermal Absorption Fraction[b]	Target Organ/Cancer	Source
Benzo(a)pyrene	50-32-8	7.3	I	7.3	O	3.1	P	B2	0.13	Tumors	A
2,3,7,8-TCDD TEQ	1746-01-6	150,000	H	150,000	O	150,000	H	B2	0.03	Liver	I

[a] See Table 5.1 in the CRA Methodology (DOE 2005) for definitions of Weight of Evidence classifications.

[b] Dermal ABS from EPA 2001.

[c] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8 and the toxicity criteria for 2,3,7,8-TCDD is used.
A = Agency for Toxic Substances and Disease Registry online database, http://www.atsdr.cdc.gov.
H = HEAST (EPA 1997a).
I - IRIS (EPA 2004a).
O = Oral slope factor used.
P = EPA-NCEA Provisional value (EPA 2004).

Table 4.2
Chemical Non-Cancer Reference Doses, Target Organs, and Effects for COCs

Contaminant of Concern[b]	CAS Number	Oral RfD (mg/kg-day)	Source	Dermal RfD (mg/kg-day)	Source	Inhalation RfD (mg/kg-day)	Source	Dermal Absorption Fraction[a]	Target Organ/Effect	Source
Benzo(a)pyrene	50-32-8	N/A	N/A	N/A	N/A	N/A	N/A	0.13	N/A	N/A
2,3,7,8-TCDD TEQ	1746-01-6	N/A	N/A	N/A	N/A	N/A	N/A	0.03	N/A	N/A

[a] Dermal ABS from EPA 2001.

[b] The TEQ for 2,3,7,8-TCDD is calculated in Table 1.8 and the toxicity criteria for 2,3,7,8-TCDD is used.

N/A = Not available or not applicable.

Table 5.1
Summary of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker

EPC/Medium/ Contaminant of Concern	Chemical Cancer Risk					Non-Cancer Hazard Quotient				
	Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Risk	Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Hazard Index
Tier 1										
Surface Soil/Surface Sediment										
2,3,7,8-TCDD TEQ	1.97E-06	1.17E-08	2.28E-07	2.21E-06	27%	NC	NC	NC	NC	NC
Benzo(a)pyrene	3.95E-06	9.93E-09	1.98E-06	5.94E-06	73%	NC	NC	NC	NC	NC
Surface Soil/Surface Sediment Total:				**8.15E-06**	**100%**				**NC**	**NC**
Tier 1 WRW Total:				**8E-06**					**NC**	
Tier 2										
Surface Soil/Surface Sediment										
2,3,7,8-TCDD TEQ	1.97E-06	1.17E-08	2.28E-07	2.21E-06	57%	NC	NC	NC	NC	NC
Benzo(a)pyrene	1.10E-06	2.76E-09	5.50E-07	1.65E-06	43%	NC	NC	NC	NC	NC
Surface Soil/Surface Sediment Total:				**3.86E-06**	**100%**				**NC**	**NC**
Tier 2 WRW Total:				**4E-06**					**NC**	

-- = Exposure route is not complete because no COCs identified or exposure route was identified as insignificant in the CRA Methodology.
NC = Not calculated, noncancer toxicity criteria were not available.

Table 5.2
Summary of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor

EPC/Medium/ Contaminant of Concern	Chemical Cancer Risk: Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Risk	Non-Cancer Hazard Quotient: Ingestion	Inhalation	Dermal	Exposure Routes Total	Percent Contribution to Hazard Index
Tier 1										
Surface Soil/Surface Sediment										
2,3,7,8-TCDD TEQ	1.83E-06	7.86E-09	3.47E-07	2.19E-06	25%	NC	NC	NC	NC	NC
Benzo(a)pyrene	3.67E-06	6.69E-09	3.02E-06	6.69E-06	75%	NC	NC	NC	NC	NC
Surface Soil/Surface Sediment Total:				**8.88E-06**	**100%**				**NC**	**NC**
Tier 1 WRV Total:				**9E-06**					**NC**	
Tier 2										
Surface Soil/Surface Sediment										
2,3,7,8-TCDD TEQ	1.83E-06	7.86E-09	3.47E-07	2.19E-06	54%	NC	NC	NC	NC	NC
Benzo(a)pyrene	1.02E-06	1.86E-09	8.37E-07	1.86E-06	46%	NC	NC	NC	NC	NC
Surface Soil/Surface Sediment Total:				**4.05E-06**	**100%**				**NC**	**NC**
Tier 2 WRV Total:				**4E-06**					**NC**	

-- = Exposure route is not complete because no COCs identified or exposure route was identified as insignificant in the CRA Methodology.
NC = Not calculated, noncancer toxicity criteria were not available.

Table 5.3
Summary of Risk Characterization Results

Exposure Scenario/EPC/Medium	Estimated Excess Lifetime Cancer Risk	Major Contributors to Chemical Cancer Risk	Estimated Non-Cancer Hazard Quotient	Major Contributors to Hazard Quotient
Wildlife Refuge Worker (WRW)				
Tier 1 EPC				
Surface Soil/Surface Sediment	8E-06	2,3,7,8-TCDD TEQ (27%)	NC	N/A
		Benzo(a)pyrene (73%)		
Tier 2 EPC				
Surface Soil/Surface Sediment	4E-06	2,3,7,8-TCDD TEQ (57%)	NC	N/A
		Benzo(a)pyrene (43%)		
Wildlife Refuge Visitor (WRV)				
Tier 1 EPC				
Surface Soil/Surface Sediment	9E-06	2,3,7,8-TCDD TEQ (25%)	NC	N/A
		Benzo(a)pyrene (75%)		
Tier 2 EPC				
Surface Soil/Surface Sediment	4E-06	2,3,7,8-TCDD TEQ (54%)	NC	N/A
		Benzo(a)pyrene (46%)		

NC = Not calculated, noncancer toxicity criteria were not available.
N/A = Not applicable.

Table 6.1
Detected PCOCs without PRGs in Each Medium by Analyte Suite[a]

Analyte	Surface Soil/ Surface Sediment	Subsurface Soil/ Subsurface Sediment
Inorganics		
Cesium	X	X
Phosphorus	N/A	X
Silica	X[b]	X[b]
Silicon	X[b]	X
Total Petroleum Hydrocarbons	N/A	X
Organics		
4-Chloro-3-methylphenol	N/A	X
Acenaphthylene	X	X
Benzo(g,h,i)perylene	X	X
Phenanthrene	X	X
Radionuclides		
Gross Alpha	X	X
Gross Beta	X	X

[a] Does not include essential nutrients or Dioxin/Furan congeners. Essential nutrients without PRGs were evaluated by comparing estimated intakes to recommended intakes. Dioxin and Furan congeners were evaluated by calculating the 2,3,7,8-TCDD Equivalents (TEQ), which are presented in Table 1.8.

b All detections are "J" qualified,; signifying that the reported resultis below the detection limit, but above the instrument detection limit.
X indicates PRG is unavailable.
N/A = Not applicable. Analyte not detected or not analyzed.

Table 7.1

Comparison of MDCs in Surface Soil to NOAEL ESLs for Terrestrial Plants, Invertebrates, and Vertebrates in the UWOEU

Analyte	MDC	Terrestrial Plants		Terrestrial Invertebrates		Mourning Dove Herbivore		Mourning Dove Insectivore		American Kestrel		Deer Mouse Herbivore		Deer Mouse Insectivore		Prairie Dog		Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor[a]		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	Results	
Inorganics (mg/kg)																													
Aluminum	30,000	50	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Plant	Yes
Ammonia	4.40	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7,320	No	586	No	26,700	No	37,000	No	2,250	No	2,310	No	2,540	No	N/A	N/A	Deer Mouse Insectivore	No
Antimony	49.8	5	Yes	78	No	N/A	N/A	N/A	N/A	N/A	N/A	9.89	Yes	0.905	Yes	18.7	Yes	57.6	No	138	No	13.2	Yes	3.85	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
Arsenic	10	10	Yes	60	No	20.0	No	164	No	1,030	No	2.57	Yes	51.4	No	9.35	Yes	13.0	No	709	No	341	No	293	No	N/A	N/A	Deer Mouse Herbivore	Yes
Barium	464	500	No	330	Yes	159	Yes	357	Yes	1,320	No	930	No	4,430	No	3,220	No	4,770	No	24,900	No	19,800	No	18,400	No	N/A	N/A	Mourning Dove Herbivore	Yes
Beryllium	4.40	10	No	40	No	N/A	N/A	N/A	N/A	N/A	N/A	160	No	6.82	No	211	No	896	No	1,070	No	103	No	29.2	No	N/A	N/A	Deer Mouse Insectivore	No
Boron	11	0.500	Yes	N/A	N/A	30.3	No	115	No	167	No	62.1	No	422	No	237	No	314	No	929	No	6,070	No	1,820	No	N/A	N/A	Terrestrial Plant	Yes
Cadmium	30	32	No	140	No	28.1	Yes	0.705	Yes	15.0	Yes	59.9	No	1.56	Yes	198	No	723	No	1,360	No	51.2	No	9.75	Yes	N/A	N/A	Mourning Dove Insectivore	Yes
Calcium	69,700	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Cesium	16.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Chromium[b]	61	1	Yes	0.400	Yes	24.6	Yes	1.34	Yes	14.0	Yes	281	No	15.9	Yes	703	No	1,460	No	4,170	No	250	No	68.5	No	N/A	N/A	Terrestrial Invertebrate	Yes
Cobalt	13.7	13	Yes	N/A	N/A	278	No	87.0	No	440	No	1,480	No	363	No	2,460	No	7,900	No	3,790	No	2,490	No	1,520	No	N/A	N/A	Terrestrial Plant	Yes
Copper	330	100	Yes	50	Yes	28.9	Yes	8.25	Yes	164	Yes	295	Yes	605	No	838	No	4,120	No	5,460	No	3,000	No	4,640	No	N/A	N/A	Mourning Dove Insectivore	Yes
Iron	29,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Lead	220	110	Yes	1,700	No	49.9	Yes	12.1	Yes	95.8	Yes	1,340	No	242	No	1,850	No	9,800	No	8,930	No	3,070	No	1,390	No	N/A	N/A	Mourning Dove Insectivore	Yes
Lithium	20	2	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,880	No	610	No	3,180	No	10,200	No	18,400	No	5,610	No	2,560	No	N/A	N/A	Plant	Yes
Magnesium	5,610	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Manganese	829	500	Yes	N/A	N/A	1,030	No	2,631	No	9,920	No	486	Yes	4,080	No	1,520	No	2,510	No	14,050	No	10,900	No	19,100	No	N/A	N/A	Deer Mouse Herbivore	Yes
Mercury	2.40	0.300	Yes	0.100	Yes	0.197	Yes	1.00E-04	Yes	1.57	Yes	0.439	Yes	0.179	Yes	3.15	No	7.56	No	8.18	No	8.49	No	37.3	No	N/A	N/A	Mourning Dove Insectivore	Yes
Molybdenum	5.90	2	Yes	N/A	N/A	44.4	No	6.97	No	76.7	No	8.68	No	1.90	Yes	27.1	No	44.3	No	275	No	28.9	No	8.18	No	N/A	N/A	Deer Mouse Insectivore	Yes
Nickel	48	30	Yes	200	No	44.1	Yes	1.24	Yes	13.1	Yes	16.4	Yes	0.431	Yes	38.3	Yes	124	No	90.9	No	6.02	Yes	1.86	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
Nitrate / Nitrite[c]	3.63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,478	No	7,650	No	16,200	No	22,700	No	32,879	No	32,200	No	32,900	No	N/A	N/A	Deer Mouse Herbivore	No
Potassium	4,460	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Selenium	1	1	Yes	70	No	1.61	No	1	Yes	8.48	No	0.872	Yes	0.754	Yes	2.80	No	3.82	No	32.5	No	12.2	No	5.39	No	N/A	N/A	Deer Mouse Insectivore	Yes
Silica	1,200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Silicon	1,560	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Silver	98	2	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Plant	Yes
Sodium	474	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Strontium	150	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	940	No	13,600	No	3,520	No	4,700	No	584,000	No	145,000	No	57,300	No	N/A	N/A	Deer Mouse Herbivore	No
Thallium	0.960	1	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	180	No	7.24	No	204	No	1,040	No	212	No	81.6	No	30.8	No	N/A	N/A	Terrestrial Plant	No
Tin	66.9	50	Yes	N/A	N/A	26.1	Yes	2.90	Yes	19.0	Yes	45.0	Yes	3.77	Yes	80.6	No	242	No	70.0	No	36.1	Yes	16.2	Yes	N/A	N/A	Mourning Dove Insectivore	Yes
Titanium	410	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Uranium	85	5	Yes	N/A	N/A	685	No	446	No	2,790	No	970	No	569	No	1,230	No	5,470	No	7,300	No	3,110	No	2,270	No	N/A	N/A	Terrestrial Plant	Yes
Vanadium	54.8	2	Yes	N/A	N/A	503	No	274	No	1,510	No	63.7	No	29.9	Yes	83.5	No	358	No	341	No	164	No	121	No	N/A	N/A	Terrestrial Plant	Yes
Zinc	650	50	Yes	200	Yes	109	Yes	0.646	Yes	113	Yes	171	Yes	5.29	Yes	1,170	No	2,770	No	16,500	No	3,890	No	431	Yes	N/A	N/A	Mourning Dove Insectivore	Yes
Organics (µg/kg)																													
1,2,4-Trichlorobenzene	0.950	N/A	N/A	20,000	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Invertebrate	No
1,2,4-Trimethylbenzene	1.50	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
2-Butanone	3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
2-Methylnaphthalene	12,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	92,700	No	2,770	Yes	319,000	No	471,000	No	12,300	No	12,200	No	12,000	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
4,4'-DDT	21	N/A	N/A	N/A	N/A	226	No	1.20	Yes	3.34	Yes	72,100	No	379	No	176,000	No	375,000	No	1,870	No	1,810	No	1,640	No	N/A	N/A	Mourning Dove Insectivore	Yes
4-Methyl-2-pentanone	4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	238,000	No	14,600	No	859,000	No	1.20E+06	No	58,400	No	59,600	No	63,400	No	N/A	N/A	Deer Mouse Insectivore	No
Acenaphthene	44,000	20,000	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Plant	Yes
Acenaphthalene	600	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Acetone	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	67,500	No	6,180	No	248,000	No	341,000	No	23,200	No	24,000	No	26,800	No	N/A	N/A	Deer Mouse Insectivore	No
Aldrin	17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,620	No	47	No	11,300	No	18,500	No	233	No	225	No	204	No	N/A	N/A	Deer Mouse Insectivore	No
Anthracene	47,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzene	1.20	500	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	30,700	No	14,900	No	1.10E+06	No	1.56E+06	No	61,800	No	62,400	No	64,700	No	N/A	N/A	Terrestrial Plant	No
Benzo(a)anthracene	45,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzo(a)pyrene	43,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	337,000	No	631	Yes	503,000	No	2.41E+06	No	3,060	Yes	2,970	Yes	2,760	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
Benzo(b)fluoranthene	49,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzo(g,h,i)perylene	28,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzo(k)fluoranthene	25,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzoic Acid	770	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Benzyl Alcohol	270	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	70,000	No	4,400	No	253,000	No	354,000	No	17,500	No	17,900	No	19,100	No	N/A	N/A	Deer Mouse Insectivore	No
bis(2-ethylhexyl)phthalate	3,500	N/A	N/A	N/A	N/A	19,500	No	137	Yes	398	Yes	960,000	No	8,070	No	2.76E+06	No	4.93E+06	No	42,300	No	40,200	No	35,000	No	N/A	N/A	Mourning Dove Insectivore	Yes
Butylbenzylphthalate	220	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.00E+06	No	24,200	No	3.37E+06	No	5.08E+06	No	110,000	No	109,000	No	105,000	No	N/A	N/A	Deer Mouse Insectivore	No
Carbazole	39	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Chrysene	46,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Di-n-butylphthalate	200	200,000	No	N/A	N/A	989	No	15.9	Yes	41.5	Yes	1.21E+07	No	281,000	No	4.06E+07	No	6.13E+07	No	1.29E+06	No	1.27E+06	No	1.22E+06	No	N/A	N/A	Mourning Dove Insectivore	Yes
Di-n-octylphthalate	83	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9.05E+07	No	731,000	No	2.58E+08	No	4.65E+08	No	3.85E+06	No	3.65E+06	No	3.17E+06	No	N/A	N/A	Deer Mouse Insectivore	No
Dibenz(a,h)anthracene	9,200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Dibenzofuran	20,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	707,000	No	21,200	No	2.44E+06	No	3.59E+06	No	93,800	No	93,200	No	91,800	No	N/A	N/A	Deer Mouse Insectivore	No
Dieldrin	34	N/A	N/A	N/A	N/A	178	No	9.87	Yes	25.7	Yes	81.4	No	7.40	Yes	301	No	411	No	33.6	Yes	33.2	Yes	32	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
Total Dioxin	1.31	N/A	N/A	N/A	N/A	0.194	Yes	0.0134	Yes	0.0775	Yes	0.0375	Yes	0.00425	Yes	0.116	Yes	0.192	Yes	0.0735	Yes	0.0339	Yes	0.01460	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
Endosulfan sulfate	24	N/A	N/A	N/A	N/A	71,400	No	1,510	No	3,810	No	2,520	No	80.1	No	8,730	No	12,800	No	352	No	350	No	347	No	N/A	N/A	Deer Mouse Insectivore	No
Endrin ketone	36	N/A	N/A	N/A	N/A	106	No	1.40	Yes	3.74	Yes	2,460	No	45.5	No	8,060	No	12,500	No	215	No	210	No	197	No	N/A	N/A	Mourning Dove Insectivore	Yes
Fluoranthene	140,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Fluorene	39,000	200,000	No	30,000	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Terrestrial Invertebrate	Yes
Heptachlor epoxide	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,710	No	64	No	9,120	No	13,800	No	293	No	289	No	277	No	N/A	N/A	Deer Mouse Insectivore	No
Indeno(1,2,3-cd)pyrene	32,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Isophorone	96	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT

Table 7.1
Comparison of MDCs in Surface Soil to NOAEL ESLs for Terrestrial Plants, Invertebrates, and Vertebrates in the UWOEU

Analyte	MDC	Terrestrial Plants		Terrestrial Invertebrates		Mourning Dove Herbivore		Mourning Dove Insectivore		American Kestrel		Deer Mouse Herbivore		Deer Mouse Insectivore		Prairie Dog		Mule Deer		Coyote Carnivore		Coyote Generalist		Coyote Insectivore		Terrestrial Receptor[a]		Most Sensitive Receptor	Retain for Further Analysis?
		NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	NOAEL	MDC > ESL?	Results	
Methoxychlor	450	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	70,500	No	1,230	No	22,900	No	35,900	No	5,840	No	5,690	No	5,310	No	N/A	N/A	Deer Mouse Insectivore	No
Methylene Chloride	2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	58,200	No	3,400	No	210,000	No	295,000	No	13,700	No	13,900	No	14,700	No	N/A	N/A	Deer Mouse Insectivore	No
Naphthalene	41,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8.08E+06	No	27,100	**Yes**	1.60E+07	No	5.57E+07	No	104,000	No	107,000	No	118,000	No	N/A	N/A	Deer Mouse Insectivore	**Yes**
Total PCBs	3,900	40,000	No	N/A	N/A	1,140	**Yes**	172	**Yes**	886	**Yes**	11,900	No	1,240	**Yes**	38,000	No	61,300	No	5,190	No	3,320	**Yes**	3,680	**Yes**	N/A	N/A	Mourning Dove Insectivore	**Yes**
Phenanthrene	170,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Phenol	80	70,000	No	30,000	No	N/A	N/A	N/A	N/A	N/A	N/A	41,500	No	23,100	No	1.49E+06	No	2.10E+06	No	93,600	No	95,100	No	100,000	No	N/A	N/A	Deer Mouse Insectivore	No
Pyrene	120,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Tetrachloroethene	6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Toluene	310	200,000	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	347,000	No	14,400	No	1.22E+06	No	1.76E+06	No	61,000	No	61,300	No	62,500	No	N/A	N/A	Deer Mouse Insectivore	No
Xylene[d]	2.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	32,000	No	1,140	No	11,200	No	16,200	No	4,930	No	4,930	No	4,940	No	N/A	N/A	Deer Mouse Insectivore	No
Radionuclides (pCi/g)																													
Americium-241	0.802	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,890	No	Terrestrial Receptors	No
Cesium-137	1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	20.8	No	Terrestrial Receptors	No
Gross Alpha	113	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Gross Beta	305	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Neptunium-237	0.00224	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Plutonium-238	0.0253	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	UT
Plutonium-239/240	5.01	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,110	No	Terrestrial Receptors	No
Radium-226	1.09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	50.6	No	Terrestrial Receptors	No
Radium-228	2.29	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	43.9	No	Terrestrial Receptors	No
Uranium-233/234	47.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,980	No	Terrestrial Receptors	No
Uranium-235	2.24	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,770	No	Terrestrial Receptors	No
Uranium-238	209	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,580	No	Terrestrial Receptors	No

[a]Radionuclide ESLs are not receptor-specific. They are considered protective of all terrestrial ecological species.

[b]The ESLs for chromium were developed using available toxicity data based on chromium (III) (birds) and chromium (VI) (plants, invertebrates, and mammals).

[c]The ESLs for nitrate are used.

[d]The value for total xylene is used

N/A = Indicates no ESL was available for that ECOI/receptor pair.

UT = Uncertain toxicity; no ESL available (assessed in Section 10).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.2
Summary of Non-PMJM NOAEL ESL Screening Results for Surface Soil in the UWOEU

Analyte	Terrestrial Plant Exceedance?	Terrestial Invertebrate Exceedance?	Terrestrial Vertebrate Exceedance?
Inorganics			
Aluminum	**Yes**	UT	UT
Ammonia	UT	UT	No
Antimony	**Yes**	No	**Yes**
Arsenic	**Yes**	No	**Yes**
Barium	No	**Yes**	**Yes**
Beryllium	No	No	No
Boron	**Yes**	UT	No
Cadmium	No	No	**Yes**
Calcium	UT	UT	UT
Cesium	UT	UT	UT
Chromium	**Yes**	**Yes**	**Yes**
Cobalt	**Yes**	UT	No
Copper	**Yes**	**Yes**	**Yes**
Iron	UT	UT	UT
Lead	**Yes**	No	**Yes**
Lithium	**Yes**	UT	No
Magnesium	UT	UT	UT
Manganese	**Yes**	UT	**Yes**
Mercury	**Yes**	**Yes**	**Yes**
Molybdenum	**Yes**	UT	**Yes**
Nickel	**Yes**	No	**Yes**
Nitrate / Nitrite	UT	UT	No
Potassium	UT	UT	UT
Selenium	**Yes**	No	**Yes**
Silica	UT	UT	UT
Silicon	UT	UT	UT
Silver	**Yes**	UT	UT
Sodium	UT	UT	UT
Strontium	UT	UT	No
Thallium	No	UT	No
Tin	**Yes**	UT	**Yes**
Titanium	UT	UT	UT
Uranium	**Yes**	UT	No
Vanadium	**Yes**	UT	**Yes**
Zinc	**Yes**	**Yes**	**Yes**
Organics			
1,2,4-Trichlorobenzene	UT	No	UT
1,2,4-Trimethylbenzene	UT	UT	UT
2-Butanone	UT	UT	UT
2-Methylnaphthalene	UT	UT	**Yes**
4,4'-DDT	UT	UT	**Yes**
4-Methyl-2-pentanone	UT	UT	No
Acenaphthene	**Yes**	UT	UT
Acenaphthaltene	UT	UT	UT
Acetone	UT	UT	No
Aldrin	UT	UT	No
Anthracene	UT	UT	UT

Table 7.2
Summary of Non-PMJM NOAEL ESL Screening Results for Surface Soil in the UWOEU

Analyte	Terrestrial Plant Exceedance?	Terrestial Invertebrate Exceedance?	Terrestrial Vertebrate Exceedance?
Benzene	No	UT	No
Benzo(a)anthracene	UT	UT	UT
Benzo(a)pyrene	UT	UT	**Yes**
Benzo(b)fluoranthene	UT	UT	UT
Benzo(g,h,i)perylene	UT	UT	UT
Benzo(k)fluoranthene	UT	UT	UT
Benzoic Acid	UT	UT	UT
Benzyl Alcohol	UT	UT	No
bis(2-ethylhexyl)phthalate	UT	UT	**Yes**
Butylbenzylphthalate	UT	UT	No
Carbazole	UT	UT	UT
Chrysene	UT	UT	UT
Di-n-butylphthalate	No	UT	**Yes**
Di-n-octylphthalate	UT	UT	No
Dibenz(a,h)anthracene	UT	UT	UT
Dibenzofuran	UT	UT	No
Dieldrin	UT	UT	**Yes**
Dioxin TEQ (mammals)	UT	UT	**Yes**
Dioxin TEQ (birds)	UT	UT	**Yes**
Endosulfan sulfate	UT	UT	No
Endrin ketone	UT	UT	**Yes**
Fluoranthene	UT	UT	UT
Fluorene	No	**Yes**	UT
Heptachlor epoxide	UT	UT	No
Indeno(1,2,3-cd)pyrene	UT	UT	UT
Isophorone	UT	UT	UT
Methoxychlor	UT	UT	No
Methylene Chloride	UT	UT	No
Naphthalene	UT	UT	**Yes**
Total PCBs	No	UT	**Yes**
Phenanthrene	UT	UT	UT
Phenol	No	No	No
Pyrene	UT	UT	UT
Tetrachloroethene	UT	UT	UT
Toluene	No	UT	No
Xylene	UT	UT	No
Radionuclides			
Americium-241	UT	UT	No
Cesium-137	UT	UT	No
Gross Alpha	UT	UT	UT
Gross Beta	UT	UT	UT
Neptunium-237	UT	UT	UT
Plutonium-238	UT	UT	UT
Plutonium-239/240	UT	UT	No
Radium-226	UT	UT	No
Radium-228	UT	UT	No
Uranium-233/234	UT	UT	No
Uranium-235	UT	UT	No
Uranium-238	UT	UT	No

UT - Uncertain toxicity; no ESL available (assessed in Section 10.0).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.3
Comparison of MDCs in Surface Soil with NOAEL ESLs for the PMJM in the UWOEU

Analyte	MDC	PMJM NOAEL ESL	MDC> PMJM ESL?
Inorganics (mg/kg)			
Aluminum	22,000	N/A	UT
Ammonia	4.40	673	No
Antimony	49.8	1	**Yes**
Arsenic	9.90	2.21	**Yes**
Barium	209	743	No
Beryllium	1.70	8.16	No
Boron	8.50	52.7	No
Cadmium	4.10	1.75	**Yes**
Calcium	27,000	N/A	UT
Cesium	16.4	N/A	UT
Chromium[a]	26	19.3	**Yes**
Cobalt	12.4	340	No
Copper	112	95	**Yes**
Iron	23,400	N/A	UT
Lead	40.2	220	No
Lithium	18.5	519	No
Magnesium	5,610	N/A	UT
Manganese	829	388	**Yes**
Mercury	0.370	0.0521	**Yes**
Molybdenum	4.40	1.84	**Yes**
Nickel	26.3	0.510	**Yes**
Nitrate / Nitrite[b]	3.63	2,910	No
Potassium	4,460	N/A	UT
Selenium	1	0.421	**Yes**
Silica	1,200	N/A	UT
Silicon	798	N/A	UT
Silver	12.6	N/A	UT
Sodium	403	N/A	UT
Strontium	94	833	No
Thallium	0.960	8.64	No
Tin	66.9	4.22	**Yes**
Titanium	410	N/A	UT
Uranium	26	370	No
Vanadium	53	21.6	**Yes**
Zinc	199	6.41	**Yes**
Organics (µg/kg)			
Acenaphthene	210	N/A	UT
Anthracene	280	N/A	UT
Benzo(a)anthracene	780	N/A	UT
Benzo(a)pyrene	790	800	No
Benzo(b)fluoranthene	1,300	N/A	UT
Benzo(g,h,i)perylene	83	N/A	UT
Benzo(k)fluoranthene	150	N/A	UT
bis(2-ethylhexyl)phthalate	210	10,200	No
Butylbenzylphthalate	220	29,800	No

Table 7.3
Comparison of MDCs in Surface Soil with NOAEL ESLs for the PMJM in the UWOEU

Analyte	MDC	PMJM NOAEL ESL	MDC> PMJM ESL?
Chrysene	820	N/A	UT
Di-n-butylphthalate	40	347,000	No
Fluoranthene	2,100	N/A	UT
Fluorene	160	N/A	UT
Indeno(1,2,3-cd)pyrene	140	N/A	UT
Total PCBs	3,900	1,350	**Yes**
Phenanthrene	1,300	N/A	UT
Pyrene	1,600	N/A	UT
Radionuclides (pCi/kg)			
Americium-241	0.139	3,890	No
Gross Alpha	114	N/A	UT
Gross Beta	305	N/A	UT
Plutonium-239/240	1,310	6,110	No
Uranium-233/234	47.5	4,980	No
Uranium-235	2.24	2,770	No
Uranium-238	210	1,580	No

[a]The ESL for chromium (VI) was used.

[b]The ESLs for nitrate are used.

N/A = No ESL available for the ECOI/receptor pair.

UT = Uncertain toxicity; no ESLs available (assessed in Section 10).

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.4
Statistical Distributions and Comparison to Background for Surface Soil in the UWOEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWOEU					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Inorganics									
Aluminum	20	NORMAL	100	130	GAMMA	100	WRS	0.364	No
Antimony	20	NON-PARAMETRIC	0	120	NON-PARAMETRIC	7	N/A	N/A	**Yes**[a]
Arsenic	20	NORMAL	100	130	NORMAL	100	t-Test_N	0.978	No
Barium	20	NORMAL	100	130	GAMMA	100	WRS	0.0330	**Yes**
Boron	N/A	N/A	N/A	18	NORMAL	72	N/A	N/A	**Yes**[a]
Cadmium	20	NON-PARAMETRIC	65	120	NON-PARAMETRIC	31	WRS	0.995	No
Chromium	20	NORMAL	100	130	GAMMA	99	WRS	0.187	No
Cobalt	20	NORMAL	100	130	NORMAL	88	t-Test_N	0.416	No
Copper	20	NON-PARAMETRIC	100	130	NON-PARAMETRIC	99	WRS	0.0120	**Yes**
Lead	20	NORMAL	100	135	LOGNORMAL	100	WRS	1	No
Lithium	20	NORMAL	100	128	GAMMA	92	WRS	0.541	No
Manganese	20	NORMAL	100	130	GAMMA	100	WRS	0.285	No
Mercury	20	NON-PARAMETRIC	40	128	NON-PARAMETRIC	47	WRS	0.898	No
Molybdenum	20	NORMAL	0	128	NON-PARAMETRIC	19	N/A	N/A	**Yes**[a]
Nickel	20	NORMAL	100	129	NON-PARAMETRIC	96	WRS	5.40E-04	**Yes**
Selenium	20	NON-PARAMETRIC	60	120	NON-PARAMETRIC	36	WRS	1	No
Silver	20	NORMAL	0	117	NON-PARAMETRIC	24	N/A	N/A	**Yes**[a]
Tin	20	NORMAL	0	129	NON-PARAMETRIC	12	N/A	N/A	**Yes**[a]
Uranium	N/A	N/A	N/A	18	NON-PARAMETRIC	39	N/A	N/A	**Yes**[a]
Vanadium	20	NORMAL	100	130	GAMMA	100	WRS	0.0960	**Yes**
Zinc	20	NORMAL	100	130	NON-PARAMETRIC	100	WRS	0.456	No

[a] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.
WRS = Wilcoxon Rank Sum
t-Test_N = Student's t-test using normal data
N/A = Not applicable; background data not available or not detected.
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.5

Statistical Distributions and Comparison to Background for Surface Soil in PMJM Habitat in the UWOEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWOEU					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Inorganics									
Antimony	20	NON-PARAMETRIC	0	29	NON-PARAMETRIC	13.8	N/A	N/A	**Yes**[a]
Arsenic	20	NORMAL	100	34	NORMAL	100	t-Test N	0.951	No
Cadmium	20	NON-PARAMETRIC	65	32	NON-PARAMETRIC	34.4	WRS	0.856	No
Chromium	20	NORMAL	100	34	NORMAL	100	t-Test N	0.00300	**Yes**
Copper	20	NON-PARAMETRIC	100	34	NON-PARAMETRIC	100	WRS	0.00200	**Yes**
Manganese	20	NORMAL	100	34	GAMMA	100	WRS	0.0170	**Yes**
Mercury	20	NON-PARAMETRIC	40	33	NON-PARAMETRIC	57.6	WRS	0.609	No
Molybdenum	20	NORMAL	0	33	LOGNORMAL	18.2	N/A	N/A	**Yes**[a]
Nickel	20	NORMAL	100	33	NORMAL	90.9	t-Test N	9.00E-04	**Yes**
Selenium	20	NON-PARAMETRIC	60	33	NON-PARAMETRIC	39.4	WRS	1	No
Tin	20	NORMAL	0	34	LOGNORMAL	17.7	N/A	N/A	**Yes**[a]
Vanadium	20	NORMAL	100	34	NON-PARAMETRIC	100	t-Test N	0.0170	**Yes**
Zinc	20	NORMAL	100	34	LOGNORMAL	100	WRS	0.0100	**Yes**

[a] Statistical comparisons to background cannot be performed. The analyte is retained for further evaluation.

WRS = Wilcoxon Rank Sum

t-Test_N = Student's t-test using normal data

N/A = Not applicable; background data not available or not detected.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.6
Statistical Concentrations in Surface Soil (Non-PMJM) in the UWOEU[a]

Analyte	Total Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th Percentile	95th Percentile	UCL	UTL	MDC
Inorganics (mg/kg)										
Antimony	120	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	4.53	2.90	6.35	7.40	7.86	7.35	49.8
Barium	130	95% Approximate Gamma UCL	GAMMA	122	120	142	205	129	199	464
Boron	18	95% Student's-t UCL	NORMAL	5.21	5.65	6.48	8.88	6.36	10.7	11
Copper	130	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	24.6	15.2	20.3	75.4	38.5	68.3	330
Molybdenum	128	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	1.14	0.800	1.40	2.22	1.50	2.15	5.90
Nickel	129	95% Student's-t UCL	NON-PARAMETRIC	13.2	12.7	15.6	21.2	14	21.1	48
Silver	117	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	2.47	0.425	0.650	3.60	9.69	3.30	98
Tin	129	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	6.28	2.80	5.30	38.3	12.7	21.1	66.9
Uranium	18	99% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	8.60	0.800	7.25	34.8	55.8	85	85
Vanadium	130	95% Approximate Gamma UCL	GAMMA	30.7	29.9	35.5	47.7	32.1	47	54.8
Organics (µg/kg)										
2-Methylnaphthalene	88	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	406	205	380	451	989	460	12,000
Acenapthene	101	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	765	220	405	700	2,653	700	44,000
Benzo(a)pyrene	98	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	810	235	400	1,200	2,719	1,200	43,000
bis(2-ethylhexyl)phthalate	89	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	273	200	370	425	443	410	3,500
Di-n-butylphthalate	89	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	250	200	375	410	302	410	480
Dioxin - TEQ (mammals)	10	95% Adjusted Gamma UCL	GAMMA	0.0110	0.00300	0.00500	0.0460	0.0550	0.0739	0.0739
Dioxin - TEQ (birds)	10	95% Adjusted Gamma UCL	GAMMA	0.0180	0.00500	0.00900	0.0780	0.0960	0.126	0.126
Fluorene	106	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	614	200	370	454	2,211	435	39,000
Naphthalene	113	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	696	220	405	720	2,951	700	41,000
PCBs - Total	90	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	331	173	199	1,465	727	1,300	3,900

[a] For inorganics and organics, one-half the detection limit used as proxy value for nondetects in computation of the statistical concentrations.
MDC = Maximum detected concentration or in some cases, maximum proxy result.
UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then MDC is used as the UCL.
UTL = 95% upper confidence limit on the 90th percentile value, unless the MDC< UTL than the MDC is used as the UTL.

Table 7.7
Upper-Bound Exposure Point Concentration Comparison to Limiting ESLs in the UWOEU

Analyte	Small Home Range Receptors			Large Home Range Receptors		
	EPC (UTL)	Limiting ESL[1]	EPC>ESL?	EPC (UCL)	Limiting ESL[2]	EPC>ESL?
Inorganics (mg/kg)						
Antimony	7.35	0.900	**Yes**	7.86	3.85	**Yes**
Barium	199	222	No	129	4,766	No
Boron	10.7	0.500	**Yes**	6.36	314	No
Copper	68.3	8.25	**Yes**	38.5	3,000	No
Molybdenum	2.15	1.90	**Yes**	1.50	8.18	No
Nickel	21.1	0.430	**Yes**	14	1.86	**Yes**
Silver	3.30	2	**Yes**	9.69	N/A	N/A
Tin	21.1	2.90	**Yes**	12.7	16	No
Uranium	85	5	**Yes**	55.8	2,270	No
Vanadium	47	2	**Yes**	32.1	121	No
Organics (µg/kg)						
2-methylnaphthalene	460	4,030	No	989	12,000	No
Acenaphthene	700	20,000	No	2,653	N/A	N/A
Benzo(a)pyrene	1,200	3,160	No	2,719	2,760	No
bis(2-ethylhexyl)phthalate	410	137	**Yes**	443	35,000	No
Di-n-butylphthalate	410	15.9	**Yes**	302	1.22E+06	No
Dioxin - TEQ (mammals)	0.0739	0.00425	**Yes**	0.0550	0.0146	**Yes**
Dioxin - TEQ (birds)	0.126	0.0134	**Yes**	0.0960	N/A	N/A
Fluorene	435	30,000	No	2,211	N/A	N/A
Napthalene	700	27,100	No	2,951	104,000	No
Total PCBs	1,300	42.3	**Yes**	727	3,320	No

[a]Lowest ESL (threshold if available) for the plant, invertebrate, deer mouse, prairie dog, dove, or kestrel receptors.

[b]Lowest ESL (threshold if available) for the coyote and mule deer receptors.

N/A = not applicable, ESL not available

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.8
Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Small Home-Range Receptors in the UWOEU

Analyte	Small Home Range Receptor UTL	Receptor-Specific ESLs[a]							
		Terrestrial Plant	Terrestrial Invertebrate	American Kestrel	Mourning Dove (herbivore)	Mourning Dove (insectivore)	Deer Mouse (herbivore)	Deer Mouse (insectivore)	Prairie Dog
Inorganics (mg/kg)									
Antimony	7.35	**5**	78	N/A	N/A	N/A	9.89	**0.905**	18.7
Boron	10.7	**0.500**	N/A	167	30.3	115	62.1	422	237
Copper	68.3	100	50	164	**28.9**	**8.25**	295	605	838
Molybdenum	2.15	**2**	N/A	76.7	44.4	6.97	8.68	**1.90**	27.1
Nickel	21.1	30	200	89.9	320	**7.84**	**16.4**	**0.430**	38.3
Silver	3.30	**2**	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tin	21.1	50	N/A	**19**	26.1	**2.90**	45	**3.77**	80.6
Uranium	85	**5**	N/A	2,790	685	446	970	569	1,230
Vanadium	47	**2**	N/A	1,150	503	274	63.7	**29.9**	83.5
Organics (µg/kg)									
bis(2-ethylhexyl)phthalate	410	N/A	N/A	**398**	19,500	**137**	960,000	8,070	2.76E+06
Di-n-butylphthalate	410	200,000	N/A	**41.5**	989	**15.9**	1.21E+07	281,000	4.06E+07
2,3,7,8-TCDD TEQ (mammals)	0.0739	N/A	N/A	N/A	N/A	N/A	**0.0375**	**0.00425**	0.116
Dioxin - TEQ (birds)	0.126	N/A	N/A	**0.0775**	0.194	**0.0134**	N/A	N/A	N/A
PCBs - Total	1,300	40,000	N/A	**42.3**	**1,140**	**172**	17,000	1,610	53,200

[a]Lowest ESL (threshold if available) for that receptor.
N/A = Not applicable; ESL not available (assessed in Section 10).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.9
Upper-Bound Exposure Point Concentration Comparison to Receptor-Specific ESLs for Large Home-Range Receptors in the UWOEU

Analyte	Large Home-Range Receptor UCL	Receptor-Specific ESLs[a]			
		Mule Deer	Coyote (carnivore)	Coyote (generalist)	Coyote (insectivore)
Inorganics (mg/kg)					
Antimony	7.86	57.6	138	13.2	**3.85**
Nickel	14	124	90.9	**6.02**	**1.86**
Organics (µg/kg)					
Dioxin - TEQ (mammal)	0.0550	0.192	0.0735	**0.0339**	**0.0146**

[a]Lowest ESL (threshold if available) for that receptor.

Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.10
Summary of ECOPC Screening Steps for Surface Soil Non-PMJM Receptors in the UWOEU

Analyte	Exceeds Any NOAEL ESL?	Detection Frequency >5%?	Exceeds Background[a]?	Upper Bound EPC > Limiting ESL	Professional Judgment Retain?	ECOPC?	Receptor(s) of Potential Concern
Inorganics							
Aluminum	Yes	Yes	No	--	--	No	--
Ammonia	No	--	--	--	--	No	--
Antimony	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Terrestrial Plant** **Deer Mouse (insectivore)** **Coyote (insectivore)**
Arsenic	Yes	Yes	No	--	--	No	--
Barium	Yes	Yes	Yes	No	--	No	--
Beryllium	No	--	--	--	--	No	--
Boron	Yes	Yes	N/A	Yes	No	No	--
Cadmium	Yes	Yes	No	--	--	No	--
Calcium	N/A	--	--	--	--	No	--
Cesium	N/A	--	--	--	--	No	--
Chromium	Yes	Yes	No	--	--	No	--
Cobalt	Yes	Yes	No	--	--	No	--
Copper	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Mourning dove (herbivore)** **Mourning dove (insectivore)**
Iron	N/A	--	--	--	--	No	--
Lead	Yes	Yes	No	--	--	No	--
Lithium	Yes	Yes	No	--	--	No	--
Magnesium	N/A	--	--	--	--	No	--
Manganese	Yes	Yes	No	--	--	No	--
Mercury	Yes	Yes	No	--	--	No	--
Molybdenum	Yes	Yes	N/A	Yes	No	No	--
Nickel	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Mourning dove (insectivore)** **Deer mouse (herbivore)** **Deer mouse (insectivore)** **Coyote (generalist)** **Coyote (insectivore)**
Nitrate / Nitrite	No	--	--	--	--	No	--
Potassium	N/A	--	--	--	--	No	--
Selenium	Yes	Yes	No	--	--	No	--
Silica	N/A	--	--	--	--	No	--
Silicon	N/A	--	--	--	--	No	--
Silver	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Terrestrial plant**
Sodium	N/A	--	--	--	--	No	--
Strontium	No	--	--	--	--	No	--
Thallium	No	--	--	--	--	No	--
Tin	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel** **Mourning dove (insectivore)** **Deer mouse (insectivore)**
Titanium	N/A	--	--	--	--	No	--
Uranium	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Terrestrial plant**
Vanadium	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Terrestrial plant** **Deer Mouse (insectivore)**
Zinc	Yes	Yes	No	--	--	No	--
Organics							
1,2,4-Trichlorobenzene	No	--	--	--	--	No	--
1,2,4-Trimethylbenzene	N/A	--	--	--	--	No	--
2-Butanone	N/A	--	--	--	--	No	--
2-Methylnaphthalene	Yes	Yes	N/A	No	--	No	--
4,4'-DDT	Yes	No	--	--	--	No	--
4-Methyl-2-pentanone	No	--	--	--	--	No	--
Acenaphthene	Yes	Yes	N/A	No	--	No	--
Acetone	No	--	--	--	--	No	--
Aldrin	No	--	--	--	--	No	--
Anthracene	N/A	--	--	--	--	No	--
Benzene	No	--	--	--	--	No	--
Benzo(a)anthracene	N/A	--	--	--	--	No	--
Benzo(a)pyrene	Yes	Yes	N/A	No	--	No	--
Benzo(b)fluoranthene	N/A	--	--	--	--	No	--
Benzo(g,h,i)perylene	N/A	--	--	--	--	No	--

Table 7.10
Summary of ECOPC Screening Steps for Surface Soil Non-PMJM Receptors in the UWOEU

Analyte	Exceeds Any NOAEL ESL?	Detection Frequency >5%?	Exceeds Background[a]?	Upper Bound EPC > Limiting ESL	Professional Judgment Retain?	ECOPC?	Receptor(s) of Potential Concern
Benzo(k)fluoranthene	N/A	--	--	--	--	No	--
Benzoic Acid	N/A	--	--	--	--	No	--
Benzyl Alcohol	No	--	--	--	--	No	--
bis(2-ethylhexyl)phthalate	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel** **Mourning dove (insectivore)**
Butylbenzylphthalate	No	--	--	--	--	No	--
Carbazole	N/A	--	--	--	--	No	--
Chrysene	N/A	--	--	--	--	No	--
Di-n-butylphthalate	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel** **Mourning dove (insectivore)**
Di-n-octylphthalate	No	--	--	--	--	No	--
Dibenz(a,h)anthracene	N/A	--	--	--	--	No	--
Dibenzofuran	No	--	--	--	--	No	--
Dieldrin	Yes	No	--	--	--	No	--
Dioxin TEQ (mammals)	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Deer mouse (herbivore)** **Deer mouse (insectivore)** **Coyote (insectivore)** **Coyote (generalist)**
Dioxin TEQ (birds)	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel** **Mourning dove (insectivore)**
Endosulfan sulfate	No	--	--	--	--	No	--
Endrin ketone	Yes	No	--	--	--	No	--
Fluoranthene	N/A	--	--	--	--	No	--
Fluorene	Yes	Yes	N/A	No	--	No	--
Heptachlor epoxide	No	--	--	--	--	No	--
Indeno(1,2,3-cd)pyrene	N/A	--	--	--	--	No	--
Isophorone	N/A	--	--	--	--	No	--
Methoxychlor	No	--	--	--	--	No	--
Methylene Chloride	No	--	--	--	--	No	--
Naphthalene	Yes	Yes	N/A	No	--	No	--
PCBs - Total	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel** **Mourning dove (herbivore)** **Mourning dove (insectivore)**
Phenanthrene	N/A	--	--	--	--	No	--
Phenol	No	--	--	--	--	No	--
Pyrene	N/A	--	--	--	--	No	--
Tetrachloroethene	N/A	--	--	--	--	No	--
Toluene	No	--	--	--	--	No	--
Xylene	No	--	--	--	--	No	--
Radionuclides							
Americium-241	No	--	--	--	--	No	--
Cesium-137	No	--	--	--	--	No	--
Gross Alpha	N/A	--	--	--	--	No	--
Gross Beta	N/A	--	--	--	--	No	--
Neptunium-237	N/A	--	--	--	--	No	--
Plutonium-238	N/A	--	--	--	--	No	--
Plutonium-239/240	No	--	--	--	--	No	--
Radium-226	No	--	--	--	--	No	--
Radium-228	No	--	--	--	--	No	--
Uranium-233/234	No	--	--	--	--	No	--
Uranium-235	No	--	--	--	--	No	--
Uranium-238	No	--	--	--	--	No	--

[a] Based on results of statistical analysis at the 0.1 level of significance.
-- = Screen not performed because ECOI was eliminated from further consideration in a previous step.
N/A = Not applicable; background comparison could not be conducted.
UT = Uncertain toxicity; no ESL available (assessed in Section 10).
Bold = Chemicals retained as ECOPCs for further risk characterization.

Table 7.11
Summary of ECOPC Screening Steps for Surface Soil PMJM Receptors in the UWOEU

Analyte	Exceed PMJM NOAEL ESL?	Exceeds Background?	Professional Judgment - Retain?	ECOPC?
Inorganics				
Aluminum	UT	--	--	No
Ammonia	No	--	--	No
Antimony	**Yes**	**N/A**	**Yes**	**Yes**
Arsenic	Yes	No	--	No
Barium	No	--	--	No
Beryllium	No	--	--	No
Boron	No	--	--	No
Cadmium	Yes	No	--	No
Calcium	UT	--	--	No
Cesium	UT	--	--	No
Chromium	**Yes**	**Yes**	**Yes**	**Yes**
Cobalt	No	--	--	No
Copper	**Yes**	**Yes**	**Yes**	**Yes**
Iron	UT	--	--	No
Lead	No	--	--	No
Lithium	No	--	--	No
Magnesium	UT	--	--	No
Manganese	**Yes**	**Yes**	**Yes**	**Yes**
Mercury	Yes	No	--	No
Molybdenum	**Yes**	**N/A**	**Yes**	**Yes**
Nickel	**Yes**	**Yes**	**Yes**	**Yes**
Nitrate / Nitrite	No	--	--	No
Potassium	UT	--	--	No
Selenium	Yes	No	--	No
Silica	UT	--	--	No
Silicon	UT	--	--	No
Silver	UT	--	--	No
Sodium	UT	--	--	No
Strontium	No	--	--	No
Thallium	No	--	--	No
Tin	**Yes**	**N/A**	**Yes**	**Yes**
Titanium	UT	--	--	No
Uranium	No	--	--	No
Vanadium	**Yes**	**Yes**	**Yes**	**Yes**
Zinc	**Yes**	**Yes**	**Yes**	**Yes**
Organics				
Acenaphthene	UT	--	--	No
Anthracene	UT	--	--	No
Benzo(a)anthracene	UT	--	--	No
Benzo(a)pyrene	No	--	--	No
Benzo(b)fluoranthene	UT	--	--	No
Benzo(g,h,i)perylene	UT	--	--	No
Benzo(k)fluoranthene	UT	--	--	No
bis(2-ethylhexyl)phthalate	No	--	--	No
Butylbenzylphthalate	No	--	--	No
Chrysene	UT	--	--	No
Di-n-butylphthalate	No	--	--	No
Fluoranthene	UT	--	--	No
Fluorene	UT	--	--	No
Indeno(1,2,3-cd)pyrene	UT	--	--	No
PCBs - Total	**Yes**	**N/A**	**Yes**	**Yes**
Phenanthrene	UT	--	--	No
Pyrene	UT	--	--	No
Radionuclides				
Americium-241	No	--	--	No
Gross Alpha	UT	--	--	No
Gross Beta	UT	--	--	No
Plutonium-239/240	No	--	--	No
Uranium-233/234	No	--	--	No
Uranium-235	No	--	--	No
Uranium-238	No	--	--	No

-- = Screen not performed because ECOI was eliminated from further consideration in a previous step.
N/A = Not applicable; background comparison could not be conducted.
UT = Uncertain toxicity; no ESL available (assessed in Section 10).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.12
Comparison of MDCs in Subsurface Soil to NOAEL ESLs for Burrowing Receptors in the UWOEU

Analyte	MDC	Prairie Dog NOAEL ESL	MDC > ESL?
Inorganics (mg/kg)			
Aluminum	32,800	N/A	UT
Antimony	149	18.7	**Yes**
Arsenic	24.3	9.35	**Yes**
Barium	1,610	3,224	No
Beryllium	446	211	**Yes**
Boron	4.70	237	No
Cadmium	71	198	No
Calcium	60,000	N/A	UT
Cesium	29.6	N/A	UT
Chromium[a]	8,310	703	**Yes**
Cobalt	701	2,461	No
Copper	8,850	838	**Yes**
Iron	107,000	N/A	UT
Lead	5,200	1,850	**Yes**
Lithium	29	3,178	No
Magnesium	9,480	N/A	UT
Manganese	2,150	1,519	**Yes**
Mercury	1.40	3.15	No
Molybdenum	470	27.1	**Yes**
Nickel	4,750	38.3	**Yes**
Phosphorus	975	N/A	UT
Potassium	4,190	N/A	UT
Selenium	80.8	2.80	**Yes**
Silica	850	N/A	UT
Silicon	1,120	N/A	UT
Silver	311	N/A	UT
Sodium	3,360	N/A	UT
Strontium	170	3,519	No
Thallium	6.30	204	No
Tin	579	80.6	**Yes**
Titanium	283	N/A	UT
Uranium	5.50	1,226	No
Vanadium	74.4	83.5	No
Zinc	6,920	1,174	**Yes**
Organics (µg/kg)			
1,1,1-Trichloroethane	2	4.85E+07	No
1,2,4-Trimethylbenzene	60	N/A	UT
1,2-Dichlorobenzene	30	N/A	UT
1,3-Dichlorobenzene	20	N/A	UT
1,4-Dichlorobenzene	10	N/A	UT
2-Butanone	8	N/A	UT
2-Chlorophenol	10	21,600	No
2-Methylnaphthalene	15,000	319,000	No
3,3'-Dichlorobenzidine	160	N/A	UT
4-Chloro-3-methylphenol	10	N/A	UT
4-Methyl-2-pentanone	2	859,000	No
Acenaphthene	31,000	N/A	UT
Acenaphthalene	47	N/A	UT
Acetone	330	248,000	No
alpha-BHC	15	2.47E+06	No
Anthracene	46,000	N/A	UT
Benzo(a)anthracene	48,000	N/A	UT
Benzo(a)pyrene	43,000	503,000	No
Benzo(b)fluoranthene	48,000	N/A	UT
Benzo(g,h,i)perylene	19,000	N/A	UT
Benzo(k)fluoranthene	19,000	N/A	UT
Benzoic Acid	260	N/A	UT
bis(2-ethylhexyl)phthalate	540	2.76E+06	No
Bromoform	2	199,000	No
Butylbenzylphthalate	1,400	3.37E+06	No
Chrysene	53,000	N/A	UT
cis-1,2-Dichloroethene	10.1	133,000	No
Di-n-butylphthalate	2,700	4.06E+07	No
Di-n-octylphthalate	50	2.58E+08	No
Dibenz(a,h)anthracene	890	N/A	UT

Table 7.12
Comparison of MDCs in Subsurface Soil to NOAEL ESLs for Burrowing Receptors in the UWOEU

Analyte	MDC	Prairie Dog NOAEL ESL	MDC > ESL?
Dibenzofuran	20,000	2.44E+06	No
Diethylphthalate	250	2.21E+08	No
Dioxin TEQ - mammals	0.00200	0.116	No
Fluoranthene	160,000	N/A	UT
Fluorene	35,000	N/A	UT
Heptachlor epoxide	11	9,120	No
Hexachlorobenzene	30	190,000	No
Indeno(1,2,3-cd)pyrene	22,000	N/A	UT
Isophorone	82	N/A	UT
Methylene Chloride	67	210,000	No
Naphthalene	61,000	1.60E+07	No
PCBs - Total	1,300	38,000	No
Pentachlorophenol	160	18,400	No
Phenanthrene	220,000	N/A	UT
Phenol	140	1.49E+06	No
Pyrene	150,000	N/A	UT
Tetrachloroethane	920	72,500	No
Toluene	420	1.22E+06	No
Trichloroethene	440	32,400	No
Radionuclides (pCi/g)			
Americium-241	2.97	3,890	No
Cesium-137	0.0720	20.8	No
Gross Alpha	742	N/A	UT
Gross Beta	1,580	N/A	UT
Plutonium-238	9.84	N/A	UT
Plutonium-239/240	5.16	6,110	No
Radium-226	2.09	50.6	No
Radium-228	2.79	43.9	No
Strontium-89/90	0.969	22.5	No
Uranium-233/234	288	4,980	No
Uranium-235	37.7	2,770	No
Uranium-238	1,160	1,580	No

[a] Chromium ESL is based on Chromium VI.
N/A = No ESL was available for that ECOI/receptor pair.
UT = Uncertain toxicity; no ESL available (assessed in Section 10).
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.13
Statistical Distributions and Comparison to Background for Subsurface Soil in the UWOEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			UWOEU[a]					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Antimony	28	NON-PARAMETRIC	7	229	NON-PARAMETRIC	21	N/A	N/A	**Yes[a]**
Arsenic	45	NON-PARAMETRIC	93	252	NON-PARAMETRIC	100	WRS	0.760	No
Beryllium	45	GAMMA	96	257	NON-PARAMETRIC	76	WRS	1	No
Chromium	45	GAMMA	100	252	NON-PARAMETRIC	100	WRS	0.794	No
Copper	45	NORMAL	96	252	NON-PARAMETRIC	97	WRS	4.49E-07	**Yes**
Lead	45	GAMMA	100	257	NON-PARAMETRIC	100	WRS	0.102	No
Manganese	45	GAMMA	100	252	GAMMA	100	WRS	6.70E-05	**Yes**
Molybdenum	45	NON-PARAMETRIC	67	251	NON-PARAMETRIC	24	WRS	1	No
Nickel	44	GAMMA	100	252	NON-PARAMETRIC	96	WRS	0.979	No
Selenium	38	LOGNORMAL	0	247	NON-PARAMETRIC	14	N/A	N/A	**Yes[a]**
Tin	41	NON-PARAMETRIC	37	251	NON-PARAMETRIC	9	N/A	N/A	**Yes[a]**
Zinc	44	NORMAL	100	252	NON-PARAMETRIC	100	WRS	4.86E-04	**Yes**

[a] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.
N/A = Not applicable; background data not available or not detected.
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.14
Statistical Concentrations in Subsurface Soil in the UWOEU[a]

Analyte	Number of Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75th Percentile	95th Percentile	UCL	UTL	MDC
Inorganics (mg/kg)										
Antimony	229	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	7	5.10	7.10	18.1	11.9	15.8	149
Copper	252	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	140	16.9	22.2	376	440	92	8,850
Manganese	252	95% Approximate Gamma UCL	GAMMA	279	220	344	782	302	617	2,150
Selenium	247	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	0.569	0.120	0.270	0.486	2	0.460	80.8
Tin	251	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	8.73	3.85	4.55	22.5	19.4	12.3	579
Zinc	252	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	137	48.5	61.2	510	337	213	6,920

[a] For inorganics and organics, one-half the detection limit used as proxy value for nondetects in computation of the statistical concentrations.

MDC = Maximum detected concentration or in some cases, maximum proxy result.

UCL = 95% upper confidence limit on the mean, unless the MDC < UCL, then MDC is used as the UCL.

UTL = 95% upper confidence limit on the 90th percentile value, unless the MDC< UTL than the MDC is used as the UTL.

Table 7.15
Upper-Bound Exposure Point Concentration Comparison to tESLs in the UWOEU

Analyte	Burrowing Receptor		
	EPC (UTL)	tESL[a]	EPC>ESL?
Inorganics (mg/kg)			
Antimony	15.8	18.7	No
Copper	92	838	No
Manganese	617	1,519	No
Selenium	0.460	2.80	No
Tin	12.3	80.6	No
Zinc	213	1,170	No

[a] Threshold ESL (if available) for the prairie dog receptor.

Table 7.16
Summary of ECOPC Screening Steps for Subsurface Soil in the UWOEU

Analyte	Exceed Prairie Dog NOAEL ESL ?	Frequency of Detection >5%?	Exceeds Background?[a]	Upper Bound EPC > Limiting ESL?	Professional Judgment - Retain?	Retain as ECOPC?
Inorganics						
Aluminum	UT	--	--	--	--	No
Antimony	Yes	Yes	N/A	No	--	No
Arsenic	Yes	Yes	No	--	--	No
Barium	No	--	--	--	--	No
Beryllium	Yes	Yes	No	--	--	No
Boron	No	--	--	--	--	No
Cadmium	No	--	--	--	--	No
Calcium	UT	--	--	--	--	No
Cesium	UT	--	--	--	--	No
Chromium	Yes	Yes	No	--	--	No
Cobalt	No	--	--	--	--	No
Copper	Yes	Yes	Yes	No	--	No
Iron	UT	--	--	--	--	No
Lead	Yes	Yes	No	--	--	No
Lithium	No	--	--	--	--	No
Magnesium	UT	--	--	--	--	No
Manganese	Yes	Yes	Yes	No	--	No
Mercury	No	--	--	--	--	No
Molybdenum	Yes	Yes	No	--	--	No
Nickel	Yes	Yes	No	--	--	No
Phosphorus	UT	--	--	--	--	No
Potassium	UT	--	--	--	--	No
Selenium	Yes	Yes	N/A	No	--	No
Silica	UT	--	--	--	--	No
Silicon	UT	--	--	--	--	No
Silver	UT	--	--	--	--	No
Sodium	UT	--	--	--	--	No
Strontium	No	--	--	--	--	No
Thallium	No	--	--	--	--	No
Tin	Yes	Yes	N/A	No	--	No
Titanium	UT	--	--	--	--	No
Uranium	No	--	--	--	--	No
Vanadium	No	--	--	--	--	No
Zinc	Yes	Yes	Yes	No	--	No
Organics						
1,1,1-Trichloroethane	No	--	--	--	--	No
1,2,4-Trimethylbenzene	UT	--	--	--	--	No
1,2-Dichlorobenzene	UT	--	--	--	--	No
1,3-Dichlorobenzene	UT	--	--	--	--	No
1,4-Dichlorobenzene	UT	--	--	--	--	No
2-Butanone	UT	--	--	--	--	No
2-Chlorophenol	No	--	--	--	--	No
2-Methylnaphthalene	No	--	--	--	--	No
3,3'-Dichlorobenzidine	UT	--	--	--	--	No
4-Chloro-3-methylphenol	UT	--	--	--	--	No
4-Methyl-2-pentanone	No	--	--	--	--	No
Acenaphthene	UT	--	--	--	--	No
Acenaphthalene	UT	--	--	--	--	No
Acetone	No	--	--	--	--	No
alpha-BHC	No	--	--	--	--	No
Anthracene	UT	--	--	--	--	No
Benzo(a)anthracene	UT	--	--	--	--	No
Benzo(a)pyrene	No	--	--	--	--	No
Benzo(b)fluoranthene	UT	--	--	--	--	No

Table 7.16
Summary of ECOPC Screening Steps for Subsurface Soil in the UWOEU

Analyte	Exceed Prairie Dog NOAEL ESL ?	Frequency of Detection >5%?	Exceeds Background?[a]	Upper Bound EPC > Limiting ESL?	Professional Judgment - Retain?	Retain as ECOPC?
Benzo(g,h,i)perylene	UT	--	--	--	--	No
Benzo(k)fluoranthene	UT	--	--	--	--	No
Benzoic Acid	UT	--	--	--	--	No
bis(2-ethylhexyl)phthalate	No	--	--	--	--	No
Bromoform	No	--	--	--	--	No
Butylbenzylphthalate	No	--	--	--	--	No
Chrysene	UT	--	--	--	--	No
cis-1,2-Dichloroethene	No	--	--	--	--	No
Di-n-butylphthalate	No	--	--	--	--	No
Di-n-octylphthalate	No	--	--	--	--	No
Dibenz(a,h)anthracene	UT	--	--	--	--	No
Dibenzofuran	No	--	--	--	--	No
Diethylphthalate	No	--	--	--	--	No
Fluoranthene	UT	--	--	--	--	No
Fluorene	UT	--	--	--	--	No
Heptachlor epoxide	No	--	--	--	--	No
Hexachlorobenzene	No	--	--	--	--	No
Indeno(1,2,3-cd)pyrene	UT	--	--	--	--	No
Isophorone	UT	--	--	--	--	No
Methylene Chloride	No	--	--	--	--	No
Naphthalene	No	--	--	--	--	No
PCB-1254	No	--	--	--	--	No
PCB-1260	No	--	--	--	--	No
Total PCBs	No	--	--	--	--	No
Pentachlorophenol	No	--	--	--	--	No
Phenanthrene	UT	--	--	--	--	No
Phenol	No	--	--	--	--	No
Pyrene	UT	--	--	--	--	No
Tetrachloroethane	UT	--	--	--	--	No
Toluene	No	--	--	--	--	No
Total Dioxins	No	--	--	--	--	No
Trichloroethene	No	--	--	--	--	No
Radionuclides						
Americium-241	No	--	--	--	--	No
Cesium-137	No	--	--	--	--	No
Gross Alpha	UT	--	--	--	--	No
Gross Beta	UT	--	--	--	--	No
Plutonium-238	UT	--	--	--	--	No
Plutonium-239/240	No	--	--	--	--	No
Radium-226	No	--	--	--	--	No
Radium-228	No	--	--	--	--	No
Strontium-89/90	No	--	--	--	--	No
Uranium-233/234	No	--	--	--	--	No
Uranium-235	No	--	--	--	--	No
Uranium-238	No	--	--	--	--	No

[a] Based on results of statistical analysis at the 0.1 level of significance.
'-- = Screen not performed because analyte was eliminated from further consideration in a previous ECOPC selection step.
N/A = Not applicable; background comparison could not be conducted.
UT - Uncertain toxicity; no ESL available (assessed in Section 10).

Table 8.1
Summary of ECOPC/Receptor Pairs

ECOPC	Receptors of Potential Concern
Surface Soil	
Antimony	Terrestrial plant Deer mouse (insectivore) Coyote (insectivore)
Copper	Mourning dove (herbivore) Mourning dove (insectivore)
Nickel	Mourning dove (insectivore) Deer mouse (herbivore) Deer mouse (insectivore) Coyote (generalist) Coyote (insectivore)
Silver	Terrestrial plant
Tin	American kestrel Mourning dove (insectivore) Deer mouse (insectivore)
Uranium	Terrestrial plant
Vanadium	Terrestrial plant Deer mouse (insectivore)
Bis(2-ethylhexyl)phthalate	American kestrel Mourning dove (insectivore)
Di-n-butylphthalate	American kestrel Mourning dove (insectivore)
Dioxin TEQ (Total)	American kestrel Mourning dove (insectivore) Deer mouse (herbivore) Deer mouse (insectivore) Coyote (generalist) Coyote (insectivore)
PCB (Total)	American kestrel Mourning dove (herbivore) Mourning dove (insectivore)
Surface Soil - PMJM	
Antimony	PMJM
Chromium	PMJM
Copper	PMJM
Manganese	PMJM
Molybdenum	PMJM
Nickel	PMJM
Tin	PMJM
Vanadium	PMJM
Zinc	PMJM
PCB (Total)	PMJM
Subsurface Soil	
None	None

Table 8.2
Surface Soil Exposure Point Concentrations for Non-PMJM Receptors

ECOPC	Tier I Exposure Point Concentrations		Tier II Exposure Point Concentrations	
	UTL	UCL	UTL	UCL
Inorganics (mg/kg)				
Antimony	7.35	7.86	30.9[b]	6.35
Copper	68.3	38.5	29.8	18.2
Nickel	21.1	14	28.1[b]	13.8
Silver	3.3	9.69	2.77	1.35
Tin	21.1	12.7	35.8[b]	8.45
Uranium	85[b]	55.8	18.5[b]	18.5[b]
Vanadium	47	32.1	46.1	35.4
Organics (ug/kg)				
Bis(2-ethylhexyl)phthalate	410	443	373[a]	282
Di-n-butylphthalate	410	302	373[a]	283
Dioxin TEQ (total) mammal	0.074[a]	0.055	0.000398[b]	0.000398[b]
Dioxin TEQ (total) bird	0.126[a]	0.096	0.000398[b]	0.000398[b]
PCB (Total)	1300	727	799[b]	510

[a]Tier 1 soil UTL and/or UCL was greater than the maximum detected concentration (MDC), or could not be calculated due to low numbers of samples, so the MDC was used as a proxy exposure point concentration.

[b]Tier 2 soil UTL and/or UCL was greater than the maximum grid average, or could not be calculated due to low numbers of samples, so the maximum grid mean was used as a proxy exposure point concentration.

Table 8.3
Surface Soil Exposure Point Concentrations in PMJM Patches

Analyte[a]	Number of Samples	Number of Detects	Frequency of Detection	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Arithmetic Mean Concentration (mg/kg)	UTL (mg/kg)	UCL (mg/kg)
Patch 19								
Antimony	10	1	10%	0.15	8.8	4.77	12.3	6.61
Chromium	10	10	100%	8.5	26	17.2	30.0	20.3
Manganese	10	10	100%	199	555	335	603	400
Nickel	10	9	90%	2.3	19.3	12.9	25.8	16.0
Tin	10	4	40%	0.46	66.9	13.4	67.8	26.7
Vanadium	10	10	100%	23.5	53	39.0	63.1	44.9
Zinc	10	10	100%	28.8	160	75.6	185	102
Patch 20								
Antimony	12	2	16.6%	2.45	49.8	10.5	46.4	18.9
Chromium	17	17	100%	3.7	24.2	14.3	24.2	16.4
Copper	17	17	100%	10.2	112	32.5	93.5	45.3
Manganese	17	17	100%	158	829	293	617	361
Molybdenum	17	1	6%	0.55	4.4	1.22	3.05	1.61
Nickel	16	16	100%	8.8	26.3	14.7	23.4	16.6
Vanadium	17	17	100%	17.5	43.6	29.4	44.4	32.6
Zinc	17	17	100%	39.3	199	81.3	168	99.5
PCBs - total	15	5	33%	0.055	3.9	0.791	3.18	1.31
Patch 21								
Antimony	7	1	14%	0.33	6.5	4.38	9.85	5.80
Chromium	7	7	100%	2.6	23.3	14.0	33.1	19.0
Manganese	7	7	100%	134	476	358	704	448
Molybdenum	6	3	50%	1.1	2.25	1.84	3.26	2.22
Nickel	7	5	71%	4.25	21.1	12.1	29	16.5
Tin	7	2	29%	0.45	47.6	21.8	70.2	34.4
Vanadium	7	7	100%	9.9	47	36	74.9	46.1
Zinc	7	7	100%	21.2	72	51	99.7	63.7

Notes:

[a] ECOPCs shown on this table were detected at least once in a given patch and are only those that have patch-specific MDCs > ESL.

Table 8.4
Surface Water Exposure Point Concentrations for Non-PMJM and PMJM Receptors

ECOPC	MDC	UTL	UCL	Mean
Inorganics (mg/L)				
Antimony	0.080	0.021	0.009	0.007
Chromium	0.348	0.026	0.020	0.010
Copper	0.259	0.047	0.022	0.014
Manganese	7.77	0.538	0.257	0.215
Molybdenum	0.016	0.006	0.003	0.003
Nickel	0.272	0.024	0.018	0.010
Silver	0.031	0.003	0.002	0.001
Tin	0.049	0.019	0.008	0.005
Uranium	0.077	0.050	0.018	0.009
Vanadium	0.747	0.052	0.043	0.021
Zinc	1.39	0.395	0.168	0.107
Organics (ug/L)				
Bis(2-ethylhexyl)phthalate	150	22.5	16.5	7.78
Di-n-butylphthalate	8.00	6.00	5.09	4.87
Dioxin TEQ (total)	N/A			
PCB (total)	N/A			

N/A = Data were not available.

Table 8.5
Receptor-Specific Exposure Parameters

Receptor	Body Weight (kg)	Body Weight Reference	Percentage of Diet				Food Ingestion Rate (kg/kg BW day^{-1})	Ingestion Rate Reference	Water Ingestion Rate (L/kg BW day^{-1})	Ingestion Rate Reference	Percentage of Diet as Soil	Soil Ingestion Reference
			Plant Tissue	Invertebrate Tissue	Bird or Mammal Tissue	Dietary Reference						
Non-Wildlife Terrestrial Receptors												
Terrestrial Plants	N/A											
Terrestrial Invertebrates	N/A											
Vertebrate Receptors - Birds												
American kestrel	0.116	Brown and Amadon (1968) - Average value	0	20	80	Generalized Diet from several studies presented in the Watershed ERA DOE (1996)	0.092	Kolpin et al. (1980)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	5	Assumed value based on conservative estimates for carnivores
Mourning Dove (herbivore)	0.113	Average of adult values from CalEPA (2004) Online Database	100	0	0	Cowan (1952)	0.23	EPA (2003)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	9.3	Beyer et al. (1994) - Wild turkey used as a surrogate.
Mourning Dove (insectivore)	0.113	Average of adult values from CalEPA (2004) Online Database	0	100	0	Generalized Diet	0.23	EPA (2003)	0.12	EPA (1993) - Estimated using model for all birds - Calder and Braun (1983)	9.3	Beyer et al. (1994) - Wild turkey used as a surrogate.
Vertebrate Receptors - Mammals												
Preble's Meadow Jumping Mouse	0.019	Morrison and Ryser (1962)	70	30	0	Estimated from Whitacker (1972)	0.17	EPA (1993) - Estimated- Nagy (1987) - Rodent Model	0.15	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	2.4	Beyer et al. (1994) - Meadow Vole used as a conservative surrogate
Deer Mouse (herbivore)	0.0187	Flake (1973)	100	0	0	Generalized Diet	0.111	Cronin and Bradley (1988)	0.19	Ross (1930); Dice (1922) as cited in EPA (1993).	2	Beyer et al. (1994)

Table 8.5
Receptor-Specific Exposure Parameters

Receptor	Body Weight (kg)	Body Weight Reference	Percentage of Diet				Food Ingestion Rate (kg/kg BW day^{-1})	Ingestion Rate Reference	Water Ingestion Rate (L/kg BW day^{-1})	Ingestion Rate Reference	Percentage of Diet as Soil	Soil Ingestion Reference
			Plant Tissue	Invertebrate Tissue	Bird or Mammal Tissue	Dietary Reference						
Deer Mouse (insectivore)	0.0187	Flake (1973)	0	100	0	Generalized Diet	0.065	Cronin and Bradley (1988)	0.19	Ross (1930); Dice (1922) as cited in USEPA 1993.	2	Beyer et al. (1994)
Coyote (generalist)	12.75	Bekoff (1977) - Average of male and female weights	0	25	75	Generalized Diet	0.015	Gier (1975)	0.08	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	5	Beyer et al. (1994) - High end estimate for Red Fox
Coyote (insectivore)	12.75	Bekoff (1977) - Average of male and female weights	0	100	0	Generalized Diet	0.015	Gier (1975)	0.08	EPA (1993) - Estimated using model for all mammals - Calder and Braun (1983)	2.8	Beyer et al. (1994) - Red Fox

Receptor parameters for all receptors with the exception of the prairie dog and mourning dove were taken from the Watershed Risk Assessment (DOE 1996) and referenced to the original source.
All receptor parameters are estimates of central tendency except where noted.
All values are presented in a dry weight basis.
N/A = Not applicable.

Table 8.6
Receptor-Specific Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
Antimony						
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.478	N/A	0.00956	0.00399	0.491
Tier 2 UTL[a]	N/A	2.01	N/A	0.0402	0.00399	2.05
Coyote - Insectivore						
Tier 1 UCL	N/A	0.118	N/A	0.00330	7.20E-04	0.122
Tier 2 UCL	N/A	0.0953	N/A	0.00267	7.20E-04	0.0986
Copper						
Mourning Dove - Herbivore						
Tier 1 UTL	2.37	N/A	N/A	1.46	0.00564	3.84
Tier 2 UTL	1.71	N/A	N/A	0.637	0.00564	2.35
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	3.75	N/A	1.46	0.00564	5.21
Tier 2 UTL	N/A	3.01	N/A	0.637	0.00564	3.65
Nickel						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	23.0	N/A	0.451	0.00288	23.4
Tier 2 UTL[a]	N/A	30.6	N/A	0.601	0.00288	31.2
Deer Mouse - Herbivore						
Tier 1 UTL	0.117	N/A	N/A	0.0468	0.00456	0.169
Tier 2 UTL[a]	0.146	N/A	N/A	0.0624	0.00456	0.213
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	6.49	N/A	0.0274	0.00456	6.52
Tier 2 UTL[a]	N/A	8.64	N/A	0.0365	0.00456	8.68
Coyote - Generalist						
Tier 1 UCL	N/A	0.248	0.0301	0.0105	0.00144	0.290
Tier 2 UCL	N/A	0.245	0.0299	0.0104	0.00144	0.286
Coyote - Insectivore						
Tier 1 UCL	N/A	0.993	N/A	0.00588	0.00144	1.00
Tier 2 UCL	N/A	0.979	N/A	0.00580	0.00144	0.986
Tin						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	4.85	N/A	0.451	0.00228	5.31
Tier 2 UTL[a]	N/A	8.23	N/A	0.766	0.00228	9.00
American Kestrel						
Tier 1 UTL	N/A	0.388	0.326	0.0971	0.00228	0.814
Tier 2 UTL[a]	N/A	0.659	0.553	0.165	0.00228	1.38
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.37	N/A	0.0274	0.00361	1.40
Tier 2 UTL[a]	N/A	2.33	N/A	0.0465	0.00361	2.38
Vanadium						
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.269	N/A	0.0611	0.142	0.472
Tier 2 UTL	N/A	0.264	N/A	0.0599	0.00817	0.332
Bis(2-ethylhexyl)phthalate						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	3.29	N/A	0.00877	0.00270	3.30
Tier 2 UTL[a]	N/A	2.99	N/A	0.00798	0.00270	3.00

Table 8.6
Receptor-Specific Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
American Kestrel						
Tier 1 UTL	N/A	0.263	0.869	0.00189	0.00270	1.14
Tier 2 UTL[a]	N/A	0.240	0.791	0.00172	0.00270	1.03
Di-n-butylphthalate						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	2.84	N/A	0.00877	9.60E-04	2.85
Tier 2 UTL[a]	N/A	2.58	N/A	0.00798	7.20E-04	2.59
American Kestrel						
Tier 1 UTL	N/A	0.227	0.858	0.00189	9.60E-04	1.09
Tier 2 UTL[a]	N/A	0.207	0.780	0.00172	7.20E-04	0.990
Dioxin (Total)						
Mourning Dove - Insectivore						
Tier 1 UTL[a]	N/A	1.94E-04	N/A	2.70E-06	0	1.96E-04
Tier 2 UTL[a]	N/A	2.14E-07	N/A	8.51E-09	0	2.23E-07
American Kestrel						
Tier 1 UTL[a]	N/A	1.55E-05	8.56E-06	5.80E-07	0	2.46E-05
Tier 2 UTL[a]	N/A	1.71E-08	1.53E-08	1.83E-09	0	3.42E-08
Deer Mouse - Herbivore						
Tier 1 UTL[a]	1.81E-06	N/A	N/A	1.64E-07	0	1.97E-06
Tier 2 UTL[a]	9.72E-09	N/A	N/A	8.84E-10	0	1.06E-08
Deer Mouse - Insectivore						
Tier 1 UTL[a]	N/A	2.92E-05	N/A	9.62E-08	0	2.93E-05
Tier 2 UTL[a]	N/A	6.06E-08	N/A	5.17E-10	0	6.11E-08
Coyote - Generalist						
Tier 1 UCL	N/A	1.18E-06	5.26E-07	4.13E-08	0	1.75E-06
Tier 2 UCL[a]	N/A	3.50E-09	2.33E-09	2.99E-10	0	6.13E-09
Coyote - Insectivore						
Tier 1 UCL	N/A	4.74E-06	N/A	2.31E-08	0	4.76E-06
Tier 2 UCL[a]	N/A	1.40E-08	N/A	1.67E-10	0	1.41E-08
PCB (Total)						
Mourning Dove - Herbivore						
Tier 1 UTL	0.0748	NA	N/A	0.0278	0	0.103
Tier 2 UTL[a]	0.0459	NA	N/A	0.0171	0	0.0630
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	1.35	N/A	0.0278	0	1.37
Tier 2 UTL[a]	N/A	0.694	N/A	0.0171	0	0.711
American Kestrel						
Tier 1 UTL	N/A	0.108	0.132	0.00598	0	0.246
Tier 2 UTL[a]	N/A	0.0555	0.121	0.00368	0	0.180
Alternative Exposure Estimates						
Nickel						
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.45	N/A	0.0274	0.00456	1.48
Tier 2 UTL[a]	N/A	1.93	N/A	0.0365	0.00456	1.98

[a] Soil UTL and/or UCL was greater than the MDC (Tier 1) or the maximum grid mean (Tier 2), or could not be calculated due to low numbers of samples, so the MDC (Tier 1) or maximum grid mean (Tier 2) was used as a proxy value to calculate intake.
N/A = Not applicable.

Table 8.7
PMJM Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
Antimony						
Patch 19						
UCL	0.0276	0.337	N/A	0.0270	0.00135	0.393
Patch 20						
UCL	0.0739	0.964	N/A	0.0771	0.00135	1.12
Patch 21						
UCL	0.0244	0.296	N/A	0.0237	0.00135	0.345
Chromium						
Patch 19						
UCL	0.203	3.27	N/A	0.0828	0.00300	3.56
Patch 20						
UCL	0.164	2.64	N/A	0.0669	0.00300	2.88
Patch 21						
UCL	0.190	3.06	N/A	0.0774	0.00300	3.33
Copper						
Patch 20						
UCL	1.04	0.745	N/A	0.185	0.00330	1.98
Manganese						
Patch 19						
UCL	11.1	6.82	N/A	1.63	0.0386	19.6
Patch 20						
UCL	10.1	6.36	N/A	1.47	0.0386	17.9
Patch 21						
UCL	12.5	7.36	N/A	1.83	0.0386	21.7
Molybdenum						
Patch 20						
UCL	0.0479	0.172	N/A	0.00657	4.50E-04	0.227
Patch 21						
UCL	0.0660	0.237	N/A	0.00906	4.50E-04	0.312
Nickel						
Patch 19						
UCL	0.103	3.86	N/A	0.0654	0.00270	4.04
Patch 20						
UCL	0.105	4.00	N/A	0.0677	0.00270	4.18
Patch 21						
UCL	0.105	3.97	N/A	0.0671	0.00270	4.14
Tin						
Patch 19						
UCL	0.0953	1.36	N/A	0.109	0.00120	1.57
Patch 21						
UCL	0.123	1.75	N/A	0.140	0.00120	2.02
Vanadium						
Patch 19						
UCL	0.0518	0.202	N/A	0.183	0.00645	0.443
Patch 20						
UCL	0.0376	0.146	N/A	0.133	0.00645	0.323
Patch 21						
UCL	0.0532	0.207	N/A	0.188	0.00645	0.455

Table 8.7
PMJM Intake Estimates

	Intake Estimates (mg/kg BW day)					
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Default Exposure Estimates						
Zinc						
Patch 19						
UCL	7.45	19.9	N/A	0.416	0.0252	27.8
Patch 20						
UCL	7.35	19.7	N/A	0.406	0.0252	27.5
Patch 21						
UCL	5.74	17.0	N/A	0.260	0.0252	23.1
PCB (Total)						
Patch 20						
UCL	0.0390	0.302	N/A	0.00534	N/A	0.346
Alternative Exposure Estimates						
Nickel						
Patch 19						
UCL	0.103	0.865	N/A	0.0654	0.00270	1.04
Patch 20						
UCL	0.105	0.896	N/A	0.0677	0.00270	1.07
Patch 21						
UCL	0.105	0.888	N/A	0.0671	0.00270	1.06

N/A = Not applicable.

Table 9.1
TRVs for Terrestrial Plant and Invertebrate Receptors

ECOPC	Soil Concentration (mg/kg)	Endpoint	Effect Measured/Observed	Reference	Notes
Terrestrial Plants					
Antimony	5	Screening ESL	Based on a report of unspecified toxic effects on plants grown in surface soil.	Kabata-Pendias and Pendias 1984 as cited in Efroymson et al. 1997a	Low confidence in value.
Silver	2	Screening ESL	Based on a report of unspecified toxic effects on plants grown in surface soil.	Kabata-Pendias and Pendias 1984 as cited in Efroymson et al. 1997a	Low confidence in value.
Uranium	5	Screening ESL	Reduction in root weight in sandy soil.	Sheppard et al. 1982 as cited in Efroymson et al 1997a	Low confidence in value.
Vanadium	2	Screening ESL	Value was not based on any specific study.	Efroymson et al. 1997a	Low confidence in value.

Table 9.2
TRVs for Terrestrial Vertebrate Receptors

ECOPC	NOAEL (mg/kg day)	NOAEL Endpoint	LOAEL (mg/kg day)	LOAEL Endpoint	TRV Source	Uncertainty Factor	Final NOAEL (mg/kg day)	Threshold (mg/kg day)	Rationale For Calculation	TRV Confidence
Birds										
Copper	2.3	No effects noted	52.3	Increase in chicken gizzard erosion	PRC (1994)	1	2.30	N/A	Threshold was not calculated.	High
Nickel	1.38	No increase in tremors or toe and leg joint edema	55.26	Increase in tremors and toe and knee joint edema in mallard.	PRC (1994)	1	1.38	8.7	The nature of the effect is not likely to cause a significant effect on growth, reproduction or survival. Thus, the data satisfy the requirements described in the text for calculating a threshold.	High
Tin (Butyltins)	0.73	No change in Japanese quail growth and reproduction.	18.34	Decrease in Japanese quail reproduction	PRC (1994)	1	0.73	N/A	The original paper was not reviewed. Not enough information was available to calculate the threshold TRV	High
bis(2-ethylhexyl)phthalate	1.1	No reproductive effects in ringed doves	214	Increase in European starling body weight.	Sample et al. (1996)/O'Shea and Stafford (1980)	1	1.1	N/A	Threshold was not calculated.	NOAEL High/LOAEL Low.
Di-n-butylphthalate	0.11	NOAEL estimated from LOAEL	1.1	Reduction in eggshell thickness and water permeability in ringed doves	Sample et al. (1996)	1	0.110	N/A	NOAEL was estimated from the LOAEL.	High
Dioxin (Total)	1.40E-05	No effect on pheasant egg production and hatchability	1.40E-04	Decrease in egg production and hatchability	Sample et al. (1996)	1	1.40E-05	N/A	Original study was not reviewed and not enough information is presented in Sample et al. (1996) to meet threshold criteria calculation.	High
PCB (total	0.09	NOAEL was estimated from LOAEL	1.27	Decrease in egg hatchability	PRC (1994)	1	0.09	N/A	NOAEL was estimated from the LOAEL.	High
Mammals										
Antimony	0.06	No change to rat progeny weight	0.59	Decrease in rat progeny weight	EPA (2003)	1	0.06	N/A	The original paper was not reviewed. Not enough information was available to calculate the threshold TRV	Very High
Chromium III	2,737	No effects on rat reproduction and life span	NA	No effects at the highest study dose	Sample et al. (1996)	1	2,737	NA	Threshold not provided in CRA Methodology.	High
Chromium VI	3.28	No effects on rat body weight or food consumption	13.14	Increased mortality in rats	Sample et al. (1996)	1	3.28	6.58	Threshold calculated for risk characterization purposes	High

Table 9.2
TRVs for Terrestrial Vertebrate Receptors

ECOPC	NOAEL (mg/kg day)	NOAEL Endpoint	LOAEL (mg/kg day)	LOAEL Endpoint	TRV Source	Uncertainty Factor	Final NOAEL (mg/kg day)	Threshold (mg/kg day)	Rationale For Calculation	TRV Confidence
Copper	2.67	No immune response effects	631.58	Increased mortality and decreased body weight in mice.	PRC (1994)	1	2.67	N/A	Not enough data available for calculation of threshold.	High
Manganese	13.7	No change in mouse testicle weight	159.1	Decrease in mouse testicle weight	PRC (1994)	1	13.7	46	Threshold calculated for risk characterization purposes	High
Molybdenum	0.26	NOAEL estimated from LOAEL	2.6	Increased incidence of runts in mice litters	Sample et al. (1996)	1	0.26	N/A	NOAEL was estimated from LOAEL.	High
Nickel	0.133	NOAEL was estimated from LOAEL	1.33	Increase in pup mortality in rats	PRC (1994)	1	0.133	N/A	NOAEL was estimated from LOAEL	High
Tin (Butyltins)	0.25	No systemic effects	15	Midrange of effects less than mortality	PRC (1994)	1	0.25	1.94	Threshold calculated for risk characterization purposes	High
Vanadium	0.21	NOAEL estimated from LOAEL	2.1	Significant reproductive effects in rats	Sample et al. (1996)	1	0.21	N/A	NOAEL was estimated from the LOAEL.	High
Zinc	9.61	NOAEL was estimated from LOAEL	411.4	Increase in fetal developmental effects in rats	PRC (1994)	1	9.61	N/A	NOAEL was estimated from LOAEL	High
Dioxin (Total)	1.00E-06	No reproductive effects in rats	1.00E-05	Decreased fertility and neonatal survival in rats	Sample et al. (1996)	1	1.00E-06	N/A	Original study was not reviewed and not enough information is presented in Sample et al. (1996) to meet threshold criteria calculation.	High
PCBs (Total)	0.36	No increase in mouse liver weight	0.71	Decrease in mouse reproductive capacity	PRC (1994)	1	0.36	0.51	The magnitude of the response was small. Thus, the data satisfy the requirements described in the text for calculating a threshold.	High

Threshold TRVs were independently calculated using the procedures outlined in the CRA Methodology, Section 3.1.4.
TRV Confidence:
N/A = No TRV has been identified or the TRV has been deemed unacceptable for use in ECOPC selection.
Low = TRVs that have data for only one species looking at one endpoint (non-mortality) and from one primary literature source.
Moderate = TRVs that have multiple primary literature sources looking at one endpoint (non-mortality or mortality) but with only one species evaluated.
Good = For TRVs that have either multiple species with one endpoint from multiple studies or those TRVs with multiple species and multiple endpoints from only one study.
High = For TRVs that have multiple study sources looking at multiple endpoints and more than one species.
Very High = All EcoSSLs (EPA 2003a) will be assigned this level of confidence by default.

Table 10.1
Hazard Quotient Summary for Non-PMJM Receptors

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs) Based on Default TRVs	Hazard Quotients (HQs) Based on Refined Analysis
Antimony	Terrestrial Plants	N/A	Tier 1	UTL = 1	No alternative TRVs identified.
			Tier 2	UTL[a] =2	No alternative TRVs identified.
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 8 ***LOAEL*** UTL = 0.8	No alternative TRVs identified.
			Tier 2	***NOAEL*** UTL[a] = 34 ***LOAEL*** UTL[a] = 3	No alternative TRVs identified.
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Coyote (Insectivore)	Default	Tier 1	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
			Tier 2	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Copper	Mourning Dove (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.07	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.8 ***LOAEL*** UTL = 0.03	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.07	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Nickel	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 17 ***LOAEL*** UTL = 0.4	Not Calculated
			Tier 2	***NOAEL*** ***UTL = 23*** ***LOAEL*** ***UTL = 0.6***	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Table 10.1
Hazard Quotient Summary for Non-PMJM Receptors

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	**Based on Refined Analysis**
Nickel (continued)	Deer Mouse (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 2 ***LOAEL*** UTL[a] = 0.2	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 49 ***LOAEL*** UTL = 5	***NOAEL*** UTL = 0.2 ***LOAEL*** UTL = 0.08
			Tier 2	***NOAEL*** UTL[a] = 65 ***LOAEL*** UTL[a] = 7	***NOAEL*** UTL[a] = 0.2 ***LOAEL*** UTL[a] = 0.1
		Median	Tier 1	***NOAEL*** UTL = 11 ***LOAEL*** UTL = 1	***NOAEL*** UTL = 0.04 ***LOAEL*** UTL = 0.02
			Tier 2	***NOAEL*** UTL[a] = 15 ***LOAEL*** UTL[a] = 1	***NOAEL*** UTL[a] = 0.05 ***LOAEL*** UTL[a] = 0.02
	Coyote (Generalist)	Default	Tier 1	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
			Tier 2	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Coyote (Insectivore)	Default	Tier 1	***NOAEL*** UCL = 8 ***LOAEL*** UCL = 0.8	Not Calculated
			Tier 2	***NOAEL*** UCL = 7 ***LOAEL*** UCL = 0.7	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Silver	Terrestrial Plants	N/A	Tier 1	UTL = 2	Not Calculated
			Tier 2	UTL =1	Not Calculated

Table 10.1
Hazard Quotient Summary for Non-PMJM Receptors

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	Based on Refined Analysis
Tin	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 7 ***LOAEL*** UTL = 0.3	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 12 ***LOAEL*** UTL[a] = 0.5	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Tin (continued)	American Kestrel	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.04	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 2 ***LOAEL*** UTL[a] = 0.08	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 6 ***LOAEL*** UTL = 0.09	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 10 ***LOAEL*** UTL[a] = 0.2	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Uranium	Terrestrial Plants	N/A	Tier 1	UTL[a] = 17	No alternative TRVs identified.
			Tier 2	UTL[a] =4	No alternative TRVs identified.
Vanadium	Terrestrial Plants	N/A	Tier 1	UTL = 24	LOEC UTL = 0.9
			Tier 2	UTL =23	LOEC UTL = 0.9
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.2	Not Calculated
			Tier 2	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.2	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Table 10.1
Hazard Quotient Summary for Non-PMJM Receptors

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs) Based on Default TRVs	Hazard Quotients (HQs) Based on Refined Analysis
Bis(2-ethylhexyl)phthalate	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 3 ***LOAEL*** UTL = 0.02	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 3 ***LOAEL*** UTL[a] = 0.01	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	American Kestrel	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.01	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 0.9 ***LOAEL*** UTL[a] = 0.005	Not Calculated
Bis(2-ethylhexyl)phthalate (continued)	American Kestrel (continued)	Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Di-n-butylphthalate	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 26 ***LOAEL*** UTL = 3	No alternative TRVs identified.
			Tier 2	***NOAEL*** UTL[a] = 24 ***LOAEL*** UTL[a] = 2	No alternative TRVs identified.
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	American Kestrel	Default	Tier 1	***NOAEL*** UTL = 10 ***LOAEL*** UTL = 0.99	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 9 ***LOAEL*** UTL[a] = 0.9	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Table 10.1
Hazard Quotient Summary for Non-PMJM Receptors

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	Based on Refined Analysis
Dioxins (Total)	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL[a] = 14 ***LOAEL*** UTL[a] = 1	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 0.02 ***LOAEL*** UTL[a] = 0.002	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	American Kestrel	Default	Tier 1	***NOAEL*** UTL[a] = 2 ***LOAEL*** UTL[a] = 0.2	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 0.002 ***LOAEL*** UTL[a] = 0.0002	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Herbivore)	Default	Tier 1	***NOAEL*** UTL[a] = 2 ***LOAEL*** UTL[a] = 0.2	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 0.01 ***LOAEL*** UTL[a] = 0.001	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Dioxins (Total) (continued)	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL[a] = 29 ***LOAEL*** UTL[a] = 3	No alternative TRVs identified.
			Tier 2	***NOAEL*** UTL[a] = 0.06 ***LOAEL*** UTL[a] = 0.01	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Coyote (Generalist)	Default	Tier 1	***NOAEL*** UCL = 2 ***LOAEL*** UCL = 0.2	Not Calculated
			Tier 2	***NOAEL*** UCL[a] = 0.01 ***LOAEL*** UCL[a] = 0.001	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Coyote (Insectivore)	Default	Tier 1	***NOAEL*** UCL = 5 ***LOAEL*** UCL = 0.5	Not Calculated
			Tier 2	***NOAEL*** UCL[a] = 0.01 ***LOAEL*** UCL[a] = 0.001	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

Table 10.1
Hazard Quotient Summary for Non-PMJM Receptors

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	Based on Refined Analysis
Total PCBs	Mourning Dove (Herbivore)	Default	Tier 1	***NOAEL*** UTL =1 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 0.7 ***LOAEL*** UTL[a] = 0.05	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 15 ***LOAEL*** UTL = 1	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 8 ***LOAEL*** UTL[a] = 0.6	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	American Kestrel	Default	Tier 1	***NOAEL*** UTL = 3 ***LOAEL*** UTL = 0.2	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 2 ***LOAEL*** UTL[a] = 0.1	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated

[a] Soil UTL and/or UCL was greater than the MDC (Tier 1) or the maximum grid mean (Tier 2), or could not be calculated due to low numbers of samples, so the MDC (Tier 1) or maximum grid mean (Tier 2) was used as a proxy value to estimate intake.
Shaded cells represent default HQ calculations based on exposure and toxicity models specifically identified in the CRA Methodology
All HQ Calculations are provided in Attachment 4.
Discussion of the chemical-specific uncertainties are provided in Attachment 5.

Table 10.2
Hazard Quotient Summary for PMJM Receptors

ECOPC	Receptor	BAF	EPC	Hazard Quotients (HQs)	
				Based on Default TRVs	**Based on Refined Analysis**
Antimony	Patch 19	Default	UCL	NOAEL = 7 LOAEL = 0.7	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 20	Default	UCL	NOAEL = 19 LOAEL = 2	No alternative TRVs identified.
		Median	UCL	Not Calculated	Not Calculated
	Patch 21	Default	UCL	NOAEL = 6 LOAEL = 0.6	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
Chromium	Patch 19	Default	UCL	***Chromium VI*** NOAEL = 1 LOAEL = 0.3 ***Chromium III*** NOAEL = 0.001	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 20	Default	UCL	***Chromium VI*** NOAEL = 0.9 LOAEL = 0.2 ***Chromium III*** NOAEL = 0.001	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 21	Default	UCL	***Chromium VI*** NOAEL = 1 LOAEL = 0.3 ***Chromium III*** NOAEL = 0.001	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
Copper	Patch 20	Default	UCL	NOAEL = 0.7 LOAEL = 0.003	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
Manganese	Patch 19	Default	UCL	NOAEL = 1 LOAEL = 0.1	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 20	Default	UCL	NOAEL = 1 LOAEL = 0.1	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 21	Default	UCL	NOAEL = 2 LOAEL = 0.1	Not Calculated
		Median	UCL	Not Calculated	Not Calculated

Table 10.2
Hazard Quotient Summary for PMJM Receptors

Molybdenum	Patch 20	Default	UCL	NOAEL = 1 LOAEL = 0.09	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 21	Default	UCL	NOAEL = 1 LOAEL = 0.1	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
Nickel	Patch 19	Default	UCL	NOAEL = 30 LOAEL = 3	NOAEL = 0.1 LOAEL = 0.05
		Median	UCL	NOAEL = 8 LOAEL = 0.8	NOAEL = 0.03 LOAEL = 0.01
	Patch 20	Default	UCL	NOAEL = 31 LOAEL = 3	NOAEL = 0.1 LOAEL = 0.05
		Median	UCL	NOAEL = 8 LOAEL = 0.8	NOAEL = 0.03 LOAEL = 0.01
	Patch 21	Default	UCL	NOAEL = 31 LOAEL = 3	NOAEL = 0.1 LOAEL = 0.05
		Median	UCL	NOAEL = 8 LOAEL = 0.8	NOAEL = 0.03 LOAEL = 0.01
Tin	Patch 19	Default	UCL	NOAEL = 6 LOAEL = 0.1	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 21	Default	UCL	NOAEL = 8 LOAEL = 0.1	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
Vanadium	Patch 19	Default	UCL	NOAEL = 2 LOAEL = 0.2	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 20	Default	UCL	NOAEL = 2 LOAEL = 0.2	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 21	Default	UCL	NOAEL = 2 LOAEL = 0.2	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
Zinc	Patch 19	Default	UCL	NOAEL = 3 LOAEL = 0.07	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 20	Default	UCL	NOAEL = 3 LOAEL = 0.07	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
	Patch 21	Default	UCL	NOAEL = 2 LOAEL = 0.06	Not Calculated
		Median	UCL	Not Calculated	Not Calculated
Total PCBs	Patch 20	Default	UCL	NOAEL = 0.96 LOAEL = 0.5	Not Calculated
		Median	UCL	Not Calculated	Not Calculated

Shaded cells represent default HQ calculations based on exposure and toxicity models specifically identified in the CRA Methodology.
All HQ Calculations are provided in Attachment 4.
Discussion of the chemical-specific uncertainties are provided in Attachment 5.

Table 10.3
Tier 2 Grid Cell Hazard Quotients for Surface Soil in UWOEU

ECOPC	Most Sensitive Receptor	Number of Grid Cells	Percent of Tier 2 Grid Cell Means											
			NOAEL TRV				Threshold TRV				LOAEL TRV			
			HQ < 1	HQ > 1 <5	HQ > 5 <10	HQ > 10	HQ < 1	HQ > 1 <5	HQ > 5 <10	HQ > 10	HQ < 1	HQ > 1 <5	HQ > 5 <10	HQ > 10
Inorganics														
Antimony	Deer Mouse - Insectivore	26	50	15	31	4	N/A	N/A	N/A	N/A	100	0	0	0
Copper	Mourning Dove - Insectivore	26	4	96	0	0	100	0	0	0	100	0	0	0
Nickel	Deer Mouse - Insectivore	26	0	0	0	100	N/A	N/A	N/A	N/A	0	96	4	0
Tin	Mourning Dove - Insectivore	26	58	35	4	4	N/A	N/A	N/A	N/A	100	0	0	0
Vanadium	Deer Mouse - Insectivore	26	27	73	0	0	N/A	N/A	N/A	N/A	100	0	0	0
Organics														
Bis(2-ethylhexyl)phthalate	Mourning Dove - Insectivore	12	0	100	0	0	N/A	N/A	N/A	N/A	100	0	0	0
Di-N-Butylphthalate	Mourning Dove - Insectivore	12	0	0	0	100	N/A	N/A	N/A	N/A	0	100	0	0
Dioxin (Total)	Deer Mouse - Insectivore	1	0	100	0	0	N/A	N/A	N/A	N/A	100	0	0	0
Total PCBs	Mourning Dove - Insectivore	11	73	27	0	0	N/A	N/A	N/A	N/A	100	0	0	0

N/A = No value available
The limiting receptor is chosen as the receptor with the lowest ESL.
Default exposure model and TRVs used.

Table 11.1
Summary of Risk Characterization Results for the UWOEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Surface Soil Non-PMJM Receptors			
Antimony	Terrestrial plants	Tier 1 EPC HQs = 1. Tier 2 EPC HQs >1. Tier 2 based on maximum grid mean.	Low Risk
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	Not an ECOPC.[a]	ECOPC of Uncertain Risk
	Mourning dove (herbivore)	Not an ECOPC.[a]	ECOPC of Uncertain Risk
	Mourning dove (insectivore)	Not an ECOPC.[a]	ECOPC of Uncertain Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	NOAEL HQs > 1 for default exposure scenarios and TRVs. Tier 1 LOAEL HQ < 1 for default exposure scenarios and TRVs. Tier 2 LOAEL HQ >1 for default exposure scenarios and TRVs. Tier 2 UTL based on maximum grid mean.	Low Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	NOAEL HQs > 1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Mule Deer	Not an ECOPC.	Not an ECOPC
Copper	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	Not an ECOPC.	Not an ECOPC
	Mourning dove (herbivore)	Tier 1 NOAEL HQ > 1 using default exposure scenarios and TRVs Tier 2 NOAEL HQ = 1 using default exposure scenarios and TRVs LOAEL HQs < 1 using default exposure scenarios.	Low Risk
	Mourning dove (insectivore)	NOAEL HQs > 1 using default exposure scenarios and TRVs LOAEL HQs < 1 using default exposure scenarios.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Nickel	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	Not an ECOPC.	Not an ECOPC
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	NOAEL HQs > 1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Deer mouse (herbivore)	NOAEL HQs >= 1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Deer mouse (Insectivore)	NOAEL and LOAEL HQs > 1 for default exposure scenarios and TRVs. NOAEL and LOAEL HQs <1 for default exposure scenarios and alternative TRVs. NOAEL HQs > 1 for alternative exposure scenarios and default TRVs. LOAEL HQs = 1 for alternative exposure scenarios and default TRVs. NOAEL and LOAEL HQs < 1 for alternative exposure scenarios and alternative TRVs.	Low to Moderate Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	NOAEL HQs > 1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Coyote (insectivore)	NOAEL HQs > 1 for default exposure scenarios and TRVs. Tier 1 LOAEL HQs = 1 for default exposure scenarios and TRVs. Tier 2 LOAEL HQs >1 for default exposure scenarios and TRVs. NOAEL and LOAEL HQs <1 for default exposure scenarios and alternative TRVs.	Low Risk
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWOEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Surface Soil Non-PMJM Receptors			
Silver	Terrestrial plants	Tier 1 HQ > 1. Tier 2 HQ = 1.	Low Risk
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Mourning dove (herbivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Mourning dove (insectivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Deer mouse (herbivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Deer mouse (Insectivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Prairie dog	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Coyote (carnivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Coyote (generalist)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Coyote (insectivore)	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Mule Deer	Not an ECOPC[a].	ECOPC of Uncertain Risk
Tin	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	NOAEL HQs >= 1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	NOAEL HQs >1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	NOAEL HQs >1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Uranium	Terrestrial plants	Tier 1 and Tier 2 HQs > 1. Tier 1 risk estimates based on MDC. Tier 2 risk estimates based on maximum grid mean.	Low to Moderate Risk
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Not an ECOPC.	Not an ECOPC
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Vanadium	Terrestrial plants	Tier 1 and Tier 2 HQs > 1. Alternative Tier 1 and Tier 2 HQs < 1.	Low Risk
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Not an ECOPC.	Not an ECOPC
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	NOAEL HQ > 1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWOEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Surface Soil Non-PMJM Receptors			
Bis(2-ethylhexyl)phthalate	Terrestrial plants	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	NOAEL HQ <= 1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	NOAEL HQ > 1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Di-n-butylphthalate	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	NOAEL HQ > 1 for default exposure scenarios and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	NOAEL HQ > 1 for default exposure scenarios and TRVs. LOAEL HQs > 1 for default exposure scenarios and TRVs.	Low to Moderate Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Dioxin (Total)	Terrestrial plants	Not an ECOPC[a].	ECOPC of Uncertain Risk
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	Tier 1 NOAEL HQ > 1 for default exposure scenario and TRVs. Tier 1 LOAEL HQ < 1 for default exposure scenario and TRVs. Tier 2 NOAEL and LOAEL HQs <1 for default exposure scenario and TRVs.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	Tier 1 NOAEL HQ > 1 for default exposure scenario and TRVs. Tier 1 LOAEL HQ = 1 for default exposure scenario and TRVs. Tier 2 NOAEL and LOAEL HQs <1 for default exposure scenario and TRVs.	Low Risk
	Deer mouse (herbivore)	Tier 1 NOAEL HQ > 1 for default exposure scenario and TRVs. Tier 1 LOAEL HQ < 1 for default exposure scenario and TRVs. Tier 2 NOAEL and LOAEL HQs <1 for default exposure scenario and TRVs.	Low Risk
	Deer mouse (Insectivore)	Tier 1 NOAEL and LOAEL HQs > 1 for default exposure scenario and TRVs. Tier 2 NOAEL and LOAEL HQs < 1 for default exposure scenario and TRVs.	Low to Moderate Risk
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Tier 1 NOAEL HQ > 1 for default exposure scenario and TRVs. Tier 1 LOAEL HQ < 1 for default exposure scenario and TRVs. Tier 2 NOAEL and LOAEL HQs <1 for default exposure scenario and TRVs.	Low Risk
	Coyote (insectivore)	Tier 1 NOAEL HQ > 1 for default exposure scenario and TRVs. Tier 1 LOAEL HQ < 1 for default exposure scenario and TRVs. Tier 2 NOAEL and LOAEL HQs <1 for default exposure scenario and TRVs.	Low Risk
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the UWOEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Surface Soil Non-PMJM Receptors			
Total PCBs	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC[a].	ECOPC of Uncertain Risk
	American kestrel	NOAEL HQs > 1 for default exposure scenario and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Mourning dove (herbivore)	Tier 1 NOAEL HQ = 1 for default exposure scenario and TRVs. Tier 2 NOAEL HQ < 1 for default exposure scenario and TRVs. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Mourning dove (insectivore)	NOAEL HQs > 1 for default exposure scenario and TRVs. LOAEL HQs <= 1 for default exposure scenarios and TRVs.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	Not an ECOPC.	Not an ECOPC
	Prairie dog	Not an ECOPC.	Not an ECOPC
	Coyote (carnivore)	Not an ECOPC.	Not an ECOPC
	Coyote (generalist)	Not an ECOPC.	Not an ECOPC
	Coyote (insectivore)	Not an ECOPC.	Not an ECOPC
	Mule Deer	Not an ECOPC.	Not an ECOPC
Surface Soil - PMJM Receptors			
Antimony	Patch 19	NOAEL HQ > 1 for default exposure scenario. LOAEL HQ < 1 for default exposure scenario.	Low Risk
	Patch 20	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ > 1 for default exposure scenario and TRVs.	Low to Moderate Risk
	Patch 21	NOAEL HQ > 1 for default exposure scenario. LOAEL HQ < 1 for default exposure scenario.	Low Risk
Chromium	Patch 19	Chromium VI NOAEL HQ = 1 for default exposure scenario. Chromium III NOAEL HQ < 1 for default exposure scenario. Chromium VI LOAEL HQ < 1 for default exposure scenario.	Low Risk
	Patch 20	Chromium VI NOAEL HQ < 1 for default exposure scenario. Chromium III NOAEL HQ < 1 for default exposure scenario. Chromium VI LOAEL HQ < 1 for default exposure scenario.	Low Risk
	Patch 21	Chromium VI NOAEL HQ = 1 for default exposure scenario. Chromium III NOAEL HQ < 1 for default exposure scenario. Chromium VI LOAEL HQ < 1 for default exposure scenario.	Low Risk
Copper	Patch 20	NOAEL and LOAEL HQs <1 for default exposure scenarios and TRVs.	Low Risk
Manganese	Patch 19	NOAEL HQ = 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
	Patch 20	NOAEL HQ = 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
	Patch 21	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
Molybdenum	Patch 20	NOAEL HQ = 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
	Patch 21	NOAEL HQ = 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
Nickel	Patch 19	NOAEL and LOAEL HQs > 1 for default exposure scenario and TRVs. NOAEL and LOAEL HQs <1 for default exposure scenario and alternative TRVs. LOAEL HQs <1 for alternative exposure scenario and default TRVs. NOAEL and LOAEL HQs <1 for alternative exposure and alternative TRVs.	Low Risk
	Patch 20	NOAEL and LOAEL HQs > 1 for default exposure scenario and TRVs. NOAEL and LOAEL HQs <1 for default exposure scenario and alternative TRVs. LOAEL HQs <1 for alternative exposure scenario and default TRVs. NOAEL and LOAEL HQs <1 for alternative exposure and alternative TRVs.	Low Risk

Table 11.1
Summary of Risk Characterization Results for the UWOEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Surface Soil Non-PMJM Receptors			
	Patch 21	NOAEL and LOAEL HQs > 1 for default exposure scenario and TRVs. NOAEL and LOAEL HQs <1 for default exposure scenario and alternative TRVs. LOAEL HQs <1 for alternative exposure scenario and default TRVs. NOAEL and LOAEL HQs <1 for alternative exposure and alternative TRVs.	Low Risk

Table 11.1
Summary of Risk Characterization Results for the UWOEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Surface Soil Non-PMJM Receptors			
Tin	Patch 19	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
	Patch 21	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
Vanadium	Patch 19	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
	Patch 20	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
	Patch 21	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
Zinc	Patch 19	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
	Patch 20	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
	Patch 21	NOAEL HQ > 1 for default exposure scenario and TRVs. LOAEL HQ < 1 for default exposure scenario and TRVs.	Low Risk
Total PCBs	Patch 20	NOAEL and LOAEL HQs < 1 for default exposure scenario and TRVs.	Low Risk
Subsurface Soil			
None	Prairie dog	No ECOPCs.	No ECOPCs

[a]ESL was not available. Analyte evaluated in Section 10.

FIGURES

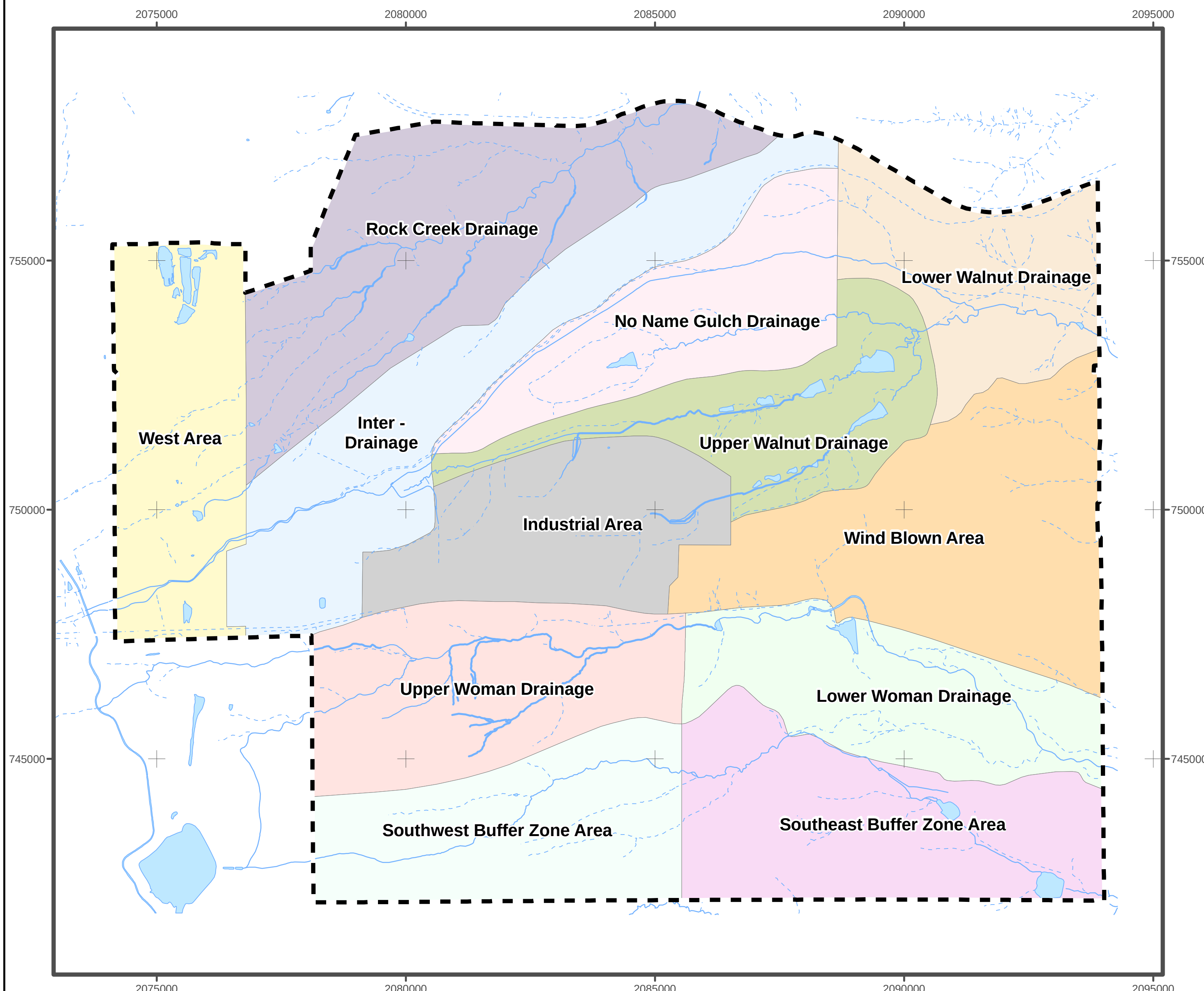

Figure 1.1
Rocky Flats Environmental
Technology Site
Exposure Units

KEY

Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W E
S

0 1,500 3,000 Feet

Scale 1:36,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental
Technology Site

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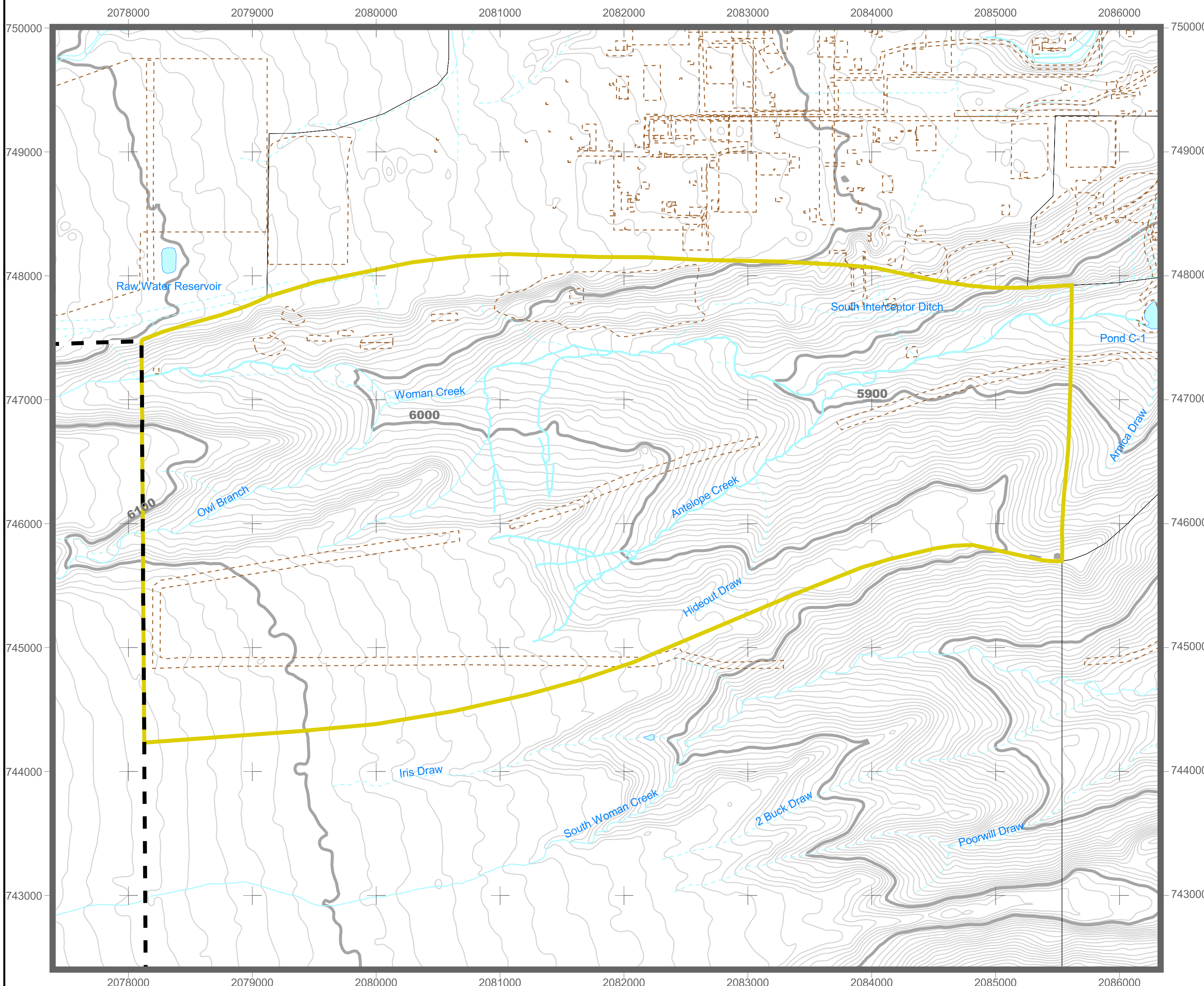

Figure 1.2
Topography and Historical IHSS Locations in the Upper Woman Drainage Exposure Unit

KEY

Upper Woman Drainage EU
Historical IHSS/PAC
Topographic contour interval = 5 ft.

Standard Map Features

Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N E S W

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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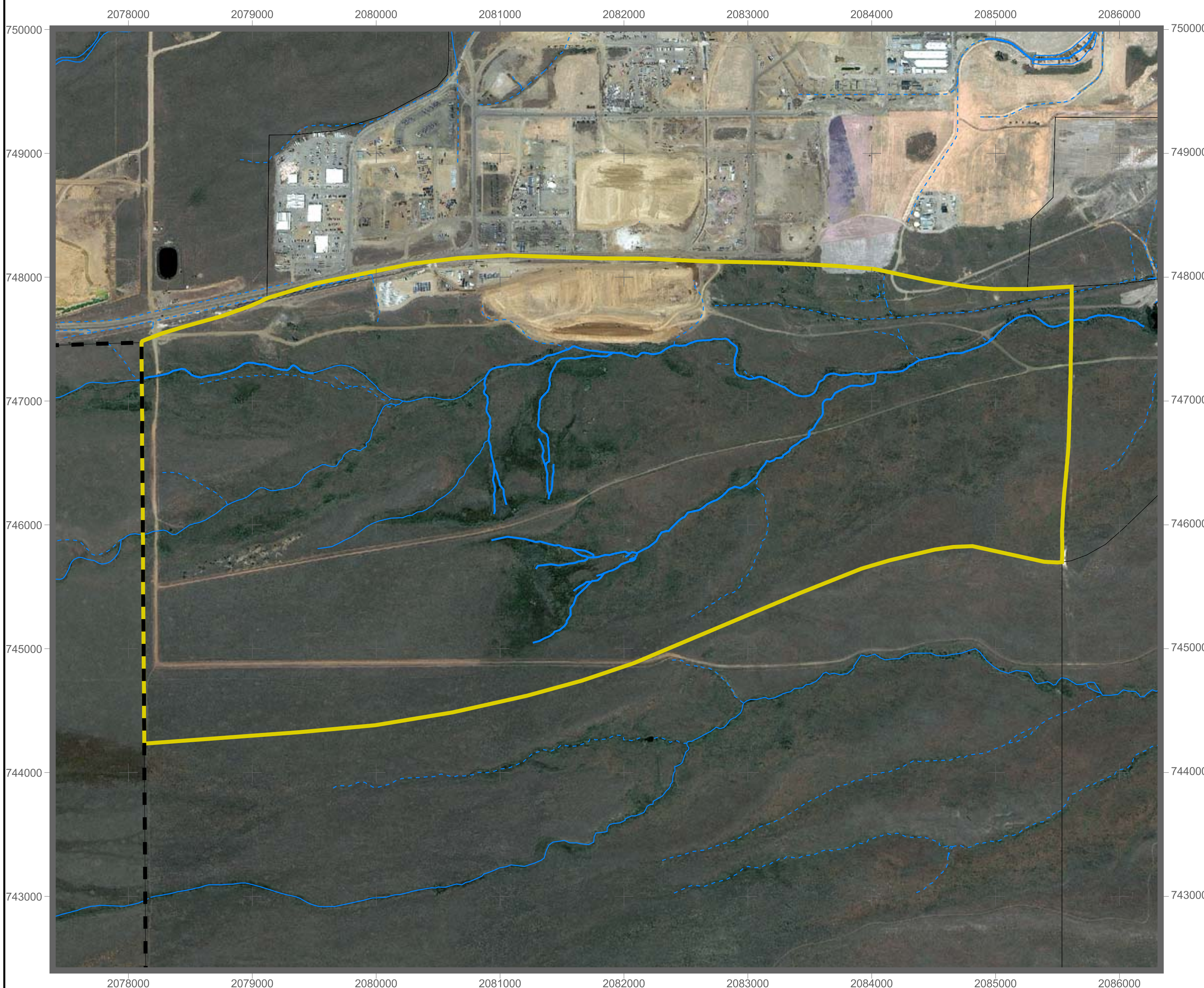
Figure 1.3
Aerial Photograph of the Upper Woman Drainage Exposure Unit
July 2005



KEY

Upper Woman Drainage EU

Standard Map Features

Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

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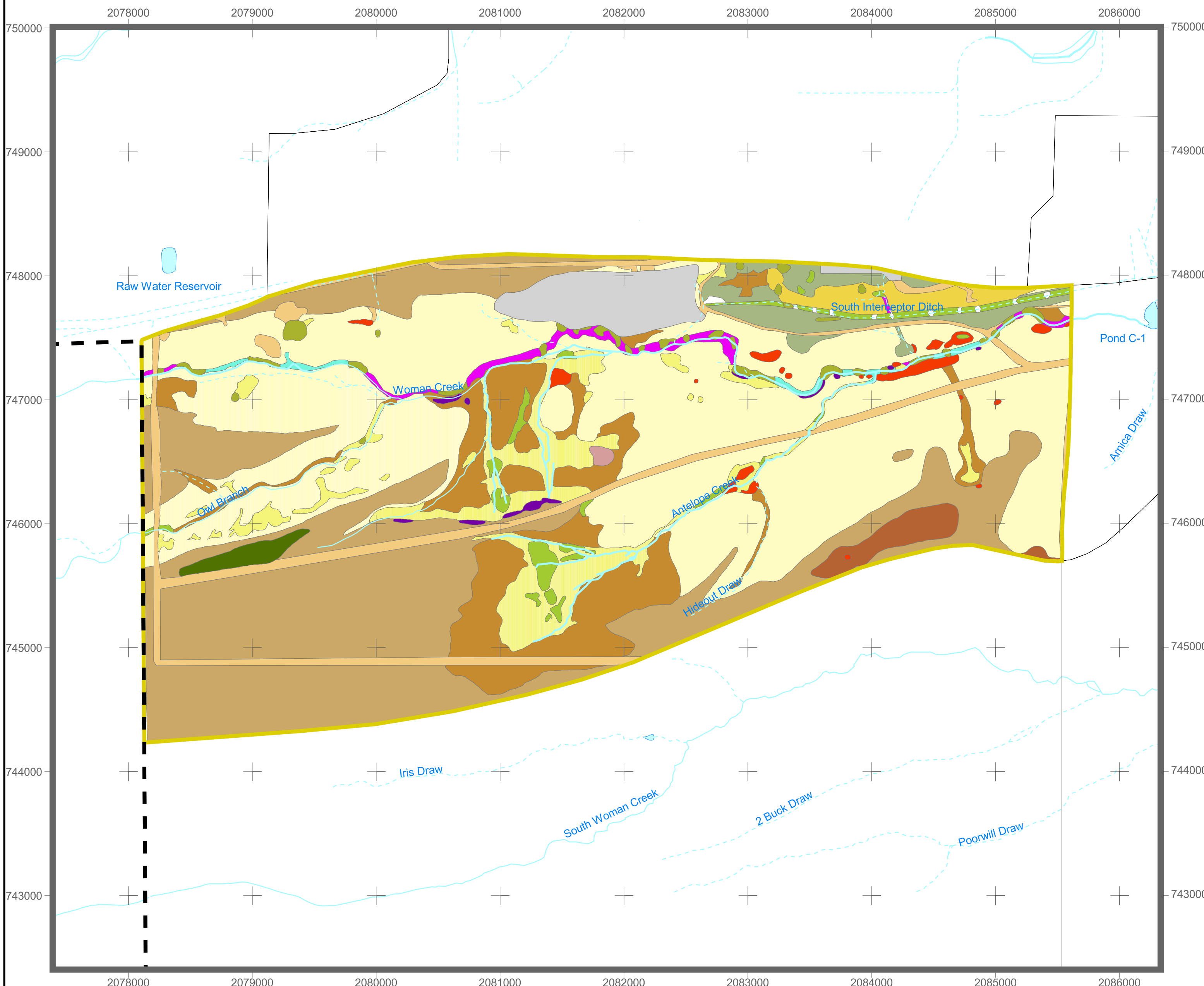

Figure 1.4
Vegetation in the Upper Woman Drainage Exposure Unit

KEY

Upper Woman Drainage EU

Vegetation, 2005

- Annual grass/forb community
- Disturbed areas
- Disturbed and revegetated areas
- Leadplant riparian shrubland
- Mesic mixed grassland
- Mudflats
- Open water
- Ponderosa woodland
- Reclaimed mixed grassland
- Riparian woodland
- Riprap, rock, and gravel piles
- Savannah shrubland
- Short grassland
- Short marsh
- Short upland shrubland
- Tall marsh
- Tall upland shrubland
- Tree plantings
- Wet meadow/marsh ecotone
- Willow riparian shrubland
- Xeric needle and thread grass prairie
- Xeric tallgrass prairie

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWoman.apr

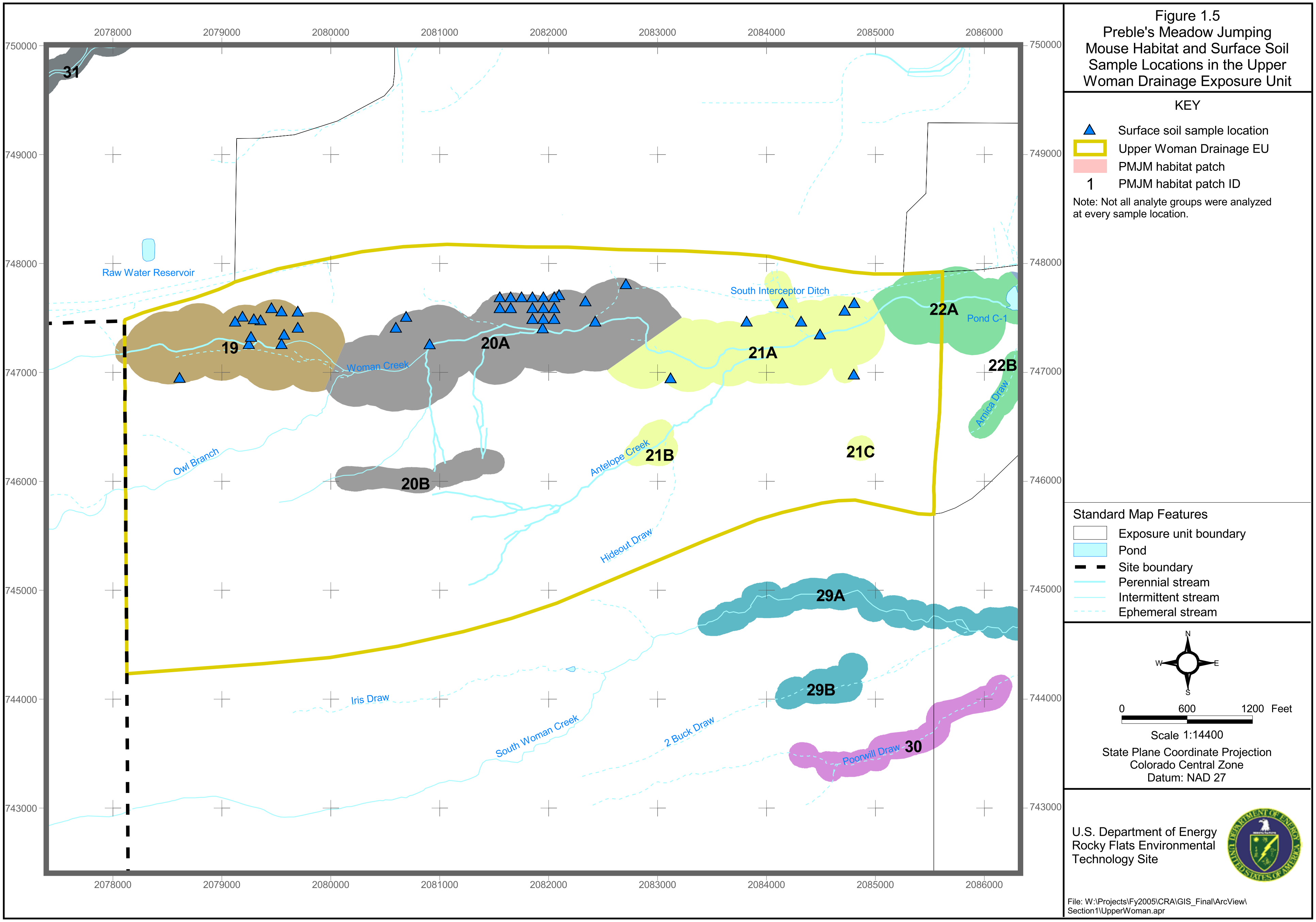
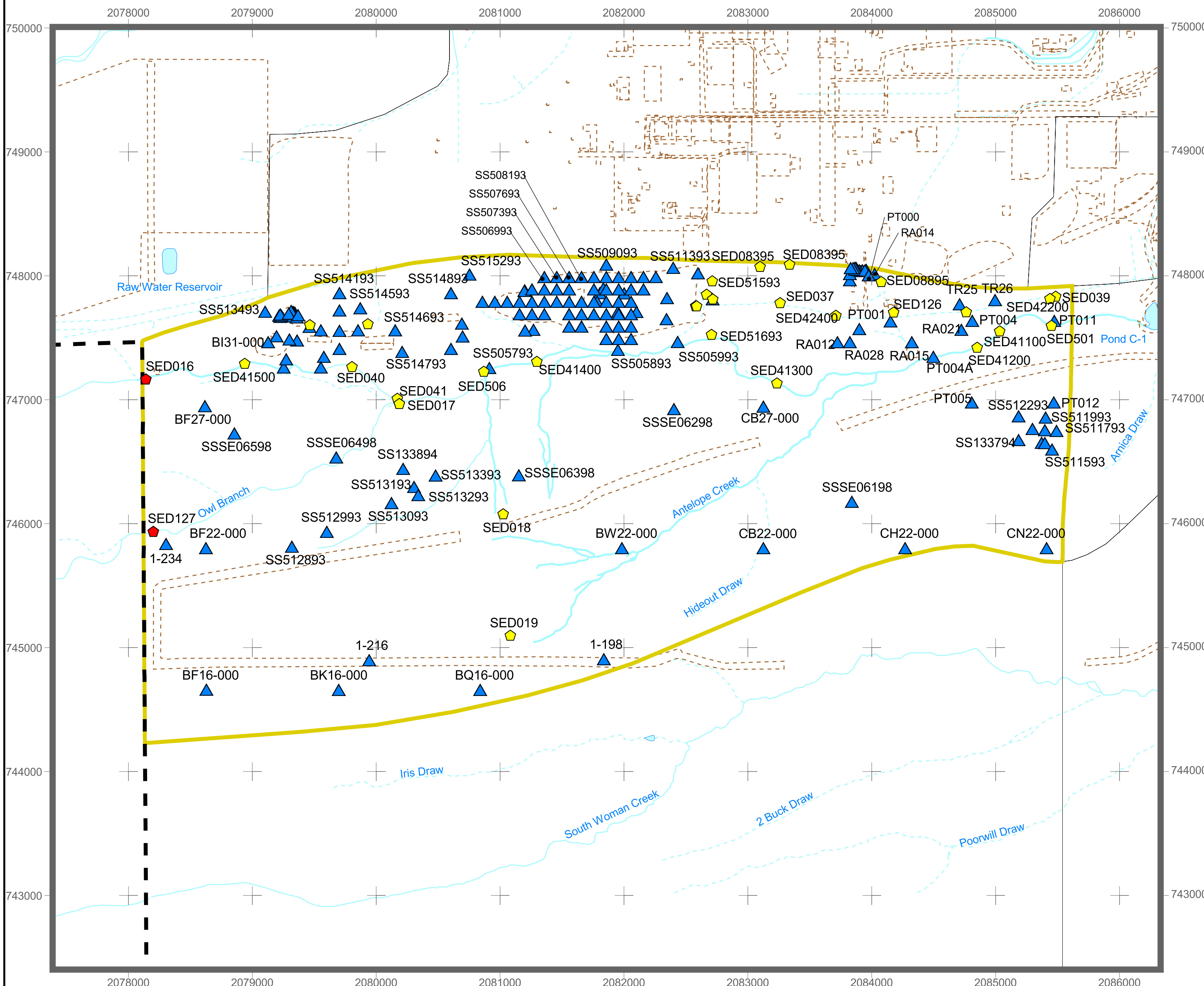


Figure 1.5
Preble's Meadow Jumping Mouse Habitat and Surface Soil Sample Locations in the Upper Woman Drainage Exposure Unit

Figure 1.6
Upper Woman Drainage Exposure Unit Surface Soil and Surface Sediment Sample Locations



KEY

Sample location
- Surface sediment sample location
- Surface soil sample location

(Background locations shown in red)
- Surface sediment sample location
- Upper Woman Drainage EU
- Historical IHSS/PAC

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

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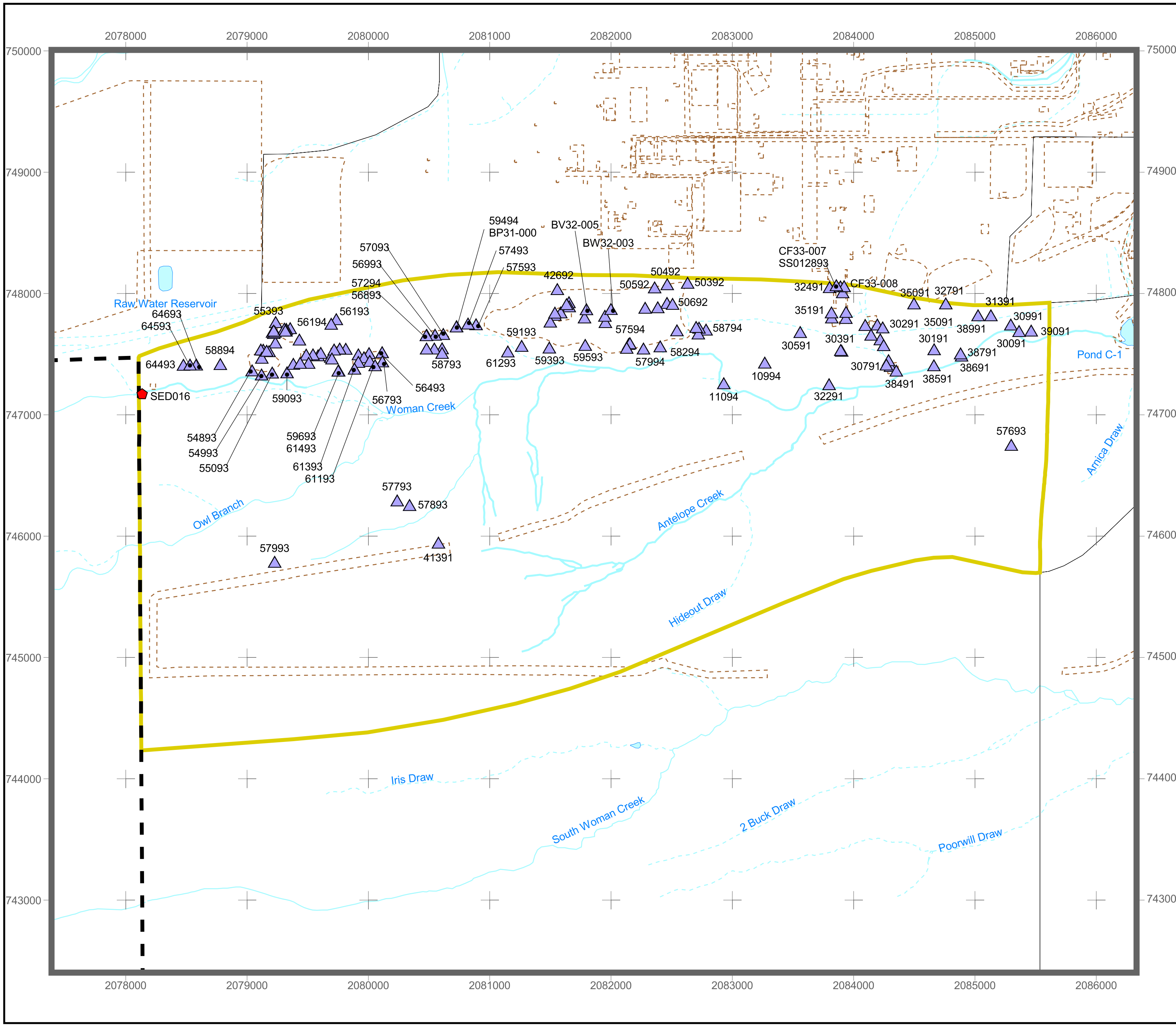

Figure 1.7
Upper Woman Drainage Exposure Unit Subsurface Soil and Subsurface Sediment Sample Locations

KEY

Sample location
- Subsurface sediment sample location
- Subsurface soil sample location

(Background locations shown in red)
- Subsurface sediment sample location
- Upper Woman Drainage EU
- Historical IHSS/PAC

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section1\UpperWoman.apr

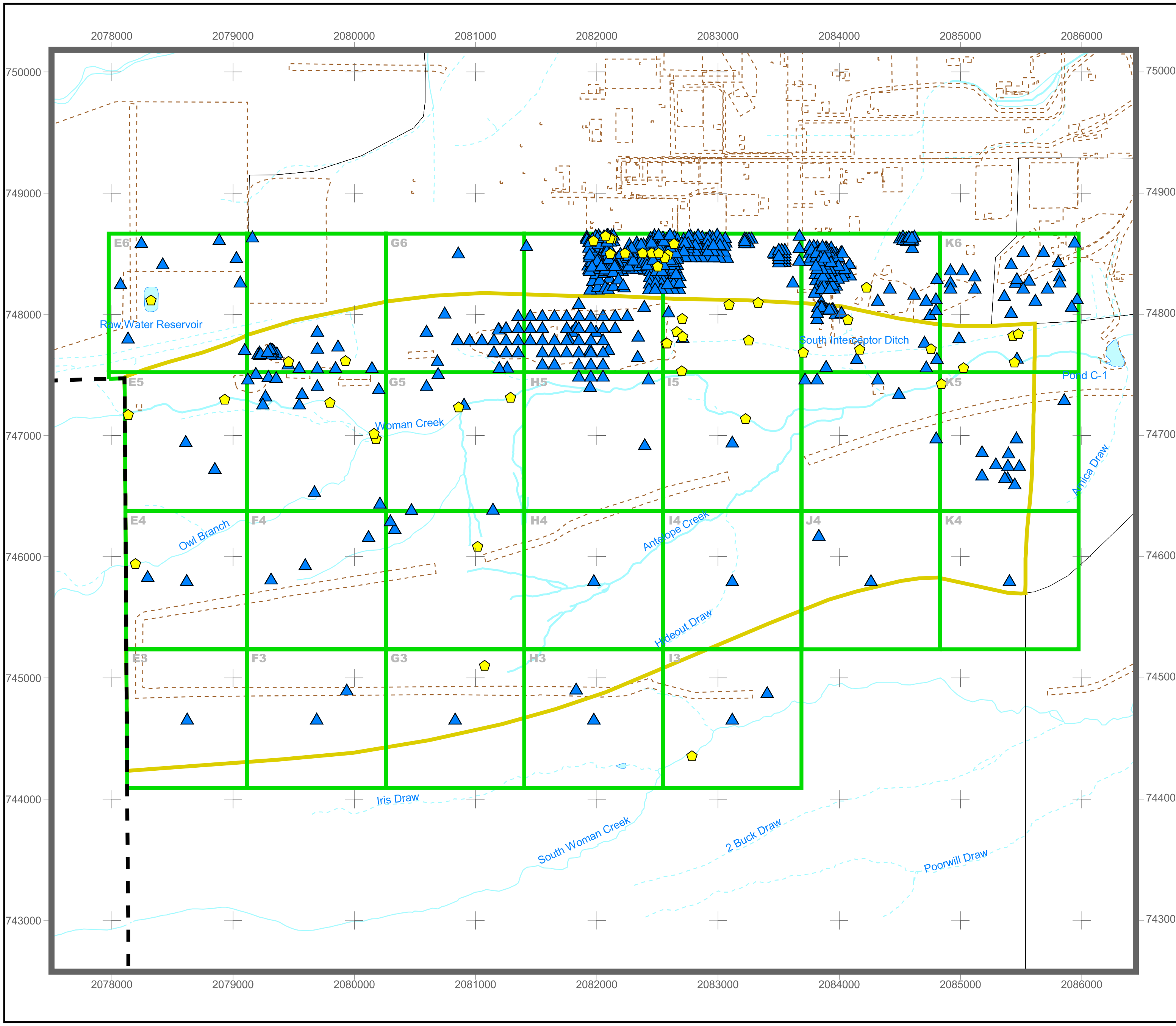

Figure 3.1
Tier 2 EPC 30-acre Grids
with Surface Soil and Surface
Sediment Sample Locations

KEY

Surface sediment sample location
Surface soil sample location
Upper Woman Drainage EU
30-acre grid
Historical IHSS/PAC
A1 Grid cell ID

Standard Map Features

Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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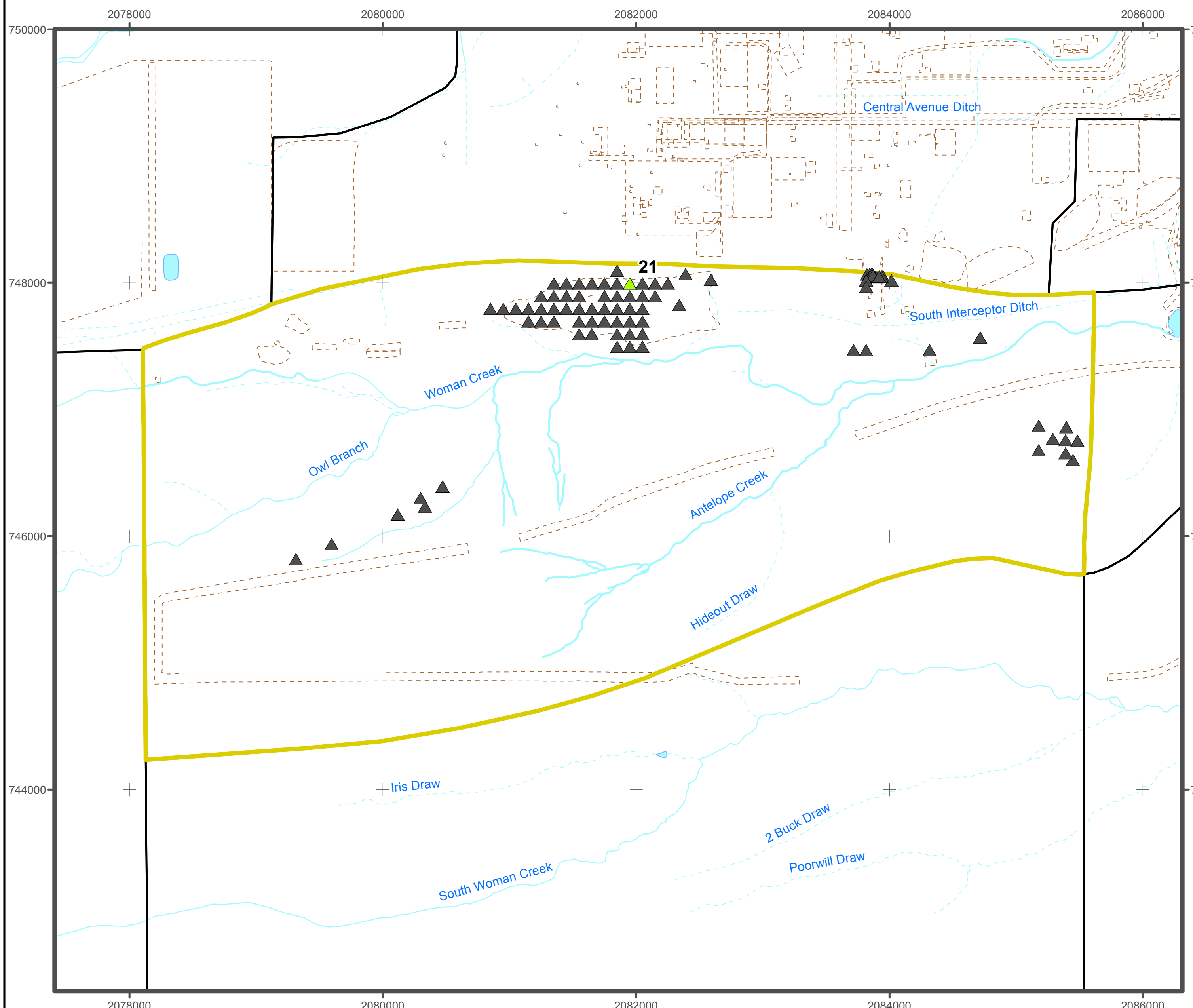

Figure 7.1
Upper Woman Drainage EU
Surface Soil Results
for 4,4-DDT

KEY

Sample location
Detect
Nondetect
Upper Woman Drainage EU
Historical IHSS/PAC

Note:
Some reported results for nondetects exceed the ESL. See Attachment 1.

CRA Methodology ESL = 1.20 ug/kg

Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W E
S
0 600 1,200 Feet
Scale 1:14,400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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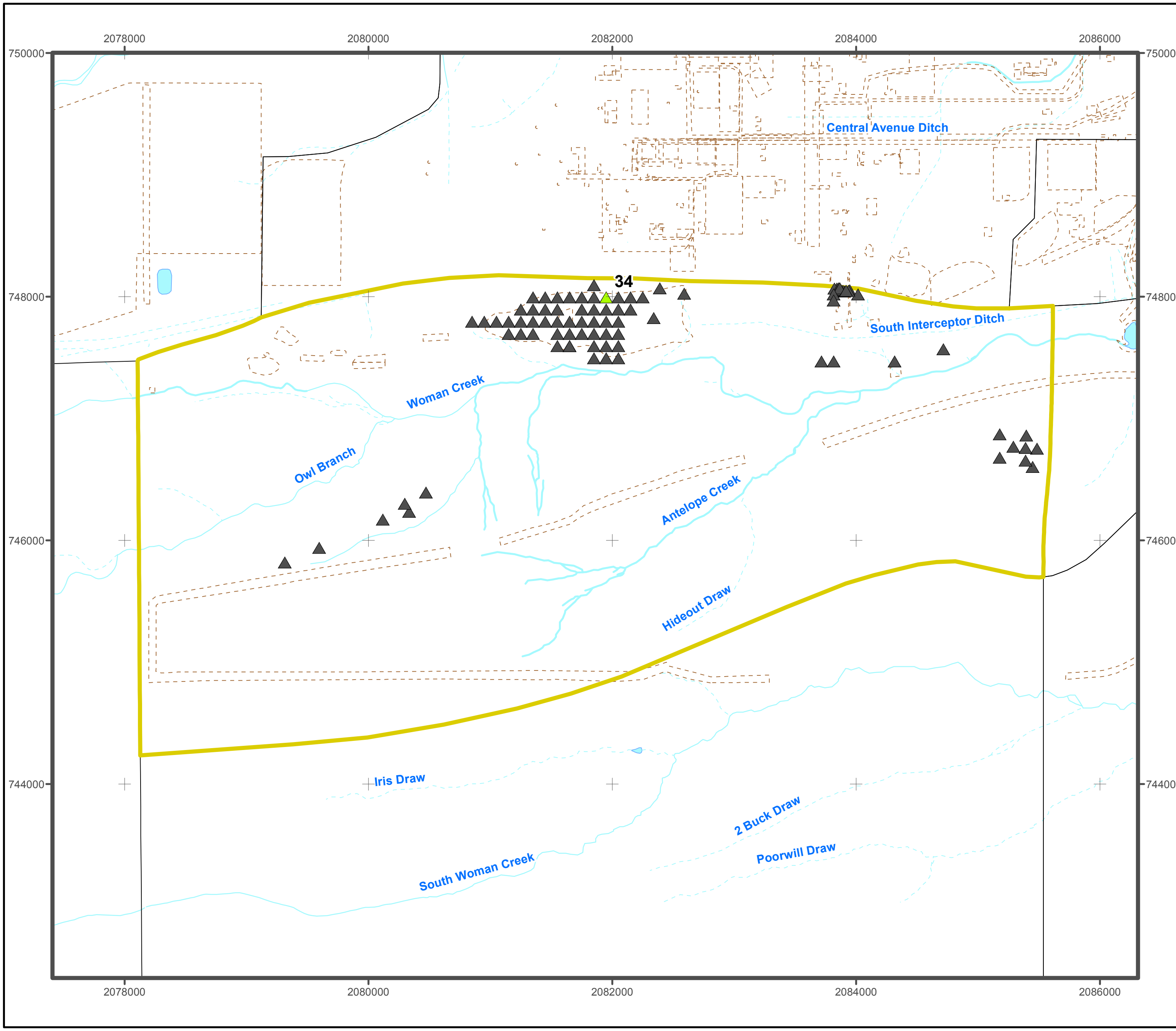

Figure 7.2
Upper Woman Drainage EU
Surface Soil Results
for Dieldrin

KEY

Sample location
Detect
Nondetect
Upper Woman Drainage EU
Historical IHSS/PAC

Note:
Some reported results for nondetects exceed the ESL. See Attachment 1.

CRA Methodology ESL = 7.40 ug/kg

Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
W
E
S
0
600
1,200
Feet
Scale 1:14,400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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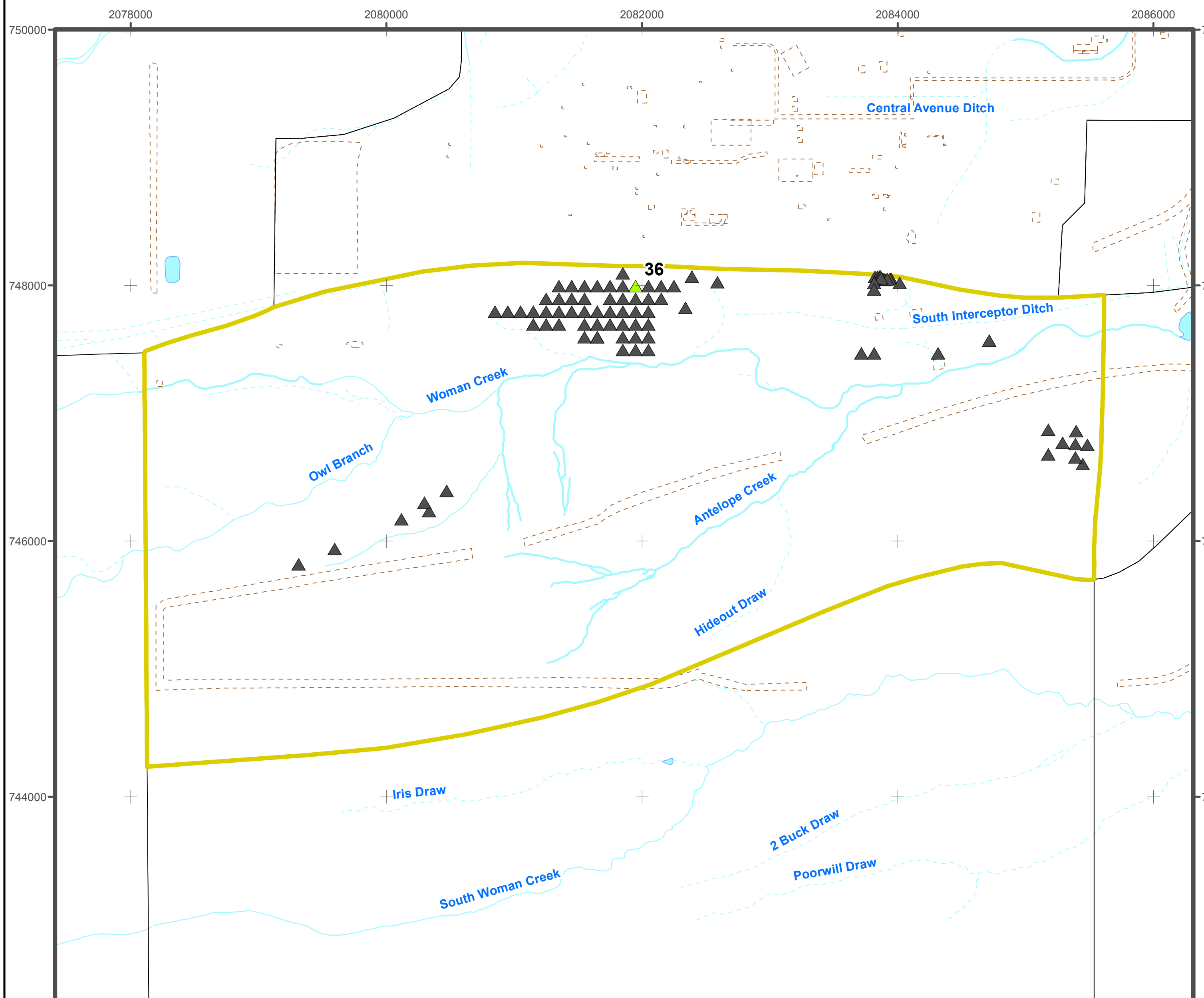

Figure 7.3
Upper Woman Drainage EU
Surface Soil Results
for Endrin Ketone

KEY

Sample location
- Detect
- Nondetect
- Upper Woman Drainage EU
- Historical IHSS/PAC

Note:
Some reported results for nondetects exceed the ESL. See Attachment 1.

CRA Methodology ESL = 1.40 ug/kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 600 1,200 Feet

Scale 1:14,400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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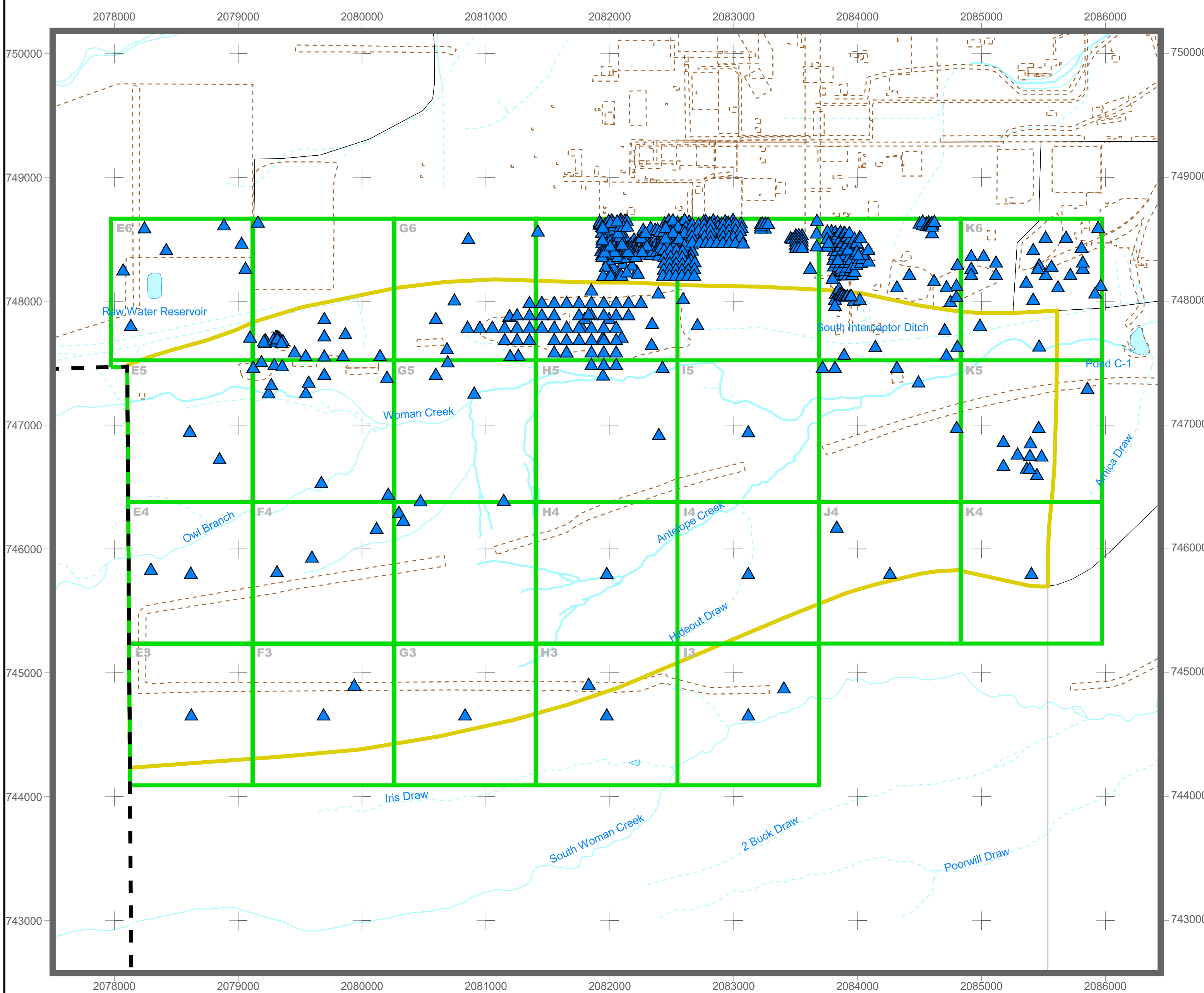

Figure 8.1
Tier 2 EPC 30-acre Grids with Surface Soil Sample Locations

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

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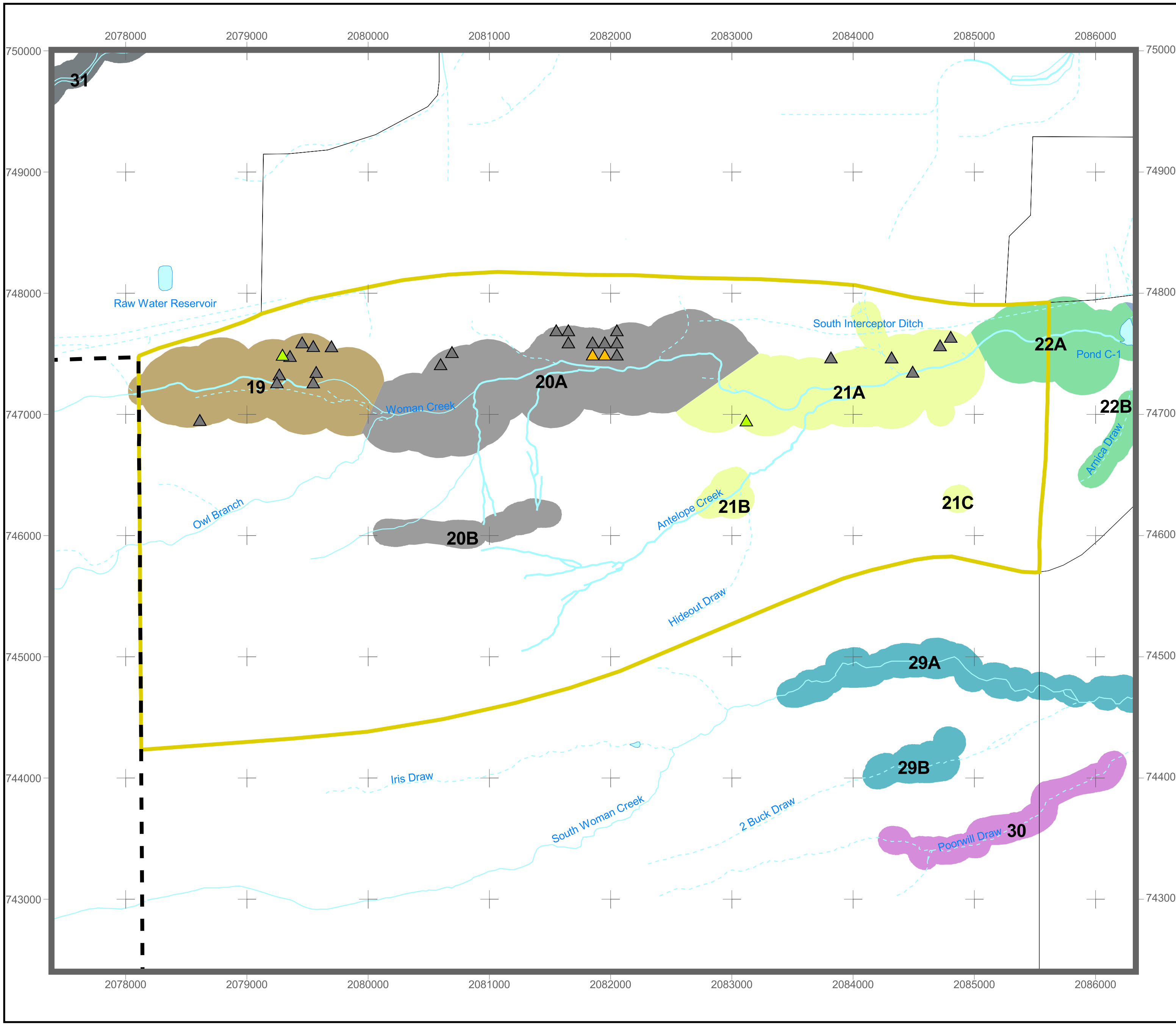

Figure 8.2
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Antimony

KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 1.0 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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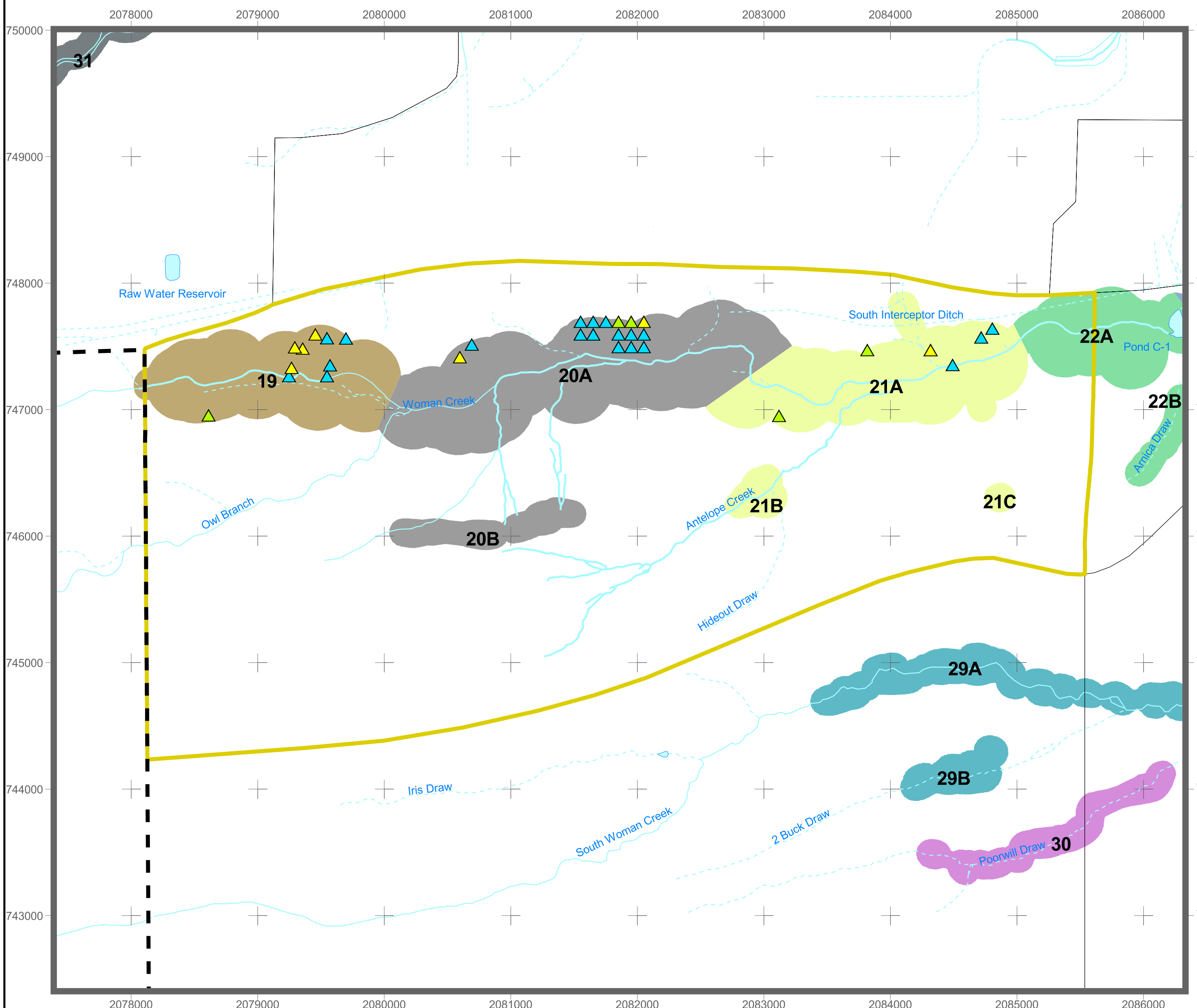
Figure 8.3
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Chromium



KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 19.26 mg/kg
Maximum background concentration: 16.9 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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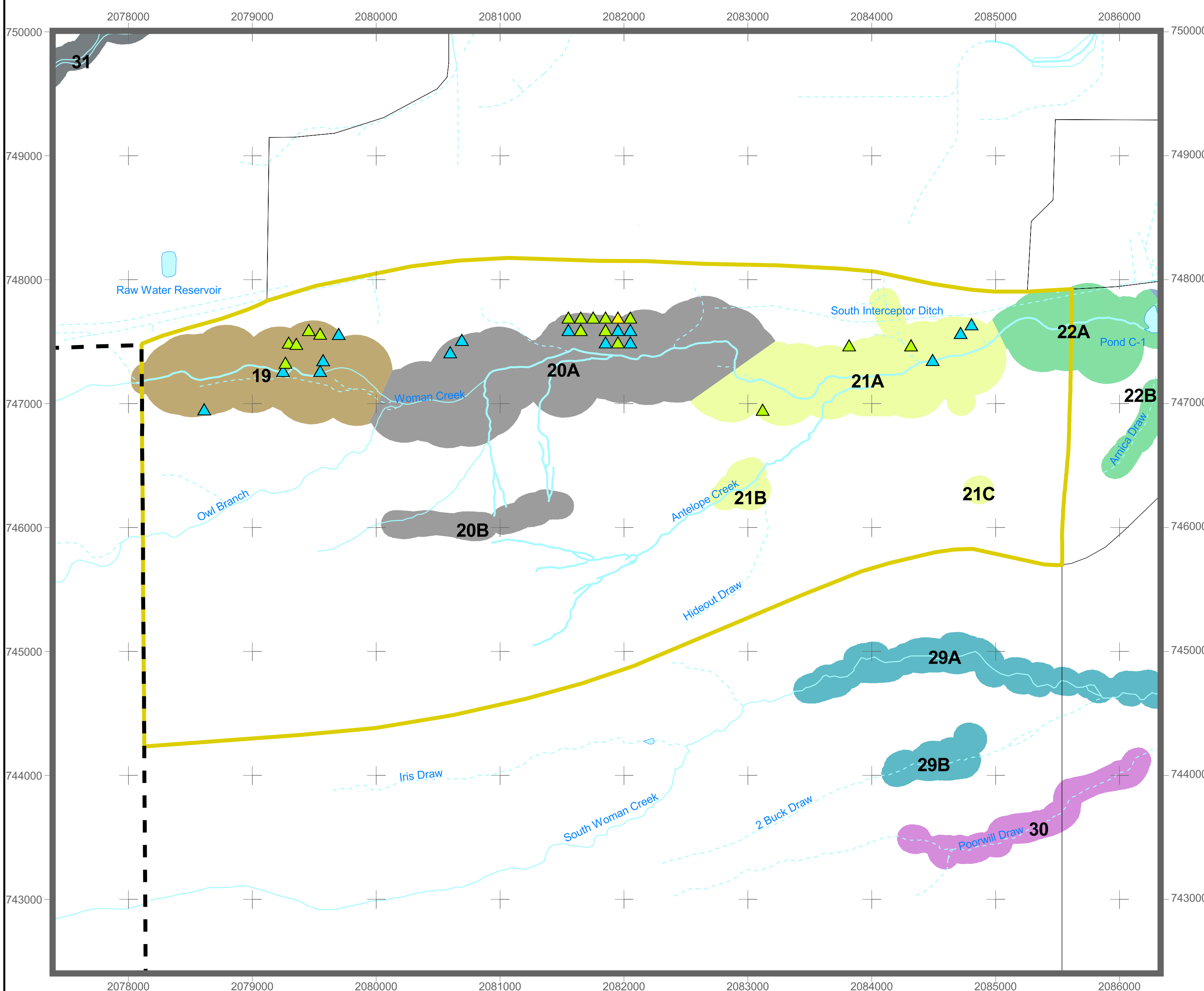
Figure 8.4
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Copper



KEY

Surface soil sample location
- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 94.97 mg/kg
Maximum background concentration: 16 mg/kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N S E W

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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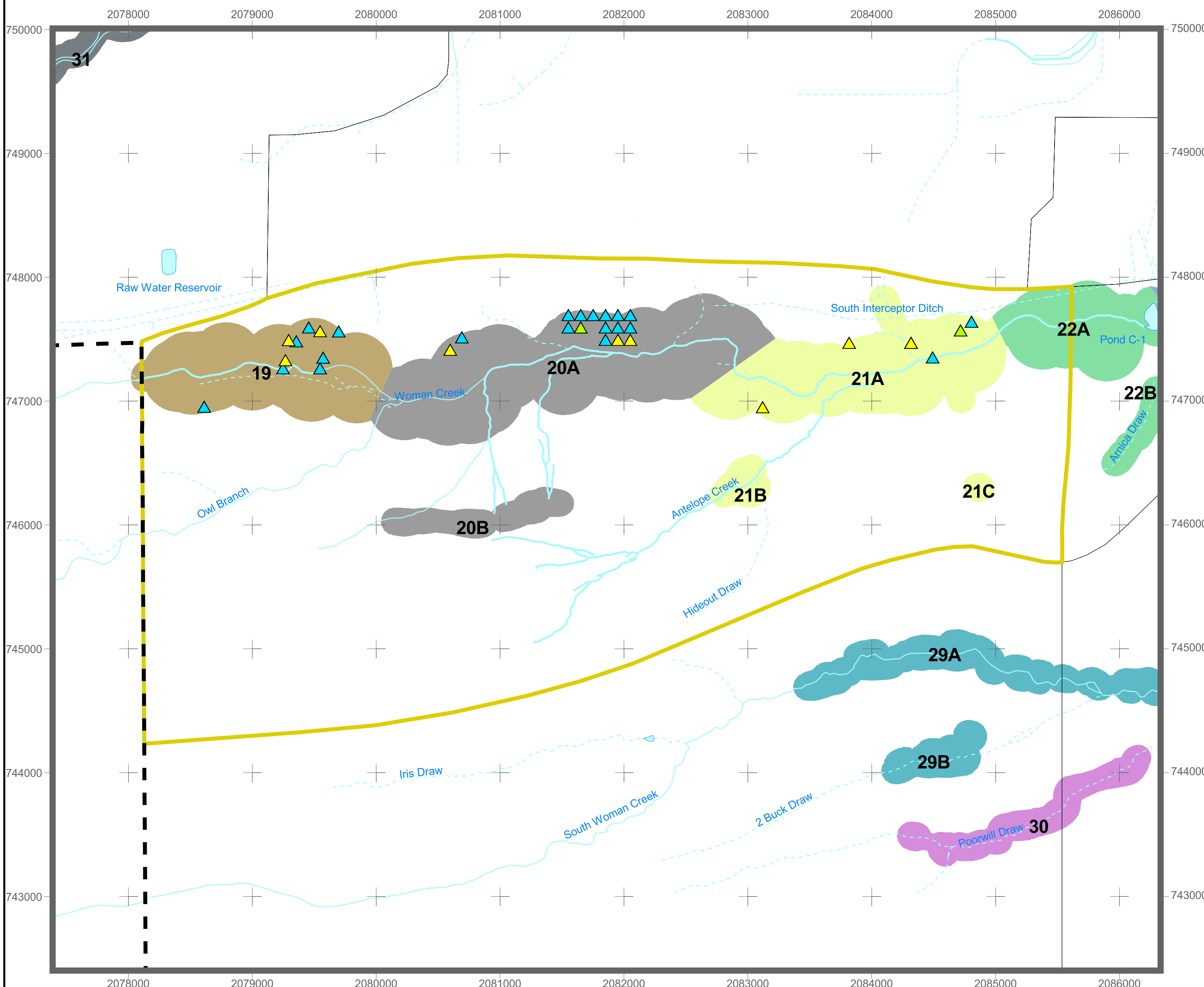
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWoman.apr

Figure 8.5
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Manganese



KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 387.9 mg/kg
Maximum background concentration: 357 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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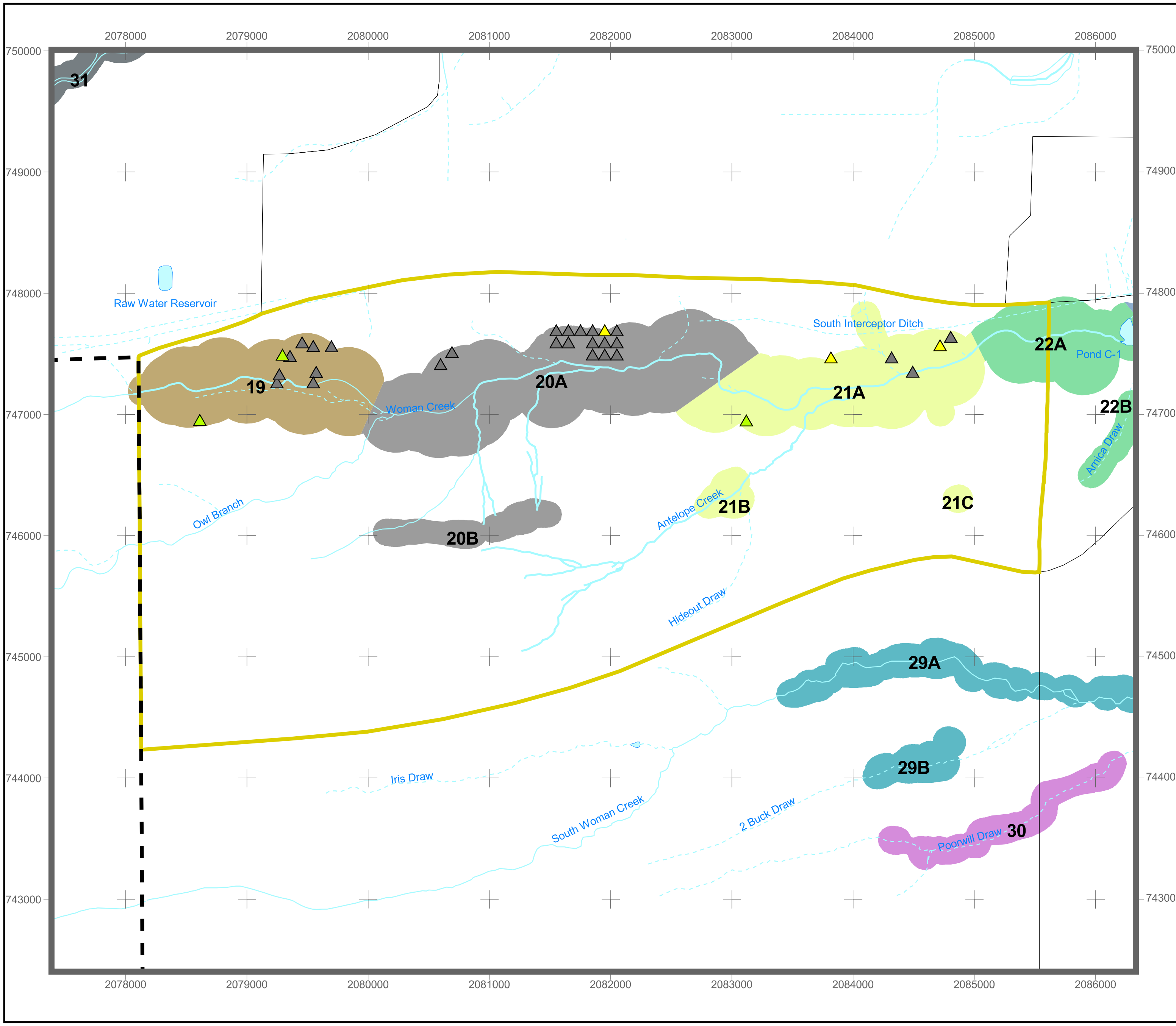
Figure 8.6
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Molybdenum



KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 1.84 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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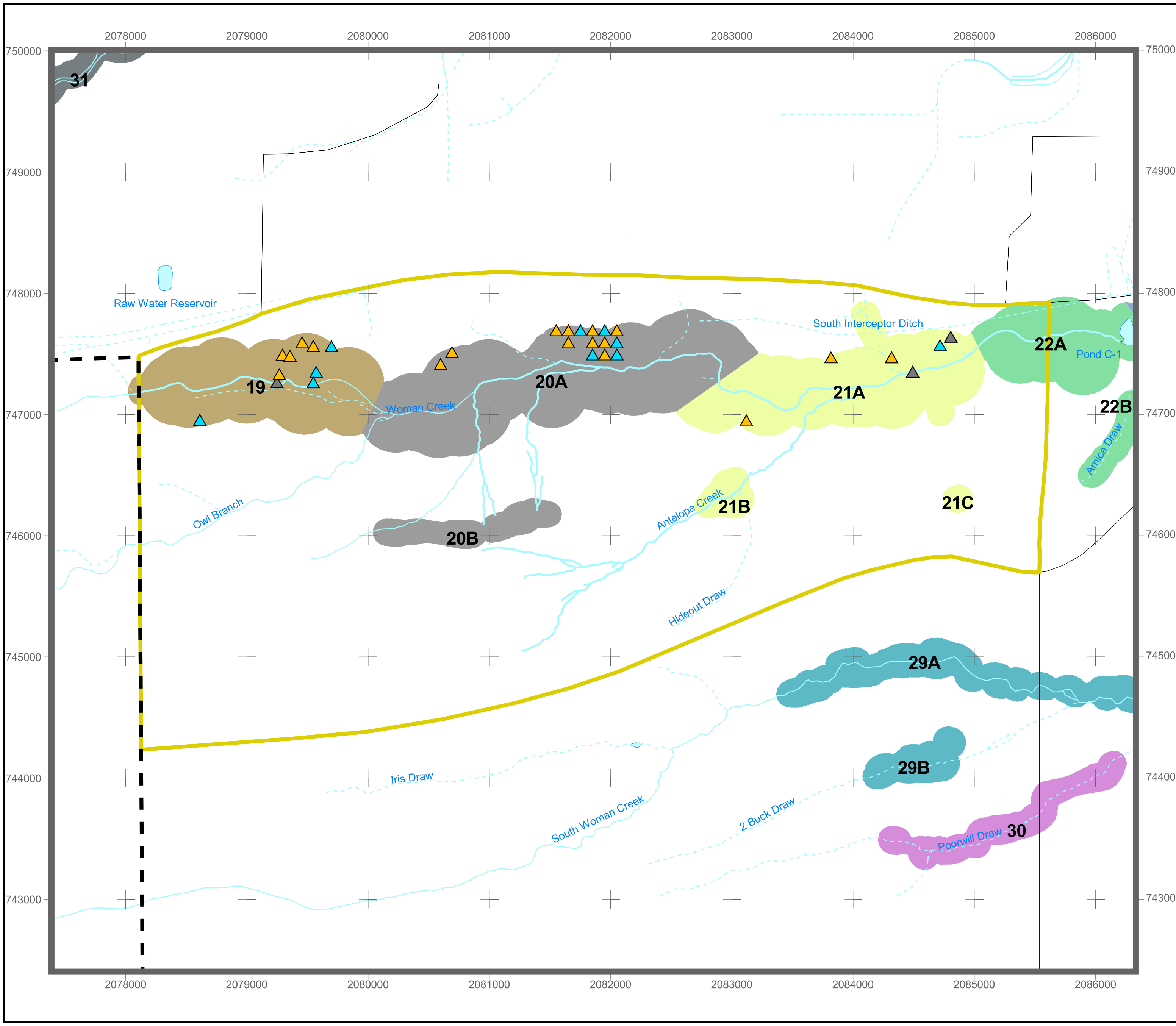

Figure 8.7
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Nickel

KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 0.51 mg/kg
Maximum background concentration: 14 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N E S W

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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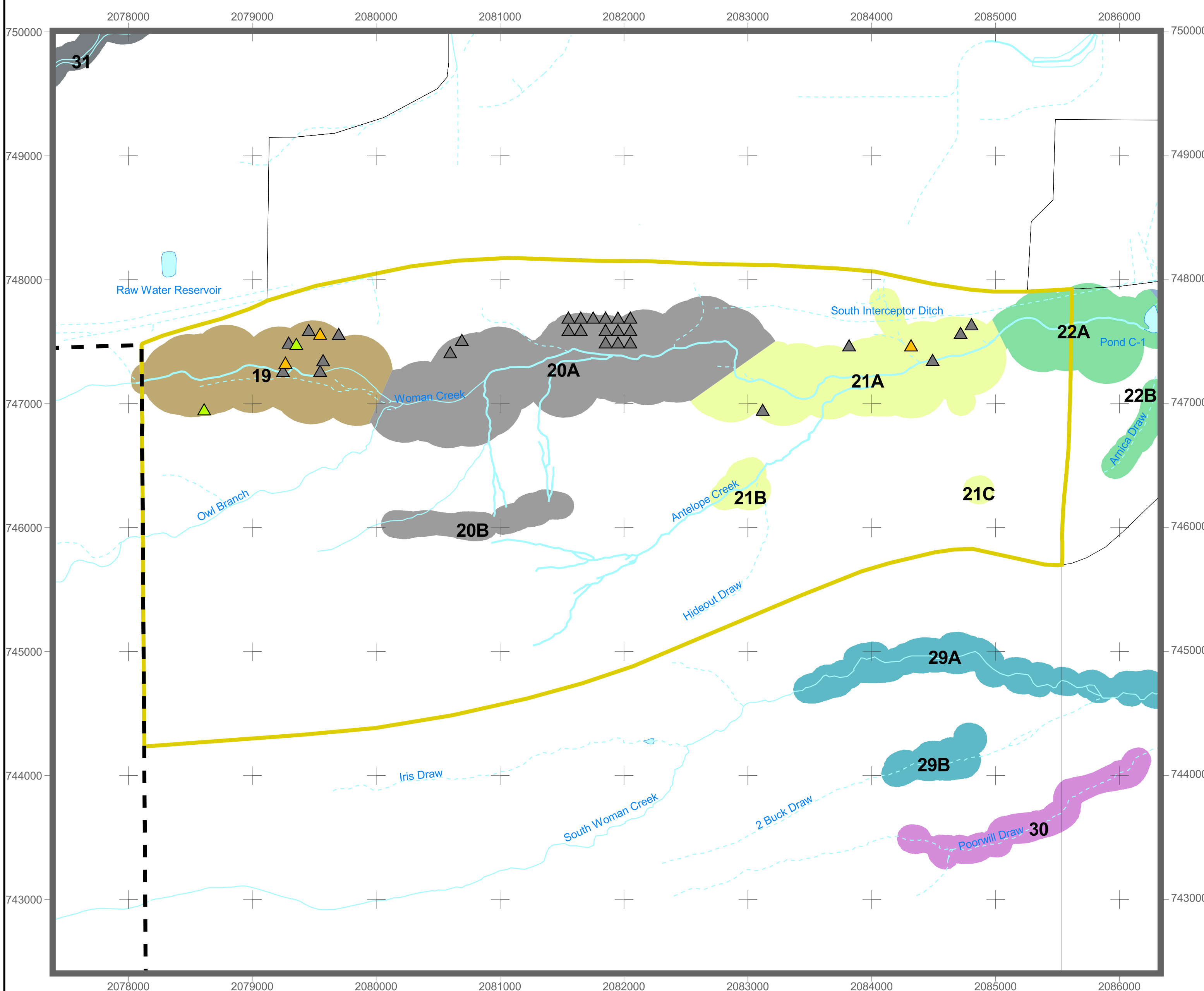

Figure 8.8
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Tin

KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 4.21 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWoman.apr

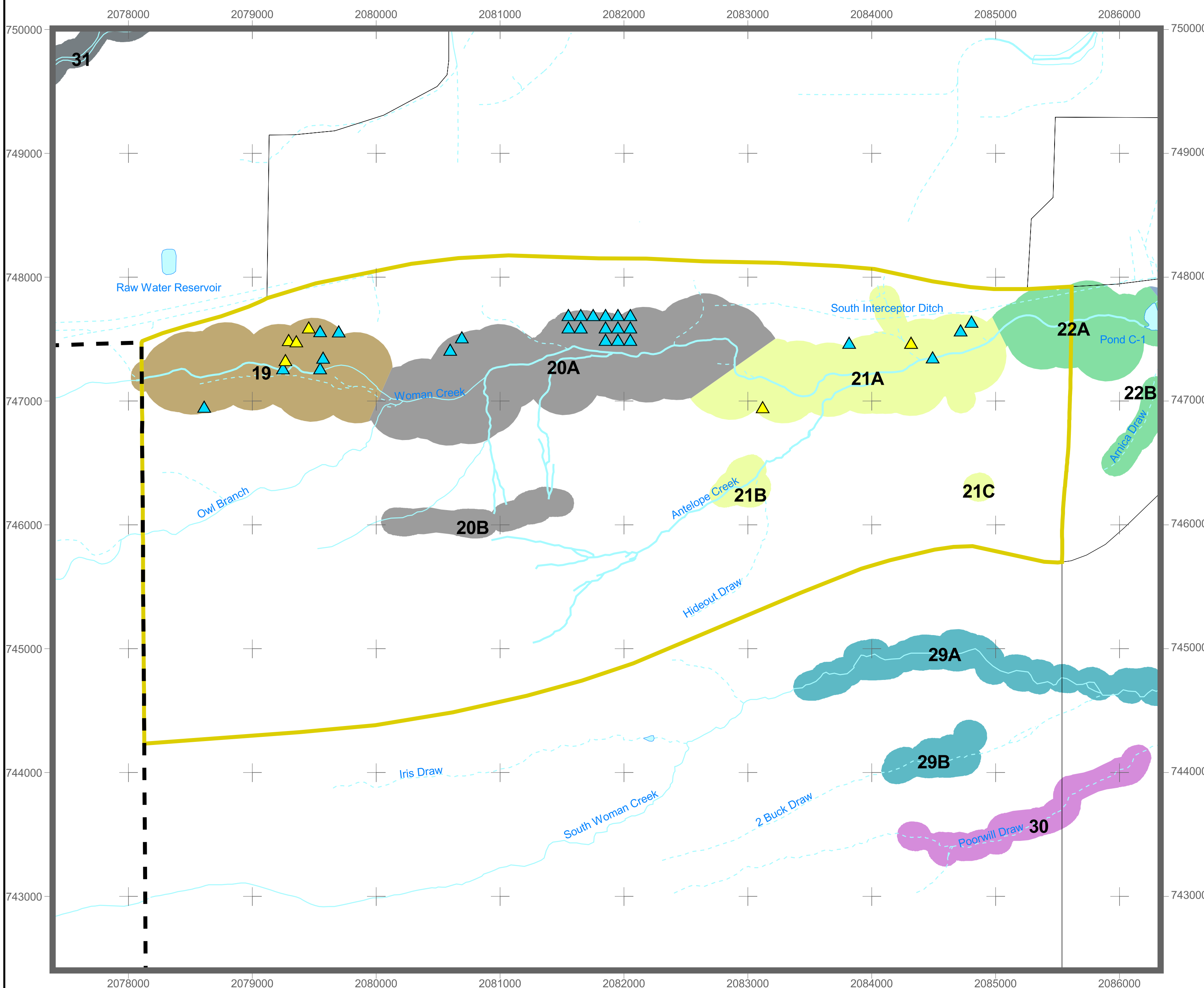

Figure 8.9
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Vanadium

KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 21.6 mg/kg
Maximum background concentration: 45.8 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\UpperWoman.apr

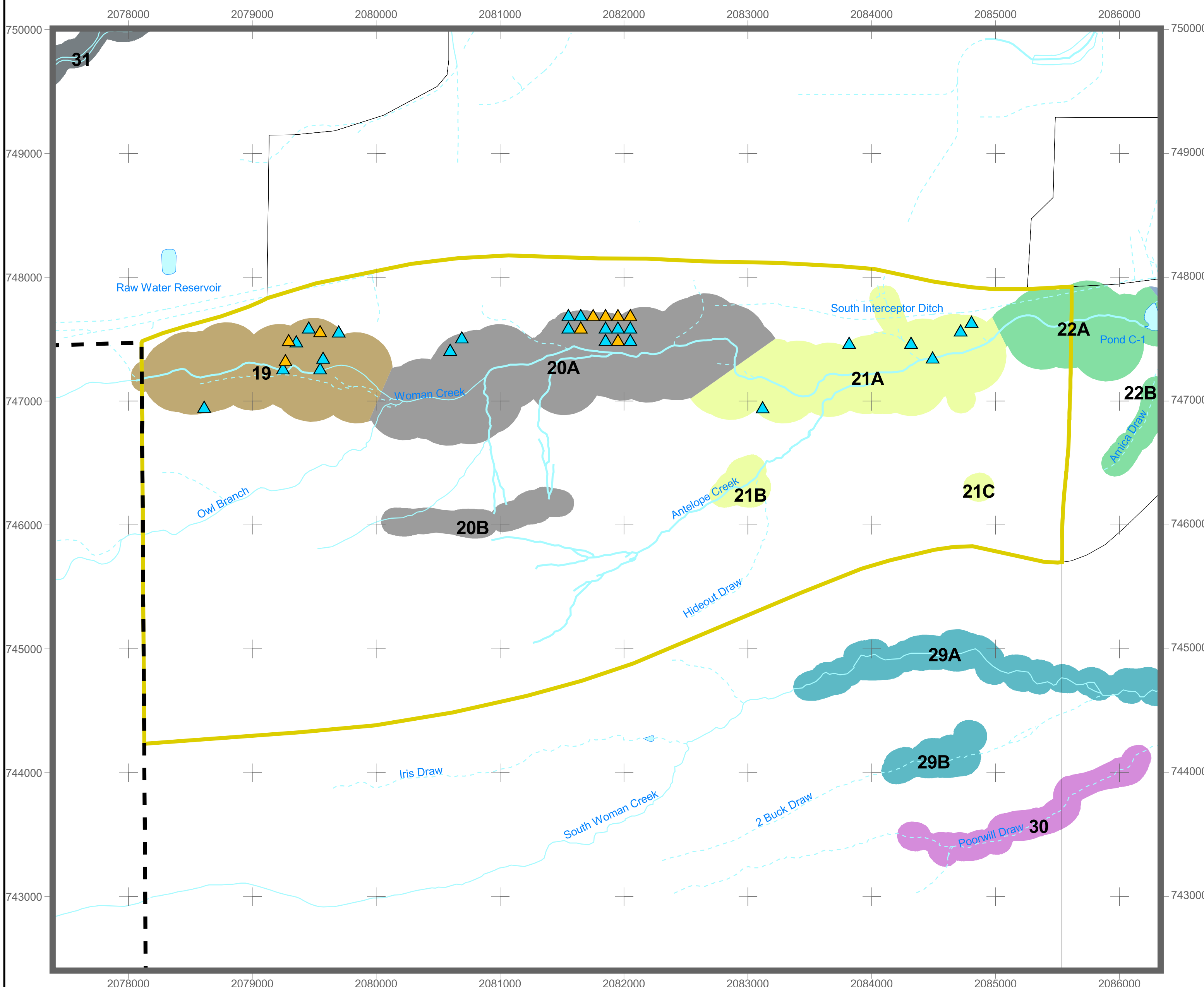

Figure 8.10
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Zinc

KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 6.4 mg/kg
Maximum background concentration: 75.9 mg/kg

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
W
E
S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental
Technology Site

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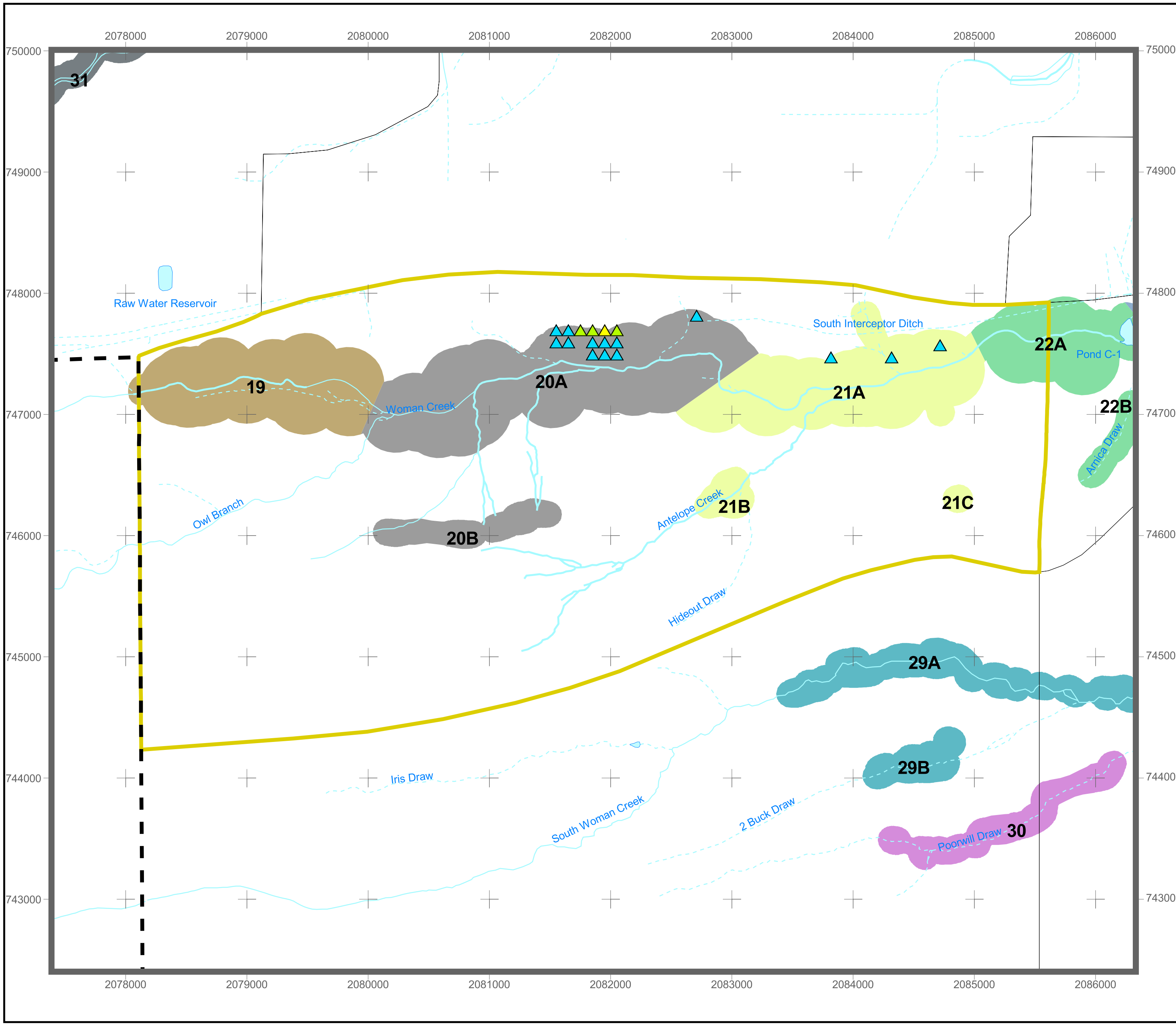

Figure 8.11
Upper Woman Drainage Exposure Unit Surface Soil Sample Locations in PMJM Habitat for Total PCBs

KEY

Surface soil sample location
- Detect >= 3 x ESL
- Detect >= ESL
- Detect < ESL
- Upper Woman Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 1349.8 mg/kg
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

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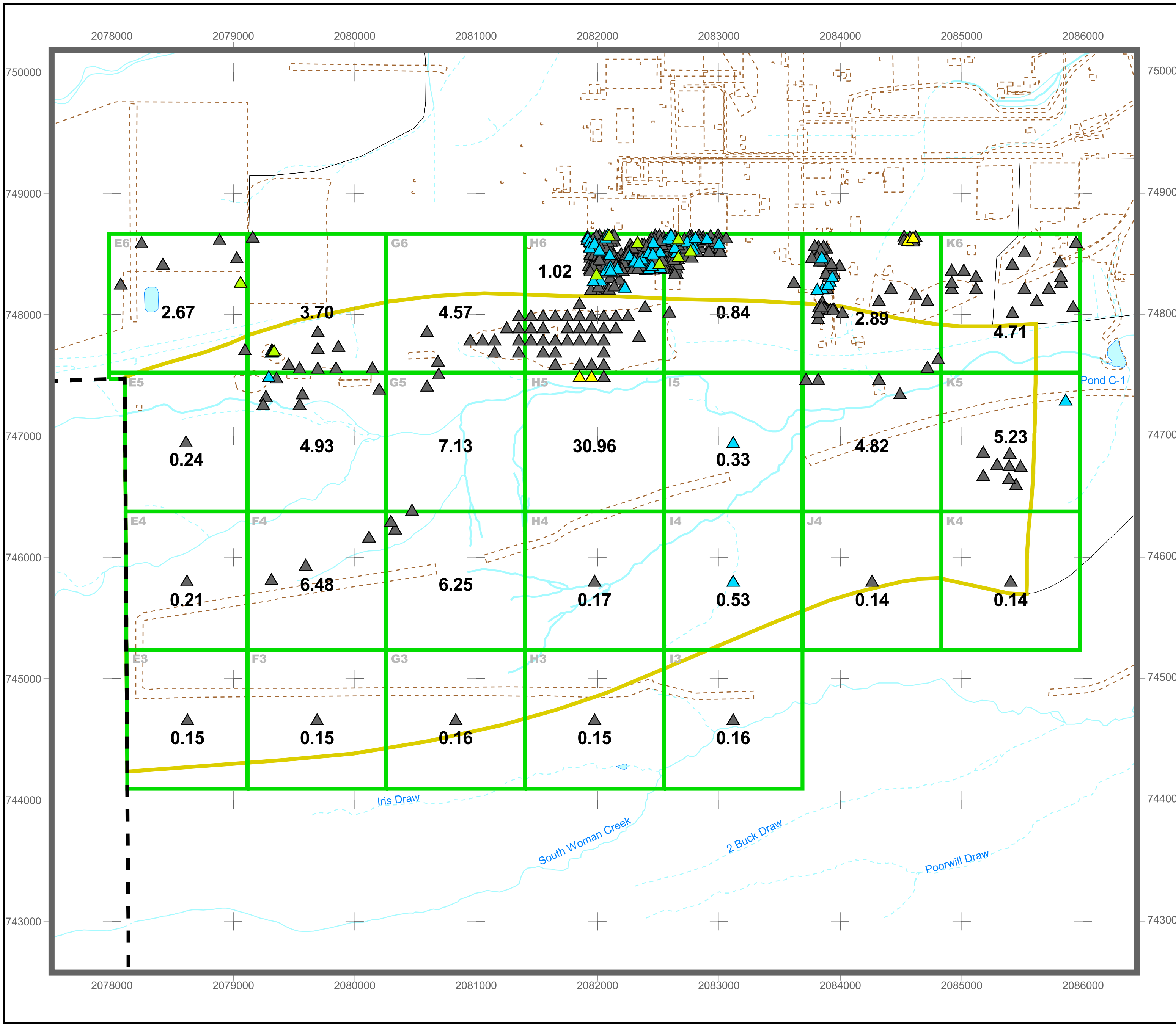
Figure 10.1
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Antimony



KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.905 mg/kg
Receptor: Deer Mouse - Insectivore
95th UCL background: 0.309 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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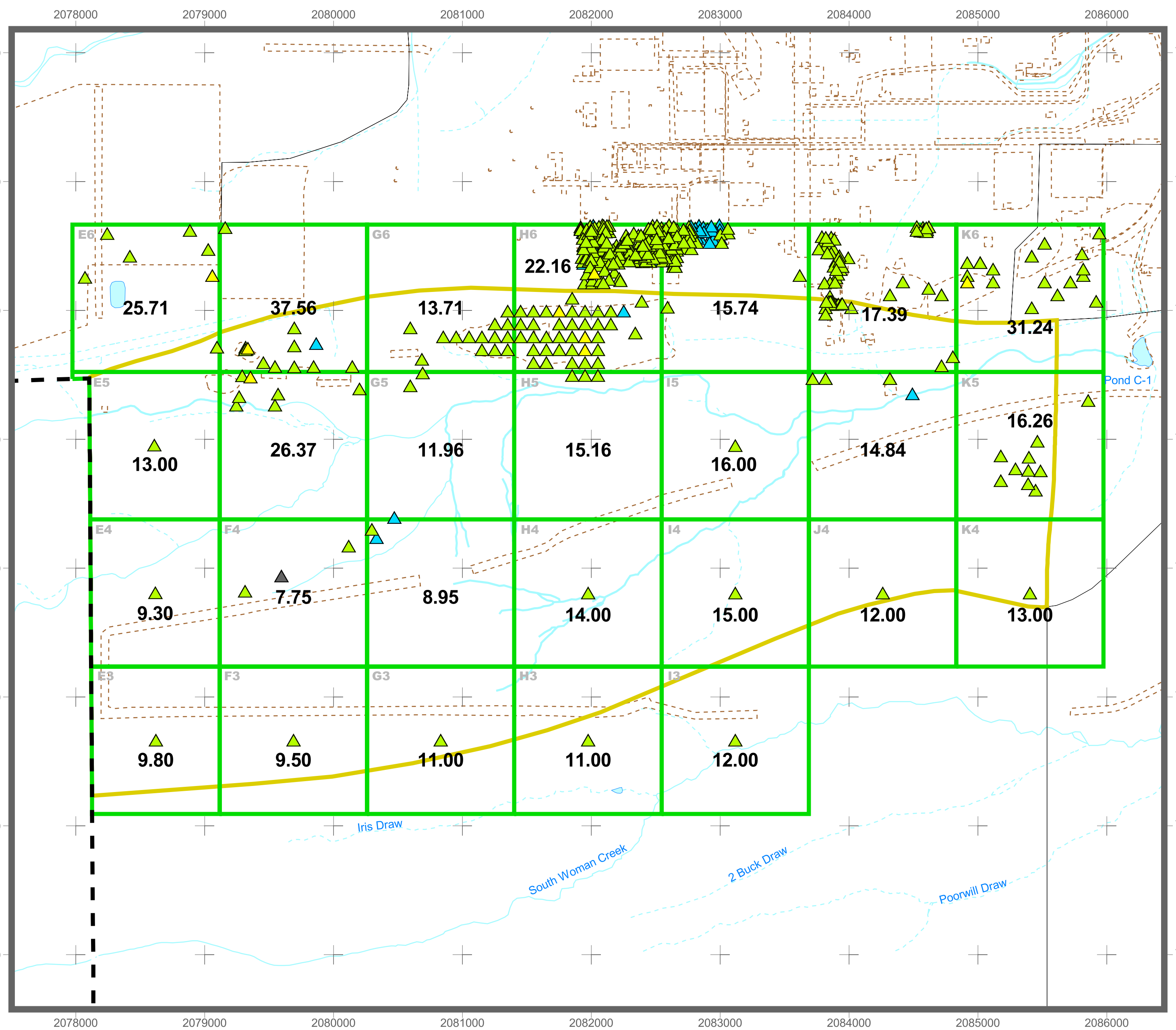

Figure 10.2
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Copper

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 8.25 mg/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: 14 mg/kg
Maximum background concentration: 16 mg/kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N S E W

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\UpperWoman.apr

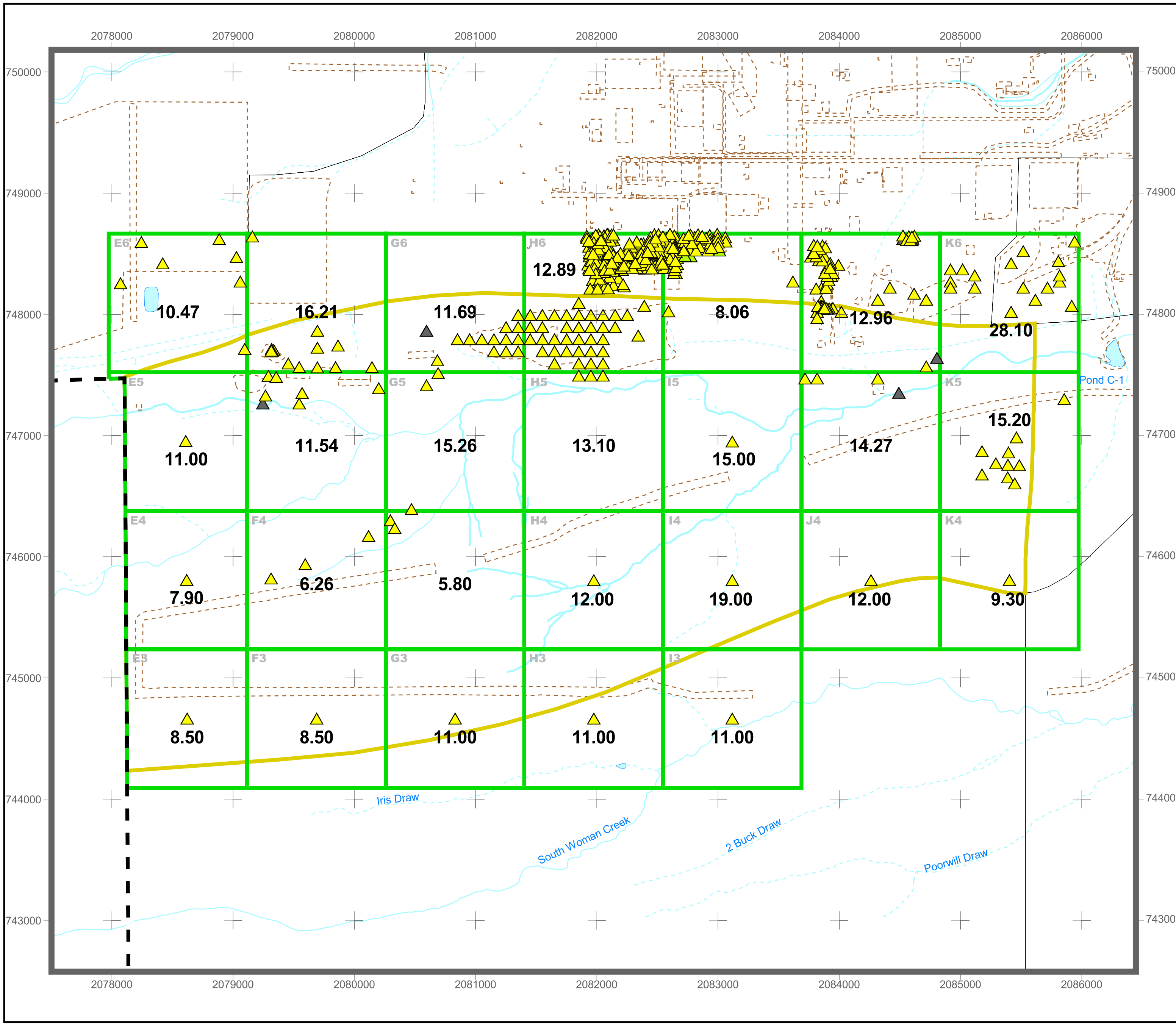

Figure 10.3
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Nickel

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.431 mg/kg
Receptor: Deer Mouse - Insectivore
95th UCL background: 10.6 mg/kg
Maximum background concentration: 14 mg/kg

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Rocky Flats Environmental Technology Site

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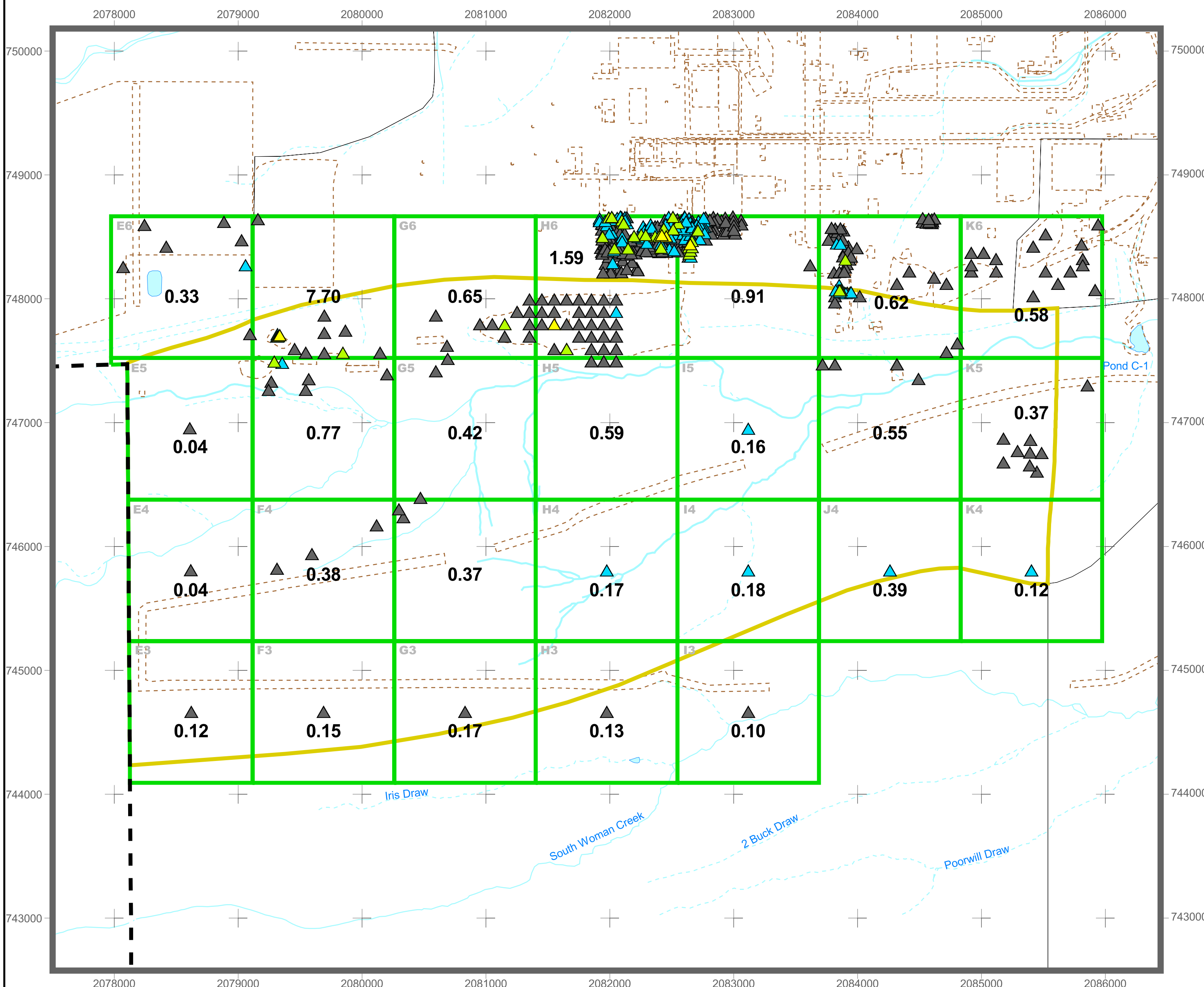
Figure 10.4
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Silver



KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 2 mg/kg
Receptor: Terrestrial Plants
95th UCL background: 0.21 mg/kg
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N
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0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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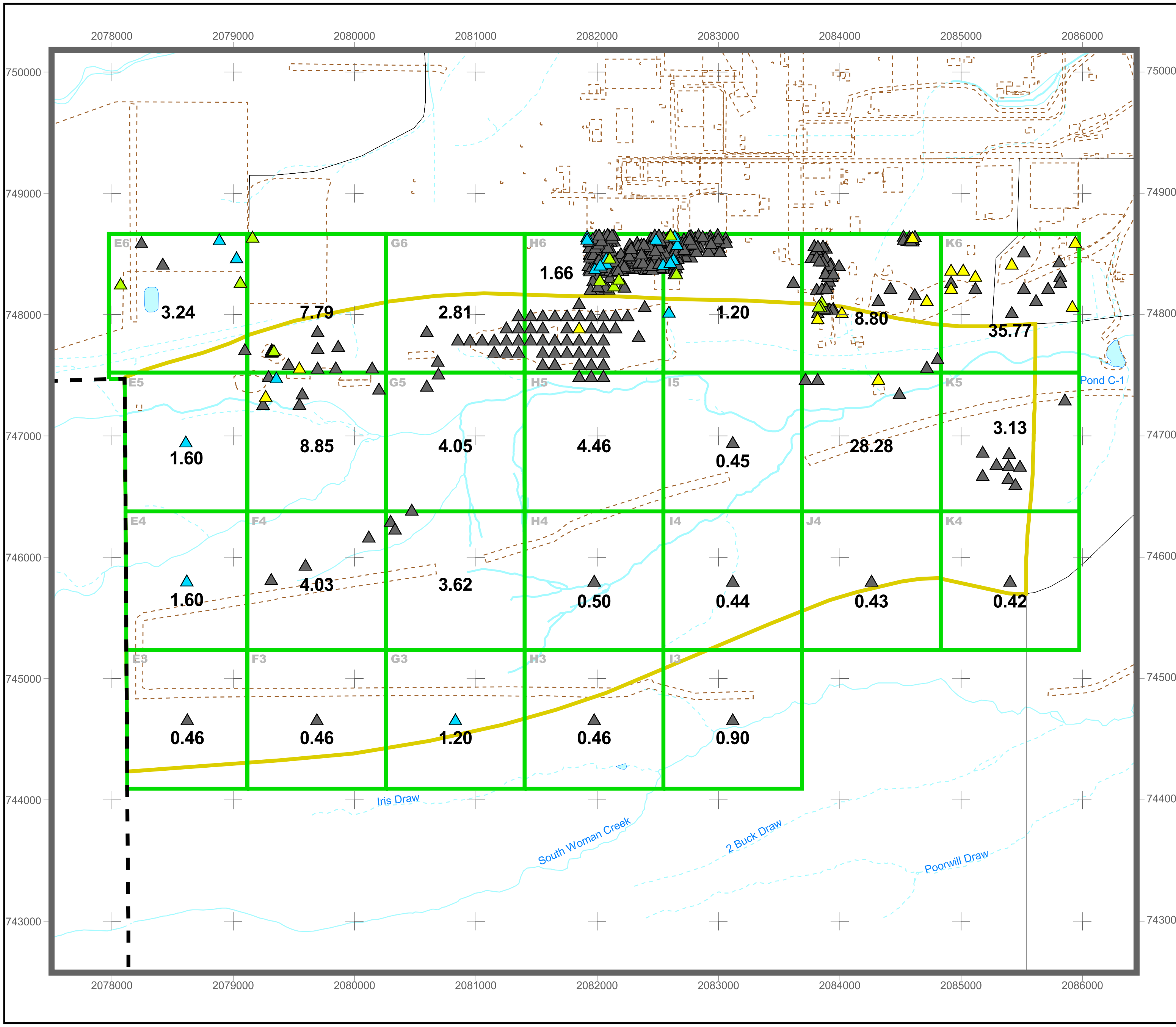

Figure 10.5
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Tin

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 2.9 mg/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: 2.22 mg/kg
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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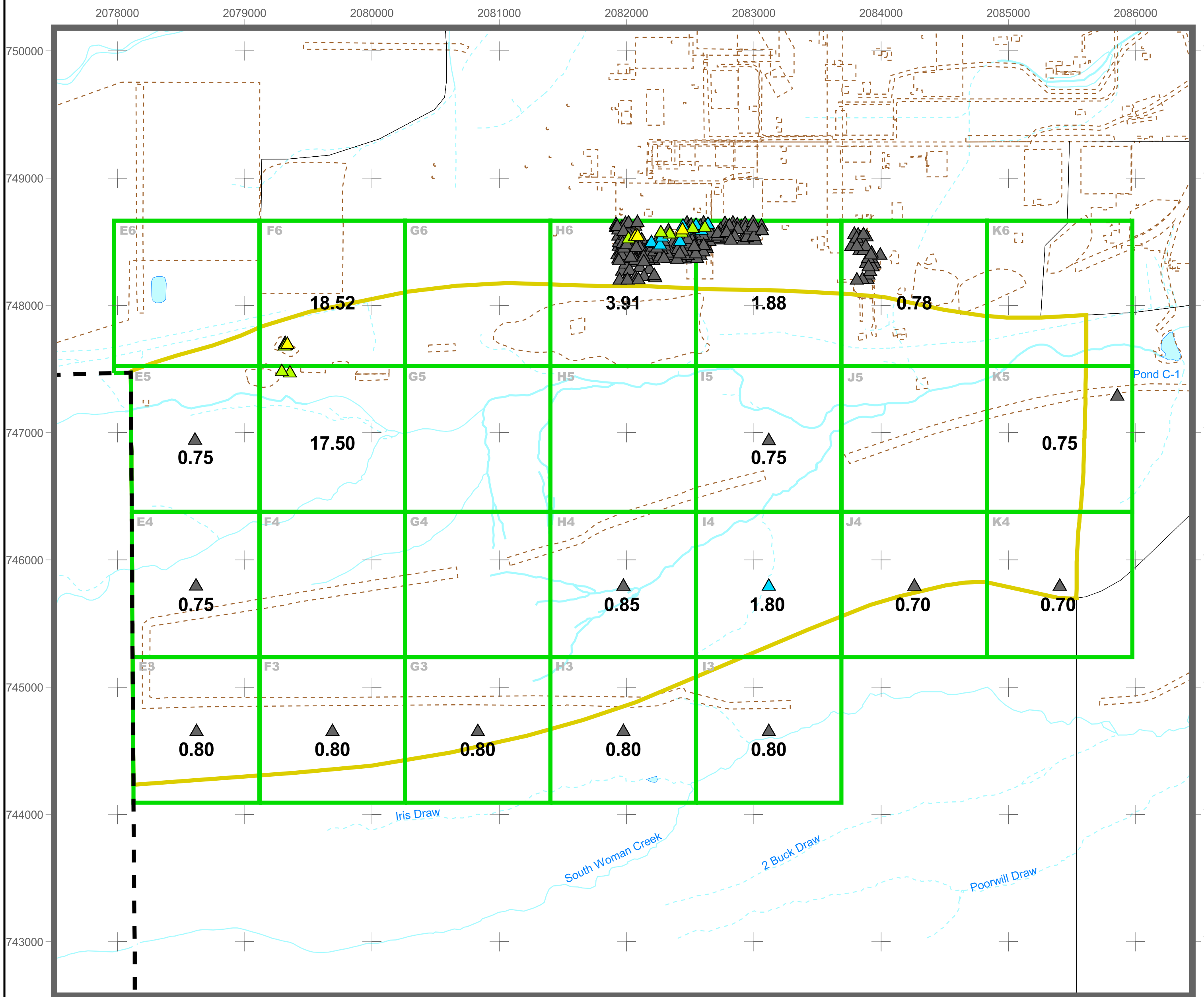

Figure 10.6
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Uranium

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 5 mg/kg
Receptor: Terrestrial Plants
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

N W E S

0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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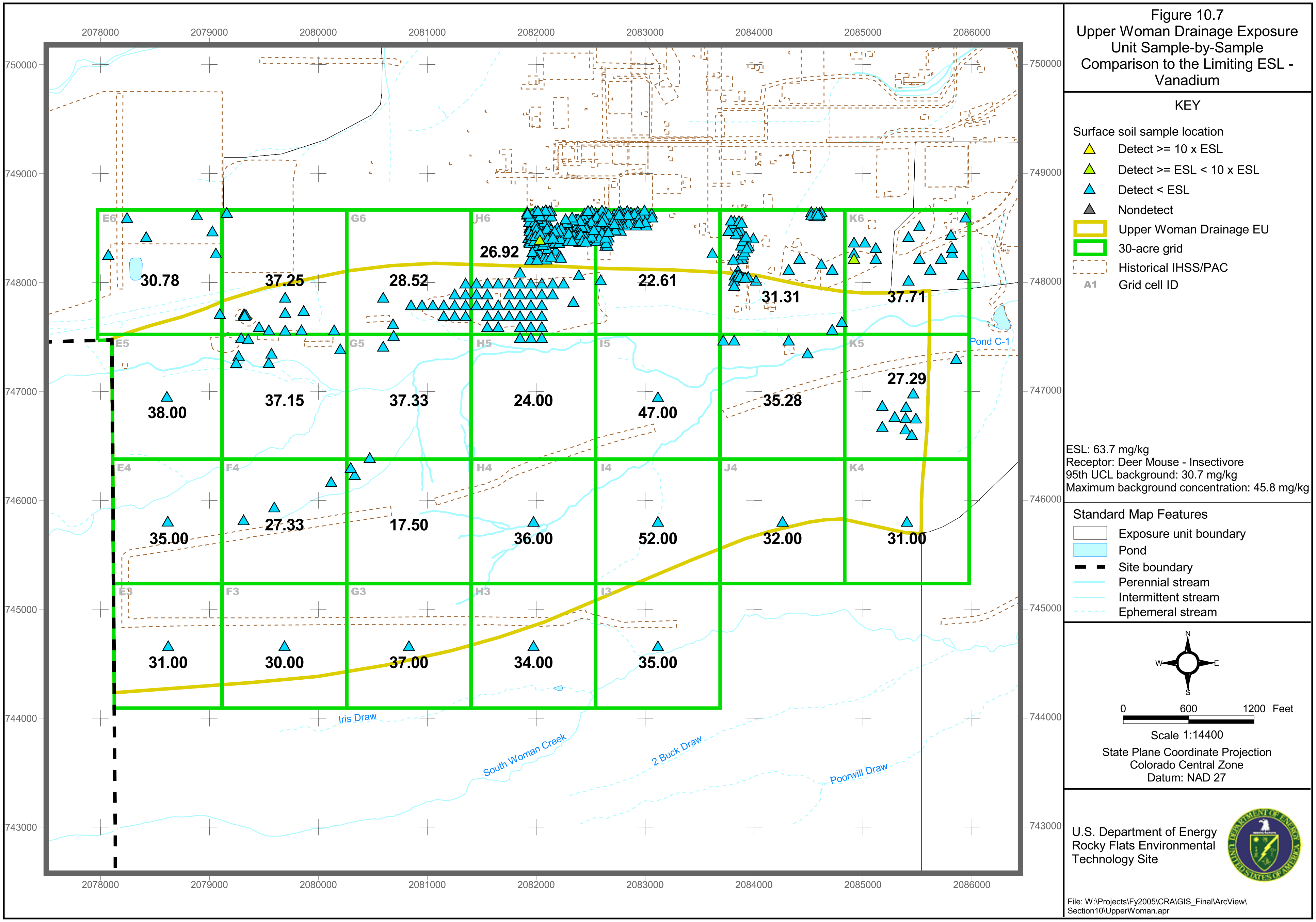
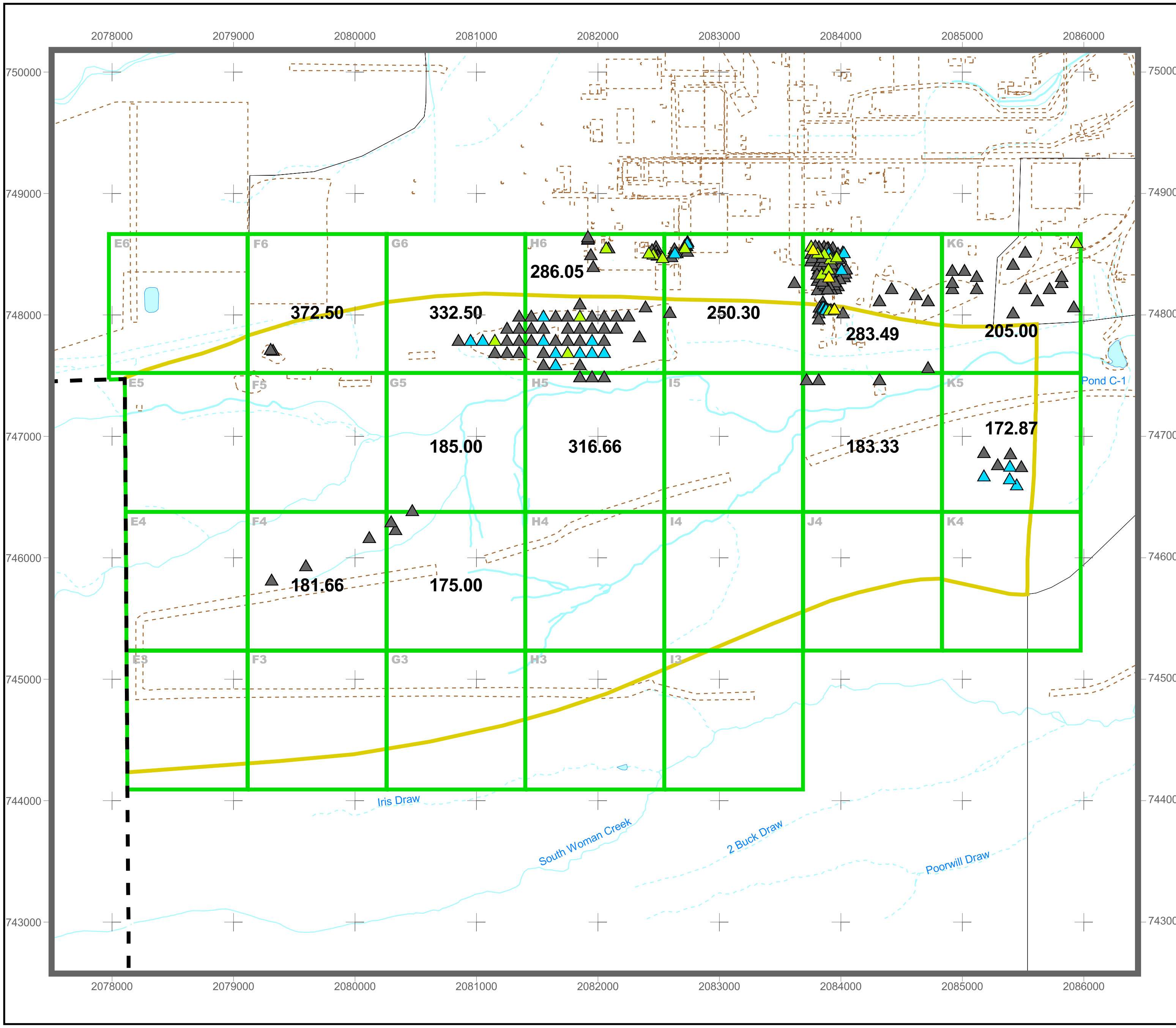


Figure 10.7
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Vanadium
KEY
Surface soil sample location
Detect >= 10 x ESL
Detect >= ESL < 10 x ESL
Detect < ESL
Nondetect
Upper Woman Drainage EU
30-acre grid
Historical IHSS/PAC
A1
Grid cell ID
ESL: 63.7 mg/kg
Receptor: Deer Mouse - Insectivore
95th UCL background: 30.7 mg/kg
Maximum background concentration: 45.8 mg/kg
Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
0
600
1200 Feet
Scale 1:14400
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\UpperWoman.apr
E6
30.78
37.25
G6
28.52
H6
26.92
22.61
31.31
K6
37.71
E5
38.00
37.15
G5
37.33
H5
24.00
I5
47.00
35.28
K5
27.29
Pond C-1
E4
35.00
F4
27.33
17.50
H4
36.00
I4
52.00
J4
32.00
K4
31.00
E3
31.00
F3
30.00
G3
37.00
H3
34.00
I3
35.00
Iris Draw
South Woman Creek
2 Buck Draw
Poorwill Draw

Figure 10.8
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Bis(2-ethylhexyl)phthalate



KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 136.8 ug/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features

- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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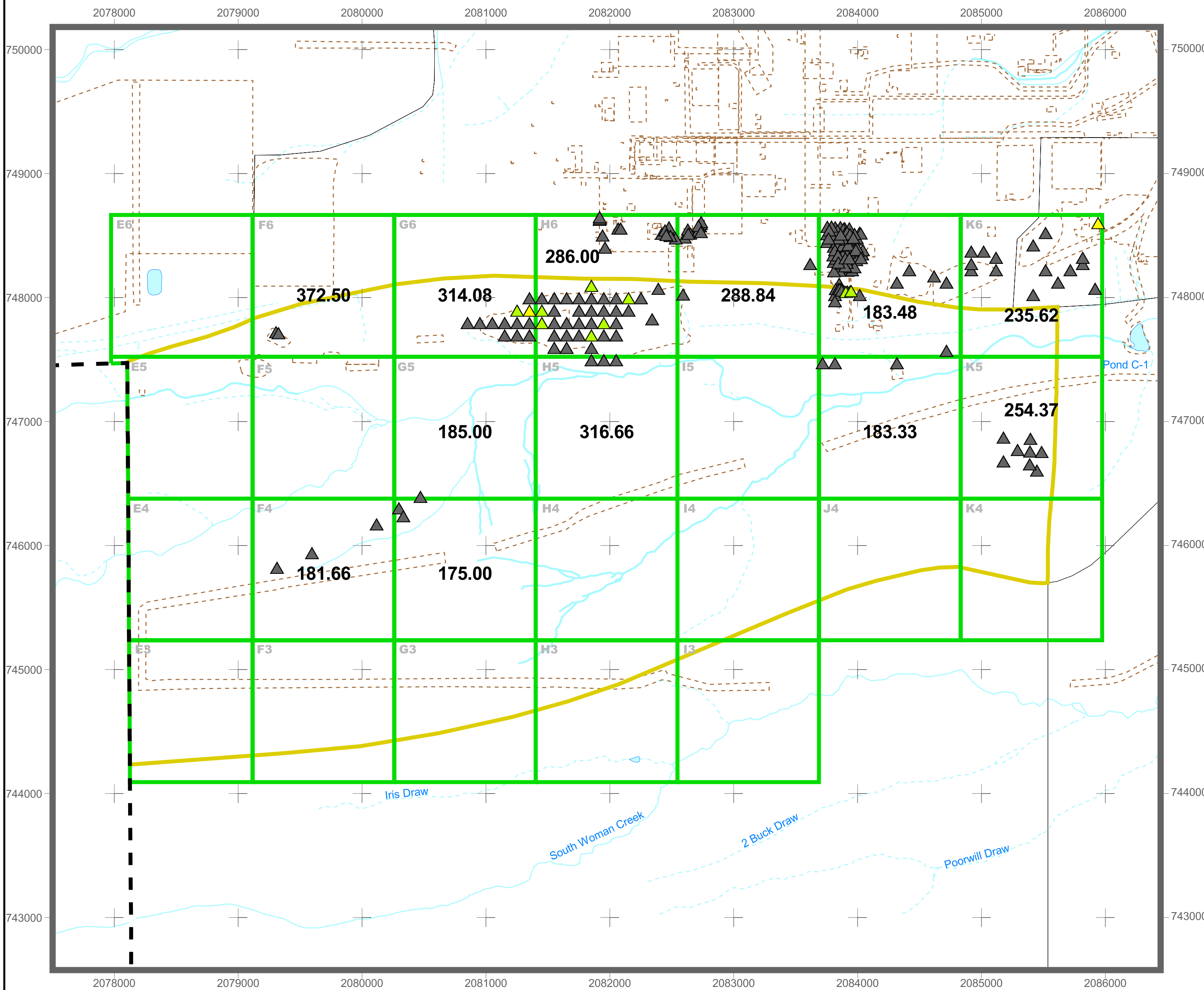

Figure 10.9
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Di-n-butylphthalate

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- Upper Woman Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 15.86 ug/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features
- Exposure unit boundary
- Pond
- Site boundary
- Perennial stream
- Intermittent stream
- Ephemeral stream

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0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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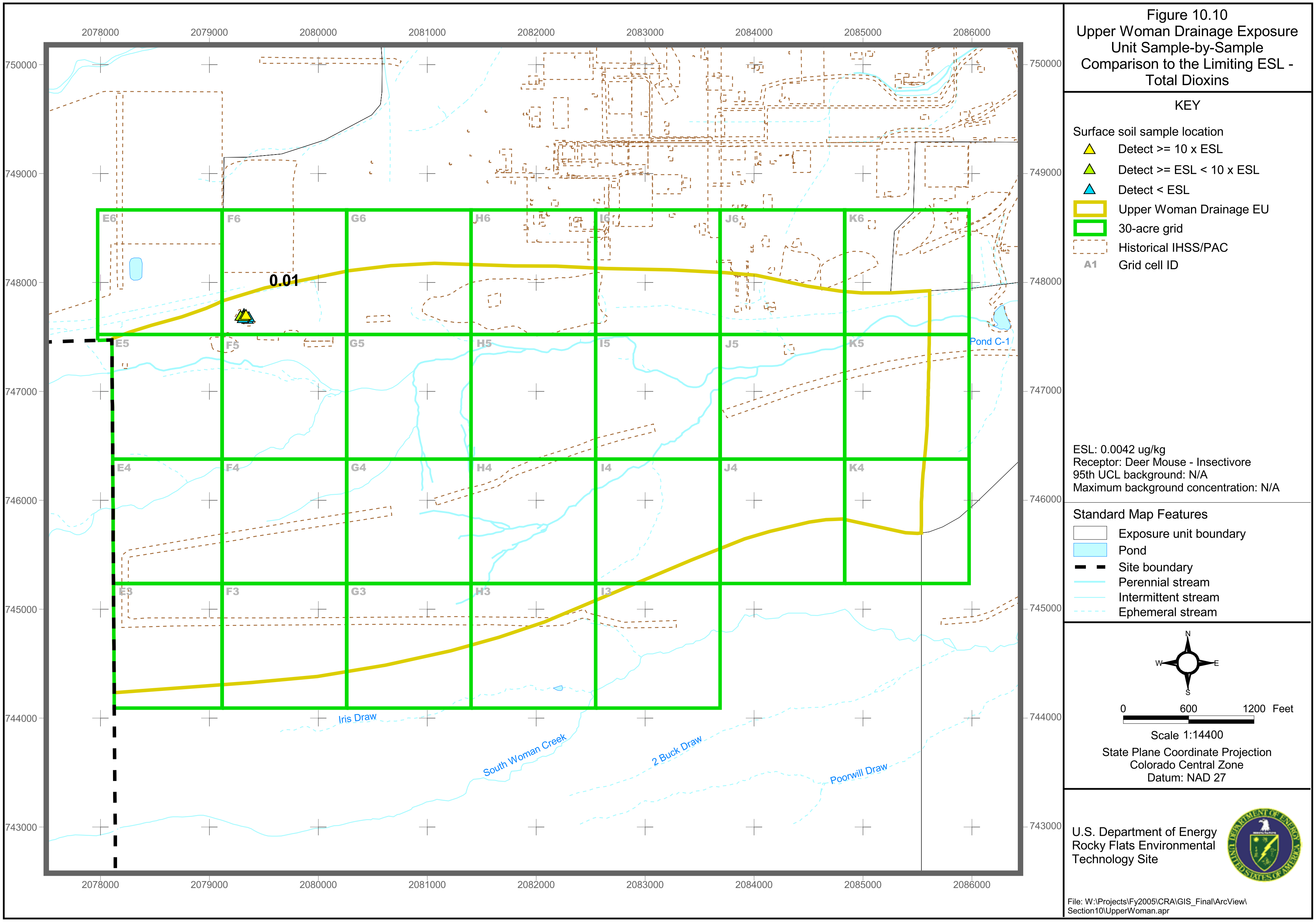
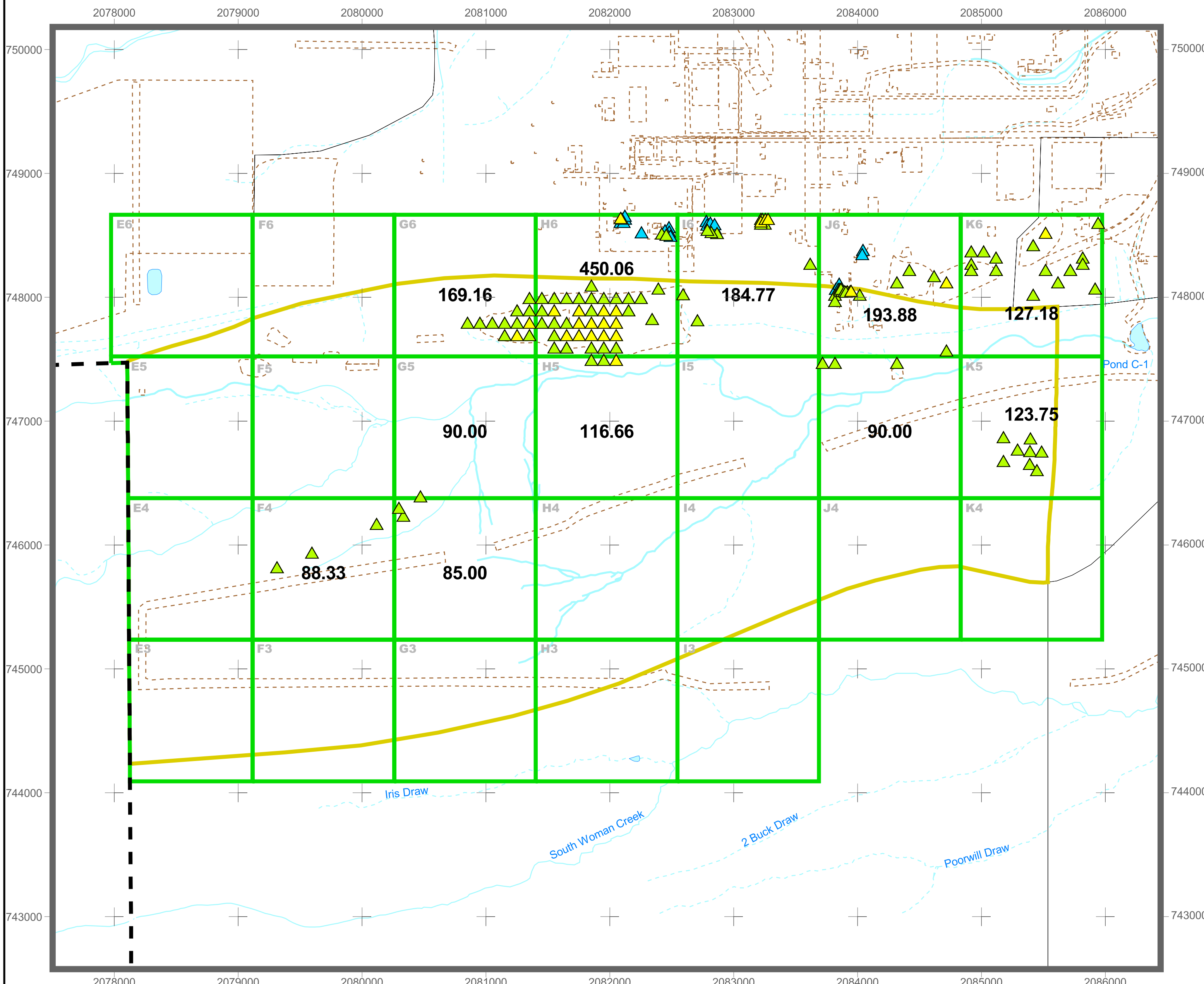


Figure 10.10
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Total Dioxins

Figure 10.11
Upper Woman Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Total PCBs



KEY

Surface soil sample location
Detect >= 10 x ESL
Detect >= ESL < 10 x ESL
Detect < ESL
Upper Woman Drainage EU
30-acre grid
Historical IHSS/PAC
A1 Grid cell ID

ESL: 42.3 ug/kg
Receptor: Mourning Dove - Insectivore
95th UCL background: N/A
Maximum background concentration: N/A

Standard Map Features
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream

N
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0 600 1200 Feet

Scale 1:14400

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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COMPREHENSIVE RISK ASSESSMENT

UPPER WOMAN DRAINAGE EXPOSURE UNIT

VOLUME 10: ATTACHMENT 1

Detection Limit Screen

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
CD	compact disc
CDH	Colorado Department of Health
CLP	Contract Laboratory Program
CRA	Comprehensive Risk Assessment
CRQL	Contract Required Quantitation Limit
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DOE	Department of Energy
ECOI	Ecological Contaminant of Interest
EPA	Environmental Protection Agency
ESL	ecological screening level
EU	Exposure Unit
IAEU	Industrial Area Exposure Unit
IDL	instrument detection limit
IHSS	Individual Hazardous Substance Site
LOAEL	Lowest Observed Adverse Effect Level
MDL	method detection limit
NOAEL	no observed adverse effect level
PAC	Potential Area of Concern
PCOC	Potential Contaminant of Concern
PRG	preliminary remediation goal

RL	reporting limit
SQL	sample quantitation limit
SVOC	Semi-volatile organic compound
SWD	soil water database
TCDD	2,3,7,8-tetrachlorodibenzo-*p*-dioxin
UWOEU	Upper Woman Drainage Exposure Unit
WRW	wildlife refuge worker

1.0 EVALUATION OF ANALYTE DETECTION LIMITS FOR THE UPPER WOMAN DRAINAGE EXPOSURE UNIT

For the Upper Woman Drainage Exposure Unit (EU) (UWOEU), the detection limits for non-detected analytes as well as analytes detected in less than 5 percent of the samples are compared to human health preliminary remediation goals (PRGs) for the wildlife refuge worker (WRW) and the lowest ecological screening levels (ESLs). The comparisons are made in the tables to this attachment for potential contaminants of concern (PCOCs) in surface soil/surface sediment and subsurface soil/subsurface sediment, and ecological contaminants of interest (ECOIs) in surface soil and subsurface soil. The percent of the samples with detection limits that exceed the PRGs and ESLs are listed in these tables. When these detection limits exceed the respective PRGs and ESLs, this is a source of uncertainty in the risk assessment process, which is discussed herein.

Laboratory reported results for "U" qualified data (nondetects) are used to perform the detection limit screen rather than the detection limit identified in the detection limit field within the Soil Water Database (SWD). The basis for the detection limit is not always provided in SWD, e.g., Instrument Detection Limit (IDL), Method Detection Limit (MDL), Reporting Limit (RL), and Sample Quantitation Limit (SQL). Therefore, to be consistent in reporting, the "reported results" are presented in the tables to this attachment. Also, for statistical computations and risk estimations presented in the main text and tables to this volume, one-half the reported results are used as proxy values for nondetected data.

The term analyte as used in the following sections refers to analytes that are non-detected or detected in less than 5 percent of the samples. PRGs and ESLs do not exist for some of these analytes, which is also a source of uncertainty for the risk assessment. This uncertainty is discussed in Sections 6.2.1 and 10.3.2 of the main text of this volume.

1.1 Comparison of Reported Results to Preliminary Remediation Goals

1.1.1 Surface Soil/Surface Sediment

As shown in Table A1.1, there are only 3 analytes in surface soil/surface sediment where some percent of the reported results exceed the PRG: 3,3'-dichlorobenzidine (1 percent), dibenz(a,h)anthracene (70 percent), and PCB-1260 (1 percent). For 3,3'-dichlorobenzidine and PCB-1260, greater than 99 percent of the reported results are less than the PRGs. For dibenz(a,h)anthracene, the maximum reported result is within a factor of 3 of the PRG. Therefore, because only a few analytes have reported results that exceed the PRGs, and for these analytes, either most of the reported results are less than the PRGs, or the maximum reported results are of similar magnitude to the PRGs, this represents minimal uncertainty in the overall risk conclusions.

1.1.2 Subsurface Soil/Subsurface Sediment

As shown in Table A1.2, there is only one analyte in subsurface soil/subsurface sediment where some percent of the reported results exceed the PRG: N-nitroso-di-n-propyamine (1 percent). However, because 99 percent of the reported results are less than the PRG, this represents minimal uncertainty in the overall risk conclusions.

1.2 Comparison of Reported Results to Ecological Screening Levels

1.2.1 Surface Soil

As shown in Table A1.3, there are 34 analytes in surface soil where some percent of the reported results exceed the lowest ESL. For over one-half of these analytes, more than 60 percent (and often more than 95 percent) of the reported results are less than the lowest ESL. Consequently, for these analytes, there is minimal uncertainty in the overall risk estimates because of these higher reported results. Of the remaining 14 analytes, all of the reported results exceed the lowest ESL, and in some cases, the maximum reported results are 1 to 2 orders of magnitude higher than the lowest ESL. This condition requires further analysis to determine the extent of uncertainty in the overall risk estimates.

First, for the remaining 14 analytes, it is noted that the reported results are generally consistent with industry standards for laboratory detection limits. In all cases, the minimum reported results (see Table A1.3) are similar in magnitude to the Contract Required Quantitation Limits (CRQLs) for the Environmental Protection Agency's (EPA) Contract Laboratory Program (CLP) (330-830 ug/kg for semi-volatile organic compounds (SVOCs) depending on the compound; and 1.7-3.3 ug/kg for pesticides depending on the compound). The CRQLs are minimum limits established by the CLP for identifying contaminants at Superfund sites.

Even though the lower limit of the range of reported results are generally consistent with industry standards for laboratory detection limits, the extent of uncertainty in the overall risk estimates was further assessed based on professional judgment and ecological risk potential, i.e., ecological risks may be underestimated because these analyte may have been included as ECOPCs had they been detected more frequently using lower detection limits (lower reported results).

Professional judgment indicates whether the analytes are likely to be ECOPCs in the UWOEU surface soil based on 1) a listing of the analytes (or classes of analytes) as constituents in wastes potentially released at historical Individual Hazardous Substance Sites (IHSSs) in the UWOEU (DOE 2005a), 2) the historical inventory for the chemical at RFETS (CDH 1991), and 3) a comparison of the maximum detected concentration and detection frequency in the EU and sitewide surface soil (see Table A1.4 for sitewide surface soil summary statistics). The comparison of the EU and sitewide maximum detected concentrations and detection frequencies in surface soil is performed to assess if the EU observations are much higher, which may potentially also indicate a source for the analyte within the EU. Using professional judgment, the analytes can be grouped into four categories that represent an ascending order of uncertainty. Category 1 is for analytes that were not listed as waste constituents for the EU historical IHSSs, and are not detected in the EU or sitewide surface soil. Category 2 is for analytes that may or may not be listed as waste constituents for the EU historical IHSSs, but nevertheless are not detected in the EU surface soil even though they were detected in other EU surface soil at RFETS at low maximum detected concentrations and low detection frequencies. Category 3 is for analytes that may or may not be listed as waste constituents for the EU historical IHSSs, and are detected in the EU (and therefore sitewide) surface soil, and the maximum detected concentrations in the EU surface soil are approximately the same order of magnitude as the ESL, and the detection frequencies are low. For these first three categories, the uncertainty with regard to the risk estimates because of the higher detection limits is considered small. Category 4 is for analytes that are detected in the EU (and therefore sitewide) surface soil at maximum concentrations that substantially exceed the ESLs and at detection frequencies generally higher than for Category 3, i.e., these analytes have the highest likelihood of being ECOPCs had they been detected more frequently using lower detection limits (lower reported results), and therefore, there is some uncertainty with regard to the risk estimates because of the higher detection limits.

The assessment of the ecological risk potential compares the maximum reported result to a Lowest Observed Adverse Effect Level (LOAEL)-based soil concentration. ESLs are based on No Observed Adverse Effect Levels (NOAELs) (DOE 2005b). The LOAEL-based soil concentration is estimated by multiplying the lowest ESL by the LOAEL/NOAEL ratio for the mammal or the bird depending on whether a mammal or bird is the most sensitive terrestrial vertebrate receptor for the chemical (see Appendix B, Table B-2 of the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005b) for the Lowest Bounded LOAELs and Final NOAELs for mammals and birds). A maximum reported result/LOAEL-based soil concentration ratio greater than one indicates a potential for an adverse ecological effect if the analyte was detected at the highest reported result.

As shown in Table A1.5, 12 of the 14 analytes assessed using professional judgment are in categories 1 through 3 (most in categories 1 and 2), and thus are not likely to be ECOPCs in the UWOEU surface soil based on professional judgment, which minimizes the uncertainty in the overall risk estimates because of their higher reported results. The two category 4 analytes are 4,4’ dichlorodiphenyltrichloroethane (DDT) and PCB-1260, primarily because they are listed waste constituents for an UWOEU historical IHSSs and the maximum detected concentrations in the UWOEU are four (PCB-1260) to 20 (DDT) times the minimum ESL. PCB-1260 was also detected at a relatively high concentration in sitewide surface soil.

Comparing the maximum reported results to the LOAEL-based soil concentrations indicates less than half of the above noted analytes would not present a potential for adverse ecological effects if they were detected at the maximum reported results. This includes DDT and PCB-1260.

In conclusion, most analytes in surface soil that have reported results that exceed the lowest ESLs contribute only minimal uncertainty to the overall risk estimates because either only a small fraction of the reported results are greater than the lowest ESL, or professional judgment indicates they are not likely to be ECOPCs in UWOEU surface soil even if detection limits (reported results) had been lower. There is some uncertainty in the overall risk estimates because of the higher reported results for DDT and PCB-1260, i.e., overall risks to the UWOEU ecological receptors may be underestimated because DDT and PCB-1260 may have been included as ECOPCs for surface soil had the analytes been detected at a higher frequency using lower detection limits (lower reported results). However, DDT and PCB-1260 do not present a potential for adverse ecological effects if they were detected at their maximum reported results.

1.2.2 Subsurface Soil

As shown in Table A1.6, only 2,4-dinitrotoluene and pentachlorophenol in subsurface soil have reported results that exceed the ESL. However, in both cases, 99 percent of the reported results are less than the ESL. Therefore, this represents only minimal uncertainty in the overall risk conclusions.

2.0 REFERENCES

CDH, 1991. Colorado Department of Health Project Task 1 Report (Revised 1), Identification of Chemicals and Radionuclides Used at Rocky Flats. Prepared by ChemRisk. March.

DOE, 2005a, 2005 Annual Update to the Historical Release Report, Rocky Flats Environmental Technology Site, October.

DOE, 2005b. Final Comprehensive Risk Assessment Work Plan and Methodology, Revision 1, Rocky Flats Environmental Technology Site, Golden, Colorado. Revision 1. September.

TABLES

Table A1.1
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Chloride	25	-	25	2		0	0	No
Nitrite	0.300	-	2.50	3	11,109	0	0	No
Sulfate	25	-	25	2		0	0	No
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	1.26	-	5.90	8	91,018	0	0	No
1,1,1-Trichloroethane	1.11	-	28	32	9.18E+06	0	0	No
1,1,2,2-Tetrachloroethane	0.980	-	28	32	10,483	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	0.993	-	5.90	8	2.38E+09	0	0	No
1,1,2-Trichloroethane	0.944	-	28	32	28,022	0	0	No
1,1-Dichloroethane	1.00	-	28	32	2.72E+06	0	0	No
1,1-Dichloroethene	1.50	-	28	32	17,366	0	0	No
1,1-Dichloropropene	1.28	-	5.90	8		0	0	No
1,2,3-Trichlorobenzene	0.713	-	5.90	8		0	0	No
1,2,3-Trichloropropane	1.05	-	5.90	8	2,079	0	0	No
1,2,4-Trichlorobenzene	0.986	-	1,000	117	151,360	0	0	Yes
1,2-Dibromo-3-chloropropane	1.83	-	5.90	8	2,968	0	0	No
1,2-Dibromoethane	0.836	-	5.90	8	35.1	0	0	No
1,2-Dichlorobenzene	0.744	-	1,000	118	2.89E+06	0	0	No
1,2-Dichloroethane	1.01	-	28	32	13,270	0	0	No
1,2-Dichloroethene	5	-	28	24	999,783	0	0	No
1,2-Dichloropropane	0.871	-	28	32	38,427	0	0	No
1,3,5-Trimethylbenzene	0.990	-	5.90	8	114,340	0	0	No
1,3-Dichlorobenzene	1.04	-	1,000	118	3.33E+06	0	0	No
1,3-Dichloropropane	0.589	-	5.90	8		0	0	No
1,4-Dichlorobenzene	1.13	-	1,000	118	91,315	0	0	No
2,2-Dichloropropane	1.03	-	5.90	8		0	0	No
2,4,5-Trichlorophenol	740	-	4,900	79	8.01E+06	0	0	No
2,4,6-Trichlorophenol	340	-	1,000	79	272,055	0	0	No
2,4-Dichlorophenol	340	-	1,000	79	240,431	0	0	No
2,4-Dimethylphenol	340	-	1,000	79	1.60E+06	0	0	No
2,4-Dinitrophenol	900	-	4,900	79	160,287	0	0	No
2,4-Dinitrotoluene	340	-	1,000	112	160,287	0	0	No
2,6-Dinitrotoluene	340	-	1,000	112	80,144	0	0	No
2-Chloronaphthalene	340	-	1,000	112	6.41E+06	0	0	No
2-Chlorophenol	340	-	1,000	79	555,435	0	0	No
2-Chlorotoluene	1.60	-	5.90	8	2.22E+06	0	0	No
2-Hexanone	8.11	-	57	31		0	0	No
2-Methylnaphthalene	340	-	1,000	106	320,574	0	0	Yes
2-Methylphenol	340	-	1,000	79	4.01E+06	0	0	No
2-Nitroaniline	900	-	4,900	109	192,137	0	0	No
2-Nitrophenol	270	-	1,000	79		0	0	No
3,3'-Dichlorobenzidine	360	-	23,000	88	6,667	1	1.14	No
3-Nitroaniline	900	-	55,000	94		0	0	No
4,4'-DDD	3.60	-	170	112	15,528	0	0	No
4,4'-DDE	3.60	-	170	112	10,961	0	0	No
4,4'-DDT	3.60	-	170	111	10,927	0	0	Yes
4,6-Dinitro-2-methylphenol	900	-	4,900	79	8,014	0	0	No
4-Bromophenyl-phenylether	340	-	1,000	112		0	0	No
4-Chloro-3-methylphenol	340	-	1,500	79		0	0	No
4-Chloroaniline	340	-	11,000	103	320,574	0	0	No
4-Chlorophenyl-phenyl ether	340	-	1,000	112		0	0	No
4-Chlorotoluene	0.940	-	5.90	8		0	0	No
4-Isopropyltoluene	1.10	-	5.90	8		0	0	No
4-Methyl-2-pentanone	6.86	-	57	31	8.32E+07	0	0	Yes

Table A1.1
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
4-Methylphenol	340	-	1,000	77	400,718	0	0	Yes
4-Nitroaniline	900	-	55,000	101	207,917	0	0	No
4-Nitrophenol	900	-	4,900	69	641,148	0	0	No
Acenaphthylene	340	-	2,300	125		0	0	Yes
Aldrin	1.80	-	85	111	176	0	0	Yes
alpha-BHC	1.80	-	85	112	570	0	0	No
alpha-Chlordane	1.80	-	850	111	10,261	0	0	No
Benzyl Alcohol	340	-	1,500	67	2.40E+07	0	0	Yes
beta-BHC	1.80	-	85	111	1,995	0	0	No
beta-Chlordane	1.80	-	850	100	10,261	0	0	No
bis(2-Chloroethoxy) methane	340	-	1,000	112		0	0	No
bis(2-Chloroethyl) ether	340	-	1,000	112	3,767	0	0	No
bis(2-Chloroisopropyl) ether	340	-	11,000	96	59,301	0	0	No
Bromobenzene	1.11	-	5.90	8		0	0	No
Bromochloromethane	1.18	-	5.90	8		0	0	No
Bromodichloromethane	0.694	-	28	32	67,070	0	0	No
Bromoform	1.13	-	28	32	419,858	0	0	No
Bromomethane	1.62	-	57	32	20,959	0	0	No
Butylbenzylphthalate	340	-	1,000	109	1.60E+07	0	0	Yes
Carbon Disulfide	2.80	-	28	32	1.64E+06	0	0	No
Carbon Tetrachloride	1.19	-	28	32	8,446	0	0	No
Chlorobenzene	1.00	-	28	32	666,523	0	0	No
Chloroethane	3.94	-	57	32	1.43E+06	0	0	No
Chloroform	0.906	-	28	32	7,850	0	0	No
Chloromethane	1.42	-	57	32	115,077	0	0	No
cis-1,2-Dichloroethene	1.07	-	2.90	8	1.11E+06	0	0	No
cis-1,3-Dichloropropene	0.884	-	28	32	19,432	0	0	No
delta-BHC	1.80	-	85	112	570	0	0	No
Dibenz(a,h)anthracene	21	-	1,000	99	379	69	69.7	Yes
Dibromochloromethane	0.737	-	28	32	49,504	0	0	No
Dibromomethane	0.770	-	5.90	8		0	0	No
Dichlorodifluoromethane	1.94	-	5.90	6	229,820	0	0	No
Dieldrin	3.60	-	170	111	187	0	0	Yes
Diethylphthalate	340	-	1,000	112	6.41E+07	0	0	Yes
Dimethylphthalate	340	-	1,000	112	8.01E+08	0	0	No
Di-n-octylphthalate	340	-	1,000	109	3.21E+06	0	0	Yes
Endosulfan I	1.80	-	85	112	480,861	0	0	No
Endosulfan II	3.60	-	92	106	480,861	0	0	No
Endosulfan sulfate	3.60	-	170	111	480,861	0	0	Yes
Endrin	3.60	-	200	112	24,043	0	0	No
Endrin aldehyde	3.60	-	11	6	24,043	0	0	No
Endrin ketone	3.60	-	170	111	33,326	0	0	Yes
Ethylbenzene	1.08	-	28	32	5.39E+06	0	0	No
gamma-BHC (Lindane)	1.80	-	85	112	2,771	0	0	No
gamma-Chlordane	100	-	220	12	10,261	0	0	No
Heptachlor	1.80	-	85	112	665	0	0	No
Heptachlor epoxide	1.80	-	85	111	329	0	0	Yes
Hexachlorobenzene	340	-	1,000	109	1,870	0	0	No
Hexachlorobutadiene	1.26	-	1,000	118	22,217	0	0	No
Hexachlorocyclopentadiene	340	-	1,000	106	380,452	0	0	No
Hexachloroethane	340	-	1,000	112	111,087	0	0	No
Isophorone	270	-	1,000	111	3.16E+06	0	0	Yes
Isopropylbenzene	1.31	-	5.90	8	32,680	0	0	No
Methoxychlor	18	-	850	111	400,718	0	0	Yes
n-Butylbenzene	1.05	-	5.90	8		0	0	No

Table A1.1
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil/Surface Sediment in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Nitrobenzene	340	-	1,000	109	43,246	0	0	No
N-Nitroso-di-n-propylamine	340	-	1,000	112	429	56	50	No
N-nitrosodiphenylamine	340	-	1,000	112	612,250	0	0	No
n-Propylbenzene	1.16	-	5.90	8		0	0	No
PCB-1016	34	-	850	114	1,349	0	0	No
PCB-1221	34	-	850	114	1,349	0	0	No
PCB-1232	34	-	850	114	1,349	0	0	No
PCB-1242	34	-	850	114	1,349	0	0	No
PCB-1248	34	-	850	114	1,349	0	0	No
PCB-1260	36	-	1,700	112	1,349	1	0.893	Yes
Pentachlorophenol	900	-	4,900	79	17,633	0	0	No
Phenol	340	-	1,000	77	2.40E+07	0	0	Yes
Pyridine	740	-	750	2		0	0	No
sec-Butylbenzene	1.10	-	5.90	8		0	0	No
Styrene	1.06	-	28	32	1.38E+07	0	0	No
tert-Butylbenzene	1.15	-	5.90	8		0	0	No
Toxaphene	110	-	1,700	112	2,720	0	0	No
trans-1,2-Dichloroethene	1.41	-	2.90	8	287,340	0	0	No
trans-1,3-Dichloropropene	0.945	-	28	32	20,820	0	0	No
Trichloroethene	0.670	-	28	32	1,770	0	0	Yes
Trichlorofluoromethane	1.32	-	5.90	8	1.51E+06	0	0	No
Vinyl acetate	11	-	57	19	2.65E+06	0	0	No
Vinyl Chloride	2.97	-	57	32	2,169	0	0	No

Table A1.2
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Nitrate / Nitrite	2.20	-	2.20	1	2.04E+06	0	0	No
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	1.28	-	1.46	8	1.05E+06	0	0	No
1,1,1-Trichloroethane	1.13	-	31	196	1.06E+08	0	0	Yes
1,1,2,2-Tetrachloroethane	0.995	-	31	195	120,551	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1.01	-	2.21	8	2.74E+10	0	0	No
1,1,2-Trichloroethane	0.958	-	31	199	322,253	0	0	No
1,1-Dichloroethane	1.02	-	31	199	3.12E+07	0	0	No
1,1-Dichloroethene	1.53	-	31	199	199,706	0	0	No
1,1-Dichloropropene	1.30	-	1.49	8		0	0	No
1,2,3-Trichlorobenzene	0.724	-	1.69	8		0	0	No
1,2,3-Trichloropropane	1.07	-	1.23	8	23,910	0	0	No
1,2,4-Trichlorobenzene	1.00	-	7,700	111	1.74E+06	0	0	Yes
1,2,4-Trimethylbenzene	1.05	-	1.21	8	1.53E+06	0	0	No
1,2-Dibromo-3-chloropropane	1.86	-	3.15	8	34,137	0	0	No
1,2-Dibromoethane	0.848	-	1.32	8	403	0	0	No
1,2-Dichlorobenzene	0.755	-	7,700	111	3.32E+07	0	0	Yes
1,2-Dichloroethane	1.03	-	31	199	152,603	0	0	No
1,2-Dichloroethene	5	-	31	188	1.15E+07	0	0	No
1,2-Dichloropropane	0.884	-	31	199	441,907	0	0	No
1,3,5-Trimethylbenzene	0.733	-	1.01	8	1.31E+06	0	0	No
1,3-Dichlorobenzene	1.05	-	7,700	111	3.83E+07	0	0	Yes
1,3-Dichloropropane	0.598	-	0.933	8		0	0	No
1,4-Dichlorobenzene	1.14	-	7,700	111	1.05E+06	0	0	Yes
2,2-Dichloropropane	1.05	-	1.23	8		0	0	No
2,4,5-Trichlorophenol	740	-	37,000	108	9.22E+07	0	0	No
2,4,6-Trichlorophenol	340	-	7,700	108	3.13E+06	0	0	No
2,4-Dichlorophenol	340	-	7,700	108	2.76E+06	0	0	No
2,4-Dimethylphenol	340	-	7,700	108	1.84E+07	0	0	No
2,4-Dinitrophenol	1,700	-	37,000	95	1.84E+06	0	0	No
2,4-Dinitrotoluene	340	-	7,700	108	1.84E+06	0	0	No
2,6-Dinitrotoluene	340	-	7,700	108	921,651	0	0	No
2-Butanone	10	-	62	171	5.33E+08	0	0	Yes
2-Chloronaphthalene	340	-	7,700	108	7.37E+07	0	0	No
2-Chlorophenol	340	-	7,700	107	6.39E+06	0	0	Yes
2-Chlorotoluene	1.63	-	1.87	8	2.56E+07	0	0	No
2-Hexanone	8.24	-	62	187		0	0	No
2-Methylphenol	340	-	7,700	108	4.61E+07	0	0	No
2-Nitroaniline	1,700	-	37,000	108	2.21E+06	0	0	No
2-Nitrophenol	340	-	7,700	108		0	0	No
3,3'-Dichlorobenzidine	690	-	15,000	106	76,667	0	0	Yes
3-Nitroaniline	1,700	-	37,000	95		0	0	No
4,4'-DDD	9.40	-	42	100	178,570	0	0	No
4,4'-DDE	9.40	-	42	97	126,049	0	0	No
4,4'-DDT	9.40	-	42	100	125,658	0	0	No
4,6-Dinitro-2-methylphenol	1,700	-	37,000	107	92,165	0	0	No
4-Bromophenyl-phenylether	340	-	7,700	108		0	0	No
4-Chloro-3-methylphenol	340	-	7,700	107		0	0	Yes
4-Chloroaniline	340	-	7,700	95	3.69E+06	0	0	No
4-Chlorophenyl-phenyl ether	340	-	7,700	108		0	0	No
4-Chlorotoluene	0.954	-	1.09	8		0	0	No
4-Isopropyltoluene	1.12	-	1.38	8		0	0	No
4-Methyl-2-pentanone	6.96	-	62	189	9.57E+08	0	0	Yes
4-Methylphenol	340	-	7,700	108	4.61E+06	0	0	No
4-Nitroaniline	1,700	-	37,000	95	2.39E+06	0	0	No
4-Nitrophenol	1,700	-	37,000	105	7.37E+06	0	0	No
Acenaphthylene	340	-	7,700	107		0	0	Yes

Table A1.2
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Aldrin	4.70	-	21	100	2,024	0	0	No
alpha-BHC	4.70	-	21	99	6,555	0	0	Yes
alpha-Chlordane	47	-	210	100	117,997	0	0	No
Benzene	0.840	-	31	199	270,977	0	0	No
Benzyl Alcohol	340	-	7,700	100	2.76E+08	0	0	No
beta-BHC	4.70	-	21	100	22,942	0	0	No
beta-Chlordane	47	-	200	94	117,997	0	0	No
bis(2-Chloroethoxy) methane	340	-	7,700	108		0	0	No
bis(2-Chloroethyl) ether	340	-	7,700	108	43,315	0	0	No
bis(2-Chloroisopropyl) ether	340	-	7,700	107	681,967	0	0	No
Bromobenzene	1.13	-	1.54	8		0	0	No
Bromochloromethane	1.20	-	1.47	8		0	0	No
Bromodichloromethane	0.705	-	31	199	771,304	0	0	No
Bromoform	1.14	-	31	193	4.83E+06	0	0	Yes
Bromomethane	1.64	-	62	185	241,033	0	0	No
Butylbenzylphthalate	340	-	7,700	103	1.84E+08	0	0	Yes
Carbon Disulfide	2.84	-	31	195	1.88E+07	0	0	No
Carbon Tetrachloride	1.21	-	31	197	97,124	0	0	No
Chlorobenzene	1.02	-	31	199	7.67E+06	0	0	No
Chloroethane	4.00	-	62	188	1.65E+07	0	0	No
Chloroform	0.920	-	31	199	90,270	0	0	No
Chloromethane	1.44	-	62	196	1.32E+06	0	0	No
cis-1,3-Dichloropropene	0.898	-	31	199	223,462	0	0	No
delta-BHC	4.70	-	21	100	6,555	0	0	No
Dibromochloromethane	0.748	-	31	199	569,296	0	0	No
Dibromomethane	0.782	-	1.30	8		0	0	No
Dichlorodifluoromethane	1.95	-	3.19	8	2.64E+06	0	0	No
Dieldrin	9.40	-	42	96	2,151	0	0	No
Diethylphthalate	340	-	7,700	106	7.37E+08	0	0	Yes
Dimethylphthalate	340	-	7,700	108	9.22E+09	0	0	No
Di-n-octylphthalate	340	-	7,700	106	3.69E+07	0	0	Yes
Endosulfan I	4.70	-	21	99	5.53E+06	0	0	No
Endosulfan II	9.40	-	42	98	5.53E+06	0	0	No
Endosulfan sulfate	9.40	-	42	97	5.53E+06	0	0	No
Endrin	9.40	-	42	96	276,495	0	0	No
Endrin ketone	9.40	-	42	100	383,250	0	0	No
Ethylbenzene	0.896	-	31	199	6.19E+07	0	0	No
gamma-BHC (Lindane)	4.70	-	21	100	31,864	0	0	No
gamma-Chlordane	160	-	210	6	117,997	0	0	No
Heptachlor	4.70	-	21	99	7,647	0	0	Yes
Heptachlor epoxide	4.70	-	21	99	3,782	0	0	Yes
Hexachlorobenzene	340	-	7,700	107	21,508	0	0	Yes
Hexachlorobutadiene	1.28	-	7,700	112	255,500	0	0	No
Hexachlorocyclopentadiene	340	-	7,700	105	4.38E+06	0	0	No
Hexachloroethane	340	-	7,700	108	1.28E+06	0	0	No
Isophorone	340	-	7,700	107	3.63E+07	0	0	Yes
Isopropylbenzene	1.33	-	1.53	8	375,823	0	0	No
Methoxychlor	47	-	210	100	4.61E+06	0	0	No
n-Butylbenzene	1.06	-	1.22	8		0	0	No
Nitrobenzene	340	-	7,700	108	497,333	0	0	No
N-Nitroso-di-n-propylamine	340	-	7,700	108	4,929	1	0.926	No
N-nitrosodiphenylamine	340	-	7,700	108	7.04E+06	0	0	No
n-Propylbenzene	1.18	-	1.35	8		0	0	No
PCB-1016	47	-	210	100	15,514	0	0	No
PCB-1221	47	-	210	100	15,514	0	0	No
PCB-1232	47	-	210	97	15,514	0	0	No
PCB-1242	47	-	210	100	15,514	0	0	No
PCB-1248	47	-	210	100	15,514	0	0	No

Table A1.2
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil/Subsurface Sediment in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
PCB-1260	94	-	420	97	15,514	0	0	Yes
Pentachlorophenol	1,700	-	37,000	107	202,777	0	0	Yes
Phenol	340	-	7,700	104	2.76E+08	0	0	Yes
Pyridine	740	-	840	4		0	0	No
sec-Butylbenzene	1.12	-	1.28	8		0	0	No
Styrene	1.07	-	31	199	1.59E+08	0	0	No
tert-Butylbenzene	1.17	-	1.34	8		0	0	No
Toxaphene	94	-	420	100	31,284	0	0	No
trans-1,2-Dichloroethene	1.43	-	6	11	3.30E+06	0	0	No
trans-1,3-Dichloropropene	0.959	-	31	198	239,434	0	0	No
Trichlorofluoromethane	1.34	-	1.53	8	1.74E+07	0	0	No
Vinyl acetate	10	-	62	182	3.04E+07	0	0	No
Vinyl Chloride	3.02	-	62	199	24,948	0	0	No
Xylene	2.68	-	31	199	1.22E+07	0	0	No

Table A1.3

Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	1.26	-	5.90	8		0	0	No
1,1,1-Trichloroethane	1.11	-	28	11	551,453	0	0	No
1,1,2,2-Tetrachloroethane	0.980	-	28	11	60,701	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	0.993	-	5.90	8		0	0	No
1,1,2-Trichloroethane	0.944	-	28	11		0	0	No
1,1-Dichloroethane	1.00	-	28	11	3,121	0	0	No
1,1-Dichloroethene	1.50	-	28	11	16,909	0	0	No
1,1-Dichloropropene	1.28	-	5.90	8		0	0	No
1,2,3-Trichlorobenzene	0.713	-	5.90	8		0	0	No
1,2,3-Trichloropropane	1.05	-	5.90	8	13,883	0	0	No
1,2,4-Trichlorobenzene	0.986	-	960	94	777	15	16.0	Yes
1,2-Dibromo-3-chloropropane	1.83	-	5.90	8		0	0	No
1,2-Dibromoethane	0.836	-	5.90	8		0	0	No
1,2-Dichlorobenzene	0.744	-	960	95		0	0	No
1,2-Dichloroethane	1.01	-	28	11	2,764	0	0	No
1,2-Dichloroethene	11	-	28	3	25,617	0	0	No
1,2-Dichloropropane	0.871	-	28	11	49,910	0	0	No
1,3,5-Trimethylbenzene	0.990	-	5.90	8	7,598	0	0	No
1,3-Dichlorobenzene	1.04	-	960	95		0	0	No
1,3-Dichloropropane	0.589	-	5.90	8		0	0	No
1,4-Dichlorobenzene	1.13	-	960	95	20,000	0	0	No
2,2-Dichloropropane	1.03	-	5.90	8		0	0	No
2,4,5-Trichlorophenol	740	-	4,100	56	4,000	2	3.57	No
2,4,6-Trichlorophenol	340	-	820	56	161	56	100	No
2,4-Dichlorophenol	340	-	820	56	2,744	0	0	No
2,4-Dimethylphenol	340	-	820	56		0	0	No
2,4-Dinitrophenol	900	-	4,100	56	20,000	0	0	No
2,4-Dinitrotoluene	340	-	960	89	32.1	89	100	No
2,6-Dinitrotoluene	340	-	960	89	6,186	0	0	No
2-Chloronaphthalene	340	-	960	89		0	0	No
2-Chlorophenol	340	-	820	56	281	56	100	No
2-Chlorotoluene	1.60	-	5.90	8		0	0	No
2-Hexanone	8.11	-	57	11		0	0	No
2-Methylphenol	340	-	820	56	123,842	0	0	No
2-Nitroaniline	900	-	4,600	86	5,659	0	0	No
2-Nitrophenol	340	-	820	56		0	0	No
3,3'-Dichlorobenzidine	360	-	23,000	66		0	0	No
3-Nitroaniline	900	-	55,000	71		0	0	No
4,4'-DDD	3.60	-	170	89	13,726	0	0	No
4,4'-DDE	3.60	-	170	89	7.95	87	97.8	No
4,4'-DDT	3.60	-	170	88	1.20	88	100	Yes
4,6-Dinitro-2-methylphenol	900	-	4,100	56	560	56	100	No
4-Bromophenyl-phenylether	340	-	960	89		0	0	No
4-Chloro-3-methylphenol	340	-	1,500	56		0	0	No
4-Chloroaniline	340	-	11,000	80	716	26	32.5	No
4-Chlorophenyl-phenyl ether	340	-	960	89		0	0	No
4-Chlorotoluene	0.940	-	5.90	8		0	0	No
4-Isopropyltoluene	1.10	-	5.90	8		0	0	No
4-Methylphenol	340	-	820	56		0	0	No
4-Nitroaniline	900	-	55,000	80	41,050	1	1.25	No
4-Nitrophenol	900	-	4,100	46	7,000	0	0	No
Acenaphthylene	340	-	2,300	102		0	0	Yes
Aldrin	1.80	-	85	88	47.0	2	2.27	Yes
alpha-BHC	1.80	-	85	89	18,662	0	0	No
alpha-Chlordane	1.80	-	850	88	289	3	3.41	No
Benzyl Alcohol	340	-	1,500	47	4,403	0	0	Yes

Table A1.3
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
beta-BHC	1.80	-	85	88	207	0	0	No
beta-Chlordane	1.80	-	850	84	289	3	3.57	No
bis(2-Chloroethoxy) methane	340	-	960	89		0	0	No
bis(2-Chloroethyl) ether	340	-	960	89		0	0	No
bis(2-Chloroisopropyl) ether	340	-	11,000	74		0	0	No
Bromobenzene	1.11	-	5.90	8		0	0	No
Bromochloromethane	1.18	-	5.90	8		0	0	No
Bromodichloromethane	0.694	-	28	11	5,750	0	0	No
Bromoform	1.13	-	28	11	2,855	0	0	No
Bromomethane	1.62	-	57	11		0	0	No
Butylbenzylphthalate	340	-	960	87	24,155	0	0	Yes
Carbon Disulfide	2.80	-	28	11	5,676	0	0	No
Carbon Tetrachloride	1.19	-	28	11	8,906	0	0	No
Chlorobenzene	1.00	-	28	11	4,750	0	0	No
Chloroethane	3.94	-	57	11		0	0	No
Chloroform	0.906	-	28	11	8,655	0	0	No
Chloromethane	1.42	-	57	11		0	0	No
cis-1,2-Dichloroethene	1.07	-	2.90	8	1,814	0	0	No
cis-1,3-Dichloropropene	0.884	-	28	11	2,800	0	0	No
delta-BHC	1.80	-	85	89	25.9	3	3.37	No
Dibromochloromethane	0.737	-	28	11	5,730	0	0	No
Dibromomethane	0.770	-	5.90	8		0	0	No
Dichlorodifluoromethane	1.94	-	5.90	6	855	0	0	No
Dieldrin	3.60	-	170	88	7.40	86	97.7	Yes
Diethylphthalate	340	-	960	89	100,000	0	0	No
Dimethylphthalate	340	-	960	89	200,000	0	0	No
Di-n-octylphthalate	340	-	960	87	731,367	0	0	Yes
Endosulfan I	1.80	-	85	89	80.1	1	1.12	No
Endosulfan II	3.60	-	92	83	80.1	1	1.20	No
Endosulfan sulfate	3.60	-	170	88	80.1	2	2.27	Yes
Endrin	3.60	-	200	89	1.40	89	100	No
Endrin aldehyde	3.60	-	3.60	2	1.40	2	100	No
Endrin ketone	3.60	-	170	88	1.40	88	100	Yes
Ethylbenzene	1.08	-	28	11		0	0	No
gamma-BHC (Lindane)	1.80	-	85	89	25.9	3	3.37	No
gamma-Chlordane	180	-	220	5	289	0	0	No
Heptachlor	1.80	-	85	89	63.3	1	1.12	No
Heptachlor epoxide	1.80	-	85	88	64.0	1	1.14	Yes
Hexachlorobenzene	340	-	960	86	7.73	86	100	No
Hexachlorobutadiene	1.26	-	960	95	431	38	40	No
Hexachlorocyclopentadiene	340	-	960	83	5,518	0	0	No
Hexachloroethane	340	-	960	89	366	73	82.0	No
Isophorone	340	-	960	88		0	0	Yes
Isopropylbenzene	1.31	-	5.90	8		0	0	No
Methoxychlor	18	-	850	88	1,226	0	0	Yes
n-Butylbenzene	1.05	-	5.90	8		0	0	No
Nitrobenzene	340	-	960	86	40,000	0	0	No
N-Nitroso-di-n-propylamine	340	-	960	89		0	0	No
N-nitrosodiphenylamine	340	-	960	89	20,000	0	0	No
n-Propylbenzene	1.16	-	5.90	8		0	0	No
PCB-1016	34	-	850	90	172	35	38.9	No
PCB-1221	34	-	850	90	172	35	38.9	No
PCB-1232	34	-	850	90	172	35	38.9	No
PCB-1242	34	-	850	90	172	35	38.9	No
PCB-1248	34	-	850	90	172	35	38.9	No
PCB-1260	36	-	1,700	88	172	72	81.8	Yes
Pentachlorophenol	900	-	4,100	56	122	56	100	No

Table A1.3
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Surface Soil in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Phenol	340	-	820	54	23,090	0	0	Yes
Pyridine	740	-	750	2		0	0	No
sec-Butylbenzene	1.10	-	5.90	8		0	0	No
Styrene	1.06	-	28	11	16,408	0	0	No
tert-Butylbenzene	1.15	-	5.90	8		0	0	No
Toxaphene	110	-	1,700	89	3,756	0	0	No
trans-1,2-Dichloroethene	1.41	-	2.90	8	25,617	0	0	No
trans-1,3-Dichloropropene	0.945	-	28	11	2,800	0	0	No
Trichloroethene	0.670	-	28	11	389	0	0	No
Trichlorofluoromethane	1.32	-	5.90	8		0	0	No
Vinyl acetate	57	-	57	1	13,986	0	0	No
Vinyl Chloride	2.97	-	57	11	97.7	0	0	No

Table A1.4
Sitewide Summary Statistics for Analytes in Surface Soil with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Conc.	Maximum Detected Conc.	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Inorganics (mg/kg)								
Aluminum	2,622	99.9	2,620	1,450	61,000	10.9	70	50
Ammonia	32	78.1	25	0.335	4.81	0.338	6.12	586
Antimony	2,482	20.0	497	0.270	348	0.0360	19.3	0.905
Arsenic	2,613	99.0	2,586	0.290	56.2	0.400	6.20	2.57
Barium	2,624	99.9	2,622	0.640	1,500	2.20	95	159
Beryllium	2,623	81.7	2,142	0.0710	26.8	0.0620	1.90	6.82
Boron	1,303	85.7	1,117	0.350	28	0.340	7	0.500
Cadmium	2,603	36.1	940	0.0600	270	0.0300	2.80	0.705
Chromium	2,624	99.2	2,604	1.20	210	2.20	19.8	0.400
Chromium VI	17	5.88	1.000	0.850	0.850	0.530	1.20	1.34
Cobalt	2,622	98.1	2,573	1.10	137	2.10	10.4	13
Copper	2,621	98.2	2,575	1.70	1,860	2.20	22.8	8.25
Cyanide	245	2.45	6.00	0.170	0.290	0.180	4.70	607
Fluoride	9	100	9	1.87	3.61	NA	NA	1.33
Lead	2,618	100	2,618	0.870	814	NA	NA	12.1
Lithium	2,433	94.5	2,300	0.990	50	1.60	20.6	2
Manganese	2,617	99.9	2,615	15	2,220	2.20	130	486
Mercury	2,541	48.8	1,239	0.00140	48	0.00120	0.190	1.00E-04
Molybdenum	2,421	47.0	1,138	0.140	19.1	0.0990	7.50	1.84
Nickel	2,620	97.5	2,554	1.90	280	1.60	19.1	0.431
Nitrate / Nitrite	450	83.3	375	0.216	765	0.200	5.60	4,478
Selenium	2,590	13.3	345	0.220	2.20	0.0540	4.50	0.754
Silver	2,589	28.4	735	0.0580	364	0.0490	7	2
Strontium	2,423	100.0	2,422	2.40	413	1.10	1.10	940
Thallium	2,597	14.1	366	0.100	5.80	0.0160	2.50	1
Tin	2,423	10.0	243	0.289	161	0.0780	58.5	2.90
Uranium	1,296	8.80	114	0.430	370	0.130	16.8	5
Vanadium	2,622	100.0	2,621	4.40	5,300	2.20	2.20	2
Zinc	2,622	99.8	2,617	4.20	11,900	2.20	99.8	0.646
Organics (ug/kg)								
1,1,1-Trichloroethane	633	1.58	10.00	1.10	47.7	0.587	680	551,453
1,1,2,2-Tetrachloroethane	632	0.158	1.000	1.39	1.39	0.527	680	60,701
1,1-Dichloroethane	633	0	0	NA	NA	0.512	680	3,121
1,1-Dichloroethene	633	0.158	1.000	7.90	7.90	0.610	680	16,909
1,2,3-Trichloropropane	517	0.193	1.000	1.47	1.47	0.525	129	13,883
1,2,4-Trichlorobenzene	1,549	0.323	5.00	0.870	150	0.621	7,000	777
1,2-Dichloroethane	629	0	0	NA	NA	0.522	680	2,764
1,2-Dichloroethene	101	0.990	1.000	16	16	5	680	25,617
1,2-Dichloropropane	633	0.316	2.00	18	140	0.413	680	49,910

Table A1.4
Sitewide Summary Statistics for Analytes in Surface Soil with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Conc.	Maximum Detected Conc.	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
1,3,5-Trimethylbenzene	515	6.60	34.0	0.610	490	0.535	65.2	7,598
1,4-Dichlorobenzene	1,329	0.677	9.00	0.450	110	0.649	6,900	20,000
2,4,5-T	9	11.1	1.000	1.80	1.80	21	100	162
2,4,5-Trichlorophenol	1,180	0.0847	1.000	1,100	1,100	330	34,000	4,000
2,4,6-Trichlorophenol	1,180	0.0847	1.000	950	950	330	7,000	161
2,4,6-Trinitrotoluene	8	12.5	1	56	56	0.220	250	283
2,4-DB	9	0	0	NA	NA	83	100	426
2,4-Dichlorophenol	1,180	0	0	NA	NA	330	7,000	2,744
2,4-Dinitrophenol	1,173	0	0	NA	NA	850	35,000	20,000
2,4-Dinitrotoluene	1,232	0	0	NA	NA	250	7,000	32.1
2,6-Dinitrotoluene	1,232	0	0	NA	NA	250	7,000	6,186
2378-TCDD	22	68.2	15.0	2.59E-05	0.00680	2.20E-04	0.00106	0.00425
2-Butanone	631	2.54	16.0	3	155	2.72	1,400	1.07E+06
2-Chlorophenol	1,180	0	0	NA	NA	330	7,000	281
2-Methylnaphthalene	1,223	6.95	85.0	34	12,000	330	7,000	2,769
2-Methylphenol	1,180	0	0	NA	NA	330	7,000	123,842
2-Nitroaniline	1,224	0	0	NA	NA	370	35,000	5,659
4,4'-DDD	468	0.427	2.00	3.50	10	1.80	190	13,726
4,4'-DDE	468	1.50	7.00	0.600	7.20	1.80	190	7.95
4,4'-DDT	468	0.855	4.00	9.10	26	1.80	190	1.20
4,6-Dinitro-2-methylphenol	1,176	0.0850	1.000	390	390	850	35,000	560
4-Chloroaniline	1,217	0	0	NA	NA	330	14,000	716
4-Methyl-2-pentanone	630	2.38	15.0	4	73	1.94	2,960	14,630
4-Nitroaniline	1,218	0.328	4.00	62	820	850	55,000	41,050
4-Nitrophenol	1,169	0.171	2.00	53	320	850	35,000	7,000
4-Nitrotoluene	5	0	0	NA	NA	250	250	61,422
Acenaphthene	1,239	22.3	276	21	44,000	330	6,900	20,000
Acetone	632	19.3	122	1.70	1,280	2.65	2,960	6,182
Aldrin	468	0.855	4.00	0.590	17	1.80	95	47.0
alpha-BHC	468	0.214	1.000	7.90	7.90	1.80	95	18,662
alpha-Chlordane	433	0	0	NA	NA	1.80	950	289
Benzene	633	0.948	6.00	1	11	0.502	680	500
Benzo(a)pyrene	1,235	41.2	509	36	43,000	19	7,000	631
Benzyl Alcohol	1,114	0.718	8.00	140	2,800	330	14,000	4,403
beta-BHC	467	0.428	2.00	11	11	1.80	95	207
beta-Chlordane	411	0.243	1.000	2.60	2.60	1.80	950	289
bis(2-ethylhexyl)phthalate	1,227	29.7	365	29	75,000	330	7,000	137
Bromodichloromethane	633	0	0	NA	NA	0.502	680	5,750
Bromoform	633	0	0	NA	NA	0.525	680	2,855
Butylbenzylphthalate	1,226	9.79	120	35	7,100	330	7,000	24,155

Table A1.4
Sitewide Summary Statistics for Analytes in Surface Soil with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Conc.	Maximum Detected Conc.	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
Carbon Disulfide	633	0.158	1.000	4	4	0.535	680	5,676
Carbon Tetrachloride	633	3.32	21.0	0.340	103	0.575	680	8,906
Chlordane	34	0	0	NA	NA	18	220	289
Chlorobenzene	633	0.316	2.00	2	2.03	0.484	680	4,750
Chloroform	633	1.11	7.00	1.30	7	0.543	680	8,655
cis-1,2-Dichloroethene	517	1.74	9.00	1.10	15	0.502	590	1,814
cis-1,3-Dichloropropene	633	0	0	NA	NA	0.502	680	2,800
delta-BHC	468	0.214	1.000	23	23	1.80	95	25.9
Dibenzofuran	1,227	10.9	134	36	20,000	330	7,000	21,200
Dibromochloromethane	633	0	0	NA	NA	0.502	680	5,730
Dicamba	9	55.6	5.00	2.30	150	42	100	1,690
Dichlorodifluoromethane	499	0	0	NA	NA	1.73	398	855
Dieldrin	468	2.35	11.0	1.80	92	1.80	190	7.40
Diethylphthalate	1,224	0.654	8.00	33	420	330	7,000	100,000
Dimethoate	7	0	0	NA	NA	18	180	13.7
Dimethylphthalate	1,227	1.47	18.0	69	460	330	7,000	200,000
Di-n-butylphthalate	1,227	7.99	98.0	35	10,000	330	7,000	15.9
Di-n-octylphthalate	1,225	3.92	48.0	38	11,000	330	7,000	731,367
Endosulfan I	468	0.427	2.00	3.90	7.40	1.80	95	80.1
Endosulfan II	461	0.651	3.00	0.700	9.90	1.80	170	80.1
Endosulfan sulfate	468	0.641	3.00	5.50	24	1.80	190	80.1
Endrin	468	1.28	6.00	2.40	17	1.80	200	1.40
Endrin aldehyde	66	3.03	2.00	8.70	9.20	1.80	38	1.40
Endrin ketone	437	0.229	1.000	36	36	1.80	190	1.40
Fluorene	1,244	18.8	234	27	39,000	140	7,000	30,000
gamma-BHC (Lindane)	468	0.214	1.000	8.30	8.30	1.80	95	25.9
gamma-Chlordane	23	0	0	NA	NA	2	260	289
Heptachlor	468	0	0	NA	NA	1.80	95	63.3
Heptachlor epoxide	467	0.642	3.00	7.20	23	1.80	95	64.0
Hexachlorobenzene	1,224	0.327	4.00	110	380	330	7,000	7.73
Hexachlorobutadiene	1,550	0.0645	1.000	2.20	2.20	0.508	7,000	431
Hexachlorocyclopentadiene	1,208	0	0	NA	NA	330	7,000	5,518
Hexachloroethane	1,227	0	0	NA	NA	330	7,000	366
HMX	5	20	1	230	230	250	250	16,012
Methoxychlor	468	1.71	8.00	0.280	450	3.50	950	1,226
Methylene Chloride	631	12.0	76.0	0.790	45	0.502	2,200	3,399
Naphthalene	1,567	14.1	221	0.850	41,000	0.751	7,000	27,048
Nitrobenzene	1,218	0	0	NA	NA	250	7,000	40,000
N-nitrosodiphenylamine	1,227	0	0	NA	NA	330	7,000	20,000
PCB-1016	795	0.755	6.00	13	95	33	4,500	172

Table A1.4
Sitewide Summary Statistics for Analytes in Surface Soil with an Ecological Screening Level

Analyte	Total Number of Results	Detection Frequency (%)	Number of Detects	Minimum Detected Conc.	Maximum Detected Conc.	Minimum Nondetected Result	Maximum Nondetected Result	Minimum ESL
PCB-1221	845	0	0	NA	NA	33	4,500	172
PCB-1232	845	0	0	NA	NA	33	4,500	172
PCB-1242	845	0.237	2.00	23	350	33	4,500	172
PCB-1248	845	0.710	6.00	17	840	33	4,500	172
PCB-1254	842	17.9	151	6.80	8,900	33	9,000	172
PCB-1260	838	17.2	144	6.20	7,800	33	4,300	172
Pentachlorophenol	1,180	1.02	12.0	39	39,000	850	35,000	122
Phenol	1,180	0.424	5.00	33	130	330	7,000	23,090
Styrene	633	0.158	1.000	7.80	7.80	0.550	680	16,408
Tetrachloroethene	633	8.53	54.0	0.380	29,000	0.641	680	763
Toluene	633	9.00	57.0	0.0990	990	0.528	60.8	14,416
Toxaphene	468	0	0	NA	NA	86	2,200	3,756
trans-1,2-Dichloroethene	532	0	0	NA	NA	0.738	93.3	25,617
trans-1,3-Dichloropropene	633	0	0	NA	NA	0.502	680	2,800
Trichloroethene	633	4.11	26.0	0.170	200	0.500	680	389
Vinyl acetate	78	0	0	NA	NA	10	1,400	13,986
Vinyl Chloride	633	0	0	NA	NA	0.748	1,400	97.7
Xylene	633	10.4	66.0	0.600	933	0.502	680	1,140

NA = Not applicable.

Table A1.5 Summary of Professional Judgment and Ecological Risk Potential															
ANALYTE	SUMMARY OF PROFESSIONAL JUDGMENT								ECOLOGICAL RISK POTENTIAL						
	Listed as Waste Constituent for UWOEU Historical IHSSs ?[1]	Historical RFETS Inventory [2] (1974/1988) (kg)	Maximum Conc. in Soil Sitewide (ug/kg)	Detection Frequency in Sitewide Soil (%)	Maximum Conc. in UWOEU Soil (ug/kg)	Detection Frequency in UWOEU Soil (%)	Potential to be an ECOPC?	Uncertainty Category[3]	Lowest ESL (ug/kg)	Most Sensitive Receptor [4]	LOAEL/ NOAEL [5]	LOAEL-Based Soil Conc. (ug/kg)	Maximum Reported Result for Non-detects in UWOEU (ug/kg)	Maximum Reported Result/ LOAEL-Based Soil Conc. [6]	Potential for Adverse Effects if Detected at Maximum Reported Result Level?
2,4,6-Trichlorophenol	No	0/.01	950	0.1	NA	0	No	2	161	Deer Mouse Insectivore	100	16100	820	0.05	No
2,4-Dinitrotoluene	No	0/0	N/A	0	NA	0	No	1	32.1	Deer Mouse Insectivore	10	321	960	3	Yes
2-Chlorophenol	No	0.12/0.02	N/A	0	NA	0	No	1	281	Deer Mouse Insectivore	100	28100	820	0.03	No
4,4'-DDE	Yes(1)	0/0.001	7.2	1.5	NA	0	No	2	7.95	Mourning Dove Insectivore	10	79.5	170	2	Yes
4,4'-DDT	Yes(1)	0/0.001	26	0.9	21	1.12	Yes	4	1.20	Mourning Dove Insectivore	167	200.4	170	1	No
4,6-Dinitro-2-methylphenol	No	0/0	390	0.1	NA	0	No	2	560	Deer Mouse Insectivore	20	11200	4100	0.40	No
Dieldrin	Yes(1)	0/0/003	92	2.4	34	1.2	No	3	7.4	Deer Mouse Insectivore	2	14.8	170	10	Yes
Endrin	Yes(1)	0/0.004	17	1.3	NA	0	No	2	1.40	Mourning Dove Insectivore	10	14	200	10	Yes
Endrin aldehyde	Yes(1)	0/0.002	9.2	3.0	NA	0	No	2	1.40	Mourning Dove Insectivore	10	14	3.6	0.2	No
Endrin ketone	Yes(1)	0/0	36	0.2	36	1.1	Yes	4	1.40	Mourning Dove Insectivore	10	14	170	10	Yes
Hexachlorobenzene	Yes(1)	1.000/1.005	380	0.3	NA	0	No	2	7.73	Mourning Dove Insectivore	40	309	960	3	Yes
Hexachloroethane	No	0.02/0.02	NA	0	NA	0	No	2	366	Deer Mouse Insectivore	20	7320	960	0.1	No
PCB-1260	Yes(2)	0/0.17	7800	17.2	600	2.2	Yes	4	172	Mourning Dove Insectivore	14.1	2425	1700	0.7	No
Pentachlorophenol	No	0.02/0.02	39000	1.0	NA	0	No	2	122	Deer Mouse Insectivore	10	1220	4100	3	Yes

1 Includes listing of the class of compound, e.g., herbicides, pesticides, chlorinated solvents, polynuclear aromatic hydrocarbons, etc. Ref. DOE, 2005a.
2 CDH, 1991.
3 See text for explanation.
4 Basis for the lowest ESL.
5 LOAELs and NOAELs from Appendix B, Table B-2, “TRVs for Terrestrial Vertebrate Receptors”, Ref. DOE 2005b.
6 Ratios are rounded to one significant figure.
(1) Pesticides may have been disposed in the Original Landfill (PAC SW-115)
(2) There are historical IHSSs upgradient of the UWOEU where transformers had leaked.
CDH – Colorado Department of Health
DDE – dichlorodiphenyldichloroethylene
DDT – dichlorodiphenyltrichloroethane
DOE – Department of Energy
ECOPC – Ecological Contaminant of Potential Concern
ESL – Ecological Screening Level
IHSS – Individual Hazardous Substance Site
LOAEL – Lowest Bounded Lowest Observed Adverse Effect Level
NOAEL - Final No Observed Adverse Effect Level
RFETS – Rocky Flats Environmental Technology Site
UWOEU – Upper Woman Drainage Exposure Unit
NA – Not applicable
NVA – No Value Available
I- Inconclusive

Table A1.6
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Organic (mg/kg)								
1,1,1,2-Tetrachloroethane	1.28	-	1.46	8		0	0	No
1,1,1-Trichloroethane	1.13	-	31	195	4.85E+07	0	0	Yes
1,1,2,2-Tetrachloroethane	0.995	-	31	194	4.70E+06	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	1.01	-	2.21	8		0	0	No
1,1,2-Trichloroethane	0.958	-	31	198		0	0	No
1,1-Dichloroethane	1.02	-	31	198	215,360	0	0	No
1,1-Dichloroethene	1.53	-	31	198	1.28E+06	0	0	No
1,1-Dichloropropene	1.30	-	1.49	8		0	0	No
1,2,3-Trichlorobenzene	0.724	-	1.69	8		0	0	No
1,2,3-Trichloropropane	1.07	-	1.23	8	1.17E+06	0	0	No
1,2,4-Trichlorobenzene	1.00	-	7,700	110	94,484	0	0	Yes
1,2,4-Trimethylbenzene	1.05	-	1.21	8		0	0	No
1,2-Dibromo-3-chloropropane	1.86	-	3.15	8		0	0	No
1,2-Dibromoethane	0.848	-	1.32	8		0	0	No
1,2-Dichlorobenzene	0.755	-	7,700	110		0	0	Yes
1,2-Dichloroethane	1.03	-	31	198	2.00E+06	0	0	No
1,2-Dichloroethene	5	-	31	187	1.87E+06	0	0	No
1,2-Dichloropropane	0.884	-	31	198	3.92E+06	0	0	No
1,3,5-Trimethylbenzene	0.733	-	1.01	8	855,709	0	0	No
1,3-Dichlorobenzene	1.05	-	7,700	110		0	0	Yes
1,3-Dichloropropane	0.598	-	0.933	8		0	0	No
1,4-Dichlorobenzene	1.14	-	7,700	110	5.93E+06	0	0	Yes
2,2-Dichloropropane	1.05	-	1.23	8		0	0	No
2,4,5-Trichlorophenol	740	-	37,000	107		0	0	No
2,4,6-Trichlorophenol	340	-	7,700	107	17,263	0	0	No
2,4-Dichlorophenol	340	-	7,700	107	249,324	0	0	No
2,4-Dimethylphenol	340	-	7,700	107		0	0	No
2,4-Dinitrophenol	1,700	-	37,000	95	4.90E+06	0	0	No
2,4-Dinitrotoluene	340	-	7,700	107	2,473	1	0.935	No
2,6-Dinitrotoluene	340	-	7,700	107	477,309	0	0	No
2-Butanone	10	-	62	170	4.94E+07	0	0	Yes
2-Chloronaphthalene	340	-	7,700	107		0	0	No
2-Chlorophenol	340	-	7,700	106	21,598	0	0	Yes
2-Chlorotoluene	1.63	-	1.87	8		0	0	No
2-Hexanone	8.24	-	62	186		0	0	No
2-Methylphenol	340	-	7,700	107	9.26E+06	0	0	No
2-Nitroaniline	1,700	-	37,000	107	418,475	0	0	No
2-Nitrophenol	340	-	7,700	107		0	0	No
3,3'-Dichlorobenzidine	690	-	15,000	105		0	0	Yes
3-Nitroaniline	1,700	-	37,000	94		0	0	No
4,4'-DDD	9.40	-	42	99	6.19E+06	0	0	No
4,4'-DDE	9.40	-	42	96	54,420	0	0	No
4,4'-DDT	9.40	-	42	99	175,708	0	0	No
4,6-Dinitro-2-methylphenol	1,700	-	37,000	107	44,283	0	0	No
4-Bromophenyl-phenylether	340	-	7,700	107		0	0	No
4-Chloro-3-methylphenol	340	-	7,700	106		0	0	Yes
4-Chloroaniline	340	-	7,700	94	48,856	0	0	No
4-Chlorophenyl-phenyl ether	340	-	7,700	107		0	0	No
4-Chlorotoluene	0.954	-	1.09	8		0	0	No
4-Isopropyltoluene	1.12	-	1.38	8		0	0	No
4-Methyl-2-pentanone	6.96	-	62	188	859,131	0	0	Yes
4-Methylphenol	340	-	7,700	107		0	0	No
4-Nitroaniline	1,700	-	37,000	94	2.62E+06	0	0	No
4-Nitrophenol	1,700	-	37,000	104	1.02E+06	0	0	No

Table A1.6
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Acenaphthylene	340	-	7,700	106		0	0	Yes
Aldrin	4.70	-	21	99	11,282	0	0	No
alpha-BHC	4.70	-	21	98	2.47E+06	0	0	Yes
alpha-Chlordane	47	-	210	99	472,808	0	0	No
Benzene	0.840	-	31	198	1.10E+06	0	0	No
Benzyl Alcohol	340	-	7,700	99	253,015	0	0	No
beta-BHC	4.70	-	21	99	27,399	0	0	No
beta-Chlordane	47	-	200	94	472,808	0	0	No
bis(2-Chloroethoxy) methane	340	-	7,700	107		0	0	No
bis(2-Chloroethyl) ether	340	-	7,700	107		0	0	No
bis(2-Chloroisopropyl) ether	340	-	7,700	106		0	0	No
Bromobenzene	1.13	-	1.54	8		0	0	No
Bromochloromethane	1.20	-	1.47	8		0	0	No
Bromodichloromethane	0.705	-	31	198	381,135	0	0	No
Bromoform	1.14	-	31	192	198,571	0	0	Yes
Bromomethane	1.64	-	62	184		0	0	No
Butylbenzylphthalate	340	-	7,700	102	3.37E+06	0	0	Yes
Carbon Disulfide	2.84	-	31	194	410,941	0	0	No
Carbon Tetrachloride	1.21	-	31	196	736,154	0	0	No
Chlorobenzene	1.02	-	31	198	413,812	0	0	No
Chloroethane	4.00	-	62	187		0	0	No
Chloroform	0.920	-	31	198	560,030	0	0	No
Chloromethane	1.44	-	62	195		0	0	No
cis-1,3-Dichloropropene	0.898	-	31	198	222,413	0	0	No
delta-BHC	4.70	-	21	99	3,425	0	0	No
Dibromochloromethane	0.748	-	31	198	389,064	0	0	No
Dibromomethane	0.782	-	1.30	8		0	0	No
Dichlorodifluoromethane	1.95	-	3.19	8	59,980	0	0	No
Dieldrin	9.40	-	42	95	301	0	0	No
Diethylphthalate	340	-	7,700	105	2.21E+08	0	0	Yes
Dimethylphthalate	340	-	7,700	107	1.35E+07	0	0	No
Di-n-octylphthalate	340	-	7,700	105	2.58E+08	0	0	Yes
Endosulfan I	4.70	-	21	98	8,726	0	0	No
Endosulfan II	9.40	-	42	97	8,726	0	0	No
Endosulfan sulfate	9.40	-	42	96	8,726	0	0	No
Endrin	9.40	-	42	95	8,060	0	0	No
Endrin ketone	9.40	-	42	99	8,060	0	0	No
Ethylbenzene	0.896	-	31	198		0	0	No
gamma-BHC (Lindane)	4.70	-	21	99	3,425	0	0	No
gamma-Chlordane	160	-	210	5	472,808	0	0	No
Heptachlor	4.70	-	21	99	12,359	0	0	No
Heptachlor epoxide	4.70	-	21	98	9,121	0	0	Yes
Hexachlorobenzene	340	-	7,700	106	190,142	0	0	Yes
Hexachlorobutadiene	1.28	-	7,700	111	150,894	0	0	No
Hexachlorocyclopentadiene	340	-	7,700	104	799,679	0	0	No
Hexachloroethane	340	-	7,700	107	45,656	0	0	No
Isophorone	340	-	7,700	106		0	0	Yes
Isopropylbenzene	1.33	-	1.53	8		0	0	No
Methoxychlor	47	-	210	99	228,896	0	0	No
n-Butylbenzene	1.06	-	1.22	8		0	0	No
Nitrobenzene	340	-	7,700	107		0	0	No
N-Nitroso-di-n-propylamine	340	-	7,700	107		0	0	No
N-nitrosodiphenylamine	340	-	7,700	107	2.15E+06	0	0	No
n-Propylbenzene	1.18	-	1.35	8		0	0	No
PCB-1016	47	-	210	99	37,963	0	0	No

Table A1.6
Evaluation of Maximum Reported Results for Nondetected Analytes and Analytes with a Detection Frequency Less than 5 Percent in Subsurface Soil in the UWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
PCB-1221	47	-	210	99	37,963	0	0	No
PCB-1232	47	-	210	96	37,963	0	0	No
PCB-1242	47	-	210	99	37,963	0	0	No
PCB-1248	47	-	210	99	37,963	0	0	No
PCB-1260	94	-	420	96	37,963	0	0	Yes
Pentachlorophenol	1,700	-	37,000	106	18,373	1	0.943	Yes
Phenol	340	-	7,700	103	1.49E+06	0	0	Yes
Pyridine	740	-	840	4		0	0	No
sec-Butylbenzene	1.12	-	1.28	8		0	0	No
Styrene	1.07	-	31	198	1.53E+06	0	0	No
tert-Butylbenzene	1.17	-	1.34	8		0	0	No
Toxaphene	94	-	420	99	909,313	0	0	No
trans-1,2-Dichloroethene	1.43	-	6	11	1.87E+06	0	0	No
trans-1,3-Dichloropropene	0.959	-	31	197	222,413	0	0	No
Trichlorofluoromethane	1.34	-	1.53	8		0	0	No
Vinyl acetate	10	-	62	181	730,903	0	0	No
Vinyl Chloride	3.02	-	62	198	6,494	0	0	No
Xylene	2.68	-	31	198	111,663	0	0	No

COMPREHENSIVE RISK ASSESSMENT

UPPER WOMAN DRAINAGEEXPOSURE UNIT

VOLUME 10: ATTACHMENT 2

Data Quality Assessment

TABLE OF CONTENTS

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ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
ASD	Analytical Services Division
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CRDL	contract required detection limit
DAR	data adequacy report
DER	duplicate error ratio
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
DRC	data review checklist
ECOPC	ecological contaminant of potential concern
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EU	exposure unit
FD	field duplicate
IAG	Interagency Agreement
ICP	inductively couple plasma
IDL	instrument detection limit
LCS	laboratory control sample
MDA	minimum detectable activity
MDL	method detection limit

MS	matrix spike
MSA	method of standard additions
MSD	matrix spike duplicate
N/A	not applicable
PARCC	precision, accuracy, representativeness, completeness, and comparability
PPT	Pipette
PCB	polychlorinated biphenyl
QC	quality control
RDL	required detection limit
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
RL	reporting limit
RPD	relative percent difference
SDP	standard data package
SOW	Statement of Work
SVOC	semi-volatile organic compound
SWD	Soil Water Database
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	toxicity equivalent
TIC	tentatively identified compound
UWOEU	Upper Woman Drainage Exposure Unit
V&V	verification and validation
VOC	volatile organic compound

1.0 INTRODUCTION

This document provides an assessment of the quality of the data used in the human health and ecological risk assessments for the Upper Woman Drainage Exposure Unit (UWOEU). The data quality was evaluated against standard precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters by the data validator under the multiple work plans that guided the data collection over the past 15 years, as well as the requirements for the PARCC parameters provided in the Comprehensive Risk Assessment (CRA) Methodology (DOE 2005). The details of this data quality assessment (DQA) process are presented in the Sitewide DQA contained in Appendix A, Volume 2, Attachment 2 of the Remedial Investigation/Feasibility Study (RI/FS).

Of the 308,204 environmental sampling records in the RFETS database associated with the UWOEU, 152,996 were used in the UWOEU risk assessment based on the data processing rules described in Section 2.0 of the Sitewide DQA. Of the 152,996 analytical records existing in the UWOEU CRA data set, 88 percent (135,126 records) have undergone verification or validation (V&V) (Table A2.1). The V&V review involved applying observation notes and qualifiers flags or observation notes without qualifier flags to the data.

PARCC parameter analysis was used to determine if the data quality could affect the risk assessment decisions (i.e., have significant impact on risk assessment calculations or selection of contaminants of concern for human health or ecological contaminants of potential concern). In consultation with the data users and project team, the primary ways in which the PARCC parameters could impact the risk decisions were identified and these include the following:

- Detect results are falsely identified as nondetects;
- Nondetect results are falsely identified as detects;
- Issues that cause detection limit uncertainty;
- Issues that cause significant overestimation of detect results; and
- Issues that cause significant underestimation of detect results.

2.0 SUMMARY OF FINDINGS

2.1 PARCC Findings

A summary of V&V observations and the associated, affected PARCC parameter is presented in Table A2.2 by analyte group and matrix (i.e., “soil” includes soil and sediment, and “water” includes surface water and groundwater). Table A2.3 presents the percentage of the UWOEU V&V data that were qualified as estimated and/or undetected by analyte group and matrix. Overall, approximately 13 percent of the UWOEU CRA data were qualified as estimated or undetected. Less than 3 percent of the data reported as detected by the laboratory were qualified as undetected by the validator due to blank contamination (Table A2.4). In general, data qualified as estimated or undetected are marked as such because of various laboratory noncompliance issues that are not serious enough to render the data unusable. The precision between field duplicate (FD)/target sample analyte pairs is summarized in Table A2.5.

Of 88 percent of the UWOEU that underwent V&V, 83 percent were qualified as having no QC issues, and approximately 13 percent were qualified as estimated or undetected (Table A2.3). The remaining 4 percent of the V&V data are made up of records qualified with additional flags indicating acceptable and non-estimated data such as “A”, “C”, or “E”.

Less than 4 percent of the entire data set was rejected during the V&V process (Table A2.6). Rejected data were removed from the UWOEU CRA data set during the data processing as defined in Section 2.0 of the Sitewide DQA.

The general discussion below summarizes the data quality as presented by the data validator’s observations. The relationship between these observations and the PARCC parameters can be found in the Sitewide DQA. Several observations have no impact on data quality because they represent issues that were noted but corrected, or represent other, general observations such as missing documentation that was not required for data assessment. Approximately 13 percent of the UWOEU V&V data were marked with these V&V observations that have no affect on any of the PARCC parameters.

Of the V&V data, approximately 2 percent was noted for observations related to precision. Of that 2 percent, 99 percent contained issues related to sample matrices. Result confirmation and instrument setup observations make up the other 1 percent.

Of the V&V data, 29 percent was noted for accuracy-related observations. Of that 29 percent, 78 percent was noted for laboratory practice-related observations, while sample-specific accuracy observations make up the other 22 percent. Although the percentage of data with noted accuracy issues is slightly elevated, it is important to note that not all accuracy-related observations resulted in data qualification. Less than 14 percent of the UWOEU CRA data set was qualified as estimated and/or undetected (Table A2.3).

The data were determined to meet the representativeness parameter because sampling locations are spatially distributed such that contaminant randomness and bias considerations are addressed based on the site-specific history (see the Data Adequacy Report [DAR] in Appendix A, Volume 2, Attachment 3). Samples were also analyzed by the SW-846 or alpha-spectroscopy methods and results were documented as quality records according to approved procedures and guidelines (V&V).

Of the V&V data, approximately 37 percent were noted for observations related to representativeness. Of that 37 percent, 67 percent was marked for blank observations, 24 percent for failure to observe allowed holding times, 3 percent for documentation issues, 4 percent for sample preparation observations, and 1 percent for instrument sensitivity issues. Matrix, LCS, instrument set-up, and other observations make up the other 1 percent of the data noted for observations related to sample representativeness. Reportable levels of target analytes were not routinely detected in the laboratory blanks greater than the laboratory RLs and samples were generally stored and preserved properly.

The CRA Methodology specifies completeness criteria based on data adequacy and these criteria and the findings are discussed in the DAR in Appendix A, Volume 2, Attachment 3 of the RI/FS. Additionally, it should be noted that less than 4 percent of all V&V data associated with the UWOEU were rejected.

Comparability of the UWOEU CRA data set is ensured as all analytical results have been converted into common units. Comparability is addressed more specifically in Appendix A, Volume 2, Attachment 2 of the RI/FS.

2.2 PARCC Findings Potential Impact on Data Usability

PARCC parameter influence on data usability is discussed below with an emphasis on the RA decisions as defined in the Introduction to this document.

Table A2.3 summarizes the overall percentage of qualified data, independent of validation observation. The table is used for overall guidance in selecting analyte group and matrix combinations of interest in the analysis of the risk assessment decisions, the impact on data usability is better analyzed using Tables A2.5 through A2.7, as these can be more directly related to the 5 key risk assessment decision factors described in the introduction.

A summary of the rejected data is presented in table A2.6. Where analyte group and matrix combinations are more than 10 percent rejected, the data are reviewed to determine if there could be an impact on the results of the risk assessment.

A summary of FD/target sample precision information can be found in Table A2.6. Where there are analyte group and matrix combinations failures in excess of 10 percent, the data are reviewed to determine if there could be an impact on the results of the risk assessment.

Table A2.7 lists V&V observations where the number of observations by analyte group and matrix exceeds 5 percent of the associated records (see column “Percent Observed”) with the exception of those observations that were determined to have no impact on any of the PARCC parameters. Such observations are identified in Table A2.2 by an “Affected PARCC Parameter” of not applicable (N/A). Additionally the analyte group and matrix is broken down further in the columns “Percent Qualified U” and “Percent

Qualified J". Data qualifications that are considered to have potential impact on risk assessment decisions were reviewed and are discussed in detail in the bulleted list below. Other issues are not considered to have the potential for significant impacts on the results of the risk assessments because the uncertainty associated with these data quality issues is assumed to be less than the overall uncertainty in the risk assessment process (e.g., uncertainties such as exposure assumptions, toxicity values, statistical methods for calculating exposure point concentrations).

Data qualifications associated with the water matrix are not discussed below. Surface water data are used in the ecological risk assessment for an EU only for those analytes identified as ECOPCs, and the surface water component of exposure contributes only minimally to the overall risk estimates. As described in the Sitewide DQA (Attachment 2 of Volume 2 of Appendix A of the RI/FS Report), groundwater data are not used in the ecological risk assessment and the groundwater evaluations for the human health portion of the risk assessment are performed on a sitewide basis. In addition, surface water is evaluated for the human health risk assessment on a sitewide basis. Therefore, data quality evaluations for groundwater and surface water are presented in the Sitewide DQA.

Issues that have the potential to impact the risk assessment decision include the following:

- Approximately 21 percent of all dioxin and furan/soil FD/target sample analyte pairs failed relative percent difference (RPD) criteria (Table A2.5). All of the 7 records that did not meet RPD criteria resulted from the analysis of the same FD/target sample pair. While some imprecision in the associated data may be indicated by this data quality observation, it is important to note dioxin and furan analyses are performed using very low detection limits. Although the RPD between such small analytical results can be large, all results associated with the RPD exceedances are within an order of magnitude of one another. While 2,3,7,8-tetrachlorodibenzo-p-dioxin (toxicity equivalent [TEQ] value) was selected both as a human health contaminant of concern (COC) and as an ecological contaminant of potential concern (ECOPC) in the UWOEU, the impact of the potential imprecision on risk assessment decisions is determined to be minimal.

- Greater than 17 percent of the dioxin and furan/soil data set was qualified as estimated and noted with V&V observations related to blank contamination. Analytical results affected by blank contamination that were not qualified as nondetect (all affected records are detect results) are high biased results. Associated results are therefore a conservative estimate. The impact on risk assessment decisions is again determined to be minimal.

- Several V&V observations related to the wet chemistry/soil analyte group and matrix combination resulted in data qualifications in notable percentages of the data set (Table A2.7), it is important to note that this analyte group contains general chemistry parameters that are not directly related to site characterization.

Therefore, the impact of these qualifications on risk assessment results is determined to be minimal.

3.0 CONCLUSIONS

This review concludes that the quality of the UWOEU data is acceptable and the CRA objectives for PARCC performance have generally been met. Where either CRA Methodology or V&V guidance have not been met, the data are either flagged by the V&V process, or for those instances where the frequency of issues may influence the risk assessment decisions, the data quality issues were reviewed for magnitude of potential impact on risk assessment results.

Those elements of data quality that could potentially affect risk decisions in the UWOEU have been analyzed and it was concluded that the noted deviations from the PARCC parameter criteria have minimal impact on risk assessment results related to the UWOEU.

4.0 REFERENCES

DOE, 2002, Final Work Plan for the Development of the Remedial Investigation and Feasibility Study Report, Rocky Flats Environmental Technology Site, Golden, Colorado, March.

DOE, 2005. Final Comprehensive Risk Assessment Work Plan and Methodology, Environmental Restoration, Rocky Flats Environmental Technology Site, Golden, Colorado. Revision 1, September 2005.

TABLES

Table A2.1
CRA Data V&V Summary

Analyte Group	Matrix	Total No. of CRA V&V Records	Total No. of CRA Records	Percent V&V (%)
Dioxins and Furans	Soil	187	187	100.00
Dioxins and Furans	Water	14	14	100.00
Herbicide	Soil	173	174	99.43
Herbicide	Water	136	188	72.34
Metal	Soil	11,455	11,507	99.55
Metal	Water	31,000	35,595	87.09
PCB	Soil	1,467	1,495	98.13
PCB	Water	728	819	88.89
Pesticide	Soil	4,340	4,432	97.92
Pesticide	Water	2,218	2,544	87.19
Radionuclide	Soil	2,842	3,155	90.08
Radionuclide	Water	5,771	7,433	77.64
SVOC	Soil	12,363	12,474	99.11
SVOC	Water	9,356	12,582	74.36
VOC	Soil	8,550	9,043	94.55
VOC	Water	41,067	47,290	86.84
Wet Chem	Soil	94	106	88.68
Wet Chem	Water	3,365	3,958	85.02
	Total	**135,126**	**152,996**	**88.32%**

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Dioxins and Furans	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	32	187	17.11	Representativeness
Dioxins and Furans	Soil	Internal Standards	Internal standards did not meet criteria	Yes	2	187	1.07	Accuracy
Herbicide	Soil	Calibration	Continuing calibration verification criteria were not met	No	2	173	1.16	Accuracy
Herbicide	Soil	Documentation Issues	Record added by the validator	No	4	173	2.31	N/A
Herbicide	Soil	Documentation Issues	Transcription error	No	4	173	2.31	N/A
Herbicide	Soil	Holding Times	Holding times were exceeded	No	6	173	3.47	Representativeness
Herbicide	Soil	Internal Standards	Internal standards did not meet criteria	No	2	173	1.16	Accuracy
Herbicide	Soil	Other	Sample results were not validated due to re-analysis	No	1	173	0.58	N/A
Herbicide	Soil	Other	See hard copy for further explanation	No	1	173	0.58	N/A
Herbicide	Soil	Surrogates	Surrogate recovery criteria were not met	No	1	173	0.58	Accuracy
Herbicide	Water	Calibration	Continuing calibration verification criteria were not met	No	3	136	2.21	Accuracy
Herbicide	Water	Holding Times	Holding times were exceeded	No	1	136	0.74	Representativeness
Herbicide	Water	Other	Sample results were not validated due to re-analysis	No	2	136	1.47	N/A
Herbicide	Water	Other	See hard copy for further explanation	No	2	136	1.47	N/A
Metal	Soil	Blanks	Calibration verification blank contamination	No	43	11,455	0.38	Representativeness
Metal	Soil	Blanks	Calibration verification blank contamination	Yes	9	11,455	0.08	Representativeness
Metal	Soil	Blanks	Method, preparation, or reagent blank contamination	No	571	11,455	4.98	Representativeness
Metal	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	114	11,455	1.00	Representativeness
Metal	Soil	Blanks	Negative bias indicated in the blanks	No	109	11,455	0.95	Representativeness
Metal	Soil	Blanks	Negative bias indicated in the blanks	Yes	62	11,455	0.54	Representativeness
Metal	Soil	Calibration	Calibration correlation coefficient did not meet requirements	No	17	11,455	0.15	Accuracy
Metal	Soil	Calibration	Calibration correlation coefficient did not meet requirements	Yes	17	11,455	0.15	Accuracy
Metal	Soil	Calibration	Continuing calibration verification criteria were not met	No	3	11,455	0.03	Accuracy
Metal	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	5	11,455	0.04	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Soil	Documentation Issues	Key data fields incorrect	No	13	11,455	0.11	N/A
Metal	Soil	Documentation Issues	Key data fields incorrect	Yes	20	11,455	0.17	N/A
Metal	Soil	Documentation Issues	Record added by the validator	No	57	11,455	0.50	N/A
Metal	Soil	Documentation Issues	Record added by the validator	Yes	116	11,455	1.01	N/A
Metal	Soil	Documentation Issues	Transcription error	No	94	11,455	0.82	N/A
Metal	Soil	Documentation Issues	Transcription error	Yes	421	11,455	3.68	N/A
Metal	Soil	Holding Times	Holding times were exceeded	No	12	11,455	0.10	Representativeness
Metal	Soil	Holding Times	Holding times were exceeded	Yes	71	11,455	0.62	Representativeness
Metal	Soil	Instrument Set-up	Interference was indicated in the interference check sample	No	64	11,455	0.56	Accuracy
Metal	Soil	Instrument Set-up	Interference was indicated in the interference check sample	Yes	124	11,455	1.08	Accuracy
Metal	Soil	LCS	CRDL check sample recovery criteria were not met	No	117	11,455	1.02	Accuracy
Metal	Soil	LCS	CRDL check sample recovery criteria were not met	Yes	162	11,455	1.41	Accuracy
Metal	Soil	LCS	LCS recovery criteria were not met	No	386	11,455	3.37	Accuracy
Metal	Soil	LCS	LCS recovery criteria were not met	Yes	787	11,455	6.87	Accuracy
Metal	Soil	LCS	Low level check sample recovery criteria were not met	No	22	11,455	0.19	Accuracy
Metal	Soil	LCS	Low level check sample recovery criteria were not met	Yes	22	11,455	0.19	Accuracy
Metal	Soil	Matrices	Duplicate sample precision criteria were not met	No	12	11,455	0.10	Precision
Metal	Soil	Matrices	Duplicate sample precision criteria were not met	Yes	474	11,455	4.14	Precision
Metal	Soil	Matrices	LCS/LCSD precision criteria were not met	Yes	19	11,455	0.17	Precision
Metal	Soil	Matrices	MSA calibration correlation coefficient < 0.995	Yes	1	11,455	0.01	Accuracy
Metal	Soil	Matrices	Percent solids < 30 percent	No	20	11,455	0.17	Representativeness
Metal	Soil	Matrices	Percent solids < 30 percent	Yes	113	11,455	0.99	Representativeness
Metal	Soil	Matrices	Post-digestion MS did not meet control criteria	No	73	11,455	0.64	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Soil	Matrices	Post-digestion MS did not meet control criteria	Yes	66	11,455	0.58	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	No	338	11,455	2.95	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	Yes	667	11,455	5.82	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery was < 30 percent	Yes	12	11,455	0.10	Accuracy
Metal	Soil	Matrices	Serial dilution criteria were not met	Yes	415	11,455	3.62	Accuracy
Metal	Soil	Other	IDL is older than 3 months from date of analysis	No	134	11,455	1.17	Accuracy
Metal	Soil	Other	IDL is older than 3 months from date of analysis	Yes	461	11,455	4.02	Accuracy
Metal	Soil	Other	Result obtained through dilution	Yes	6	11,455	0.05	N/A
Metal	Soil	Other	See hard copy for further explanation	No	72	11,455	0.63	N/A
Metal	Soil	Other	See hard copy for further explanation	Yes	344	11,455	3.00	N/A
Metal	Soil	Sensitivity	IDL changed due to a significant figure discrepancy	No	11	11,455	0.10	Representativeness
Metal	Water	Blanks	Calibration verification blank contamination	No	1,031	31,000	3.33	Representativeness
Metal	Water	Blanks	Calibration verification blank contamination	Yes	168	31,000	0.54	Representativeness
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	No	1,685	31,000	5.44	Representativeness
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	469	31,000	1.51	Representativeness
Metal	Water	Blanks	Negative bias indicated in the blanks	No	308	31,000	0.99	Representativeness
Metal	Water	Blanks	Negative bias indicated in the blanks	Yes	179	31,000	0.58	Representativeness
Metal	Water	Calculation Errors	Calculation error	No	5	31,000	0.02	N/A
Metal	Water	Calculation Errors	Calculation error	Yes	1	31,000	0.00	N/A
Metal	Water	Calculation Errors	Control limits not assigned correctly	No	49	31,000	0.16	N/A
Metal	Water	Calculation Errors	Control limits not assigned correctly	Yes	45	31,000	0.15	N/A
Metal	Water	Calibration	Calibration correlation coefficient did not meet requirements	No	146	31,000	0.47	Accuracy
Metal	Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	26	31,000	0.08	Accuracy
Metal	Water	Calibration	Continuing calibration verification criteria were not met	No	14	31,000	0.05	Accuracy
Metal	Water	Calibration	Continuing calibration verification criteria were not met	Yes	17	31,000	0.05	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Water	Calibration	Frequency or sequencing verification criteria not met	No	13	31,000	0.04	Accuracy
Metal	Water	Calibration	Frequency or sequencing verification criteria not met	Yes	50	31,000	0.16	Accuracy
Metal	Water	Documentation Issues	Electronic qualifiers were applied from validation report by hand	No	20	31,000	0.06	N/A
Metal	Water	Documentation Issues	Electronic qualifiers were applied from validation report by hand	Yes	9	31,000	0.03	N/A
Metal	Water	Documentation Issues	Information missing from case narrative	No	10	31,000	0.03	N/A
Metal	Water	Documentation Issues	Information missing from case narrative	Yes	13	31,000	0.04	N/A
Metal	Water	Documentation Issues	Key data fields incorrect	No	103	31,000	0.33	N/A
Metal	Water	Documentation Issues	Key data fields incorrect	Yes	308	31,000	0.99	N/A
Metal	Water	Documentation Issues	Missing deliverables (not required for validation)	No	199	31,000	0.64	N/A
Metal	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	185	31,000	0.60	N/A
Metal	Water	Documentation Issues	Missing deliverables (required for validation)	No	169	31,000	0.55	Representativeness
Metal	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	198	31,000	0.64	Representativeness
Metal	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	531	31,000	1.71	N/A
Metal	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	906	31,000	2.92	N/A
Metal	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	7	31,000	0.02	Representativeness
Metal	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	1	31,000	0.00	Representativeness
Metal	Water	Documentation Issues	Record added by the validator	No	21	31,000	0.07	N/A
Metal	Water	Documentation Issues	Record added by the validator	Yes	23	31,000	0.07	N/A
Metal	Water	Documentation Issues	Reported data does not agree with raw data	No	1	31,000	0.00	N/A
Metal	Water	Documentation Issues	Transcription error	No	837	31,000	2.70	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Water	Documentation Issues	Transcription error	Yes	377	31,000	1.22	N/A
Metal	Water	Holding Times	Holding times were exceeded	No	80	31,000	0.26	Representativeness
Metal	Water	Holding Times	Holding times were exceeded	Yes	47	31,000	0.15	Representativeness
Metal	Water	Holding Times	Holding times were grossly exceeded	Yes	4	31,000	0.01	Representativeness
Metal	Water	Instrument Set-up	AA duplicate injection precision criteria were not met	No	4	31,000	0.01	Precision
Metal	Water	Instrument Set-up	AA duplicate injection precision criteria were not met	Yes	1	31,000	0.00	Precision
Metal	Water	Instrument Set-up	Interference was indicated in the interference check sample	No	46	31,000	0.15	Accuracy
Metal	Water	Instrument Set-up	Interference was indicated in the interference check sample	Yes	137	31,000	0.44	Accuracy
Metal	Water	LCS	CRDL check sample recovery criteria were not met	No	235	31,000	0.76	Accuracy
Metal	Water	LCS	CRDL check sample recovery criteria were not met	Yes	165	31,000	0.53	Accuracy
Metal	Water	LCS	LCS data not submitted by the laboratory	No	1	31,000	0.00	Representativeness
Metal	Water	LCS	LCS recovery criteria were not met	No	84	31,000	0.27	Accuracy
Metal	Water	LCS	LCS recovery criteria were not met	Yes	103	31,000	0.33	Accuracy
Metal	Water	LCS	Low level check sample recovery criteria were not met	No	240	31,000	0.77	Accuracy
Metal	Water	LCS	Low level check sample recovery criteria were not met	Yes	248	31,000	0.80	Accuracy
Metal	Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	79	31,000	0.25	Representativeness
Metal	Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	83	31,000	0.27	Representativeness
Metal	Water	Matrices	Duplicate sample precision criteria were not met	No	38	31,000	0.12	Precision
Metal	Water	Matrices	Duplicate sample precision criteria were not met	Yes	122	31,000	0.39	Precision
Metal	Water	Matrices	LCS/LCSD precision criteria were not met	No	31	31,000	0.10	Precision
Metal	Water	Matrices	LCS/LCSD precision criteria were not met	Yes	33	31,000	0.11	Precision
Metal	Water	Matrices	MSA calibration correlation coefficient < 0.995	No	1	31,000	0.00	Accuracy
Metal	Water	Matrices	MSA calibration correlation coefficient < 0.995	Yes	6	31,000	0.02	Accuracy
Metal	Water	Matrices	Post-digestion MS did not meet control criteria	No	288	31,000	0.93	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Metal	Water	Matrices	Post-digestion MS did not meet control criteria	Yes	42	31,000	0.14	Accuracy
Metal	Water	Matrices	Predigestion MS recovery criteria were not met	No	369	31,000	1.19	Accuracy
Metal	Water	Matrices	Predigestion MS recovery criteria were not met	Yes	363	31,000	1.17	Accuracy
Metal	Water	Matrices	Predigestion MS recovery was < 30 percent	No	2	31,000	0.01	Accuracy
Metal	Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	15	31,000	0.05	Accuracy
Metal	Water	Matrices	Recovery criteria were not met	Yes	1	31,000	0.00	Accuracy
Metal	Water	Matrices	Serial dilution criteria were not met	No	21	31,000	0.07	Accuracy
Metal	Water	Matrices	Serial dilution criteria were not met	Yes	617	31,000	1.99	Accuracy
Metal	Water	Matrices	Site samples were not used for sample matrix QC	No	5	31,000	0.02	Representativeness
Metal	Water	Matrices	Site samples were not used for sample matrix QC	Yes	22	31,000	0.07	Representativeness
Metal	Water	Other	IDL is older than 3 months from date of analysis	No	598	31,000	1.93	Accuracy
Metal	Water	Other	IDL is older than 3 months from date of analysis	Yes	949	31,000	3.06	Accuracy
Metal	Water	Other	See hard copy for further explanation	No	19	31,000	0.06	N/A
Metal	Water	Other	See hard copy for further explanation	Yes	25	31,000	0.08	N/A
Metal	Water	Sample Preparation	Samples were not properly preserved in the field	No	297	31,000	0.96	Representativeness
Metal	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	520	31,000	1.68	Representativeness
Metal	Water	Sensitivity	IDL changed due to a significant figure discrepancy	No	73	31,000	0.24	Representativeness
Metal	Water	Sensitivity	Instrument detection limit > the associated RDL	Yes	1	31,000	0.00	Representativeness
PCB	Soil	Documentation Issues	Transcription error	No	35	1,467	2.39	N/A
PCB	Soil	Holding Times	Holding times were exceeded	No	49	1,467	3.34	Representativeness
PCB	Soil	Other	See hard copy for further explanation	Yes	1	1,467	0.07	N/A
PCB	Soil	Surrogates	Surrogate recovery criteria were not met	Yes	1	1,467	0.07	Accuracy
PCB	Water	Documentation Issues	Transcription error	No	56	728	7.69	N/A
PCB	Water	Holding Times	Holding times were exceeded	No	35	728	4.81	Representativeness
PCB	Water	Surrogates	Surrogate recovery criteria were not met	No	28	728	3.85	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Pesticide	Soil	Calibration	Continuing calibration verification criteria were not met	No	14	4,340	0.32	Accuracy
Pesticide	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	3	4,340	0.07	Accuracy
Pesticide	Soil	Documentation Issues	Record added by the validator	No	6	4,340	0.14	N/A
Pesticide	Soil	Documentation Issues	Transcription error	No	21	4,340	0.48	N/A
Pesticide	Soil	Holding Times	Holding times were exceeded	No	146	4,340	3.36	Representativeness
Pesticide	Soil	Internal Standards	Internal standards did not meet criteria	No	2	4,340	0.05	Accuracy
Pesticide	Soil	Other	Sample results were not validated due to re-analysis	No	1	4,340	0.02	N/A
Pesticide	Soil	Other	See hard copy for further explanation	No	7	4,340	0.16	N/A
Pesticide	Soil	Surrogates	Surrogate recovery criteria were not met	No	3	4,340	0.07	Accuracy
Pesticide	Water	Blanks	Method, preparation, or reagent blank contamination	No	4	2,218	0.18	Representativeness
Pesticide	Water	Calibration	Continuing calibration verification criteria were not met	No	32	2,218	1.44	Accuracy
Pesticide	Water	Documentation Issues	Transcription error	No	123	2,218	5.55	N/A
Pesticide	Water	Holding Times	Holding times were exceeded	No	106	2,218	4.78	Representativeness
Pesticide	Water	Other	Sample results were not validated due to re-analysis	No	2	2,218	0.09	N/A
Pesticide	Water	Other	See hard copy for further explanation	No	2	2,218	0.09	N/A
Pesticide	Water	Other	See hard copy for further explanation	Yes	4	2,218	0.18	N/A
Pesticide	Water	Surrogates	Surrogate recovery criteria were not met	No	64	2,218	2.89	Accuracy
Radionuclide	Soil	Blanks	Blank recovery criteria were not met	Yes	68	2,842	2.39	Representativeness
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	No	7	2,842	0.25	Representativeness
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	416	2,842	14.64	Representativeness
Radionuclide	Soil	Calculation Errors	Calculation error	Yes	5	2,842	0.18	N/A
Radionuclide	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	147	2,842	5.17	Accuracy
Radionuclide	Soil	Documentation Issues	Key data fields incorrect	Yes	28	2,842	0.99	N/A
Radionuclide	Soil	Documentation Issues	Record added by the validator	Yes	50	2,842	1.76	N/A
Radionuclide	Soil	Documentation Issues	Results were not included on Data Summary Table	Yes	1	2,842	0.04	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Soil	Documentation Issues	Sample analysis was not requested	Yes	3	2,842	0.11	N/A
Radionuclide	Soil	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	387	2,842	13.62	Representativeness
Radionuclide	Soil	Documentation Issues	Transcription error	No	18	2,842	0.63	N/A
Radionuclide	Soil	Documentation Issues	Transcription error	Yes	307	2,842	10.80	N/A
Radionuclide	Soil	Holding Times	Holding times were grossly exceeded	Yes	3	2,842	0.11	Representativeness
Radionuclide	Soil	Instrument Set-up	Detector efficiency did not meet requirements	Yes	16	2,842	0.56	Accuracy
Radionuclide	Soil	Instrument Set-up	Resolution criteria were not met	Yes	12	2,842	0.42	Representativeness
Radionuclide	Soil	LCS	Lab control samples >+/- 2 sigma and <+/- 3 sigma	Yes	4	2,842	0.14	Accuracy
Radionuclide	Soil	LCS	LCS data not submitted by the laboratory	Yes	29	2,842	1.02	Representativeness
Radionuclide	Soil	LCS	LCS recovery > +/- 3 sigma	No	8	2,842	0.28	Accuracy
Radionuclide	Soil	LCS	LCS recovery > +/- 3 sigma	Yes	306	2,842	10.77	Accuracy
Radionuclide	Soil	LCS	LCS recovery criteria were not met	No	5	2,842	0.18	Accuracy
Radionuclide	Soil	LCS	LCS recovery criteria were not met	Yes	32	2,842	1.13	Accuracy
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	No	17	2,842	0.60	Accuracy
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	Yes	198	2,842	6.97	Accuracy
Radionuclide	Soil	Matrices	Recovery criteria were not met	Yes	41	2,842	1.44	Accuracy
Radionuclide	Soil	Matrices	Replicate analysis was not performed	Yes	4	2,842	0.14	Precision
Radionuclide	Soil	Matrices	Replicate precision criteria were not met	No	2	2,842	0.07	Precision
Radionuclide	Soil	Matrices	Replicate precision criteria were not met	Yes	304	2,842	10.70	Precision
Radionuclide	Soil	Matrices	Replicate recovery criteria were not met	No	4	2,842	0.14	Accuracy
Radionuclide	Soil	Matrices	Replicate recovery criteria were not met	Yes	57	2,842	2.01	Accuracy
Radionuclide	Soil	Other	Lab results not verified due to unsubmitted data	Yes	69	2,842	2.43	Representativeness
Radionuclide	Soil	Other	QC sample does not meet method requirements	No	16	2,842	0.56	Representativeness
Radionuclide	Soil	Other	QC sample does not meet method requirements	Yes	9	2,842	0.32	Representativeness
Radionuclide	Soil	Other	Sample exceeded efficiency curve weight limit	Yes	5	2,842	0.18	Accuracy
Radionuclide	Soil	Other	See hard copy for further explanation	No	3	2,842	0.11	N/A
Radionuclide	Soil	Other	See hard copy for further explanation	Yes	87	2,842	3.06	N/A
Radionuclide	Soil	Sensitivity	Incorrect reported activity or MDA	No	2	2,842	0.07	N/A
Radionuclide	Soil	Sensitivity	Incorrect reported activity or MDA	Yes	2	2,842	0.07	N/A
Radionuclide	Soil	Sensitivity	MDA exceeded the RDL	No	2	2,842	0.07	Representativeness

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Soil	Sensitivity	MDA exceeded the RDL	Yes	43	2,842	1.51	Representativeness
Radionuclide	Soil	Sensitivity	MDA was calculated by reviewer	Yes	639	2,842	22.48	N/A
Radionuclide	Water	Blanks	Blank data not submitted	Yes	4	5,771	0.07	Representativeness
Radionuclide	Water	Blanks	Blank recovery criteria were not met	No	4	5,771	0.07	Representativeness
Radionuclide	Water	Blanks	Blank recovery criteria were not met	Yes	51	5,771	0.88	Representativeness
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	No	41	5,771	0.71	Representativeness
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	385	5,771	6.67	Representativeness
Radionuclide	Water	Calculation Errors	Calculation error	No	5	5,771	0.09	N/A
Radionuclide	Water	Calculation Errors	Calculation error	Yes	11	5,771	0.19	N/A
Radionuclide	Water	Calibration	Calibration counting statistics did not meet criteria	No	18	5,771	0.31	Accuracy
Radionuclide	Water	Calibration	Calibration counting statistics did not meet criteria	Yes	2	5,771	0.03	Accuracy
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	No	105	5,771	1.82	Accuracy
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	Yes	425	5,771	7.36	Accuracy
Radionuclide	Water	Documentation Issues	Information missing from case narrative	Yes	5	5,771	0.09	N/A
Radionuclide	Water	Documentation Issues	Key data fields incorrect	Yes	1	5,771	0.02	N/A
Radionuclide	Water	Documentation Issues	Missing deliverables (required for validation)	No	1	5,771	0.02	Representativeness
Radionuclide	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	1	5,771	0.02	Representativeness
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	15	5,771	0.26	N/A
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	56	5,771	0.97	N/A
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	4	5,771	0.07	Representativeness
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	17	5,771	0.29	Representativeness
Radionuclide	Water	Documentation Issues	Record added by the validator	Yes	76	5,771	1.32	N/A
Radionuclide	Water	Documentation Issues	Sample analysis was not requested	Yes	8	5,771	0.14	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	No	2	5,771	0.03	Representativeness
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	535	5,771	9.27	Representativeness
Radionuclide	Water	Documentation Issues	Transcription error	No	293	5,771	5.08	N/A
Radionuclide	Water	Documentation Issues	Transcription error	Yes	248	5,771	4.30	N/A
Radionuclide	Water	Holding Times	Holding times were exceeded	No	59	5,771	1.02	Representativeness
Radionuclide	Water	Holding Times	Holding times were exceeded	Yes	93	5,771	1.61	Representativeness
Radionuclide	Water	Holding Times	Holding times were grossly exceeded	No	4	5,771	0.07	Representativeness
Radionuclide	Water	Holding Times	Holding times were grossly exceeded	Yes	13	5,771	0.23	Representativeness
Radionuclide	Water	Instrument Set-up	Resolution criteria were not met	No	5	5,771	0.09	Representativeness
Radionuclide	Water	Instrument Set-up	Resolution criteria were not met	Yes	19	5,771	0.33	Representativeness
Radionuclide	Water	Instrument Set-up	Transformed spectral index external site criteria were not met	No	5	5,771	0.09	Representativeness
Radionuclide	Water	LCS	Expected LCS value not submitted/verifiable	No	21	5,771	0.36	Representativeness
Radionuclide	Water	LCS	Expected LCS value not submitted/verifiable	Yes	66	5,771	1.14	Representativeness
Radionuclide	Water	LCS	LCS recovery > +/- 3 sigma	No	108	5,771	1.87	Accuracy
Radionuclide	Water	LCS	LCS recovery > +/- 3 sigma	Yes	141	5,771	2.44	Accuracy
Radionuclide	Water	LCS	LCS recovery criteria were not met	No	11	5,771	0.19	Accuracy
Radionuclide	Water	LCS	LCS recovery criteria were not met	Yes	28	5,771	0.49	Accuracy
Radionuclide	Water	LCS	LCS relative percent error criteria not met	No	46	5,771	0.80	Accuracy
Radionuclide	Water	LCS	LCS relative percent error criteria not met	Yes	222	5,771	3.85	Accuracy
Radionuclide	Water	Matrices	Duplicate sample precision criteria were not met	No	1	5,771	0.02	Precision
Radionuclide	Water	Matrices	Duplicate sample precision criteria were not met	Yes	1	5,771	0.02	Precision
Radionuclide	Water	Matrices	Laboratory duplicate was not analyzed	Yes	1	5,771	0.02	Precision
Radionuclide	Water	Matrices	Recovery criteria were not met	No	11	5,771	0.19	Accuracy
Radionuclide	Water	Matrices	Recovery criteria were not met	Yes	31	5,771	0.54	Accuracy
Radionuclide	Water	Matrices	Replicate analysis was not performed	No	22	5,771	0.38	Precision
Radionuclide	Water	Matrices	Replicate analysis was not performed	Yes	68	5,771	1.18	Precision
Radionuclide	Water	Matrices	Replicate precision criteria were not met	No	59	5,771	1.02	Precision
Radionuclide	Water	Matrices	Replicate precision criteria were not met	Yes	243	5,771	4.21	Precision
Radionuclide	Water	Matrices	Replicate recovery criteria were not met	No	2	5,771	0.03	Accuracy
Radionuclide	Water	Matrices	Replicate recovery criteria were not met	Yes	6	5,771	0.10	Accuracy

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Radionuclide	Water	Other	Lab results not verified due to unsubmitted data	No	1	5,771	0.02	Representativeness
Radionuclide	Water	Other	Lab results not verified due to unsubmitted data	Yes	16	5,771	0.28	Representativeness
Radionuclide	Water	Other	QC sample does not meet method requirements	No	13	5,771	0.23	Representativeness
Radionuclide	Water	Other	QC sample does not meet method requirements	Yes	23	5,771	0.40	Representativeness
Radionuclide	Water	Other	Sample exceeded efficiency curve weight limit	Yes	4	5,771	0.07	Accuracy
Radionuclide	Water	Other	See hard copy for further explanation	No	83	5,771	1.44	N/A
Radionuclide	Water	Other	See hard copy for further explanation	Yes	279	5,771	4.83	N/A
Radionuclide	Water	Other	Tracer requirements were not met	No	13	5,771	0.23	Accuracy
Radionuclide	Water	Other	Tracer requirements were not met	Yes	75	5,771	1.30	Accuracy
Radionuclide	Water	Other	Unit conversion of results	Yes	2	5,771	0.03	N/A
Radionuclide	Water	Sample Preparation	Improper aliquot size	Yes	1	5,771	0.02	Accuracy
Radionuclide	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	6	5,771	0.10	Representativeness
Radionuclide	Water	Sensitivity	Incorrect reported activity or MDA	No	3	5,771	0.05	N/A
Radionuclide	Water	Sensitivity	Incorrect reported activity or MDA	Yes	18	5,771	0.31	N/A
Radionuclide	Water	Sensitivity	MDA exceeded the RDL	No	17	5,771	0.29	Representativeness
Radionuclide	Water	Sensitivity	MDA exceeded the RDL	Yes	151	5,771	2.62	Representativeness
Radionuclide	Water	Sensitivity	MDA was calculated by reviewer	No	14	5,771	0.24	N/A
Radionuclide	Water	Sensitivity	MDA was calculated by reviewer	Yes	1,100	5,771	19.06	N/A
SVOC	Soil	Blanks	Method, preparation, or reagent blank contamination	No	54	12,363	0.44	Representativeness
SVOC	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	3	12,363	0.02	Representativeness
SVOC	Soil	Calculation Errors	Calculation error	Yes	3	12,363	0.02	N/A
SVOC	Soil	Calibration	Continuing calibration verification criteria were not met	No	21	12,363	0.17	Accuracy
SVOC	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	49	12,363	0.40	Accuracy
SVOC	Soil	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	2	12,363	0.02	Accuracy
SVOC	Soil	Documentation Issues	Record added by the validator	No	231	12,363	1.87	N/A
SVOC	Soil	Documentation Issues	Record added by the validator	Yes	1	12,363	0.01	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
SVOC	Soil	Documentation Issues	Transcription error	No	222	12,363	1.80	N/A
SVOC	Soil	Documentation Issues	Transcription error	Yes	69	12,363	0.56	N/A
SVOC	Soil	Holding Times	Holding times were exceeded	No	345	12,363	2.79	Representativeness
SVOC	Soil	Holding Times	Holding times were exceeded	Yes	7	12,363	0.06	Representativeness
SVOC	Soil	Internal Standards	Internal standards did not meet criteria	No	110	12,363	0.89	Accuracy
SVOC	Soil	Internal Standards	Internal standards did not meet criteria	Yes	17	12,363	0.14	Accuracy
SVOC	Soil	Matrices	Percent solids < 30 percent	Yes	9	12,363	0.07	Representativeness
SVOC	Soil	Other	Sample results were not validated due to re-analysis	No	39	12,363	0.32	N/A
SVOC	Soil	Other	Sample results were not validated due to re-analysis	Yes	40	12,363	0.32	N/A
SVOC	Soil	Other	See hard copy for further explanation	No	58	12,363	0.47	N/A
SVOC	Soil	Other	See hard copy for further explanation	Yes	18	12,363	0.15	N/A
SVOC	Soil	Surrogates	Surrogate recovery criteria were not met	No	123	12,363	0.99	Accuracy
SVOC	Soil	Surrogates	Surrogate recovery criteria were not met	Yes	16	12,363	0.13	Accuracy
SVOC	Water	Blanks	Method, preparation, or reagent blank contamination	No	42	9,356	0.45	Representativeness
SVOC	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	4	9,356	0.04	Representativeness
SVOC	Water	Calibration	Continuing calibration verification criteria were not met	No	141	9,356	1.51	Accuracy
SVOC	Water	Calibration	Continuing calibration verification criteria were not met	Yes	3	9,356	0.03	Accuracy
SVOC	Water	Calibration	Independent calibration verification criteria not met	No	11	9,356	0.12	Accuracy
SVOC	Water	Documentation Issues	Information missing from case narrative	No	12	9,356	0.13	N/A
SVOC	Water	Documentation Issues	Missing deliverables (not required for validation)	No	42	9,356	0.45	N/A
SVOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	165	9,356	1.76	N/A
SVOC	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	6	9,356	0.06	Representativeness
SVOC	Water	Documentation Issues	Original documentation not provided	No	3	9,356	0.03	N/A
SVOC	Water	Documentation Issues	Transcription error	No	36	9,356	0.38	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
SVOC	Water	Documentation Issues	Transcription error	Yes	2	9,356	0.02	N/A
SVOC	Water	Holding Times	Holding times were exceeded	No	240	9,356	2.57	Representativeness
SVOC	Water	Holding Times	Holding times were exceeded	Yes	6	9,356	0.06	Representativeness
SVOC	Water	Instrument Set-up	Instrument tune criteria were not met	No	101	9,356	1.08	Accuracy
SVOC	Water	Instrument Set-up	Instrument tune criteria were not met	Yes	1	9,356	0.01	Accuracy
SVOC	Water	LCS	LCS recovery criteria were not met	No	48	9,356	0.51	Accuracy
SVOC	Water	LCS	LCS recovery criteria were not met	Yes	2	9,356	0.02	Accuracy
SVOC	Water	Matrices	MS/MSD precision criteria were not met	No	3	9,356	0.03	Precision
SVOC	Water	Matrices	MS/MSD precision criteria were not met	Yes	1	9,356	0.01	Precision
SVOC	Water	Other	Sample results were not validated due to re-analysis	No	105	9,356	1.12	N/A
SVOC	Water	Other	Sample results were not validated due to re-analysis	Yes	7	9,356	0.07	N/A
SVOC	Water	Other	See hard copy for further explanation	No	110	9,356	1.18	N/A
SVOC	Water	Other	See hard copy for further explanation	Yes	2	9,356	0.02	N/A
SVOC	Water	Sample Preparation	Preservation requirements were not met by the laboratory	No	3	9,356	0.03	Representativeness
SVOC	Water	Sample Preparation	Samples were not properly preserved in the field	No	50	9,356	0.53	Representativeness
SVOC	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	1	9,356	0.01	Representativeness
SVOC	Water	Surrogates	Surrogate recovery criteria were not met	No	48	9,356	0.51	Accuracy
SVOC	Water	Surrogates	Surrogate recovery criteria were not met	Yes	2	9,356	0.02	Accuracy
VOC	Soil	Blanks	Method, preparation, or reagent blank contamination	No	226	8,550	2.64	Representativeness
VOC	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	20	8,550	0.23	Representativeness
VOC	Soil	Calculation Errors	Calculation error	No	34	8,550	0.40	N/A
VOC	Soil	Calibration	Continuing calibration verification criteria were not met	No	45	8,550	0.53	Accuracy
VOC	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	22	8,550	0.26	Accuracy
VOC	Soil	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	1	8,550	0.01	Accuracy
VOC	Soil	Confirmation	Results were not confirmed	No	1	8,550	0.01	Precision
VOC	Soil	Documentation Issues	Record added by the validator	No	178	8,550	2.08	N/A
VOC	Soil	Documentation Issues	Record added by the validator	Yes	8	8,550	0.09	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
VOC	Soil	Documentation Issues	Transcription error	No	271	8,550	3.17	N/A
VOC	Soil	Documentation Issues	Transcription error	Yes	12	8,550	0.14	N/A
VOC	Soil	Holding Times	Holding times were exceeded	No	118	8,550	1.38	Representativeness
VOC	Soil	Holding Times	Holding times were exceeded	Yes	4	8,550	0.05	Representativeness
VOC	Soil	Internal Standards	Internal standards did not meet criteria	No	84	8,550	0.98	Accuracy
VOC	Soil	Internal Standards	Internal standards did not meet criteria	Yes	4	8,550	0.05	Accuracy
VOC	Soil	Matrices	Percent solids < 30 percent	Yes	8	8,550	0.09	Representativeness
VOC	Soil	Other	Lab results not verified due to unsubmitted data	No	1	8,550	0.01	Representativeness
VOC	Soil	Other	Sample results were not validated due to re-analysis	No	280	8,550	3.27	N/A
VOC	Soil	Other	Sample results were not validated due to re-analysis	Yes	26	8,550	0.30	N/A
VOC	Soil	Other	See hard copy for further explanation	No	4	8,550	0.05	N/A
VOC	Soil	Other	See hard copy for further explanation	Yes	2	8,550	0.02	N/A
VOC	Soil	Surrogates	Surrogate recovery criteria were not met	No	104	8,550	1.22	Accuracy
VOC	Soil	Surrogates	Surrogate recovery criteria were not met	Yes	7	8,550	0.08	Accuracy
VOC	Water	Blanks	Method, preparation, or reagent blank contamination	No	163	41,067	0.40	Representativeness
VOC	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	62	41,067	0.15	Representativeness
VOC	Water	Calibration	Continuing calibration verification criteria were not met	No	853	41,067	2.08	Accuracy
VOC	Water	Calibration	Continuing calibration verification criteria were not met	Yes	39	41,067	0.09	Accuracy
VOC	Water	Calibration	Independent calibration verification criteria not met	No	40	41,067	0.10	Accuracy
VOC	Water	Calibration	Independent calibration verification criteria not met	Yes	17	41,067	0.04	Accuracy
VOC	Water	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	2	41,067	0.00	Accuracy
VOC	Water	Confirmation	Results were not confirmed	No	7	41,067	0.02	Precision
VOC	Water	Documentation Issues	Information missing from case narrative	No	223	41,067	0.54	N/A
VOC	Water	Documentation Issues	Missing deliverables (not required for validation)	No	754	41,067	1.84	N/A
VOC	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	12	41,067	0.03	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
VOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	2,893	41,067	7.04	N/A
VOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	64	41,067	0.16	N/A
VOC	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	109	41,067	0.27	Representativeness
VOC	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	1	41,067	0.00	Representativeness
VOC	Water	Documentation Issues	Original documentation not provided	No	54	41,067	0.13	N/A
VOC	Water	Documentation Issues	Record added by the validator	No	79	41,067	0.19	N/A
VOC	Water	Documentation Issues	Transcription error	No	1,211	41,067	2.95	N/A
VOC	Water	Documentation Issues	Transcription error	Yes	50	41,067	0.12	N/A
VOC	Water	Holding Times	Holding times were exceeded	No	2,492	41,067	6.07	Representativeness
VOC	Water	Holding Times	Holding times were exceeded	Yes	13	41,067	0.03	Representativeness
VOC	Water	Holding Times	Holding times were grossly exceeded	Yes	1	41,067	0.00	Representativeness
VOC	Water	Instrument Set-up	Instrument tune criteria were not met	No	1,818	41,067	4.43	Accuracy
VOC	Water	Instrument Set-up	Instrument tune criteria were not met	Yes	45	41,067	0.11	Accuracy
VOC	Water	Internal Standards	Internal standards did not meet criteria	No	97	41,067	0.24	Accuracy
VOC	Water	Internal Standards	Internal standards did not meet criteria	Yes	2	41,067	0.00	Accuracy
VOC	Water	LCS	LCS recovery criteria were not met	No	566	41,067	1.38	Accuracy
VOC	Water	LCS	LCS recovery criteria were not met	Yes	34	41,067	0.08	Accuracy
VOC	Water	Matrices	MS/MSD precision criteria were not met	No	81	41,067	0.20	Precision
VOC	Water	Matrices	MS/MSD precision criteria were not met	Yes	11	41,067	0.03	Precision
VOC	Water	Other	Sample results were not validated due to re-analysis	No	8	41,067	0.02	N/A
VOC	Water	Other	Sample results were not validated due to re-analysis	Yes	2	41,067	0.00	N/A
VOC	Water	Other	See hard copy for further explanation	No	70	41,067	0.17	N/A
VOC	Water	Other	See hard copy for further explanation	Yes	12	41,067	0.03	N/A
VOC	Water	Sample Preparation	Preservation requirements were not met by the laboratory	No	49	41,067	0.12	Representativeness
VOC	Water	Sample Preparation	Samples were not properly preserved in the field	No	902	41,067	2.20	Representativeness
VOC	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	33	41,067	0.08	Representativeness

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
VOC	Water	Sensitivity	Instrument detection limit > the associated RDL	No	8	41,067	0.02	Representativeness
VOC	Water	Surrogates	Surrogate recovery criteria were not met	No	172	41,067	0.42	Accuracy
VOC	Water	Surrogates	Surrogate recovery criteria were not met	Yes	3	41,067	0.01	Accuracy
Wet Chem	Soil	Blanks	Method, preparation, or reagent blank contamination	No	1	94	1.06	Representativeness
Wet Chem	Soil	Documentation Issues	Record added by the validator	No	1	94	1.06	N/A
Wet Chem	Soil	Documentation Issues	Record added by the validator	Yes	1	94	1.06	N/A
Wet Chem	Soil	Holding Times	Holding times were exceeded	No	2	94	2.13	Representativeness
Wet Chem	Soil	Holding Times	Holding times were exceeded	Yes	1	94	1.06	Representativeness
Wet Chem	Soil	Holding Times	Holding times were grossly exceeded	No	1	94	1.06	Representativeness
Wet Chem	Soil	Matrices	Duplicate sample precision criteria were not met	Yes	2	94	2.13	Precision
Wet Chem	Soil	Matrices	Percent solids < 30 percent	Yes	5	94	5.32	Representativeness
Wet Chem	Soil	Matrices	Predigestion MS recovery criteria were not met	No	4	94	4.26	Accuracy
Wet Chem	Soil	Matrices	Predigestion MS recovery criteria were not met	Yes	12	94	12.77	Accuracy
Wet Chem	Soil	Matrices	Predigestion MS recovery was < 30 percent	Yes	24	94	25.53	Accuracy
Wet Chem	Soil	Other	IDL is older than 3 months from date of analysis	Yes	21	94	22.34	Accuracy
Wet Chem	Water	Blanks	Method, preparation, or reagent blank contamination	No	23	3,365	0.68	Representativeness
Wet Chem	Water	Blanks	Negative bias indicated in the blanks	No	13	3,365	0.39	Representativeness
Wet Chem	Water	Blanks	Negative bias indicated in the blanks	Yes	1	3,365	0.03	Representativeness
Wet Chem	Water	Calculation Errors	Control limits not assigned correctly	Yes	1	3,365	0.03	N/A
Wet Chem	Water	Calibration	Calibration correlation coefficient did not meet requirements	No	1	3,365	0.03	Accuracy
Wet Chem	Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	6	3,365	0.18	Accuracy
Wet Chem	Water	Calibration	Continuing calibration verification criteria were not met	Yes	11	3,365	0.33	Accuracy
Wet Chem	Water	Calibration	Result exceeded linear range of measurement system	Yes	1	3,365	0.03	Accuracy
Wet Chem	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	4	3,365	0.12	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Wet Chem	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	1	3,365	0.03	Representativeness
Wet Chem	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	3	3,365	0.09	N/A
Wet Chem	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	43	3,365	1.28	N/A
Wet Chem	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	1	3,365	0.03	Representativeness
Wet Chem	Water	Documentation Issues	Record added by the validator	No	39	3,365	1.16	N/A
Wet Chem	Water	Documentation Issues	Record added by the validator	Yes	35	3,365	1.04	N/A
Wet Chem	Water	Documentation Issues	Transcription error	No	52	3,365	1.55	N/A
Wet Chem	Water	Documentation Issues	Transcription error	Yes	152	3,365	4.52	N/A
Wet Chem	Water	Holding Times	Holding times were exceeded	No	15	3,365	0.45	Representativeness
Wet Chem	Water	Holding Times	Holding times were exceeded	Yes	39	3,365	1.16	Representativeness
Wet Chem	Water	Holding Times	Holding times were grossly exceeded	No	24	3,365	0.71	Representativeness
Wet Chem	Water	Holding Times	Holding times were grossly exceeded	Yes	19	3,365	0.56	Representativeness
Wet Chem	Water	LCS	LCS recovery criteria were not met	No	3	3,365	0.09	Accuracy
Wet Chem	Water	Matrices	Duplicate sample precision criteria were not met	Yes	2	3,365	0.06	Precision
Wet Chem	Water	Matrices	LCS/LCSD precision criteria were not met	Yes	1	3,365	0.03	Precision
Wet Chem	Water	Matrices	Predigestion MS recovery criteria were not met	No	31	3,365	0.92	Accuracy
Wet Chem	Water	Matrices	Predigestion MS recovery criteria were not met	Yes	76	3,365	2.26	Accuracy
Wet Chem	Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	3	3,365	0.09	Accuracy
Wet Chem	Water	Matrices	Site samples were not used for sample matrix QC	Yes	3	3,365	0.09	Representativeness
Wet Chem	Water	Other	Lab results not verified due to unsubmitted data	No	1	3,365	0.03	Representativeness
Wet Chem	Water	Other	Lab results not verified due to unsubmitted data	Yes	33	3,365	0.98	Representativeness
Wet Chem	Water	Other	Result obtained through dilution	Yes	8	3,365	0.24	N/A
Wet Chem	Water	Other	See hard copy for further explanation	No	1	3,365	0.03	N/A
Wet Chem	Water	Other	See hard copy for further explanation	Yes	7	3,365	0.21	N/A

Table A2.2
Summary of V&V Observations

Analyte Group	Matrix	QC Category	V&V Observation	Detect	No. of Records w/ Noted Observation	Total No. of V&V Records	Percent Observed (%)	PARCC Parameter Affected
Wet Chem	Water	Sample Preparation	Preservation requirements were not met by the laboratory	Yes	13	3,365	0.39	Representativeness
Wet Chem	Water	Sample Preparation	Sample pretreatment or preparation method was incorrect	Yes	1	3,365	0.03	Representativeness
Wet Chem	Water	Sample Preparation	Samples were not properly preserved in the field	No	1	3,365	0.03	Representativeness
Wet Chem	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	13	3,365	0.39	Representativeness

Table A2.3
Summary of Data Estimated or Undetected Due to V&V Determinations

Analyte Group	Matrix	No. of CRA Data Records Qualified	Total No. of V&V CRA Records	Detect	Percent Qualified (%)
Dioxins and Furans	Soil	34	187	Yes	18.18
Herbicide	Soil	12	173	No	6.94
Herbicide	Water	6	136	No	4.41
Metal	Soil	1,654	11,455	No	14.44
Metal	Soil	2,641	11,455	Yes	23.06
Metal	Water	4,219	31,000	No	13.61
Metal	Water	2,532	31,000	Yes	8.17
PCB	Soil	49	1,467	No	3.34
PCB	Water	63	728	No	8.65
Pesticide	Soil	165	4,340	No	3.80
Pesticide	Soil	3	4,340	Yes	0.07
Pesticide	Water	197	2,218	No	8.88
Radionuclide	Soil	1	2,842	No	0.04
Radionuclide	Soil	16	2,842	Yes	0.56
Radionuclide	Water	31	5,771	No	0.54
Radionuclide	Water	76	5,771	Yes	1.32
SVOC	Soil	707	12,363	No	5.72
SVOC	Soil	27	12,363	Yes	0.22
SVOC	Water	572	9,356	No	6.11
SVOC	Water	7	9,356	Yes	0.07
VOC	Soil	535	8,550	No	6.26
VOC	Soil	40	8,550	Yes	0.47
VOC	Water	4,064	41,067	No	9.90
VOC	Water	120	41,067	Yes	0.29
Wet Chem	Soil	8	94	No	8.51
Wet Chem	Soil	44	94	Yes	46.81
Wet Chem	Water	105	3,365	No	3.12
Wet Chem	Water	185	3,365	Yes	5.50
	Total	**18,113**	**135,126**		**13.40%**

Table A2.4
Summary of Data Qualified as Undetected Due to Blank Contamination

Analyte Group	Matrix	No. of CRA Records Qualified as Undetected Due to Blank Contaimination	Total No. of CRA Records with Detected Results[a]	Percent Qualified as Undetected
Metal	Soil	26	8,329	0.31
Metal	Water	651	15,488	4.20
VOC	Soil	1	219	0.46
VOC	Water	9	699	1.29
Wet Chem	Water	2	2,392	0.08
	Total	**689**	**27,127**	**2.54%**

[a] As determined by the laboratory prior to V&V.

Table A2.5
Summary of RPDs/DERs of Field Duplicate Analyte Pairs

Analyte Group	Matrix	No. of Duplicates Failing RPD/DER Criteria	Total No. of Duplicate Pairs	Percent Failure (%)	Field Duplicate Frequency (%)
Dioxins and Furans	Soil	7	34	20.59	18.18
Herbicide	Soil	0	26	0.00	14.94
Herbicide	Water	0	12	0.00	6.38
Metal	Soil	72	1,245	5.78	10.82
Metal	Water	74	2,389	3.10	6.71
PCB	Soil	1	202	0.50	13.51
PCB	Water	0	56	0.00	6.84
Pesticide	Soil	0	610	0.00	13.76
Pesticide	Water	0	177	0.00	6.96
Radionuclide	Soil	12	368	3.26	11.66
Radionuclide	Water	3	523	0.57	7.04
SVOC	Soil	1	1,771	0.06	14.20
SVOC	Water	0	784	0.00	6.23
VOC	Soil	0	403	0.00	4.46
VOC	Water	1	1,921	0.05	4.06
Wet Chem	Soil	0	22	0.00	20.75
Wet Chem	Water	7	264	2.65	6.67

Table A2.6
Summary of Data Rejected During V&V

Analyte Group	Matrix	Total No. of Rejected Records	Total No. of V&V Records	Percent Rejected (%)
Dioxins and Furans	Soil	0	205	0.00
Dioxins and Furans	Water	0	14	0.00
Herbicide	Soil	20	299	6.69
Herbicide	Water	12	250	4.80
Metal	Soil	425	18,555	2.29
Metal	Water	1,715	52,456	3.27
PCB	Soil	48	2,238	2.14
PCB	Water	14	1,505	0.93
Pesticide	Soil	167	6,689	2.50
Pesticide	Water	48	4,538	1.06
Radionuclide	Soil	438	5,833	7.51
Radionuclide	Water	1,270	10,841	11.71
SVOC	Soil	762	19,356	3.94
SVOC	Water	264	15,914	1.66
VOC	Soil	704	18,574	3.79
VOC	Water	1,802	60,052	3.00
Wet Chem	Soil	11	349	3.15
Wet Chem	Water	111	5,761	1.93
	Total	**7,811**	**223,429**	**3.50%**

Table A2.7
Summary of Data Quality Issues Identified by V&V

Analyte Group	Matrix	Categories Description	V&V Observation	Detect	Percent Observed	Percent Qualified U[a]	Percent Qualified J[b]	PARCC Parameter Affected	Impacts Risk Assessment Decisions
Dioxins and Furans	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	17.11	0.00	17.11	Representativeness	No
Metal	Soil	LCS	LCS recovery criteria were not met	Yes	6.87	0.00	6.87	Accuracy	No
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	Yes	5.82	0.00	5.82	Accuracy	No
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	14.64	0.00	0.00	Representativeness	No
Radionuclide	Soil	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	13.62	0.00	0.14	Representativeness	No
Radionuclide	Soil	LCS	LCS recovery > +/- 3 sigma	Yes	10.77	0.00	0.00	Accuracy	No
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	Yes	6.97	0.00	0.00	Accuracy	No
Radionuclide	Soil	Matrices	Replicate precision criteria were not met	Yes	10.70	0.00	0.00	Precision	No
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	6.67	0.00	0.35	Representativeness	No
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	Yes	7.36	0.00	0.42	Accuracy	No
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	9.27	0.00	0.05	Representativeness	No
VOC	Water	Holding Times	Holding times were exceeded	No	6.07	4.74	1.33	Representativeness	No
Wet Chem	Soil	Matrices	Predigestion MS recovery criteria were not met	Yes	12.77	0.00	12.77	Accuracy	No
Wet Chem	Soil	Matrices	Predigestion MS recovery was < 30 percent	Yes	25.53	0.00	25.53	Accuracy	No
Wet Chem	Soil	Other	IDL is older than 3 months from date of analysis	Yes	22.34	0.00	22.34	Accuracy	No

[a]Defined as validation qualifier codes containing "U"

[b]Defined as validation qualifier codes containing "J", except "UJ"

<u>COMPREHENSIVE RISK ASSESSMENT</u>

UPPER WOMAN DRAINAGE EXPOSURE UNIT

VOLUME 10: ATTACHMENT 3

Statistical Analyses and Professional Judgment

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ACRONYMS AND ABBREVIATIONS

µg/kg	Micrograms per kilogram
AL	action level
CDH	Colorado Department of Health
CDPHE	Colorado Department of Public Health and Environment
CMS	Corrective Measures Study
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EcoSSL	Ecological Soil Screening Level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
GIS	Geographical Information System
HEPA	High-Efficiency Particulate Air
HHRA	Human Health Risk Assessment
HRR	Historical Release Report
IHSS	Individual Hazardous Substance Site
MDC	maximum detected concentration
mg/kg	milligrams per kilogram

NCP	National Contingency Plan
NFA	No Further Action
NOAEL	no observed adverse effect level
OU	Operable Unit
PAC	Potential Area of Concern
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
PCOC	potential contaminant of concern
PDSR	Pre-Demolition Survey Report
PMJM	Preble's meadow jumping mouse
PRG	preliminary remediation goal
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
RLCR	Reconnaissance-Level Characterization Reports
tESL	threshold ESL
UBC	Under Building Contamination
UCL	upper confidence limit
UTL	upper tolerance limit
UWOEU	Upper Woman Drainage Exposure Unit
WRS	Wilcoxon Rank Sum
WRW	wildlife refuge worker

1.0 INTRODUCTION

This attachment presents the results for the statistical analyses and professional judgment evaluation used to select human health contaminants of concern (COCs) as part of the Human Health Risk Assessment (HHRA) and ecological contaminants of potential concern (ECOPCs) as part of the Ecological Risk Assessment (ERA) for the Upper Woman Drainage Exposure Unit (EU) (UWOEU) at the Rocky Flats Environmental Technology Site (RFETS). The methods used to perform the statistical analysis and to develop the professional judgment sections are described in Appendix A, Volume 2, Section 2.0 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation/Corrective Measures Study (CMS)-Feasibility Study (RI/FS) Report (hereafter referred to as the RI/FS Report).

2.0 RESULTS OF STATISTICAL COMPARISONS TO BACKGROUND FOR THE UPPER WOMAN DRAINAGE EXPOSURE UNIT

The results of the statistical background comparisons for inorganic and radionuclide potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) in surface soil/surface sediment, subsurface soil/subsurface sediment, surface soil, and subsurface soil samples collected from the UWOEU are presented in this section. Box plots are provided for analytes that were carried forward into the statistical comparison step and are presented in Figures A3.2.1 to A3.2.40.[1] The box plots display several reference points: 1) the line inside the box is the median; 2) the lower edge of the box is the 25th percentile; 3) the upper edge of the box is the 75th percentile; 4) the upper lines (called whiskers) are drawn to the greatest value that is less than or equal to 1.5 times the inter-quartile range (the interquartile range is between the 75th and 25th percentiles); 5) the lower whiskers are drawn to the lowest value that is greater than or equal to 1.5 times the inter-quartile range; and 6) solid circles are data points greater or less than the whiskers.

ECOIs for surface soil (Preble's meadow jumping mouse [PMJM] receptor) and PCOCs with concentrations in the UWOEU that are statistically greater than background (or those where background comparisons were not performed) are carried through to the professional judgment step of the COC/ECOPC selection processes. ECOIs (for non-PMJM receptors) with concentrations in the UWOEU that are statistically greater than

[1] Statistical background comparisons are not performed for analytes if: (1) the background concentrations are non-detections; 2) background data are unavailable; 3) the analyte has low detection frequency in the UWOEU or background data set (less than 20 percent); or 4) the analyte is an organic compound. Box plots are not provided for these analytes. However, these analytes are carried forward into the professional judgment evaluation.

background (or those where background comparisons were not performed) are carried through to the exposure point concentration (EPC) – minimum ecological screening level (ESL) comparison step of the ECOPC selection processes.

PCOCs and ECOIs with concentrations that are not statistically greater than background are not identified as COCs/ECOPCs and are not evaluated further.

2.1 Surface Soil/Surface Sediment Data Used in the HHRA

For the UWOEU surface soil/surface sediment data set, the maximum detected concentrations (MDCs) and upper confidence limits on the mean (UCLs) for arsenic, benzo(a)pyrene, dibenz(a,h)anthracene, 2,3,7,8-TCDD (TEQ), cesium-134, cesium-137, and radium-228 exceed the wildlife refuge worker (WRW) preliminary remediation goals (PRGs) for the UWOEU data set, and these PCOCs were carried forward into the statistical background comparison step. The results of the statistical comparison of the UWOEU surface soil/surface sediment data to background data for these PCOCs are presented in Table A3.2.1 and the summary statistics for background and UWOEU surface soil/surface sediment data are shown in Table A3.2.2. The UWOEU MDCs for all other PCOCs do not exceed the PRGs or the UCL for the UWOEU data set does not exceed the PRGs, and were not evaluated further.

The results of the statistical comparisons of the UWOEU surface soil/surface sediment data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Arsenic

Not Statistically Greater than Background at the 0.1 Significance Level

- Cesium-134
- Cesium-137
- Radium-228

Background Comparison Not Performed[1]

- Benzo(a)pyrene
- Dibenz(a,h)anthracene (Eliminated based on low frequency of detection [less than 5 percent])
- 2,3,7,8-TCDD (TEQ)

2.2 Subsurface Soil/Subsurface Sediment Data Used in the HHRA

For the UWOEU subsurface soil/subsurface sediment data set, the MDCs and UCLs for radium-228 exceed the wildlife refuge worker (WRW) PRGs for the UWOEU data set, and this PCOC was carried forward into the statistical background comparison step. The results of the statistical comparison of the UWOEU subsurface soil/subsurface sediment data to background data for this PCOC is presented in Table A3.2.3 and the summary statistics for background and UWOEU subsurface soil/subsurface sediment data are shown in Table A3.2.4. The UWOEU MDCs for all other PCOCs do not exceed the PRGs or the UCL for the UWOEU data set does not exceed the PRGs, and were not evaluated further.

The results of the statistical comparisons of the UWOEU subsurface soil/subsurface sediment data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- None

Not Statistically Greater than Background at the 0.1 Significance Level

- Radium-228

Background Comparison Not Performed[1]

- None.

2.3 Surface Soil Data Used in the ERA (Non-PMJM Receptors)

For the ECOIs in surface soil, the MDCs for aluminum, antimony, arsenic, barium, boron, cadmium, chromium, cobalt, copper, lead, lithium, manganese, mercury, molybdenum, nickel, selenium, silver, tin, uranium, vanadium, and zinc exceed a non-PMJM ESL, and these ECOIs were carried forward into the statistical background comparison step. The MDCs for 2-methylnaphthalene, 4,4'-DDT, acenaphthene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, dieldrin, 2,3,7,8-TCDD (TEQ) (mammal), 2,3,7,8-TCDD (TEQ) (bird), endrin ketone, fluorene, naphthalene, and total PCBs also exceed a non-PMJM ESL. The results of the statistical comparison of the UWOEU surface soil data to background data are presented in Table A3.2.5 and the summary statistics for background and UWOEU surface soil data are shown in Table A3.2.6.

The results of the statistical comparisons of the UWOEU surface soil to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Barium

- Copper
- Nickel
- Vanadium

Not Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Arsenic
- Cadmium
- Chromium
- Cobalt
- Lead
- Lithium
- Manganese
- Mercury
- Selenium
- Zinc

Background Comparison not Performed[1]

- Antimony
- Boron
- Molybdenum
- Silver
- Tin
- Uranium
- 2-Methylnaphthalene
- 4,4'-DDT
- Acenaphthene

- Benzo(a)pyrene
- Bis(2 ethylhexyl)phthalate
- Di-n-butylphthalate
- Dieldrin
- 2,3,7,8-TCDD (TEQ) (mammal)
- 2,3,7,8-TCDD (TEQ) (bird)
- Endrin ketone
- Fluorene
- Naphthalene
- Total PCBs

2.4 Surface Soil Data Used in the ERA (PMJM Receptors)

For the ECOIs in surface soil in PMJM habitat, the MDCs for antimony, arsenic, cadmium, chromium, copper, manganese, mercury, molybdenum, nickel, selenium, tin, vanadium, and zinc exceed the PMJM ESLs, and were carried forward into the background comparison step. The MDC for total PCBs also exceed a non-PMJM ESL. The results of the statistical comparison of the UWOEU surface soil data to background data are presented in Table A3.2.7 and the summary statistics for background and UWOEU surface soil data are shown in Table A3.2.8.

The results of the statistical comparisons of the UWOEU surface soil in PMJM habitat to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Chromium
- Copper
- Manganese
- Nickel
- Vanadium
- Zinc

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Cadmium
- Mercury
- Selenium

Background Comparison not Performed[1]

- Antimony
- Molybdenum
- Tin
- Total PCBs

2.5 Subsurface Soil Data Used in the ERA

For the ECOIs in subsurface soil, the MDCs for antimony, arsenic, beryllium, chromium, copper, lead, manganese, molybdenum, nickel, selenium, tin, and zinc exceed the prairie dog ESL and were carried forward into the statistical background comparison step. The MDCs for all other ECOIs do not exceed the prairie dog ESL. The results of the statistical comparison of the UWOEU subsurface soil data to background data are presented in Table A3.9 and the summary statistics for background and UWOEU subsurface soil data are shown in Table A3.10.

The results of the statistical comparisons of the surface soil data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Copper
- Manganese
- Zinc

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Beryllium
- Chromium

- Lead
- Molybdenum
- Nickel

***Background Comparison not Performed*[1]**

- Antimony
- Selenium
- Tin

3.0 UPPER-BOUND EXPOSURE POINT CONCENTRATION COMPARISON TO LIMITING ECOLOGICAL SCREENING LEVELS

ECOIs in surface soil and subsurface soil with concentrations that are statistically greater than background, or background comparisons were not performed, are evaluated further by comparing the UWOEU EPCs to the limiting threshold (tESLs). The EPCs are the 95 percent UCLs of the 90th percentile [upper tolerance limit (UTL)] for small home-range receptors, the UCL for large home-range receptors, or the MDC in the event that the UCL or UTL is greater than the MDC.

3.1 ECOIs in Surface Soil

Barium, 2-methylnaphthalene, acenaphthene, benzo(a)pyrene, fluorene, and naphthalene in surface soil (non-PMJM) were eliminated from further consideration because the EPCs are not greater than the limiting tESLs (see Table 7.7). Antimony, boron, copper, molybdenum, nickel, silver, tin, uranium, and vanadium along with five organics (bis(2-ethylhexyl)phthalate, di-n-butylphthalate, 2,3,7,8-TCDD (TEQ) (mammal), 2,3,7,8-TCDD (TEQ) (bird), and total PCBs) have EPCs greater than the limiting tESLs and are evaluated in the professional judgment evaluation screening step (Section 4.0).

3.2 ECOIs in Subsurface Soil

Antimony, copper, manganese, selenium, tin, and zinc in subsurface soil were eliminated from further consideration because the EPCs are not greater than the tESLs (see Table 7.15). No ECOIs have an EPC greater than the limiting tESL and, therefore, no analytes are evaluated in the professional judgment evaluation screening step (Section 4.0).

4.0 PROFESSIONAL JUDGMENT

This section presents the results of the professional judgment step of the COC and ECOPC selection processes for the HHRA and ERA, respectively. Based on the weight of evidence evaluated in the professional judgment step, PCOCs and ECOIs are either included for further evaluation as COCs/ECOPCs in the risk characterization step, or excluded from further evaluation.

The professional judgment evaluation takes into account the following lines of evidence: process knowledge, spatial trends, pattern recognition[2], comparison to RFETS background and regional background data sets (see Table A3.11 for a summary of regional background data)[3], and risk potential. For PCOCs or ECOIs where the process knowledge and/or spatial trends indicate that the presence of the analyte in the EU may be a result of historical site-related activities, the professional judgment discussion includes only two of the lines of evidence listed above, and it is concluded that these analytes are COCs/ECOPCs and are carried forward into risk characterization. For the other PCOCs and ECOIs that are evaluated in the professional judgment step, each of the lines of evidence listed above are included in the discussion.

For metals, Appendix A, Volume 2, Attachment 8 of the RI/FS Report provides the details of the process knowledge and spatial trend evaluations. The conclusions from these evaluations are noted in this attachment.

The following PCOCs/ECOIs are evaluated further in the professional judgment step for UWOEU:

- Surface soil/surface sediment (HHRA)

[2] The pattern recognition evaluation includes the use of probability plots. If two or more distinct populations are evident in the probability plot, this suggests that one or more local releases may have occurred. Conversely, if only one distinct low-concentration population is defined, likely representing a background population, a local release may or may not have occurred. Similar to all statistical methods, the probability plot has limitations in cases where there is inadequate sampling and the magnitude of the release is relatively small. Thus, absence of two clear populations in the probability plots is consistent with, but not definitive proof of, the hypothesis that no releases have occurred. However, if a release has occurred within the sampled area and has been included in the samples, then the elemental concentrations associated with that release are either within the background concentration range or the entire sampled population represents a release, a highly unlikely probability.

[3] The regional background data set for Colorado and the bordering states was extracted from data for the western United States (Shacklette and Boerngen 1984), and is composed of data from Colorado as well as Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming. Although the Colorado and bordering states background data set is not specific to Colorado’s Front Range, it is useful for the professional judgment evaluation in the absence of a robust data set for the Front Range. Colorado’s Front Range has highly variable terrain that changes elevation over short distances. Consequently, numerous soil types and geologic materials are present at RFETS, and the data set for Colorado and bordering states provides regional benchmarks for naturally-occurring metals in soil. The comparison of RFETS’s soil data to these regional benchmarks is only performed for non-PMJM professional judgment because the PMJM habitat is restricted to the front range of Colorado.

   - Arsenic
   - Benzo(a)pyrene
   - 2,3,7,8-TCDD (TEQ)
- Subsurface soil/subsurface sediment (HHRA)
   - No PCOCs were found to be statistically greater than background and above a PRG in accordance with the COC selection process; therefore, no PCOCs in subsurface soil/subsurface sediment are evaluated using professional judgment.
- Surface soil for non-PMJM receptors (ERA)
   - Antimony
   - Boron
   - Copper
   - Molybdenum
   - Nickel
   - Silver
   - Tin
   - Uranium
   - Vanadium
   - Bis(2-Ethylhexyl)phthalate
   - Di-n-butylphthalate
   - 2,3,7,8-TCDD (TEQ) (mammal)
   - 2,3,7,8-TCDD (TEQ) (bird)
   - Total PCBs
- Surface soil for PMJM receptors (ERA)
   - Antimony
   - Chromium
   - Copper
   - Manganese
   - Molybdenum
   - Nickel
   - Tin
   - Vanadium
   - Zinc
   - Total PCBs

- Subsurface soil (ERA)
  - No ECOIs were found to be statistically greater than background and above an ESL in accordance with the ECOPC selection process; therefore, no ECOIs in subsurface soil are evaluated using professional judgment.

The following sections provide the professional judgment evaluations, by analyte and by medium, for the PCOCs/ECOIs listed above.

4.1 Antimony

Antimony had an EPC in surface soil for non-PMJM receptors greater than the limiting tESL and a MDC in surface soil for the PMJM greater than ESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if antimony should be retained for risk characterization are summarized below.

4.1.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates antimony was used in very small quantities and only as a laboratory standard. Therefore, antimony is unlikely to be present in UWOEU soil as a result of historical site-related activities.

4.1.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis for antimony could not be performed because antimony is at nondetectable concentrations in UWOEU background data set. Antimony concentrations exceed three times the background MDC in UWOEU and largely occur in historical IHSSs. Thus, antimony cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

Antimony concentrations exceed three times the regional background MDC in UWOEU and largely occur in historical IHSSs. Thus, antimony cannot be eliminated as an ECOPC.

4.1.3 Conclusion

Antimony in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization because elevated concentrations (greater than three times the regional background MDC) are located near a historical IHSS. Antimony was used in very small quantities during historical RFETS operations, which would indicate it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, antimony is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

4.2 Arsenic

Arsenic has concentrations statistically greater than background in surface soil/surface sediment, and therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if arsenic should be retained for risk characterization are summarized below.

4.2.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates arsenic is unlikely to be present in UWOEU soil as a result of historical site-related activities.

4.2.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis suggests that arsenic concentrations in UWOEU surface soil/surface sediment reflect variations in naturally occurring arsenic.

4.2.3 Pattern Recognition

Surface Soil/Surface Sediment

With the exception of two surface sediment analyses, arsenic concentrations in surface soil/surface sediment form a normally distributed, single population suggesting background conditions (Figure A3.4.1). The two surface sediment samples have concentrations of 27.9 and 19.7 mg/kg.

4.2.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil/Surface Sediment

Arsenic concentrations in UWOEU surface soil/surface sediment range from 0.290 to 27.9 mg/kg, with a mean concentration of 5.07 mg/kg and a standard deviation of 3.05 mg/kg. Arsenic concentrations in the background data set range from 0.270 to 9.60 mg/kg, with a mean concentration of 3.42 mg/kg and a standard deviation of 2.55 mg/kg (Table A3.2.2). The range of concentrations of arsenic in the UWOEU and background samples overlap considerably with only five of the 159 detections greater than the background MDC.

Arsenic concentrations UWOEU surface soil/surface sediment are well within the range for arsenic in soils of Colorado and the bordering states (1.22 to 97 mg/kg, with a mean concentration of 6.9 mg/kg and a standard deviation of 7.64 mg/kg) (Table A3.4.1).

4.2.5 Risk Potential for HHRA

Surface Soil/Surface Sediment

The arsenic MDC for surface soil/surface sediment is 27.9 mg/kg and the UCL is 6.11 mg/kg. The UCL is less than three times greater than the PRG (2.41 mg/kg), with 137 of the 159 detections greater than the PRG. Because the PRG is based on an excess carcinogenic risk of 1E-06, the cancer risk based on the UCL concentration is less than 3E-06, and is well within the National Contingency Plan (NCP) risk range of 1E-06 to 1E-04. Arsenic is detected in 67 of 73 background samples, and concentrations in 39 of the 67 samples with detects exceed the PRG. The background UCL for arsenic in surface soil/surface sediment is 4.03 mg/kg (Appendix A, Volume 2, Attachment 9 of the RI/FS Report), which equates to a cancer risk of 2E-06. Therefore, the excess cancer risks to the WRW from exposure to arsenic in surface soil/surface sediment in the UWOEU is similar to background risk.

4.2.6 Conclusion

The weight of evidence presented above shows that arsenic concentrations in UWOEU surface soil/surface sediment are not likely to be a result of historical site-related activities based on process knowledge, a spatial distribution that suggests arsenic is naturally occurring, probability plots that suggests the presence of single arsenic data populations which are also indicative of background conditions, UWOEU concentrations that are well within regional background levels, and UWOEU concentrations that are unlikely to result in risks to humans significantly above background risks. Arsenic is not considered a COC in surface soil/surface sediment for the UWOEU and, therefore, is not further evaluated quantitatively.

4.3 Benzo(a)pyrene

Benzo(a)pyrene in surface soil/surface sediment has a UCL greater than the PRG and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if benzo(a)pyrene should be retained for risk characterization are summarized below.

4.3.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU, and no documented operations or activities that occurred in UWOEU involving the use of benzo(a)pyrene (CDH 1992; DOE 1992, 1995). Therefore, the potential for benzo(a)pyrene to be present in UWOEU surface soil/surface sediment as a result of historical site-related activities is unlikely.

4.3.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment

Benzo(a)pyrene was detected in 27 percent of the UWOEU surface soil/surface sediment samples. The detections are estimated values well below the reported detection limits of 330 to 400 micrograms per kilogram (µg/kg). As shown in Figure A3.4.2, there are several locations greater than the PRG that are located near a historical IHSS. Based on this line of evidence, benzo(a) Pyrene cannot be eliminated as a COC.

4.3.3 Conclusion

Although benzo(a)pyrene is not necessarily associated with site activities in the UWOEU, as a conservative measure, benzo(a)pyrene is carried forward into the risk characterization recognizing that its classification as a COC is uncertain.

4.4 Bis(2-ethylhexyl)phthalate

Bis(2-ethylhexyl)phthalate has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if bis(2-ethylhexyl)phthalate should be retained for risk characterization are summarized below.

4.4.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU, and no documented operations or activities that occurred in UWOEU involving the use of bis(2-ethylhexyl)phthalate (CDH 1992; DOE 1992, 1995). Therefore, the potential for bis(2-ethylhexyl)phthalate to be present in UWOEU surface soil as a result of historical site-related activities is unlikely.

4.4.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Bis(2-ethylhexyl)phthalate was detected in 27 percent of the UWOEU surface soil samples. The detections are estimated values well below the reported detection limit of 330 µg/kg. As shown in Figure A3.4.3, five of the 24 detections where the concentration is greater than the ESL are located near a historical IHSS. Based on this line of evidence, bis(2-ethylhexyl)phthalate cannot be eliminated as an ECOPC.

4.4.3 Conclusion

Although bis(2-ethylhexyl)phthalate is not necessarily associated with site activities in the UWOEU, as a conservative measure, bis(2-ethylhexyl)phthalate is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

4.5 Boron

For boron in surface soil, a statistical comparison between UWOEU and RFETS background data could not be performed because RFETS background surface soil samples were not analyzed for boron. Boron has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if boron should be retained for risk characterization are summarized below.

4.5.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates boron is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.5.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis suggests that boron concentrations in UWOEU surface soil reflect variations in naturally occurring boron.

4.5.3 Pattern Recognition

Surface Soil (Non-PMJM)

The boron concentrations are normally distributed forming a single population, which suggests background conditions (Figure A3.4.4). However, this interpretation is based on a limited data set.

4.5.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

The reported range for boron in surface soil within Colorado and the bordering states is 20 to 150 mg/kg, with a mean concentration of 27.9 mg/kg and a standard deviation of 19.7 mg/kg (Table A3.4.1). Boron concentrations reported in surface soil samples at the UWOEU are 3.90 to 11.0 mg/kg, with a mean concentration of 5.21 mg/kg and a standard deviation of 2.79 mg/kg (Table A3.6). The range of concentrations of boron in surface soil is below the range for boron in soils of Colorado and the bordering states.

4.5.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for boron in the UWOEU (10.6 mg/kg) exceeds the NOAEL ESL for only one receptor group, terrestrial plants (0.5 mg/kg). All other NOAEL ESLs were greater than the UTL and ranged from 30.3 to 6,070 mg/kg. Site-specific background data for boron were not available, but the MDC did not exceed the low end (20 mg/kg) of the background range presented in Shacklette and Boerngen (1984). This indicates the terrestrial plant NOAEL ESL (0.5 mg/kg) is well below expected background concentrations and, because risks are not typically expected at background concentrations, that boron concentrations are not likely to be indicative of site-related risk to the terrestrial plant community in the UWOEU. Kabata-Pendias and Pendias (1992) indicate soil with boron concentrations equal to 0.3 mg/kg is critically deficient in boron, and effects on plant reproduction would be expected. Additionally, the summary of boron toxicity in Efroymson et al. (1997) notes that the source of the 0.5-mg/kg NOAEL ESL indicates boron was toxic when added at 0.5 mg/kg to soil, but gives no indication of the boron concentration in the baseline soil before addition. The confidence placed by Efroymson et al. (1997) was low. No boron Eco-SSLs are currently available. Because no NOAEL ESLs other than the terrestrial plant NOAEL ESL are exceeded by the MDC, boron is unlikely to present a risk to terrestrial receptor populations in the UWOEU.

4.5.6 Conclusion

The weight of evidence presented above shows that boron concentrations in UWOEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge; a spatial distribution that suggests boron is naturally occurring; a probability plot that suggests the presence of a single population, which is also indicative of background conditions; UWOEU concentrations that are well within regional background levels; and UWOEU concentrations that are unlikely to result in risk concerns for wildlife populations. Boron is not considered an ECOPC in surface soil for the UWOEU and, therefore, is not further evaluated quantitatively.

4.6 Chromium

Chromium in surface soil (for PMJM receptors) has concentrations statistically greater than background. The lines of evidence used to determine if chromium should be retained for risk characterization are summarized below.

4.6.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for chromium to have been released into RFETS soil because of the moderate chromium metal inventory and presence of chromium in waste generated during former operations. Spills of chromium contaminated wastes have also occurred at RFETS. Therefore, chromium may be present in UWOEU soil as a result of historical site-related activities.

4.6.2 Evaluation of Spatial Trends

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that elevated chromium concentrations in UWOEU surface soil are located near historical IHSSs. Based on this line of evidence, chromium cannot be eliminated as an ECOPC.

4.6.3 Conclusion

Chromium in surface soil is being carried forward into the ecological PMJM risk characterization because elevated concentrations are located near a historical IHSS. Chromium was used in moderate quantities during historical RFETS operations, which would indicate it is a possible site-related contaminant. Therefore, chromium is carried forward into the risk characterization.

4.7 Copper

Copper in surface soil (for PMJM and non-PMJM receptors) has concentrations statistically greater than background, and an EPC that exceed the limiting tESLs for non-PMJM receptors, and was carried forward to the professional judgment step. The lines of evidence used to determine if copper should be retained for risk characterization are summarized below.

4.7.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates copper was used in relatively small quantities. Therefore copper is unlikely to be present in UWOEU soil as a result of historical site-related activities.

4.7.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that copper concentrations in UWOEU surface soil exceed three times the background MDC at locations near historical IHSSs. Based on this line of evidence, copper cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that copper concentrations in UWOEU surface soil exceed three times the background MDC at locations near historical IHSSs. Based on this line of evidence, copper cannot be eliminated as an ECOPC.

4.7.3 Conclusion

Copper in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization because elevated concentrations (greater than three times the background MDC) are near historical IHSSs. Copper was used in relatively small quantities during historical RFETS operations, which would indicate it is not likely to be a site-related contaminant. Nevertheless, as a conservative measure, copper is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

4.8 Di-n-butylphthalate

Di-n-butylphthalate has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if di-n-butylphthalate should be retained for risk characterization are summarized below.

4.8.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU, and no documented operations or activities that occurred in UWOEU involving the use of di-n-butylphthalate (CDH 1992; DOE 1992, 1995). Therefore, the potential for di-n-butylphthalate to be present in UWOEU surface soil as a result of historical site-related activities is unlikely.

4.8.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Di-n-butylphthalate was detected in 11 percent of the UWOEU surface soil samples. The detections are estimated values well below the reported detection limit of 330 µg/kg. As shown in Figure A3.4.5, the detections occur in historical IHSSs in the northern portion of the UWOEU, and all of the 10 detections were greater than the ESL.

4.8.3 Conclusion

Although di-n-butylphthalate is not necessarily associated with site activities in the UWOEU, because detections of this chemical only occur in historical IHSSs, albeit at estimated values well below the detection limit, di-n-butylphthalate is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

4.9 2,3,7,8-TCDD (TEQ)

2,3,7,8-TCDD (TEQ) has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. 2,3,7,8-TCDD (TEQ) also has an EPC in surface soil/surface sediment greater than a

PRG. The lines of evidence used to determine if 2,3,7,8-TCDD (TEQ) should be retained for risk characterization are summarized below.

4.9.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU involving the use or generation of dioxin (CDH 1992; DOE 1992, 1995). Therefore, the potential for dioxin to be present in UWOEU surface soil as a result of historical site-related activities is unlikely.

4.9.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment

2,3,7,8 TCDD TEQ was detected in 27 percent of the UWOEU surface soil/surface sediment samples. The detections are estimated values well below the reported detection limits of 330 to 400 µg/kg. As shown on Figure A3.4.6, detections occur near historical IHSS and, therefore, cannot be eliminated as an ECOPC.

Surface Soil (Non-PMJM)

2,3,7,8-TCDD (TEQ) (bird) was detected in the one UWOEU surface soil sample. The detections are estimated values well below the reported detection limit of 330 µg/kg. As shown in Figure A3.4.8, the detections occur randomly throughout the UWOEU, and all of the 10 detections were greater than the ESL. 2,3,7,8-TCDD (TEQ) (mammal) was detected in all of the UWOEU surface soil samples. The detections are estimated values well below the reported detection limit of 330 micrograms per kilogram (µg/kg). As shown in Figure A3.4.7, the detections occur near historical IHSS the UWOEU, and all of the 10 detections were greater than the ESL.

4.9.3 Conclusion

Although 2,3,7,8-TCDD (TEQ) is not necessarily associated with site activities in the UWOEU, a decision could not be made whether concentrations in samples collected from the UWOEU surface soil/surface sediment are significantly elevated compared to background because the background comparison is not performed for organics. Nevertheless, as a conservative measure, 2,3,7,8-TCDD (TEQ) is carried forward into the risk characterization recognizing that its classification as a COC/ECOP is uncertain.

Although 2,3,7,8-TCDD (TEQ) (bird) is not necessarily associated with site activities in the UWOEU, as a conservative measure, 2,3,7,8-TCDD (TEQ) (bird) is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

Although 2,3,7,8-TCDD (TEQ) (mammal) is not necessarily associated with site activities in the UWOEU, as a conservative measure, 2,3,7,8-TCDD (TEQ) (mammal) is carried forward into the risk characterization recognizing that its classification as a COC and an ECOPC is uncertain.

4.10 Manganese

Manganese has concentrations statistically greater than background in surface soil (for PMJM receptors) in the UWOEU. Therefore, manganese in surface soil (for PMJM receptors) was carried forward to the professional judgment step. The lines of evidence used to determine if manganese should be retained for risk characterization are summarized below.

4.10.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, manganese was used in moderate quantities; however, process knowledge indicates manganese is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.10.2 Evaluation of Spatial Trends

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that manganese concentrations in UWOEU surface soil exceed the background MDC near historical IHSSs. Based on this line of evidence, manganese cannot be eliminated as an ECOPC.

4.10.3 Conclusion

Manganese in surface soil is being carried forward into the ecological PMJM risk characterization because elevated concentrations are located near historical IHSSs. Process knowledge indicates it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, manganese is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

4.11 Molybdenum

For molybdenum in surface soil, a statistical comparison between UWOEU and RFETS background data could not be performed because molybdenum was not detected in RFETS background surface soil samples. Molybdenum has an EPC in surface soil for non-PMJM receptors greater than the limiting tESL and an MDC in surface soil for PMJM greater than the ESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if molybdenum should be retained for risk characterization are summarized below.

4.11.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, molybdenum was used in relatively small quantities and process knowledge indicates molybdenum is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.11.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that molybdenum concentrations in UWOEU surface soil reflect variations in naturally occurring molybdenum.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that molybdenum concentrations in UWOEU surface soil in PMJM habitat appear to reflect variations in naturally occurring molybdenum. However, because there are five locations that exceed the ESL in PMJM habitat, to be conservative, molybdenum will not be eliminated as an ECOPC.

4.11.3 Pattern Recognition

Surface Soil (Non-PMJM)

The log-probability plot for molybdenum (Figure A3.4.9) indicates a stair-step characteristic in the lower concentrations. This is a result of the censored data having multiple detection limits. Accordingly, the distribution of the data cannot be discerned.

4.11.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

The reported range for molybdenum in surface soil within Colorado and the bordering states is 3 to 7 mg/kg, with a mean concentration of 1.59 mg/kg and a standard deviation of 0.522 mg/kg (Table A3.11). Molybdenum concentrations reported in surface soil samples at the UWOEU is 0.310 to 5.90 mg/kg, with a mean concentration of 1.14 mg/kg and a standard deviation of 0.920 mg/kg (Table A3.6). The range of concentrations of molybdenum in surface soil is below the range for molybdenum in soils of Colorado and the bordering states.

4.11.5 Risk Potential for Plants and Wildlife

Surface Soil (Non-PMJM)

The UTL for molybdenum in the UWOEU (2.15 mg/kg) exceeds the NOAEL ESL for two receptor groups, terrestrial plants (2.0 mg/kg), and deer mouse insectivore (1.90 mg/kg). All other NOAEL ESLs were greater than the UTL and ranged from 6.97 to 275 mg/kg. Only the ESL for terrestrial plants is within the range of background concentrations. No molybdenum Eco-SSLs are currently available.

4.11.6 Conclusion

Surface Soil (Non-PMJM)

The weight of evidence presented above shows that molybdenum concentrations in UWOEU surface soil (non-PMJM receptors) are not likely to be a result of historical site-related activities based on process knowledge, a spatial distribution that suggests molybdenum is naturally occurring, and UWOEU concentrations that are well within regional background levels. Although the log-probability plot is inconclusive on the presence of a single background population , molybdenum is not considered an ECOPC in surface soil (for non-PMJM receptors) for the UWOEU, and therefore, is not further evaluated quantitatively.

Surface Soil (PMJM)

Molybdenum in surface soil is being carried forward into the ecological PMJM risk characterization as a conservative measure recognizing its classification as an ECOPC is uncertain.

4.12 Nickel

Nickel in surface soil (for PMJM and non-PMJM receptors) has concentrations statistically greater than background, and an EPC that exceed the limiting tESLs for non-PMJM receptors, and was carried forward to the professional judgment step. The lines of evidence used to determine if nickel should be retained for risk characterization are summarized below.

4.12.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for nickel to have been released into RFETS soil because of the moderate nickel metal inventory and presence of nickel in waste generated during former operations. Therefore, nickel may be present in UWOEU soil as a result of historical site-related activities.

4.12.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that nickel concentrations in UWOEU surface soil exceed three times the background MDC at locations near historical IHSSs. Based on this line of evidence, nickel cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that nickel concentrations in UWOEU surface soil exceed three times the background MDC at locations near historical IHSSs. Based on this line of evidence, nickel cannot be eliminated as an ECOPC.

4.12.3 Conclusion

Nickel in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization because elevated concentrations (three times the background MDC) are located near a historical IHSS. Nickel was used in moderate quantities during historical RFETS operations, and it may be present in RFETS soil as a result of historical site-related activities.

4.13 Silver

Silver had an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if silver should be retained for risk characterization are summarized below.

4.13.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for silver to have been released into RFETS soil because of silver in waste generated during former operations. Therefore, silver may be present in UWOEU soil as a result of historical site-related activities.

4.13.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that silver concentrations in UWOEU surface soil exceed the minimum ESL at locations near historical IHSSs. Based on this line of evidence, silver cannot be eliminated as an ECOPC.

4.13.3 Conclusion

Silver in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations are located near a historical IHSSs. Also, silver may be present in RFETS soil as a result of historical site-related activities.

4.14 Tin

For tin in surface soil, a statistical comparison between UWOEU and RFETS background data could not be performed because tin was not detected in RFETS background surface soil samples. Tin has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. In addition, tin in surface soil (for PMJM receptors) has an MDC greater than the ESL, and was carried forward to the professional judgment step. The lines of evidence used to determine if tin should be retained for risk characterization are summarized below.

4.14.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for tin to have been released into RFETS soil because of the moderate tin metal inventory during former operations. Therefore, tin may be present in UWOEU soil as a result of historical site-related activities.

4.14.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that tin concentrations in UWOEU surface soil exceed the minimum ESL at locations near historical IHSSs. Based on this line of evidence, tin cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that tin concentrations in UWOEU surface soil exceed the minimum ESL at locations near historical IHSSs. Based on this line of evidence, tin cannot be eliminated as an ECOPC.

4.14.3 Conclusion

Tin in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization because elevated concentrations are located near a historical IHSS. Tin was used in moderate quantities during historical RFETS operations, and it may be present in RFETS soil as a result of historical site-related activities.

4.15 Total PCBs

Total PCBs have an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. In addition, total PCBs in surface soil (for PMJM receptors) has a MDC greater than the ESL, and was carried forward to the professional judgment step. The lines of evidence used to determine if total PCBs should be retained for risk characterization are summarized below.

4.15.1 Summary of Process Knowledge

There are no documented historical source areas present in the UWOEU, and no documented operations or activities that occurred in UWOEU involving the use of PCBs (CDH 1992; DOE 1995, 1992). Therefore, the potential for PCBs to be present in UWOEU surface soil as a result of historical site-related activities is unlikely.

4.15.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

Total PCBs were detected in 16 percent of the UWOEU surface soil samples. The detections are estimated values based on the reported detection limits of 1.4 to 160 μg/kg. As shown in Figure A3.4.10, detected results were greater than three times ESL at most locations. The samples are near an historical IHSS. Based on this line of evidence, total PCBs cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

Total PCBs were detected in 32 percent of the UWOEU surface soil samples. The detections are estimated values based on reported detection limits of 1.4 to 160 μg/kg. As shown in Figure A3.4.11, there are 6 detections were greater than the ESL located near historical IHSS. Therefore, PCPs cannot be eliminated as an ECOPC.

4.15.3 Conclusion

Although total PCBs is not necessarily associated with site activities in the UWOEU, as a conservative measure, total PCBs is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

4.16 Uranium

Uranium has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if uranium should be retained for risk characterization are summarized below.

4.16.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates a potential for uranium to have been released into RFETS soil because of the large uranium metal inventory during former operations. Therefore, uranium may be present in UWOEU soil as a result of historical site-related activities.

4.16.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that uranium concentrations in UWOEU surface soil exceed three times the minimum ESL at locations near historical IHSSs. Based on this line of evidence, uranium cannot be eliminated as an ECOPC.

4.16.3 Conclusion

Uranium in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations are located near a historical IHSS. Uranium was used in large quantities during historical RFETS operations, and it may be present in RFETS soil as a result of historical site-related activities.

4.17 Vanadium

Vanadium has an EPC in surface soil (for non-PMJM receptors) greater than the limiting tESL, and therefore, was carried forward to the professional judgment step. In addition, vanadium in surface soil (for PMJM receptors) has concentrations statistically greater than background, and was carried forward to the professional judgment step. The lines of evidence used to determine if vanadium should be retained for risk characterization are summarized below.

4.17.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, process knowledge indicates vanadium is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.17.2 Evaluation of Spatial Trends

Surface Soil (Non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that vanadium concentrations in UWOEU surface soil exceed the background MDC at locations near historical IHSSs. Based on this line of evidence, vanadium cannot be eliminated as an ECOPC.

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that vanadium concentrations in UWOEU surface soil exceed the background MDC at locations near historical IHSSs. Based on this line of evidence, vanadium cannot be eliminated as an ECOPC.

4.17.3 Conclusion

Surface Soil (PMJM and Non-PMJM))

Vanadium in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization as a conservative measure recognizing that its classification as an ECOPC is uncertain.

4.18 Zinc

Zinc has concentrations statistically greater than background in surface soil (for PMJM receptors) in the UWOEU. Therefore, zinc in surface soil (for PMJM receptors) was carried forward to the professional judgment step. The lines of evidence used to determine if zinc should be retained for risk characterization are summarized below.

4.18.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, zinc was used in moderate quantities. However, zinc was not identified or discussed in building process information, and has not been found associated with UBC building processes. Base process knowledge indicates zinc is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.18.2 Evaluation of Spatial Trends

Surface Soil (PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS Report, the spatial trend analysis indicates that zinc concentrations in UWOEU surface soil exceed the background MDC at locations near historical IHSSs. Based on this line of evidence, zinc cannot be eliminated as an ECOPC.

4.18.3 Conclusion

Zinc in surface soil is being carried forward into the ecological PMJM risk characterization because elevated concentrations are located near historical IHSSs. Process knowledge indicates it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, zinc is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

5.0 REFERENCES

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TABLES

Table A3.2.1
Statistical Distributions and Comparison to Background for UWOEU Surface Soil/ Surface Sediment

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Dataset			UWOEU Dataset (excluding background samples)					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Arsenic	**20**	**NORMAL**	**92**	**130**	**NORMAL**	**99**	**t-Test_N**	**1.38E-05**	**Yes**
Cesium-134	70	NON-PARAMETRIC	N/A	N/A	N/A	100	WRS	9.00E-01	No
Cesium-137	70	NORMAL	N/A	1	0	100	WRS	1.00E+00	No
Radium-228	20	NORMAL	N/A	4	NORMAL	100	t-Test_N	6.51E-01	No

WRS = Wilcoxon Rank Sum.
t-Test_N = Student's t-test using normal data
Bolded entries indicated analytes retained for further consideration in the next COC selection step.

Table A3.2.2

Summary Statistics for Background and UWOEU Surface Soil/ Surface Sediment [a]

Analyte	Units	Background Dataset					UWOEU Dataset (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Aluminum	mg/kg	73	811	25,200	7,712	5,349	161	1,140	30,200	10,799	5,267
Antimony	mg/kg	66	1.00	12.4	2.64	3.12	148	0.330	51.3	5.68	8.25
Arsenic	mg/kg	73	0.270	9.60	3.42	2.55	161	0.290	27.9	5.07	3.05
Chromium	mg/kg	73	1.50	30.4	9.21	6.69	161	1.50	70.1	13.0	8.22
Iron	mg/kg	73	1,040	31,400	10,433	6,064	161	2,660	38,800	14,077	5,227
Manganese	mg/kg	73	9.00	1,280	241	189	161	45.2	829	258	116
Benzo(a)anthracene	ug/kg	62	37.0	1,700	408	281	111	22.0	45,000	755	4,269
Benzo(a)pyrene	ug/kg	62	120	900	389	217	121	37.0	43,000	702	3,904
Dibenz(a,h)anthracene	ug/kg	62	220	220	386	211	104	60.0	9,200	329	889
Indeno(1,2,3-cd)pyrene	ug/kg	61	220	470	376	202	106	24.0	32,000	575	3,097
PCB-1254	ug/kg	59	19.0	58.0	262	635	115	19.0	3,900	282	541
Cesium-134	pCi/g	77	1.00E-03	0.300	0.141	0.066	13	1.00E-03	0.300	0.093	0.091
Cesium-137	pCi/g	105	-0.027	1.80	0.692	0.492	22	0.030	1.00	0.173	0.201
Plutonium-239/240	pCi/g	94	-0.010	0.350	0.032	0.039	214	-0.013	17.1	0.230	1.23
Radium-228	pCi/g	40	0.200	4.10	1.60	0.799	8	0.880	2.29	1.41	0.483
Uranium-233/234	pCi/g	65	0.136	4.78	1.49	0.982	188	0.191	47.5	1.43	3.55
Uranium-235	pCi/g	64	0	0.191	0.058	0.041	188	-0.023	2.24	0.086	0.228
Uranium-238	pCi/g	65	0.127	3.82	1.36	0.825	188	0.283	209	3.11	16.5

[a] Statistics are computed using one-half the reported value for nondetects.

Table A3.2.3
Statistical Distributions and Comparison to Background for UWOEU Subsurface Soil/ Subsurface Sediment

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Dataset			UWOEU Dataset (excluding background samples)					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Radium-228	31	GAMMA	N/A	26	NORMAL	100	N/A	0.170	No

WRS = Wilcoxon Rank Sum.

Table A3.2.4
Summary Statistics for Background and UWOEU Subsurface Soil/ Subsurface Sediment [a]

Analyte	Units	Background Dataset					UWOEU Dataset (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Radium-228	pCi/g	31	1.00	2.10	1.45	0.320	26	0	2.79	1.55	0.577

[a] Statistics are computed using one-half the reported value for nondetects.

Table A3.2.5
Statistical Distributions and Comparison to Background for UWOEU Surface Soil (non-PMJM)

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Dataset			UWOEU Dataset (excluding background samples)					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Aluminum	20	NORMAL	100	130	GAMMA	100	WRS	0.364	No
Antimony	**20**	**NON-PARAMETRIC**	**0**	**120**	**NON-PARAMETRIC**	**7**	**N/A**	**N/A**	**N/A**
Arsenic	20	NORMAL	100	130	NORMAL	100	t-Test_N	0.978	No
Barium	**20**	**NORMAL**	**100**	**130**	**GAMMA**	**100**	**WRS**	**0.033**	**Yes**
Boron	**N/A**	**N/A**	**N/A**	**18**	**NORMAL**	**72**	**N/A**	**N/A**	**N/A**
Cadmium	20	NON-PARAMETRIC	65	120	NON-PARAMETRIC	31	WRS	0.995	No
Chromium	20	NORMAL	100	130	GAMMA	99	WRS	0.187	No
Cobalt	20	NORMAL	100	130	NORMAL	88	t-Test_N	0.416	No
Copper	**20**	**NON-PARAMETRIC**	**100**	**130**	**NON-PARAMETRIC**	**99**	**WRS**	**0.012**	**Yes**
Lead	20	NORMAL	100	135	LOGNORMAL	100	WRS	1.000	No
Lithium	20	NORMAL	100	128	GAMMA	92	WRS	0.541	No
Manganese	20	NORMAL	100	130	GAMMA	100	WRS	0.285	No
Mercury	20	NON-PARAMETRIC	40	128	NON-PARAMETRIC	47	WRS	0.898	No
Molybdenum	**20**	**NORMAL**	**0**	**128**	**NON-PARAMETRIC**	**19**	**N/A**	**N/A**	**N/A**
Nickel	**20**	**NORMAL**	**100**	**129**	**NON-PARAMETRIC**	**96**	**WRS**	**5.40E-04**	**Yes**
Selenium	20	NON-PARAMETRIC	60	120	NON-PARAMETRIC	36	WRS	1.000	No
Silver	**20**	**NORMAL**	**0**	**117**	**NON-PARAMETRIC**	**24**	**N/A**	**N/A**	**N/A**
Tin	**20**	**NORMAL**	**0**	**129**	**NON-PARAMETRIC**	**12**	**N/A**	**N/A**	**N/A**
Uranium	**N/A**	**N/A**	**N/A**	**18**	**NON-PARAMETRIC**	**39**	**N/A**	**N/A**	**N/A**
Vanadium	**20**	**NORMAL**	**100**	**130**	**GAMMA**	**100**	**WRS**	**0.096**	**Yes**
Zinc	20	NORMAL	100	130	NON-PARAMETRIC	100	WRS	0.456	No

t-Test_N = Student's t-test using normal data
WRS = Wilcoxon Rank Sum.
N/A = not applicable; site and/or background detection frequency less than 20%.
Bolded entries indicated analytes retained for further consideration in the next ECOPC selection step.

Table A3.2.6

Summary Statistics for Background and UWOEU Surface Soil (non-PMJM) [a]

Analyte	Units	Background Dataset					UWOEU Dataset (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Aluminum	mg/kg	20	4,050	17,100	10,203	3,256	130	1,950	30,000	11,069	4,969
Antimony	mg/kg	20	ND	ND	0.279	0.078	120	0.330	49.8	4.53	5.84
Arsenic	mg/kg	20	2.30	9.60	6.09	2.00	130	0.290	10.0	5.06	2.11
Barium	mg/kg	20	45.7	134	102	19.4	130	40.1	464	122	51.2
Boron	mg/kg	N/A	N/A	N/A	N/A	N/A	18	3.90	11.0	5.21	2.79
Cadmium	mg/kg	20	0.670	2.30	0.708	0.455	120	0.270	30.0	0.777	2.76
Chromium	mg/kg	20	5.50	16.9	11.2	2.78	130	2.60	61.0	13.1	6.91
Cobalt	mg/kg	20	3.40	11.2	7.27	1.79	130	2.40	13.7	7.39	2.31
Copper	mg/kg	20	5.20	16.0	13.0	2.58	130	5.10	330	24.6	36.3
Lead	mg/kg	20	8.60	53.3	33.5	10.5	135	5.80	220	26.4	22.7
Lithium	mg/kg	20	4.80	11.6	7.66	1.89	128	2.40	20.0	7.93	3.52
Manganese	mg/kg	20	129	357	237	63.9	130	45.2	829	261	112
Mercury	mg/kg	20	0.090	0.120	0.072	0.031	128	0.017	2.40	0.091	0.217
Molybdenum	mg/kg	20	ND	ND	0.573	0.184	128	0.310	5.90	1.14	0.920
Nickel	mg/kg	20	3.80	14.0	9.60	2.59	129	4.70	48.0	13.2	5.71
Selenium	mg/kg	20	0.680	1.40	0.628	0.305	120	0.220	1.00	0.283	0.194
Silver	mg/kg	20	ND	ND	0.207	0.007	117	0.095	98.0	2.47	12.5
Tin	mg/kg	20	ND	ND	2.06	0.410	129	1.20	66.9	6.28	11.7
Uranium	mg/kg	N/A	N/A	N/A	N/A	N/A	18	1.80	85.0	8.60	20.1
Vanadium	mg/kg	20	10.8	45.8	27.7	7.68	130	9.90	54.8	30.7	8.87
Zinc	mg/kg	20	21.1	75.9	49.8	12.2	130	11.8	650	65.5	71.0
2-Methylnaphthalene	ug/kg	N/A	N/A	N/A	N/A	N/A	88	57.0	12,000	406	1,256
4,4'-DDT	ug/kg	N/A	N/A	N/A	N/A	N/A	89	21.0	21.0	14.5	10.2
Acenaphthene	ug/kg	N/A	N/A	N/A	N/A	N/A	101	51.0	44,000	765	4,355
Benzo(a)pyrene	ug/kg	N/A	N/A	N/A	N/A	N/A	98	60.0	43,000	810	4,334
bis(2-ethylhexyl)phthalate	ug/kg	N/A	N/A	N/A	N/A	N/A	89	48.0	3,500	273	367
Dieldrin	ug/kg	N/A	N/A	N/A	N/A	N/A	89	34.0	34.0	14.9	10.5
Di-n-butylphthalate	ug/kg	N/A	N/A	N/A	N/A	N/A	89	40.0	200	250	111
Endrin ketone	ug/kg	N/A	N/A	N/A	N/A	N/A	89	36.0	36.0	14.7	10.5
Fluorene	ug/kg	N/A	N/A	N/A	N/A	N/A	106	39.0	39,000	614	3,771
2,3,7,8-TCDD TEQ (Mammal)	ug/kg	N/A	N/A	N/A	N/A	N/A	10	4.87E-08	0.074	0.011	0.023
2,3,7,8-TCDD TEQ (Bird)	ug/kg	N/A	N/A	N/A	N/A	N/A	1	0.004	0.004	0.004	N/A
Naphthalene	ug/kg	N/A	N/A	N/A	N/A	N/A	113	0.950	41,000	696	3,839
Total PCBs	ug/kg	N/A	N/A	N/A	N/A	N/A	90	220	3,900	331	602

[a] Statistics are computed using one-half the reported value for nondetects.
N/A = Not available.
ND = Analyte not detected.

Table A3.2.7
Statistical Distributions and Comparison to Background for UWOEU Surface Soil (PMJM)

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Dataset			UWOEU Dataset (excluding background samples)					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Antimony	**20**	**NON-PARAMETRIC**	**0.0**	**29**	**NON-PARAMETRIC**	**13.79**	**N/A**	**N/A**	**N/A**
Arsenic	20	NORMAL	100.0	34	NORMAL	100.00	t-Test_N	0.951	No
Cadmium	20	NON-PARAMETRIC	65.0	32	NON-PARAMETRIC	34.38	WRS	0.856	No
Chromium	**20**	**NORMAL**	**100.0**	**34**	**NORMAL**	**100.00**	**t-Test_N**	**0.003**	**Yes**
Copper	**20**	**NON-PARAMETRIC**	**100.0**	**34**	**NON-PARAMETRIC**	**100.00**	**WRS**	**0.002**	**Yes**
Manganese	**20**	**NORMAL**	**100.0**	**34**	**GAMMA**	**100.00**	**WRS**	**0.017**	**Yes**
Mercury	20	NON-PARAMETRIC	40.0	33	NON-PARAMETRIC	57.58	WRS	0.609	No
Molybdenum	**20**	**NORMAL**	**0.0**	**33**	**LOGNORMAL**	**18.18**	**N/A**	**N/A**	**N/A**
Nickel	**20**	**NORMAL**	**100.0**	**33**	**NORMAL**	**90.91**	**t-Test_N**	**9.00E-04**	**Yes**
Selenium	20	NON-PARAMETRIC	60.0	33	NON-PARAMETRIC	39.39	WRS	1.000	No
Tin	**20**	**NORMAL**	**0.0**	**34**	**LOGNORMAL**	**17.65**	**N/A**	**N/A**	**N/A**
Vanadium	**20**	**NORMAL**	**100.0**	**34**	**NORMAL**	**100.00**	**t-Test_N**	**0.017**	**Yes**
Zinc	**20**	**NORMAL**	**100.0**	**34**	**LOGNORMAL**	**100.00**	**WRS**	**0.010**	**Yes**

t-Test_N = Student's t-test using normal data
WRS = Wilcoxon Rank Sum.
N/A = not applicable; site and/or background detection frequency less than 20%.
Bolded entries indicated analytes retained for further consideration in the next ECOPC selection step.

Table A3.2.8

Summary Statistics for Background and UWOEU Surface Soil (PMJM) [a]

Analyte	Units	Background Dataset					UWOEU Dataset (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Antimony	mg/kg	20	ND	ND	0.279	0.078	29	0.330	49.8	7.06	10.8
Arsenic	mg/kg	20	2.30	9.60	6.09	2.00	34	1.90	9.90	5.25	1.60
Cadmium	mg/kg	20	0.670	2.30	0.708	0.455	32	0.420	4.10	0.734	0.834
Chromium	mg/kg	20	5.50	16.9	11.2	2.78	34	2.60	26.0	15.1	5.52
Copper	mg/kg	20	5.20	16.0	13.0	2.58	34	5.10	112	26.4	25.5
Manganese	mg/kg	20	129	357	237	63.9	34	134	829	319	141
Mercury	mg/kg	20	0.090	0.120	0.072	0.031	33	0.027	0.370	0.092	0.092
Molybdenum	mg/kg	20	ND	ND	0.573	0.184	33	0.840	4.40	1.18	0.784
Nickel	mg/kg	20	3.80	14.0	9.60	2.59	33	5.70	26.3	13.6	5.03
Selenium	mg/kg	20	0.680	1.40	0.628	0.305	33	0.220	1.00	0.277	0.204
Tin	mg/kg	20	ND	ND	2.06	0.410	34	1.60	66.9	10.3	16.1
Vanadium	mg/kg	20	10.8	45.8	27.7	7.68	34	9.90	53.0	33.6	10.5
Zinc	mg/kg	20	21.1	75.9	49.8	12.2	34	21.2	199	73.4	41.1
Total PCBs	ug/kg	N/A	N/A	N/A	N/A	N/A	19	150	4,230	1,138	1,153

[a] Statistics are computed using one-half the reported value for nondetects.

N/A = Not available.

ND = Analyte not detected.

Table A3.2.9
Statistical Distributions and Comparison to Background for UWOEU Subsurface Soil

Analyte	Statistical Distribution Testing Results						Background Comparison Test Results		
	Background Dataset			UWOEU Dataset (excluding background samples)					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Statistically Greater than Background?
Antimony	**28**	**NON-PARAMETRIC**	**7**	**229**	**NON-PARAMETRIC**	**21**	**N/A**	**N/A**	**N/A**
Arsenic	45	NON-PARAMETRIC	93	252	NON-PARAMETRIC	100	WRS	0.760	No
Beryllium	45	GAMMA	96	257	NON-PARAMETRIC	76	WRS	1.00	No
Chromium	45	GAMMA	100	252	NON-PARAMETRIC	100	WRS	0.794	No
Copper	**45**	**NORMAL**	**96**	**252**	**NON-PARAMETRIC**	**97**	**WRS**	**4.49E-07**	**Yes**
Lead	45	GAMMA	100	257	NON-PARAMETRIC	100	WRS	0.102	No
Manganese	**45**	**GAMMA**	**100**	**252**	**GAMMA**	**100**	**WRS**	**6.70E-05**	**Yes**
Molybdenum	45	NON-PARAMETRIC	67	251	NON-PARAMETRIC	24	WRS	1.00	No
Nickel	44	GAMMA	100	252	NON-PARAMETRIC	96	WRS	0.979	No
Selenium	**38**	**LOGNORMAL**	**0**	**247**	**NON-PARAMETRIC**	**14**	**N/A**	**N/A**	**N/A**
Tin	**41**	**NON-PARAMETRIC**	**37**	**251**	**NON-PARAMETRIC**	**9**	**N/A**	**N/A**	**N/A**
Zinc	**44**	**NORMAL**	**100**	**252**	**NON-PARAMETRIC**	**100**	**WRS**	**4.86E-04**	**Yes**

WRS = Wilcoxon Rank Sum.
N/A = not applicable; site and/or background detection frequency less than 20%.
Bolded entries indicated analytes retained for further consideration in the next ECOPC selection step.

Table A3.2.10

Summary Statistics for Background and UWOEU Subsurface Soil [a]

Analyte	Units	Background Dataset					UWOEU Dataset (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentration	Standard Deviation
Antimony	mg/kg	28	2.90	8.20	4.21	2.78	229	0.340	149	7.00	11.9
Arsenic	mg/kg	45	1.70	41.8	5.48	6.02	252	0.470	24.3	4.68	2.82
Beryllium	mg/kg	45	1.00	22.4	5.76	5.01	257	0.280	446	3.61	29.3
Chromium	mg/kg	45	5.80	69.6	18.4	11.9	252	4.30	8,310	53.0	523
Copper	mg/kg	45	2.20	31.6	11.6	6.09	252	3.60	8,850	140	761
Lead	mg/kg	45	4.20	25.8	13.9	6.31	257	2.90	5,200	60.9	344
Manganese	mg/kg	45	16.0	747	171	158	252	14.3	2,150	279	253
Molybdenum	mg/kg	45	3.50	41.0	13.5	7.80	251	0.320	470	5.06	33.2
Nickel	mg/kg	44	4.30	54.2	20.9	11.1	252	2.70	4,750	40.3	299
Selenium	mg/kg	38	ND	ND	0.592	0.543	247	0.150	80.8	0.569	5.15
Tin	mg/kg	41	25.7	441	86.0	134	251	1.50	579	8.73	38.7
Zinc	mg/kg	44	0.520	79.8	36.2	21.0	252	7.60	6,920	137	510

[a] Statistics are computed using one-half the reported value for nondetects.

ND = Analyte not detected.

Table A3.4.1

Summary of Element Soil Concentrations in Colorado and Bordering States[a]

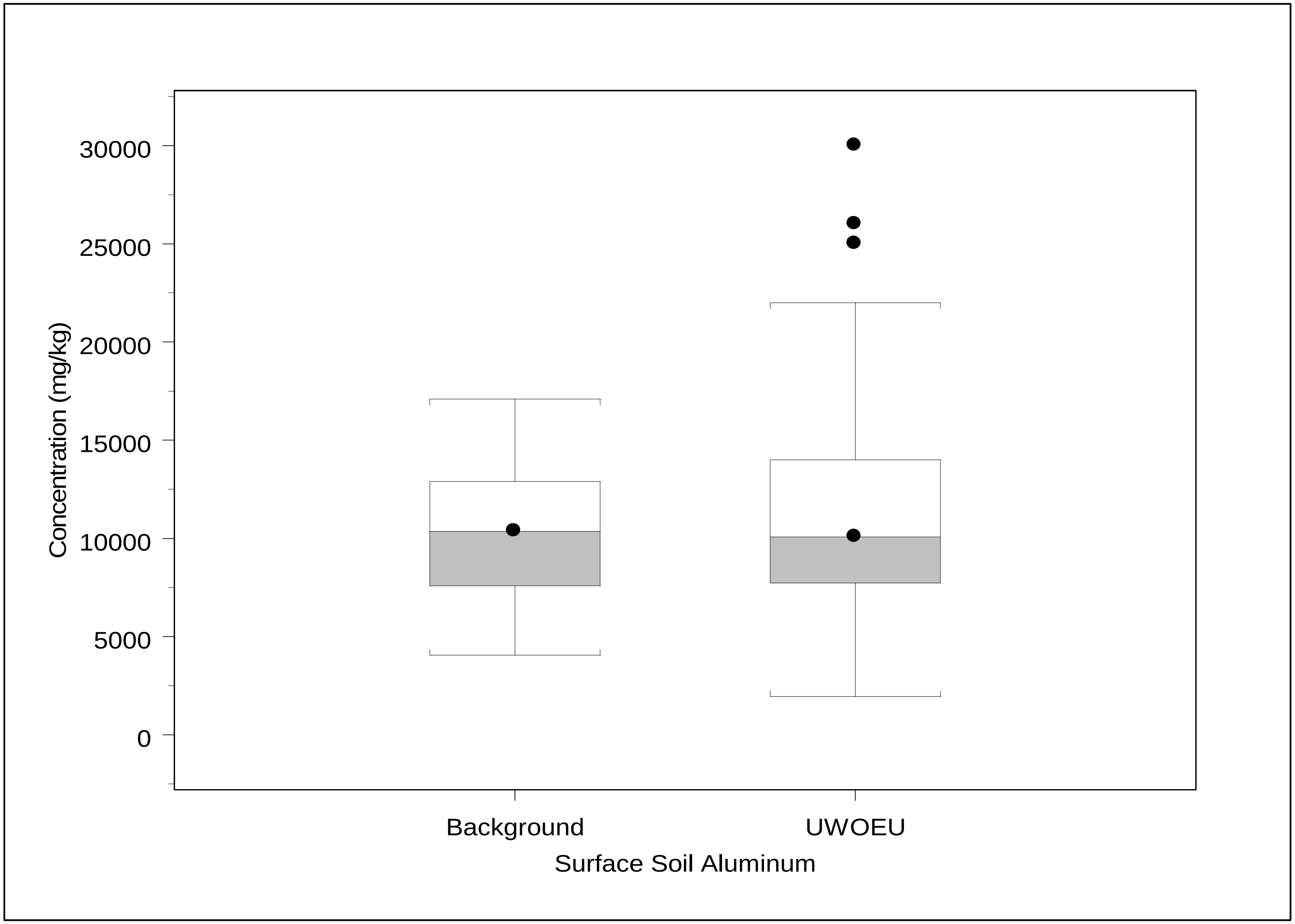
Analyte	Total Number of Results	Detection Frequency (%)	Range of Detected Values (mg/kg)	Mean (mg/kg)[b]	Standard Deviation (mg/kg)[b]
Aluminum	303	100	5,000 - 100,000	50,800	23,500
Antimony	84	15.5	1.038 - 2.531	0.647	0.378
Arsenic	307	99.3	1.224 - 97	6.9	7.64
Barium	342	100	100 - 3,000	642	330
Beryllium	342	36.0	1 - 7	0.991	0.876
Boron	342	66.7	20 - 150	27.9	19.7
Bromine	85	50.6	0.5038 - 3.522	0.681	0.599
Calcium	342	100	0.055 - 32	3.09	4.13
Carbon	85	100	0.3 - 10	2.18	1.92
Cerium	291	16.2	150 - 300	90	38.4
Chromium	342	100	3 - 500	48.2	41
Cobalt	342	88.6	3 - 30	8.09	5.03
Copper	342	100	2 - 200	23.1	17.7
Fluorine	264	97.3	10 - 1,900	394	261
Gallium	340	99.1	5 - 50	18.3	8.9
Germanium	85	100	0.578 - 2.146	1.18	0.316
Iodine	85	78.8	0.516 - 3.487	1.07	0.708
Iron	342	100	3,000 - 100,000	21,100	13,500
Lanthanum	341	66.3	30 - 200	39.8	28.8
Lead	342	92.7	10 - 700	24.8	41.5
Lithium	307	100	5 - 130	25.3	14.4
Magnesium	341	100	300 - 50,000	8,630	6,400
Manganese	342	100	70 - 2,000	414	272
Mercury	309	99.0	0.01 - 4.6	0.0768	0.276
Molybdenum	340	3.53	3 - 7	1.59	0.522
Neodymium	256	22.7	70 - 300	47.1	31.7
Nickel	342	96.5	5 - 700	18.8	39.8
Niobium	335	63.3	10 - 100	11.4	8.68
Phosphorus	249	100	40 - 4,497	399	397
Potassium	341	100	1,900 - 63,000	18,900	6,980
Rubidium	85	100	35 - 140	75.8	25
Scandium	342	85.1	5 - 30	8.64	4.69
Selenium	309	80.6	0.1023 - 4.3183	0.349	0.415
Silicon	85	100	149,340 - 413,260	302,000	61,500
Sodium	335	100	500 - 70,000	10,400	6,260
Strontium	342	100	10 - 2,000	243	212
Sulfur	85	16.5	816 - 47,760	1,250	5,300
Thallium	76	100	2.45 - 20.79	9.71	3.54
Tin	85	96.5	0.117 - 5.001	1.15	0.772
Titanium	342	100	500 - 7,000	2,290	1,350
Uranium	85	100	1.11 - 5.98	2.87	0.883
Vanadium	342	100	7 - 300	73	41.7
Ytterbium	330	99.1	1 - 20	3.33	2.06
Yttrium	342	98.0	10 - 150	26.9	18.1
Zinc	330	100	10 - 2,080	72.4	159
Zirconium	342	100	30 - 1,500	220	157

[a] Based on data from Shacklette and Boerngen 1984 for the states of Colorado, Arizona, Kansas, Nebraska, New Mexico, Oklahoma, Utah, and Wyoming.

[b] One-half the detection limit used as proxy value for nondetects in computation of the mean and standard deviation.

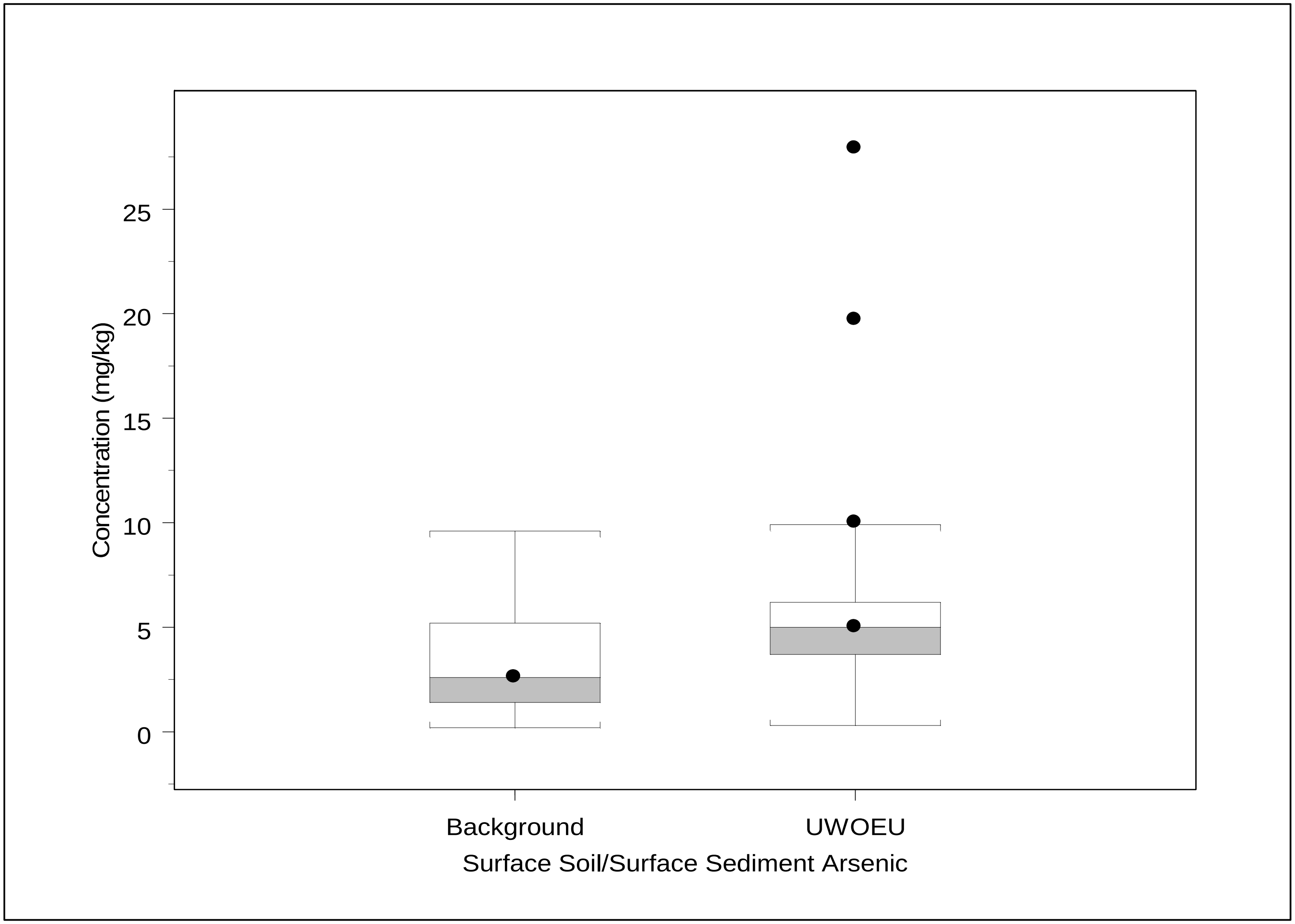
FIGURES

Figure A3.2.1
UWOEU Surface Soil Box Plots for Aluminum



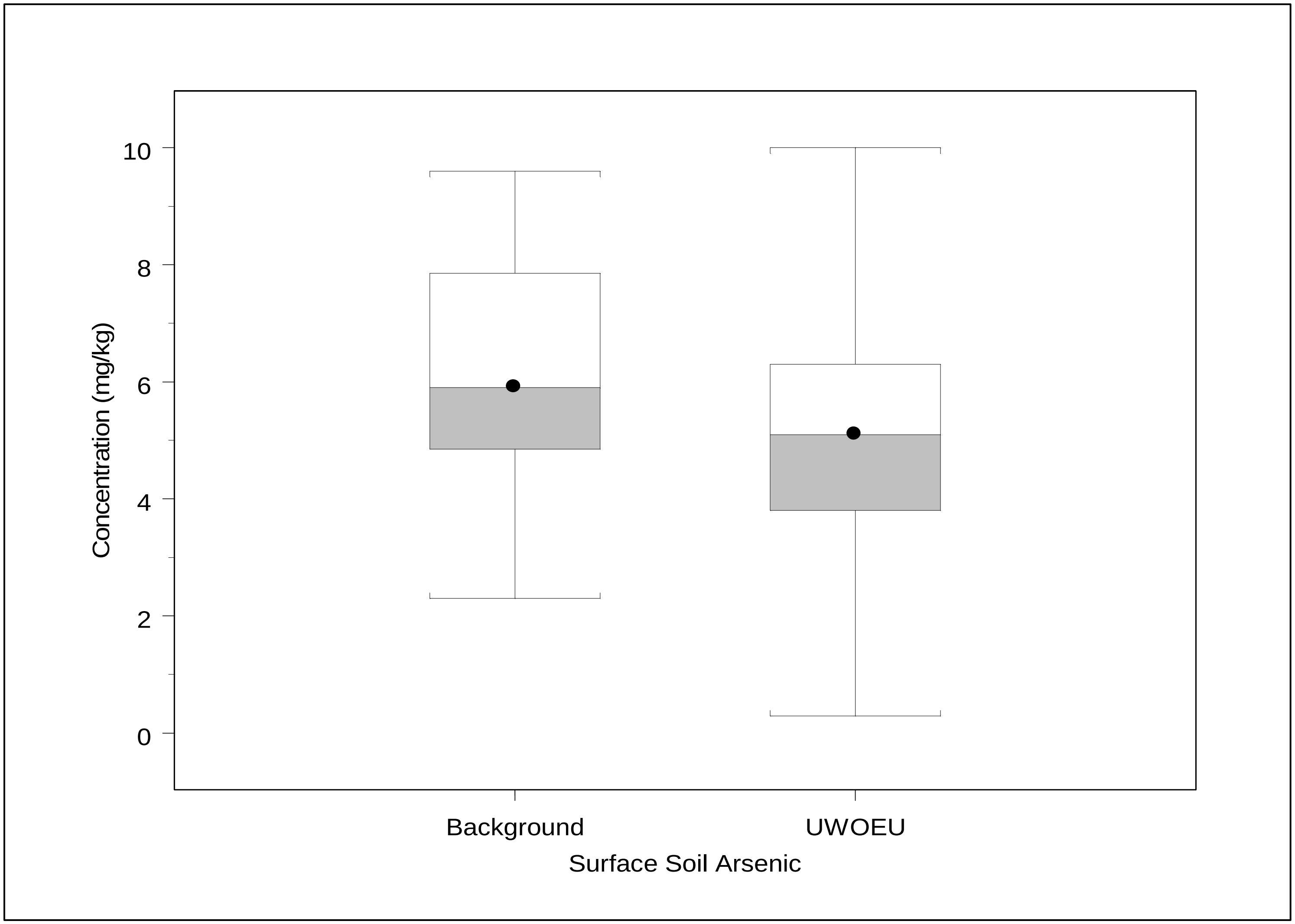
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.2
UWOEU Surface Soil/Surface Sediment Box Plots for Arsenic



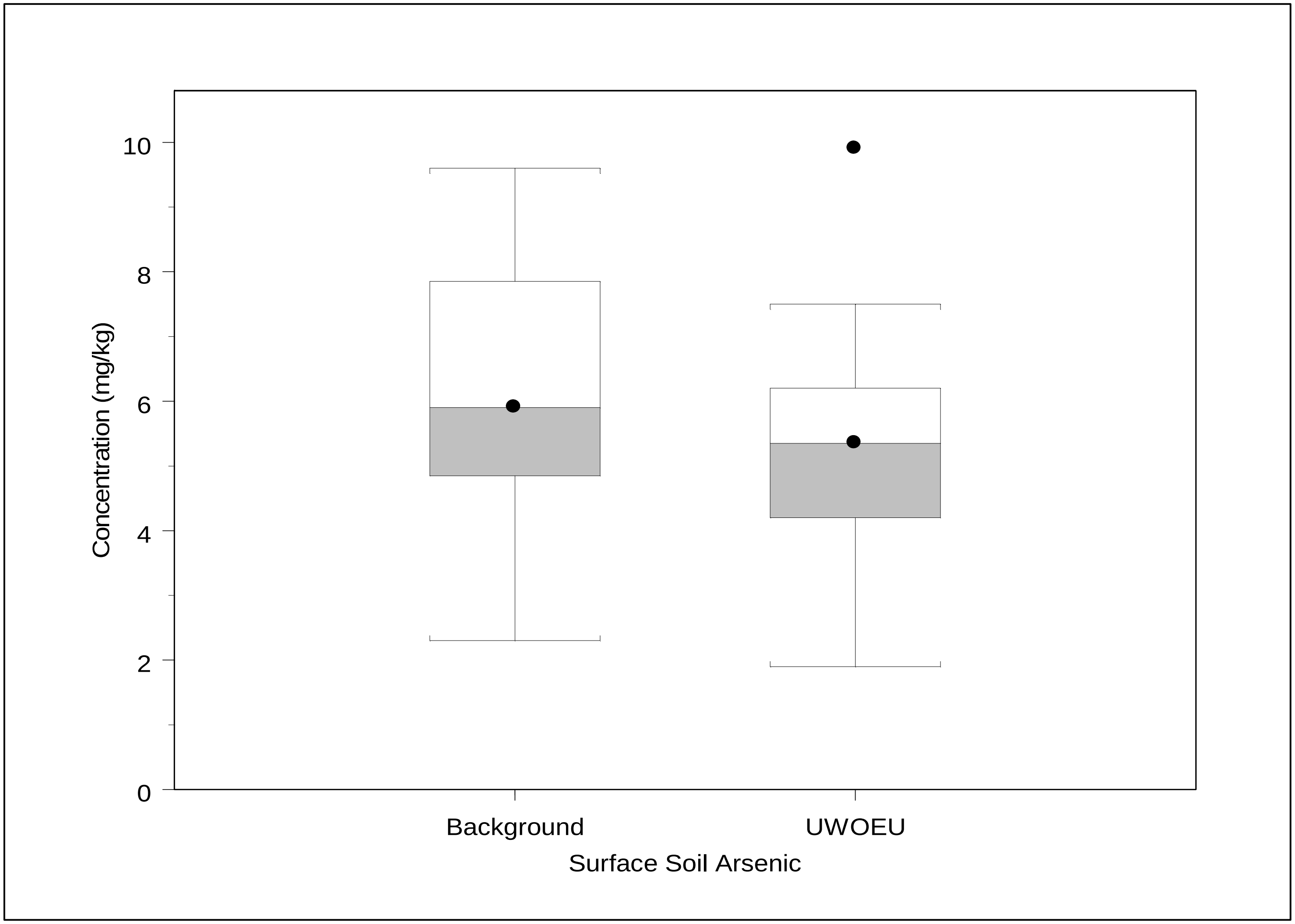
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.3
UWOEU Surface Soil Box Plots for Arsenic



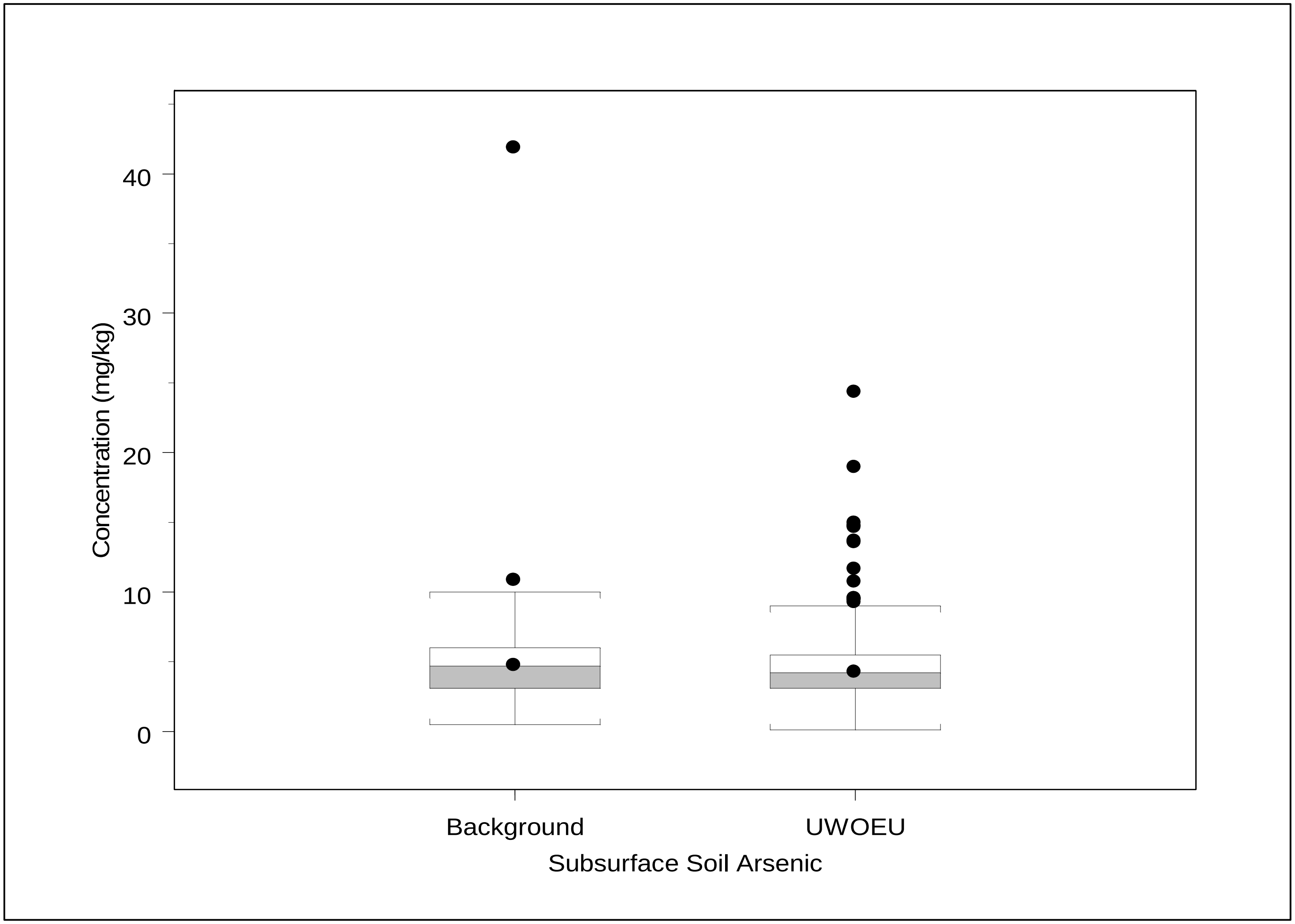
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.4
UWOEU Surface Soil (PMJM) Box Plots for Arsenic



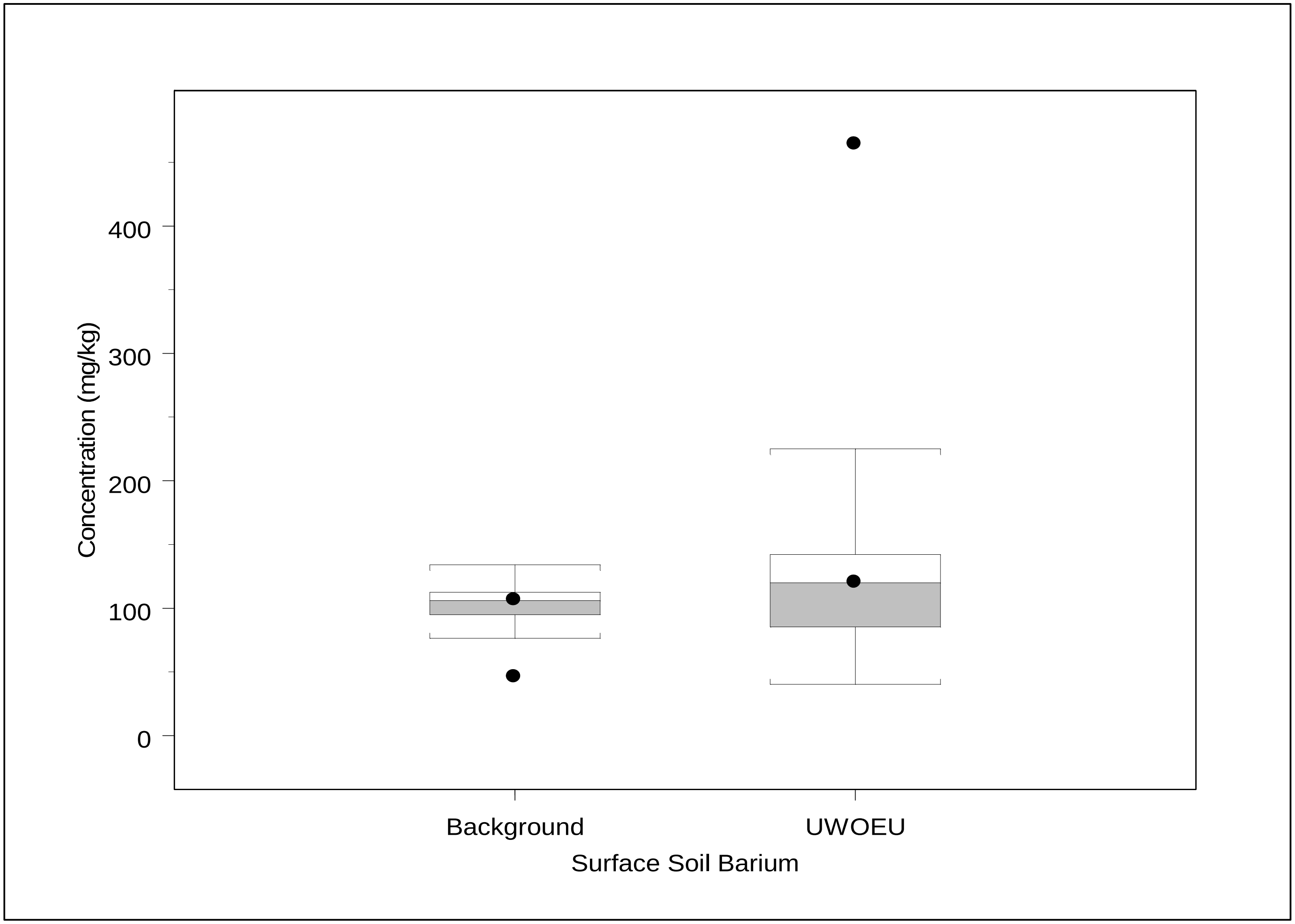
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.5
UWOEU Subsurface Soil Box Plots for Arsenic



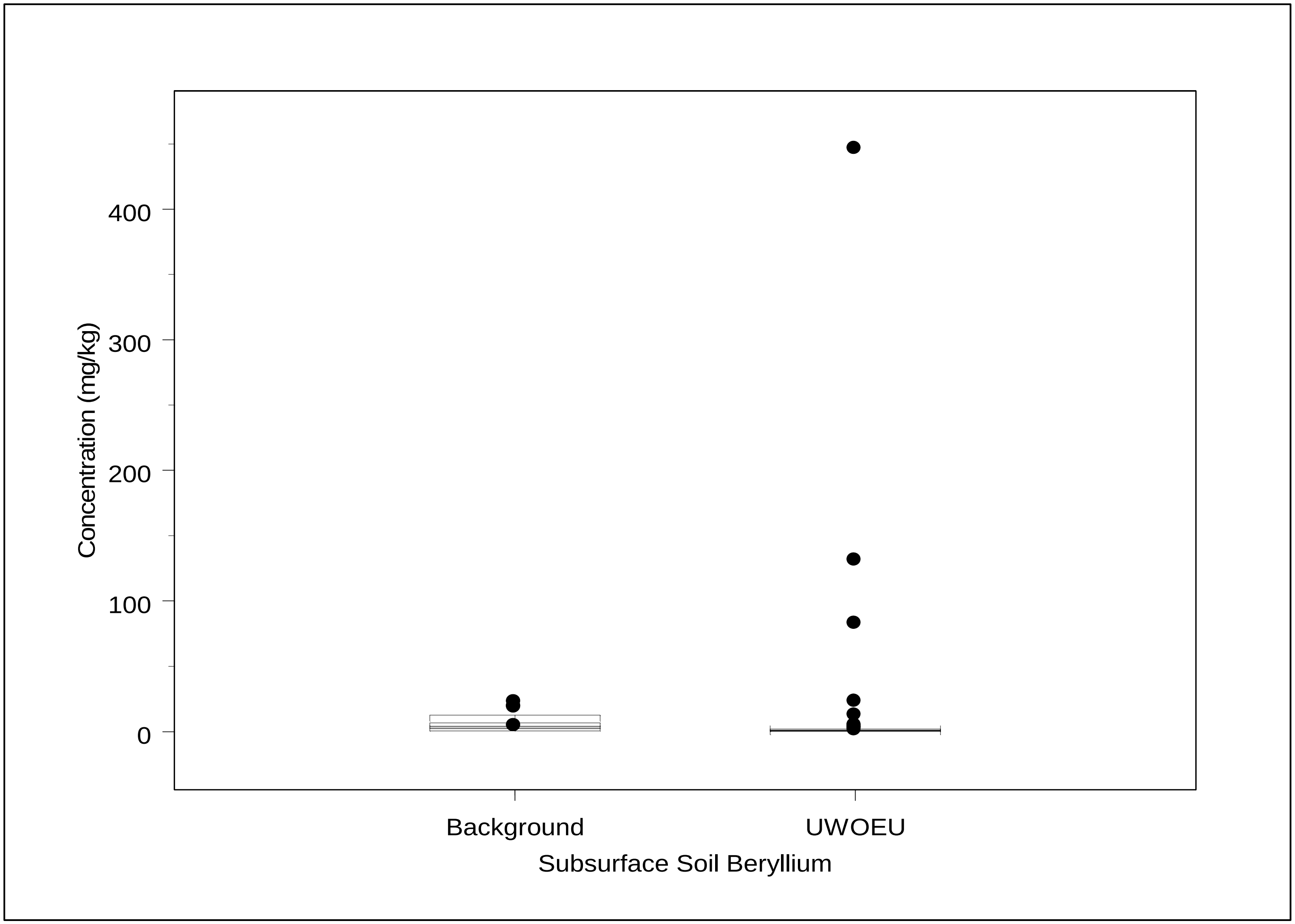
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.6
UWOEU Surface Soil Box Plots for Barium



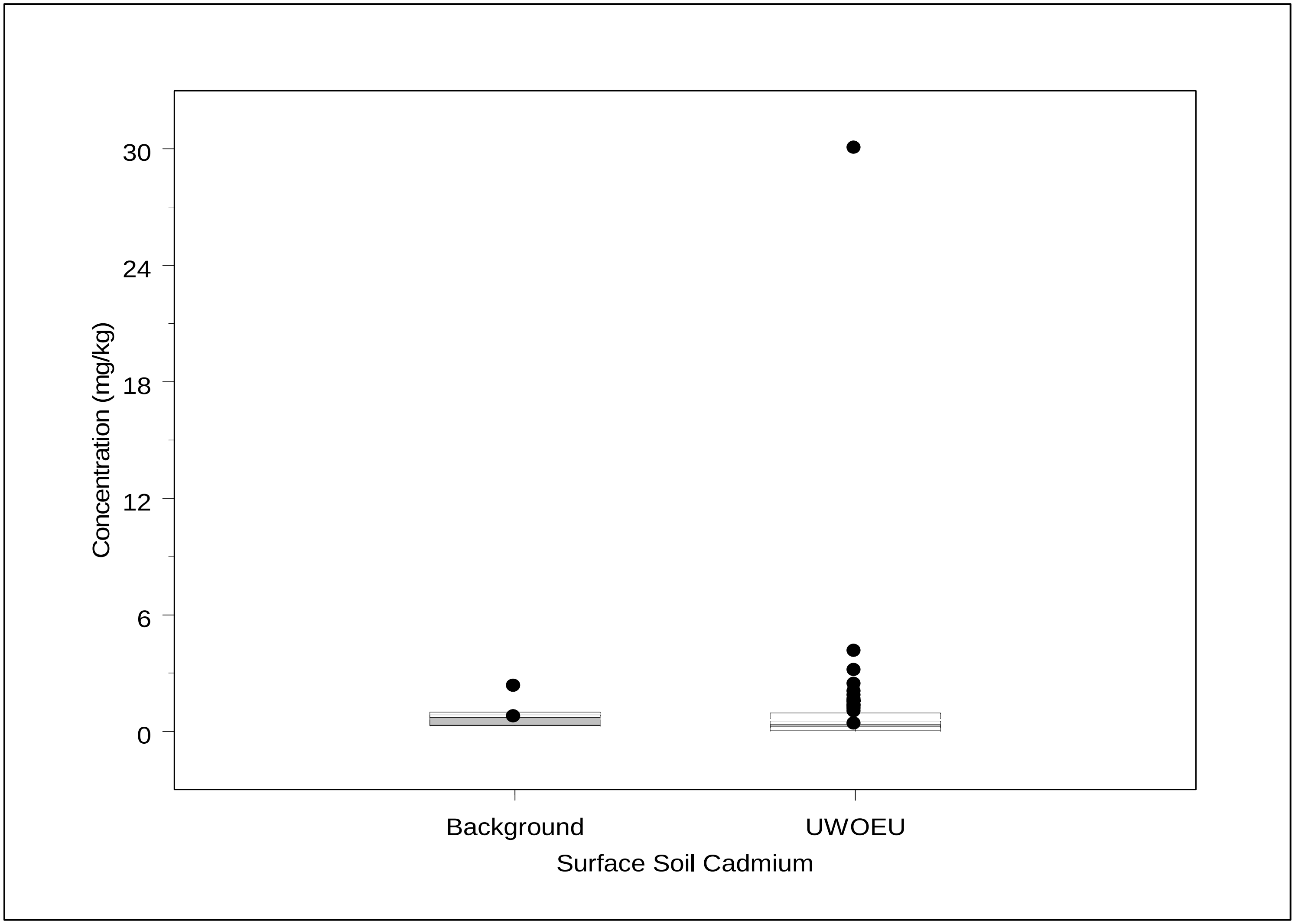
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.7
UWOEU Subsurface Soil Box Plots for Beryllium



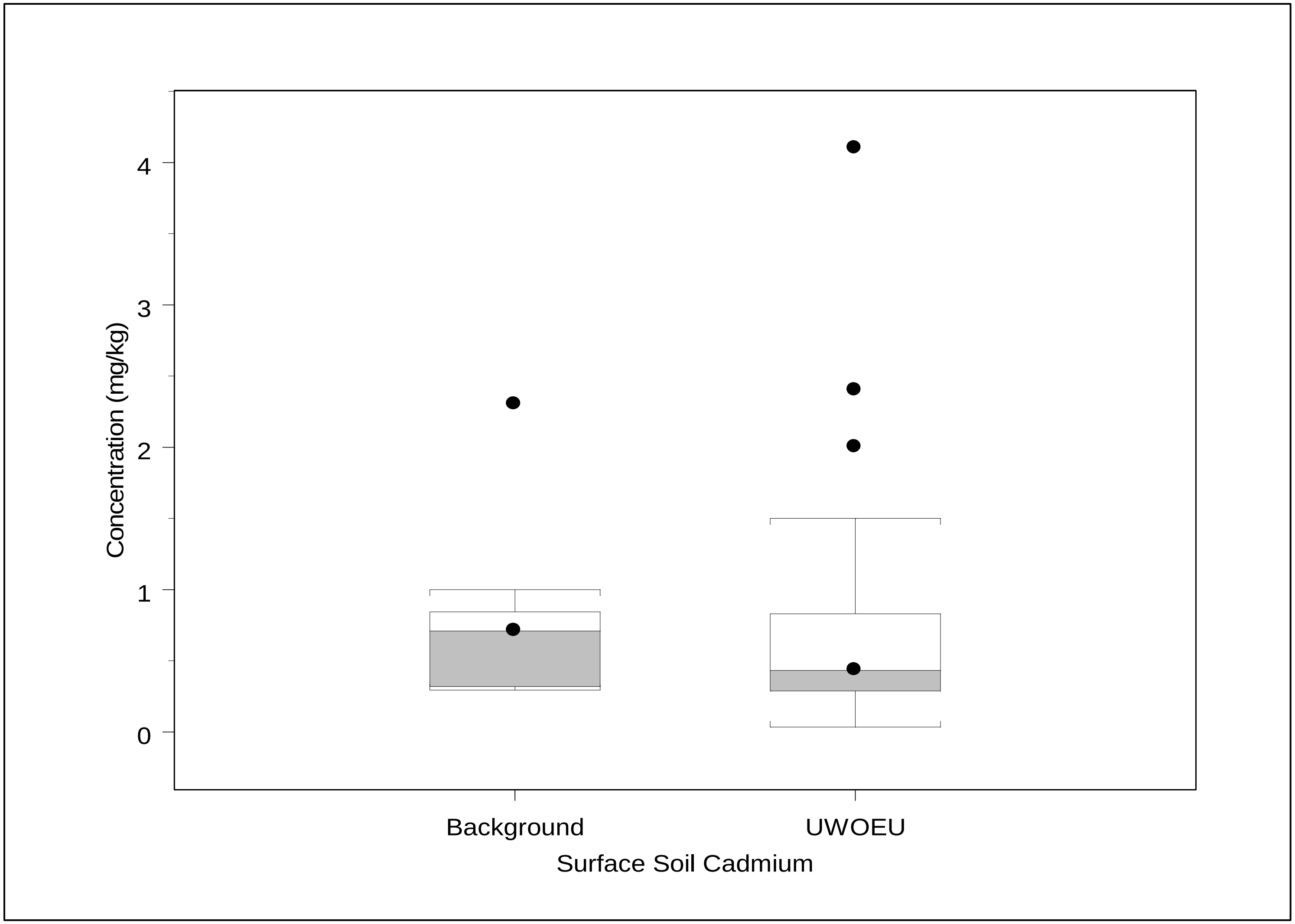
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.8
UWOEU Surface Soil Box Plots for Cadmium



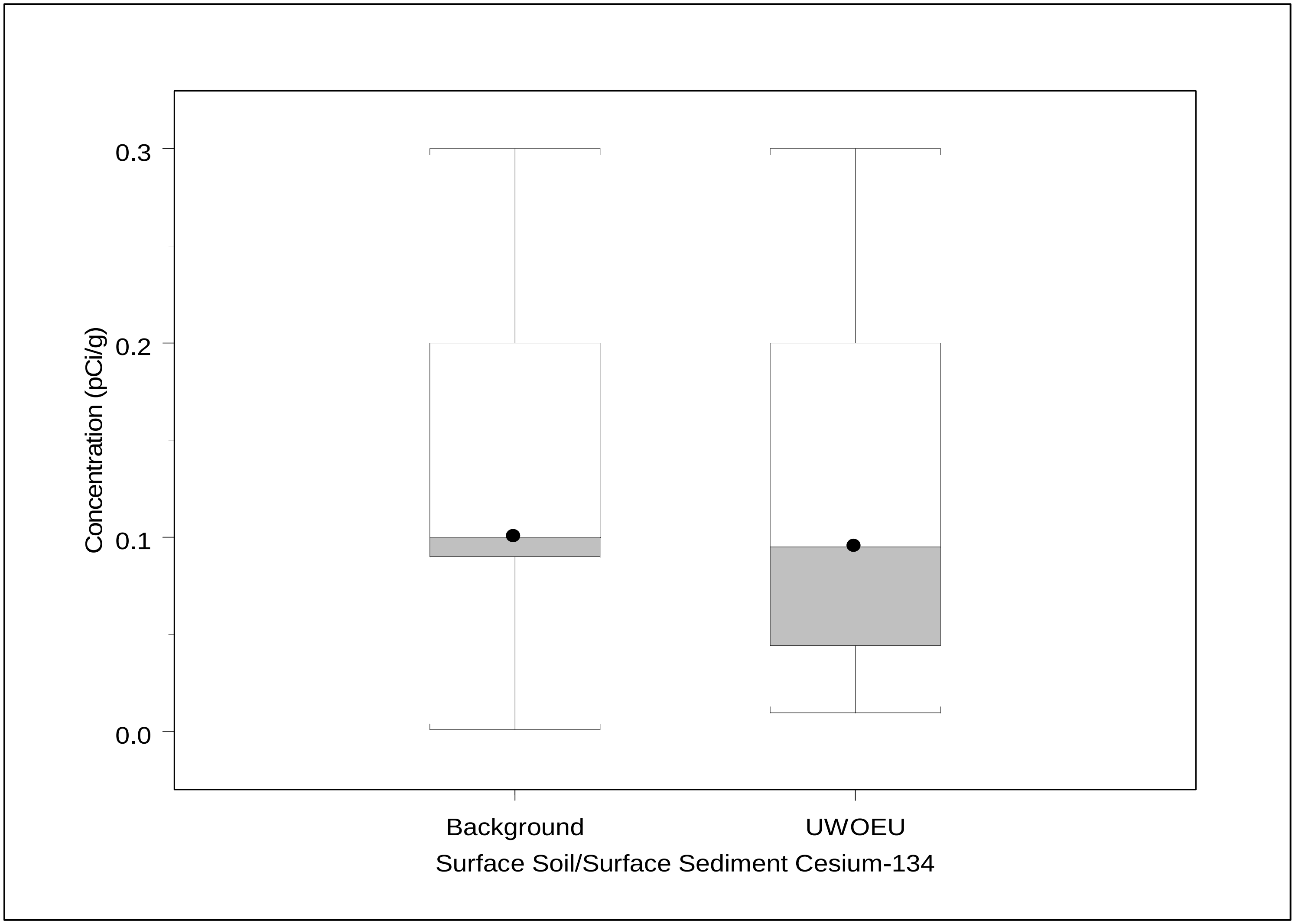
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.9
UWOEU Surface Soil (PMJM) Box Plots for Cadmium



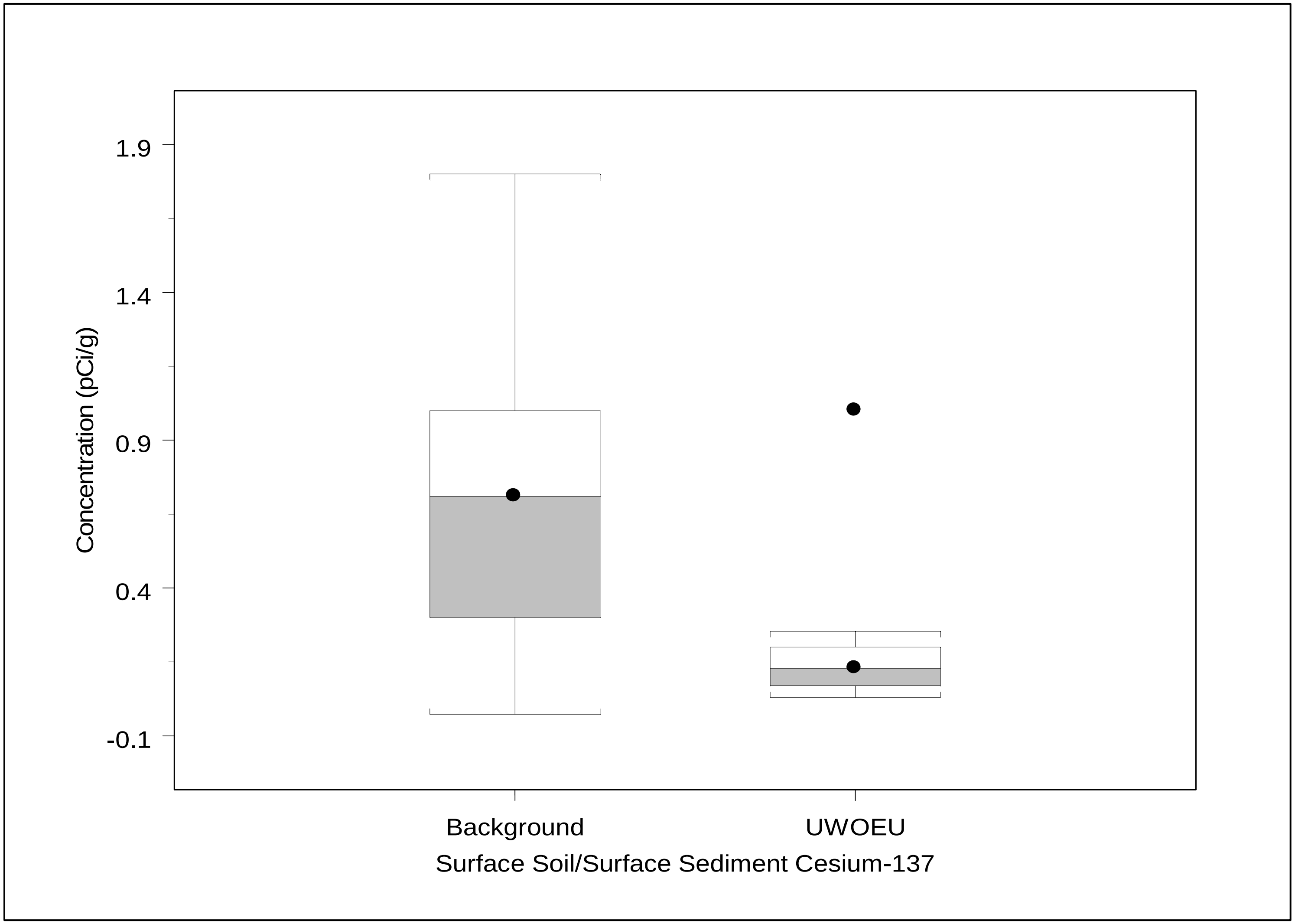
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.10
UWOEU Surface Soil/Surface Sediment Box Plots for Cesium-134



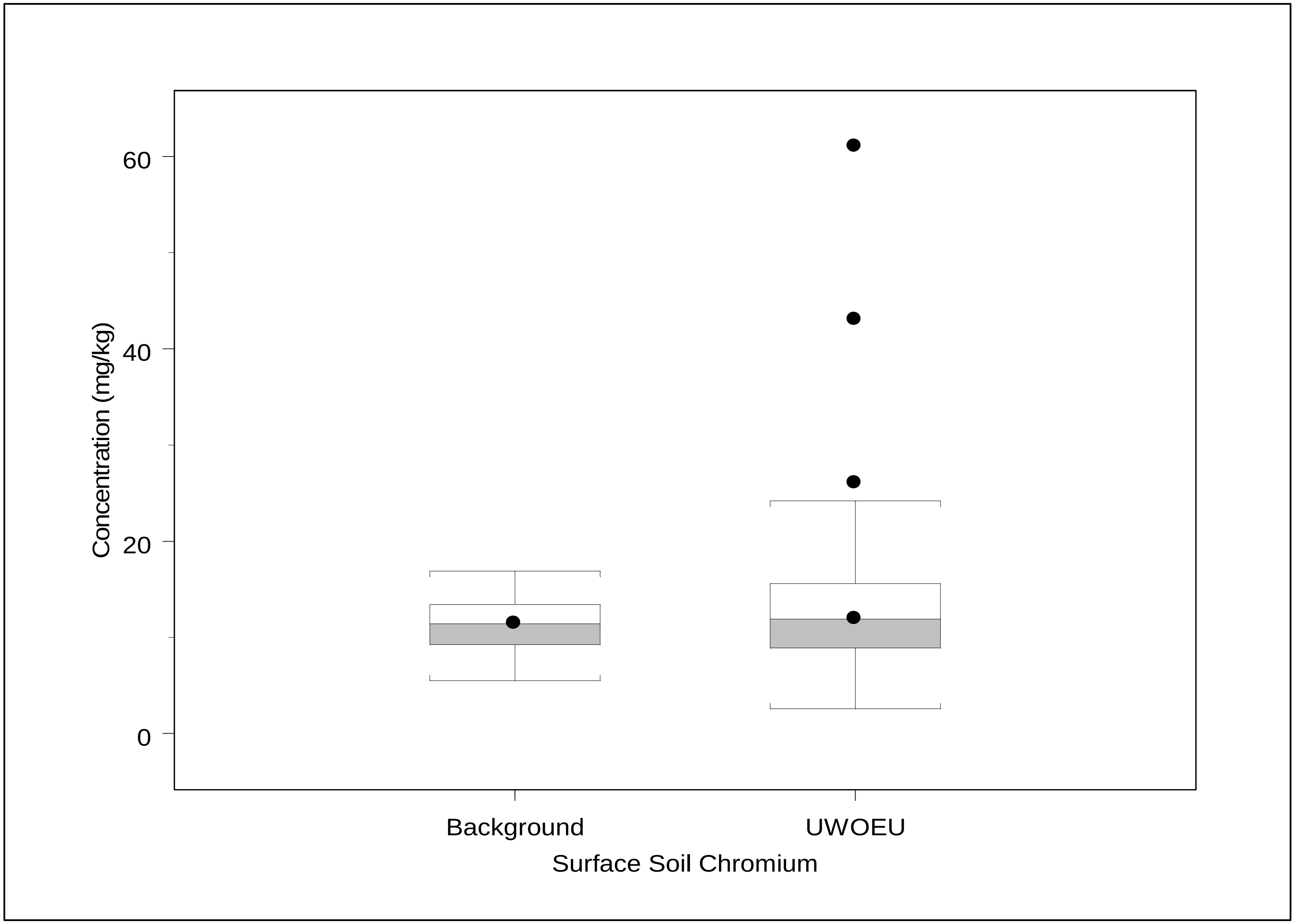
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.11
UWOEU Surface Soil/Surface Sediment Box Plots for Cesium-137



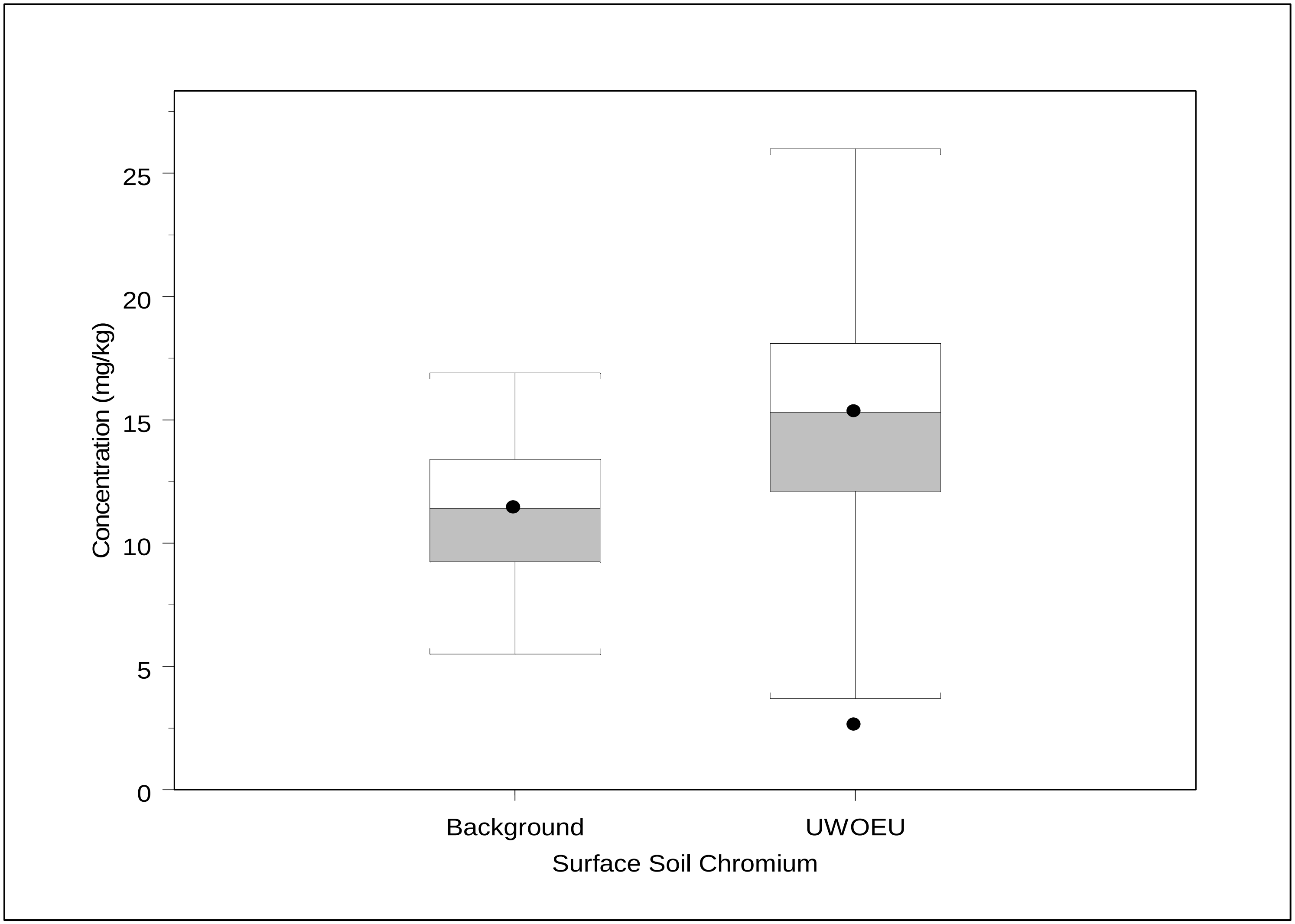
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.12
UWOEU Surface Soil Box Plots for Chromium



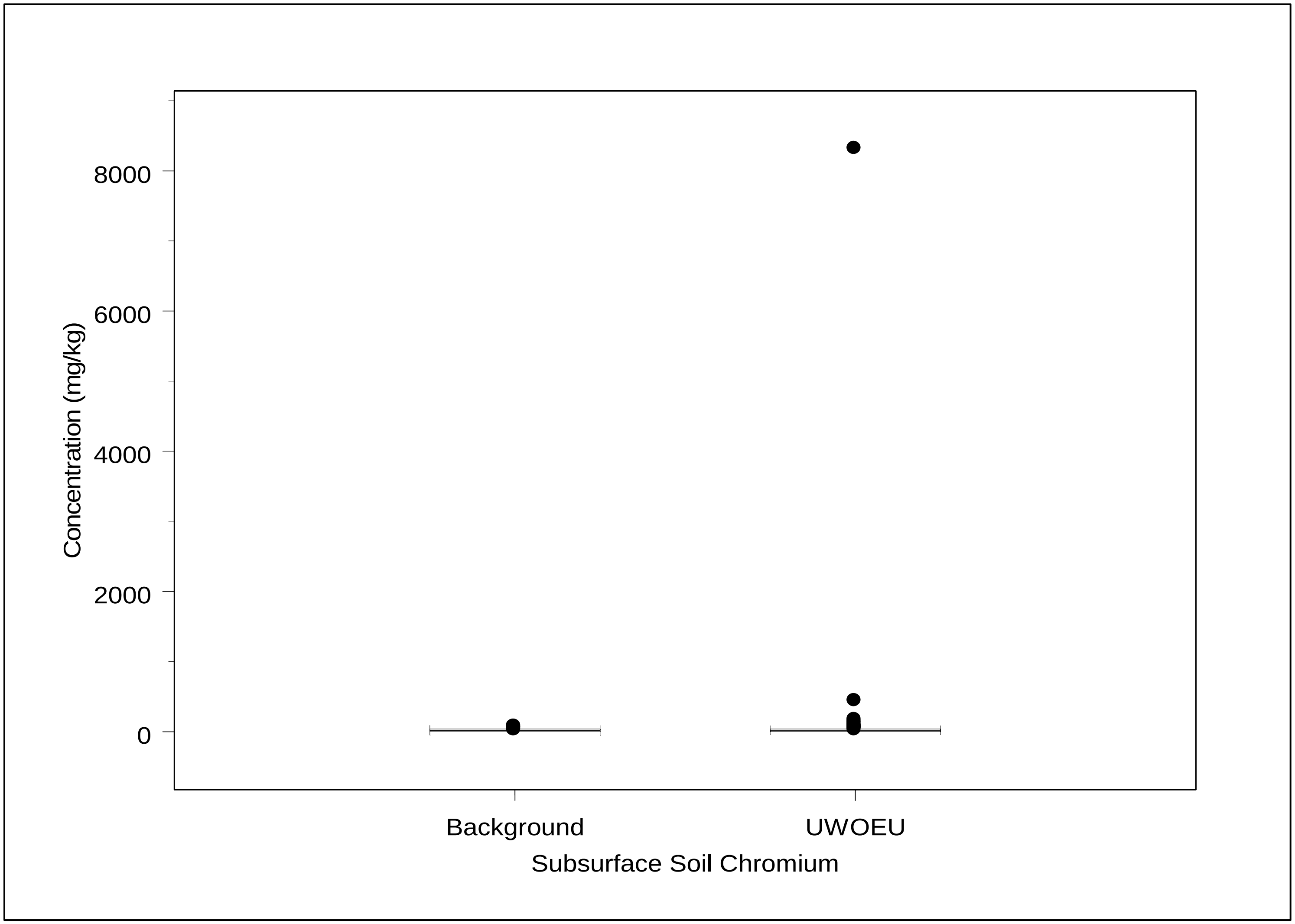
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.13
UWOEU Surface Soil (PMJM) Box Plots for Chromium



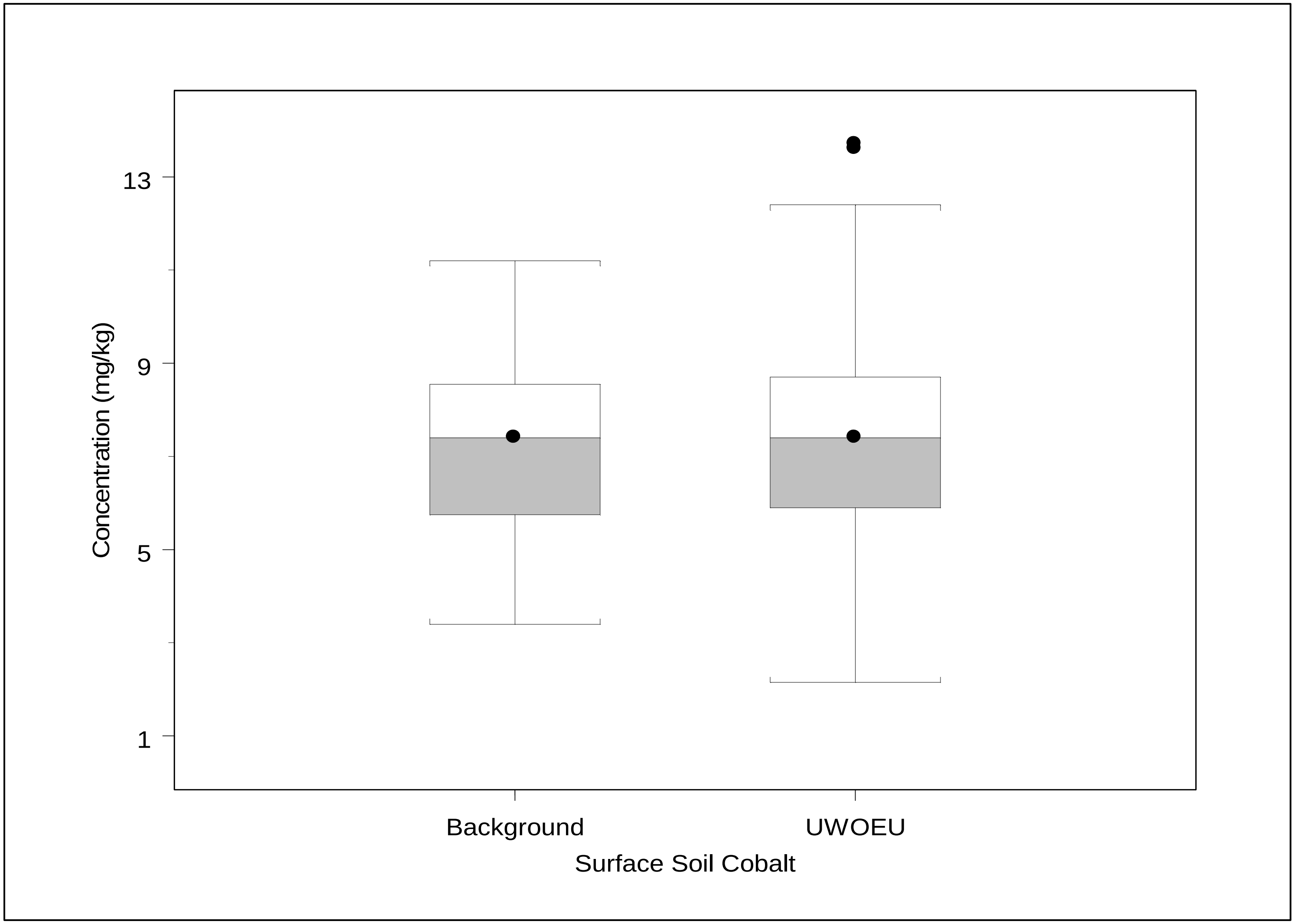
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.14
UWOEU Subsurface Soil Box Plots for Chromium



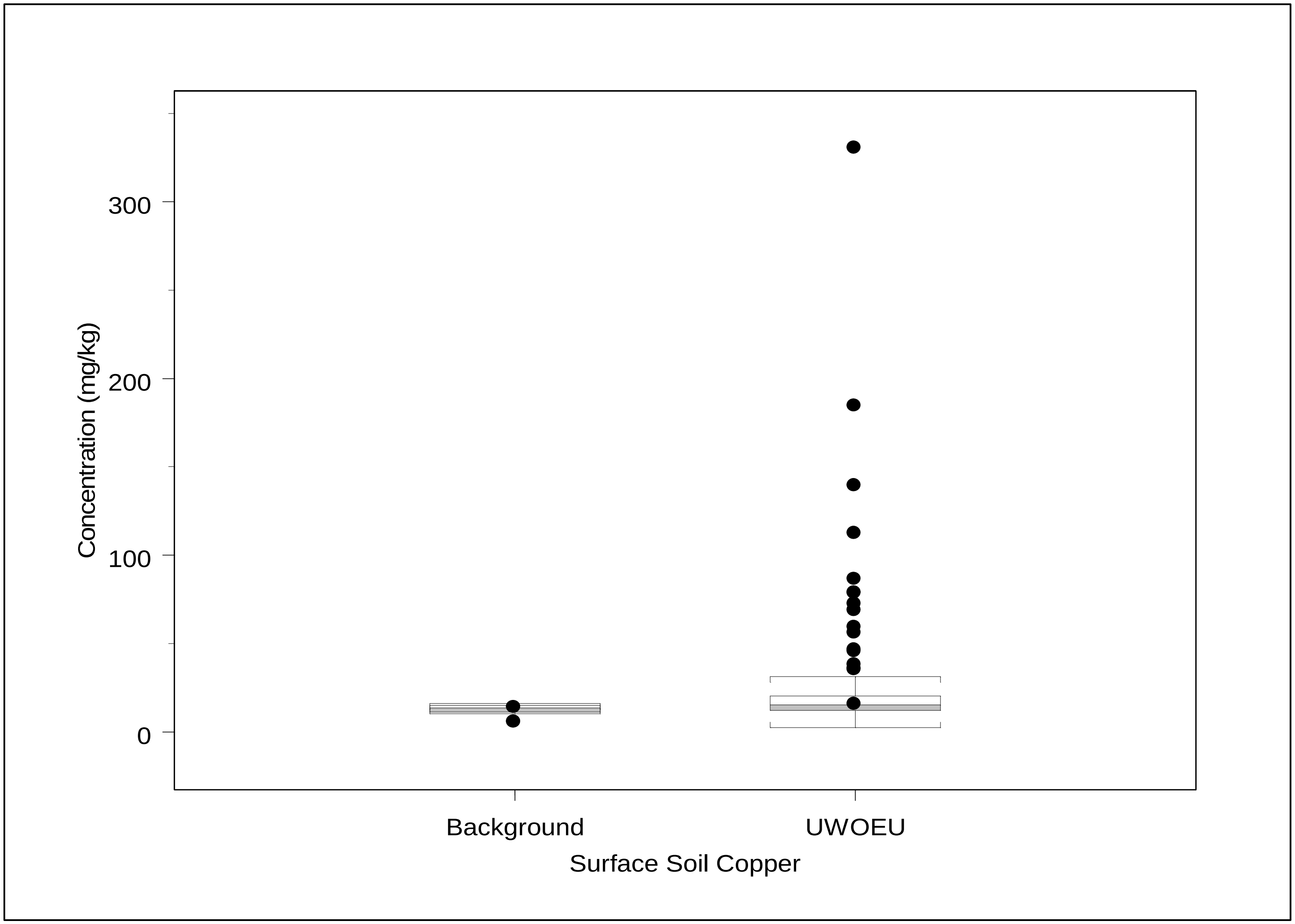
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.15
UWOEU Surface Soil Box Plots for Cobalt



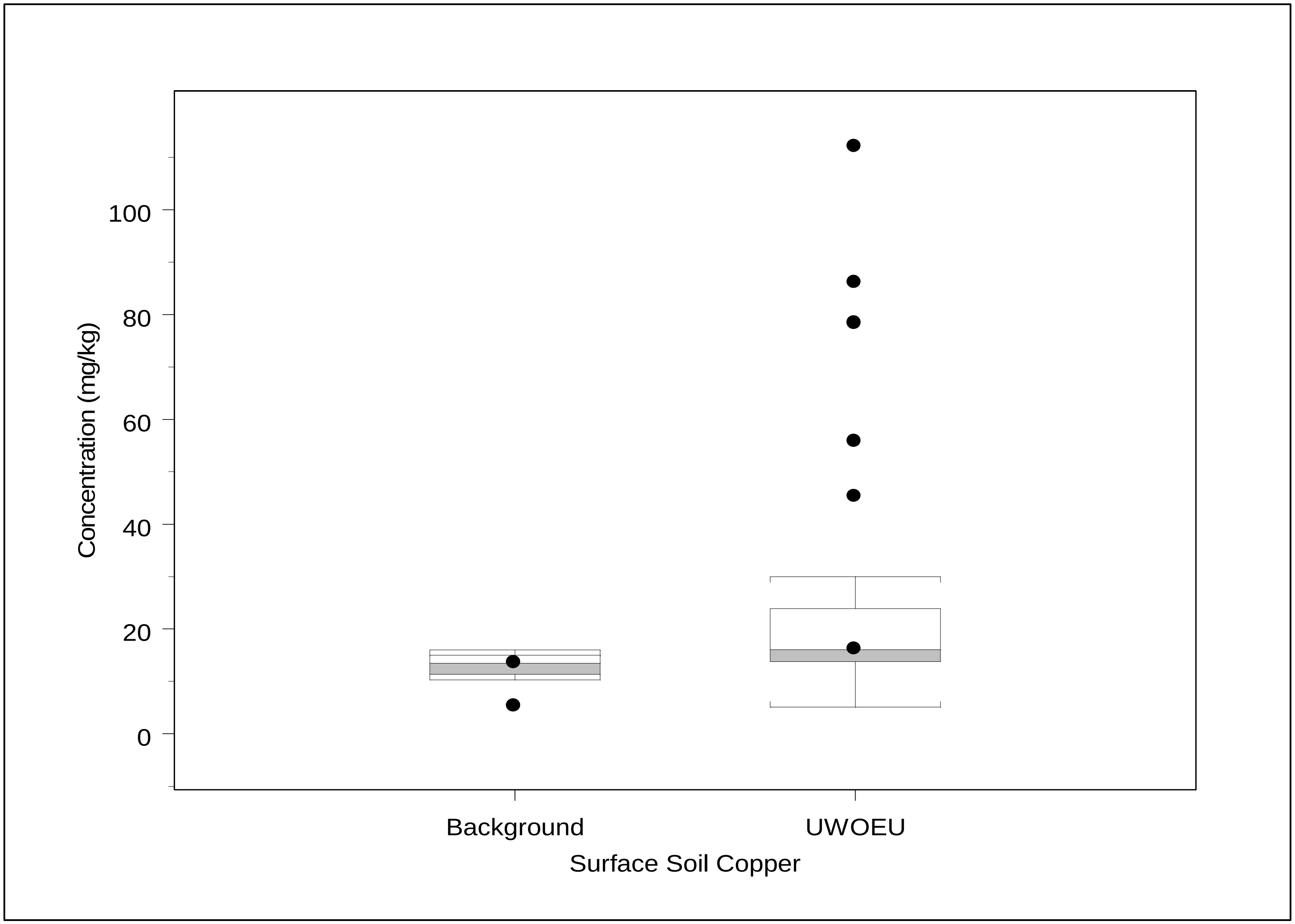
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.16
UWOEU Surface Soil Box Plots for Copper



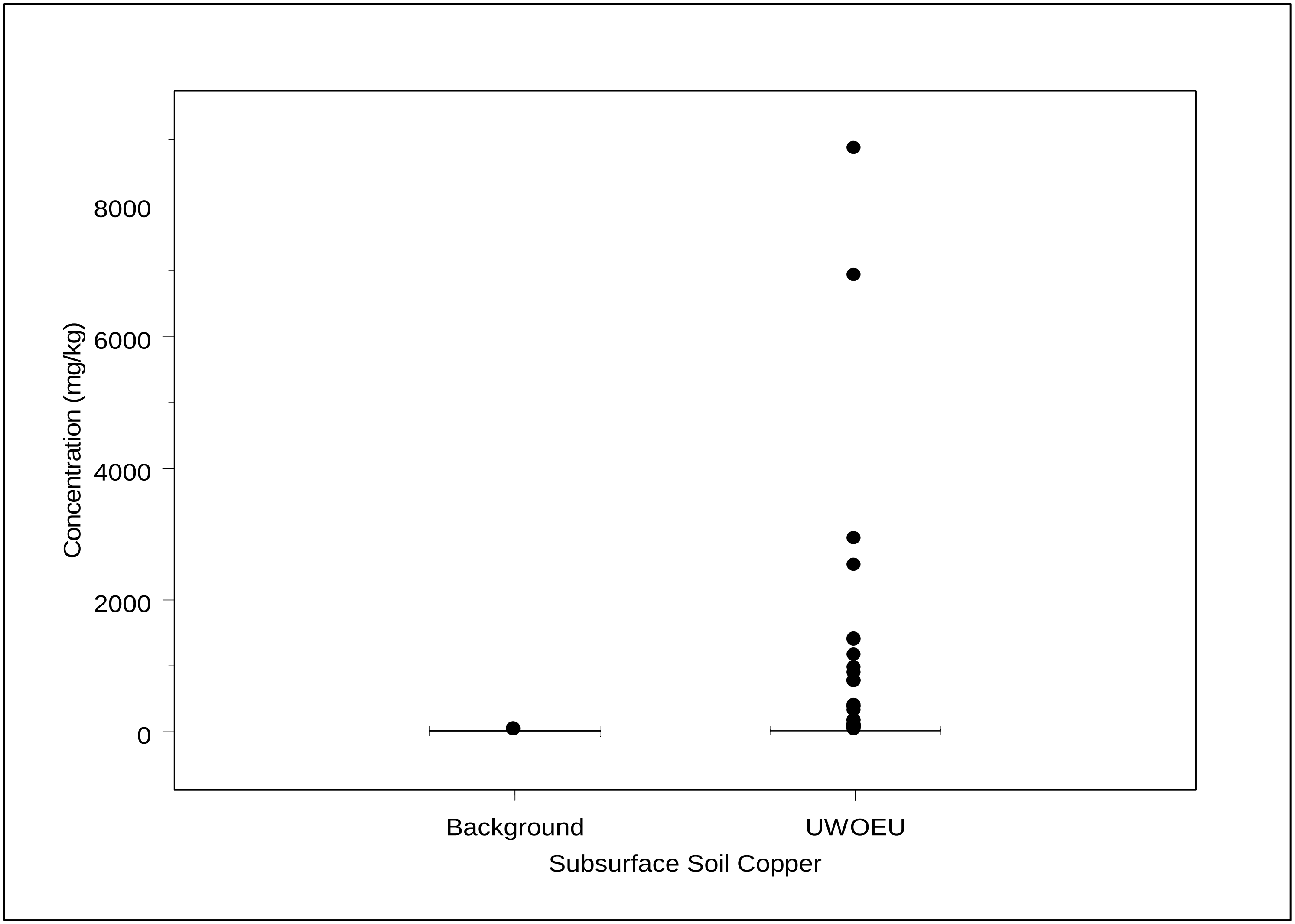
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.17
UWOEU Surface Soil (PMJM) Box Plots for Copper



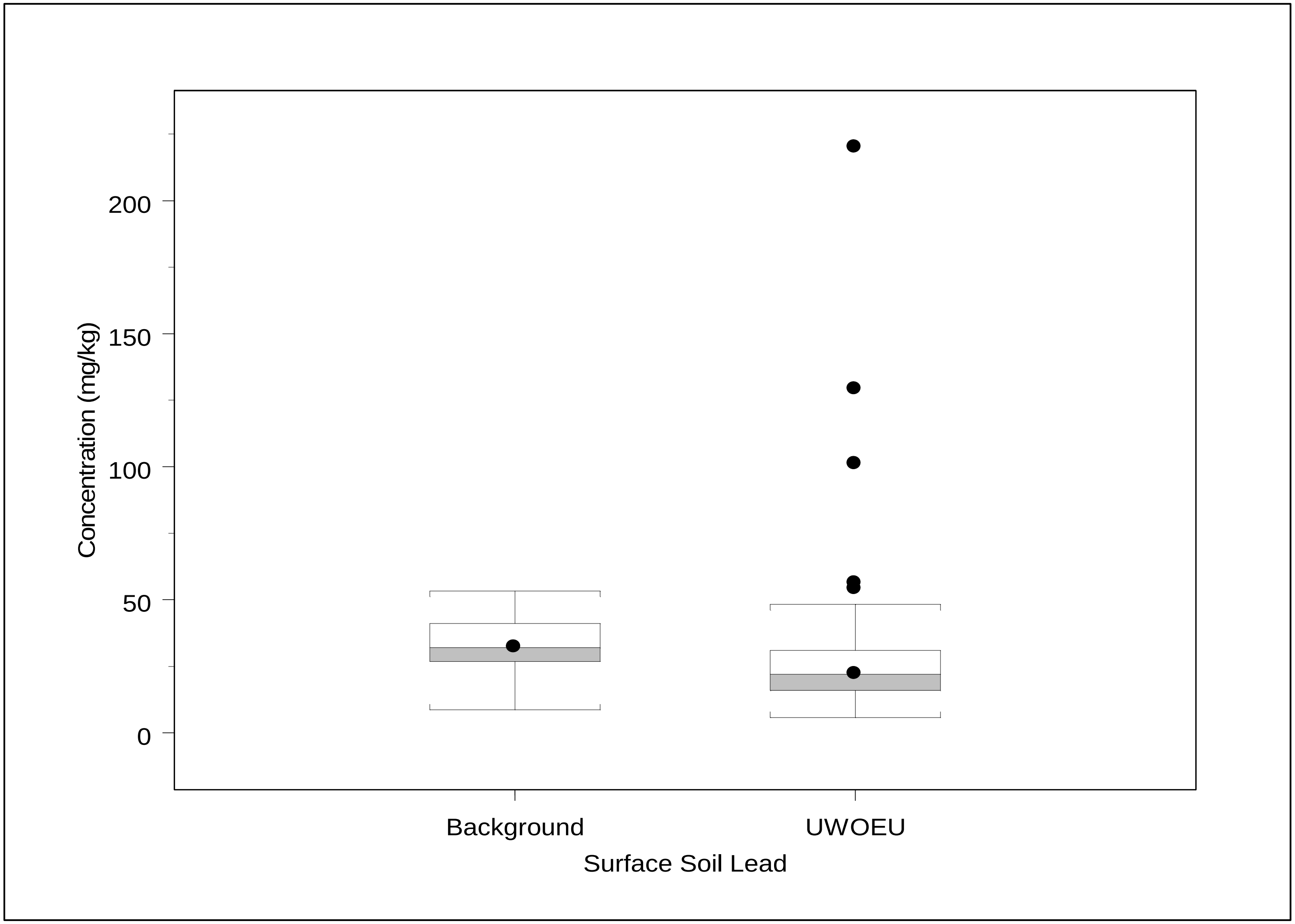
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.18
UWOEU Subsurface Soil Box Plots for Copper



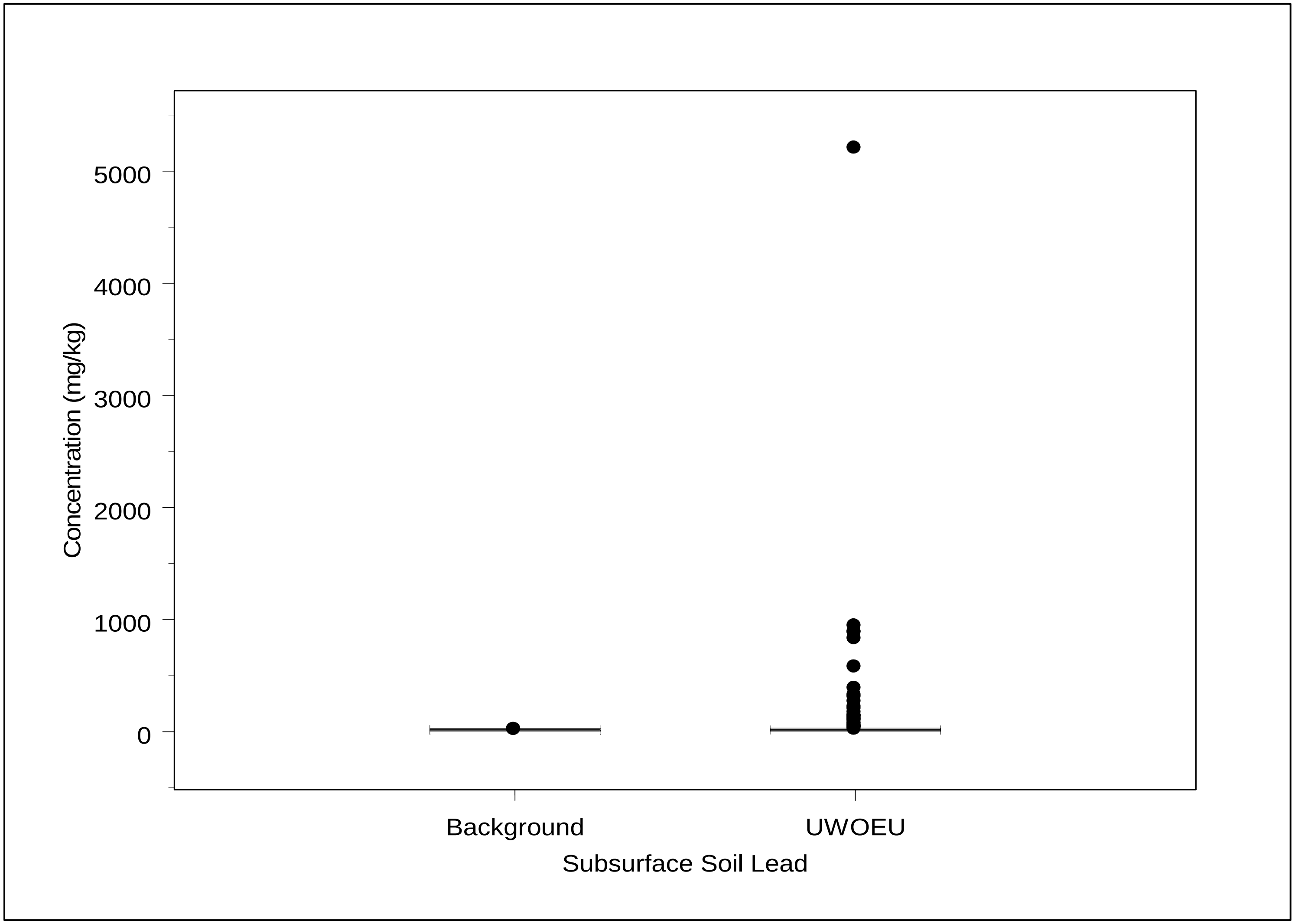
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.19
UWOEU Surface Soil Box Plots for Lead



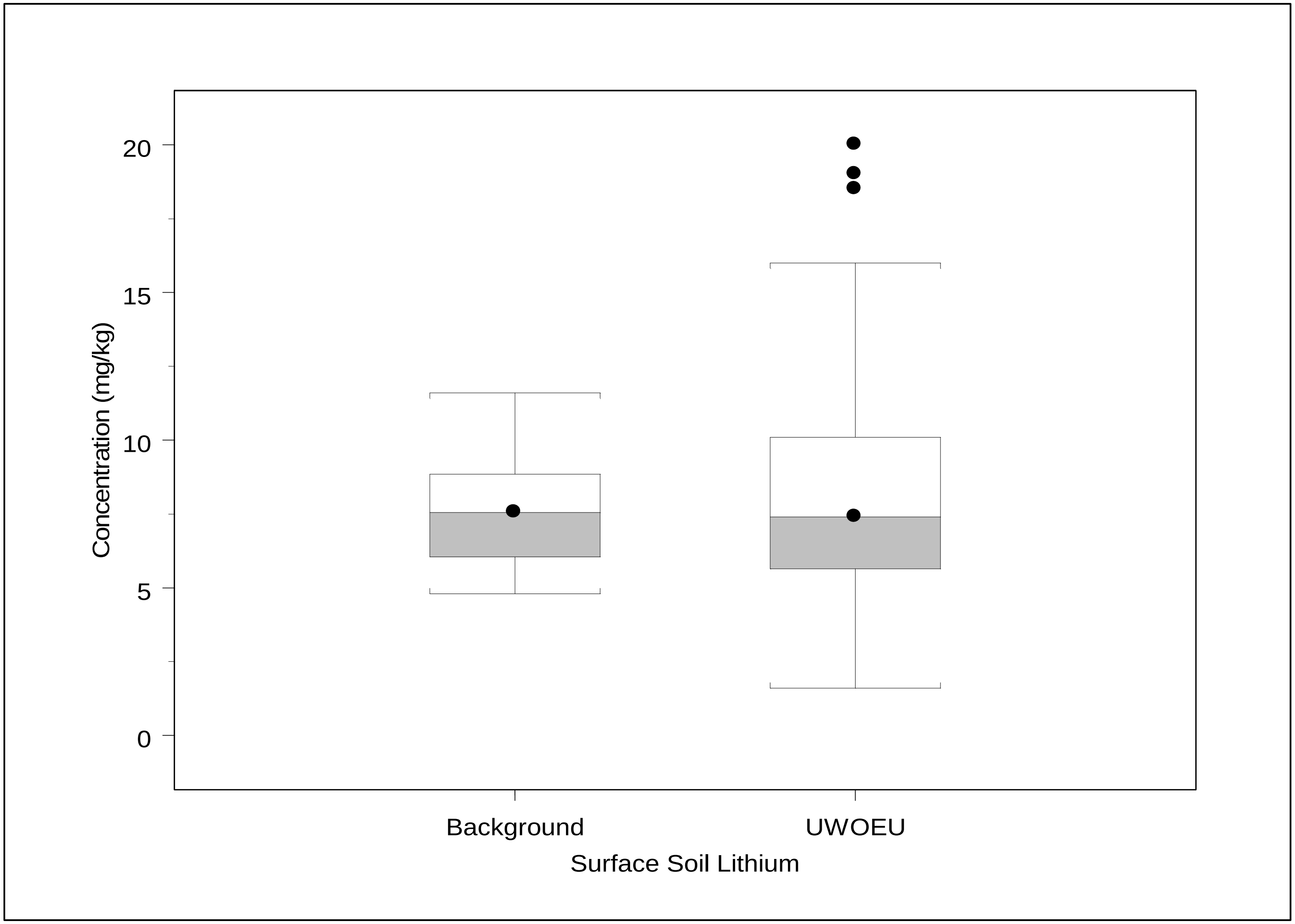
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.20
UWOEU Subsurface Soil Box Plots for Lead



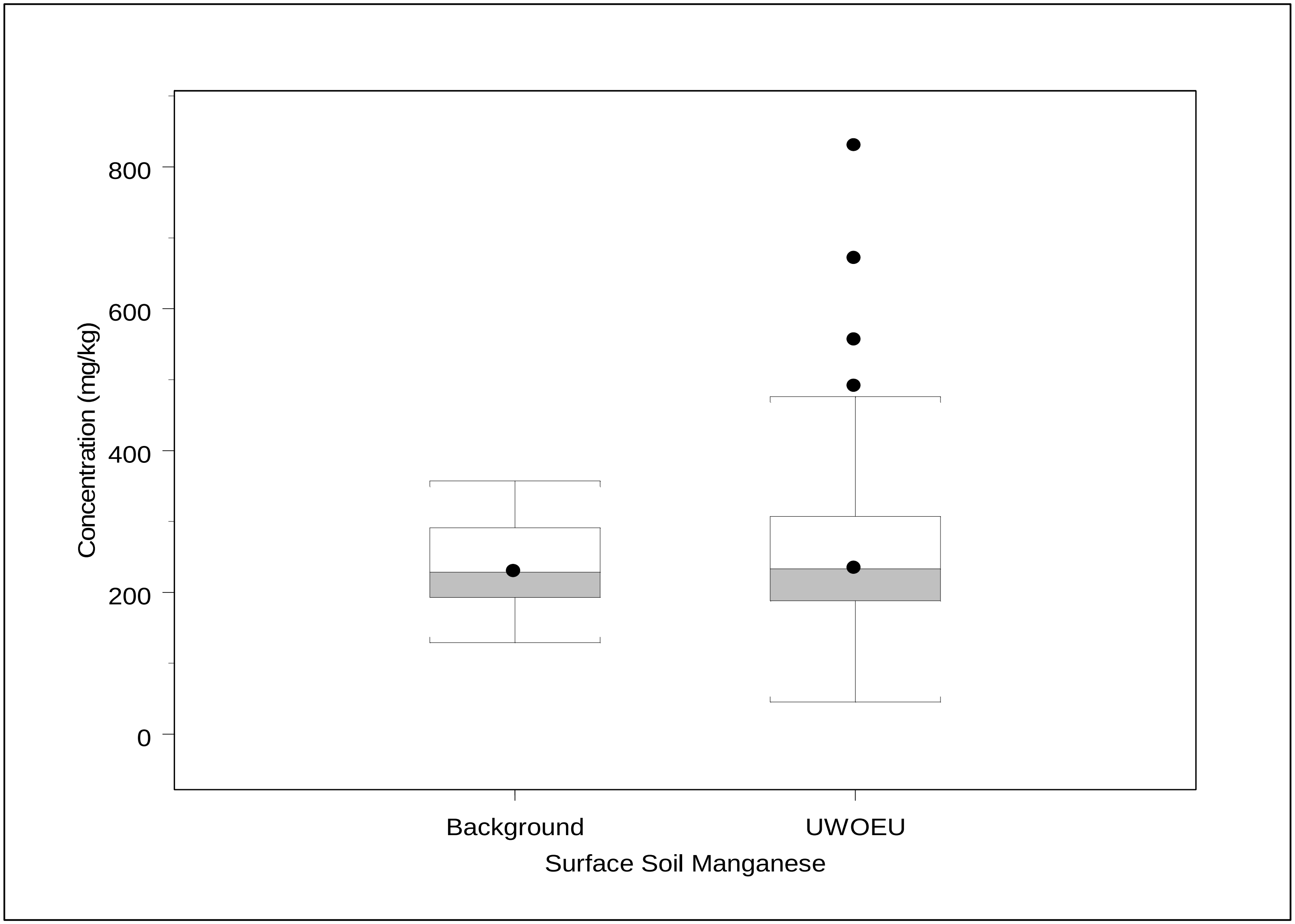
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.21
UWOEU Surface Soil Box Plots for Lithium



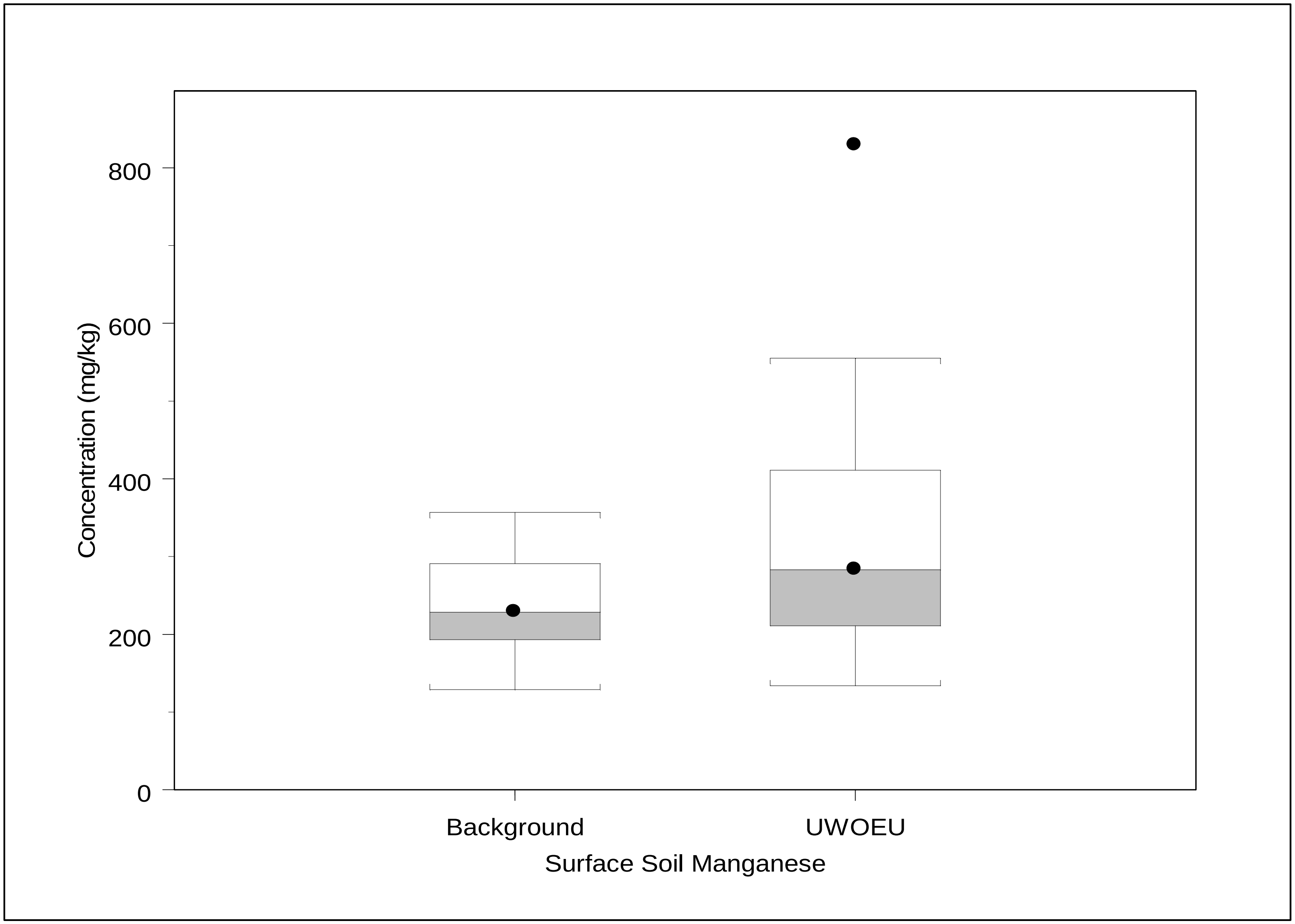
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.22
UWOEU Surface Soil Box Plots for Manganese



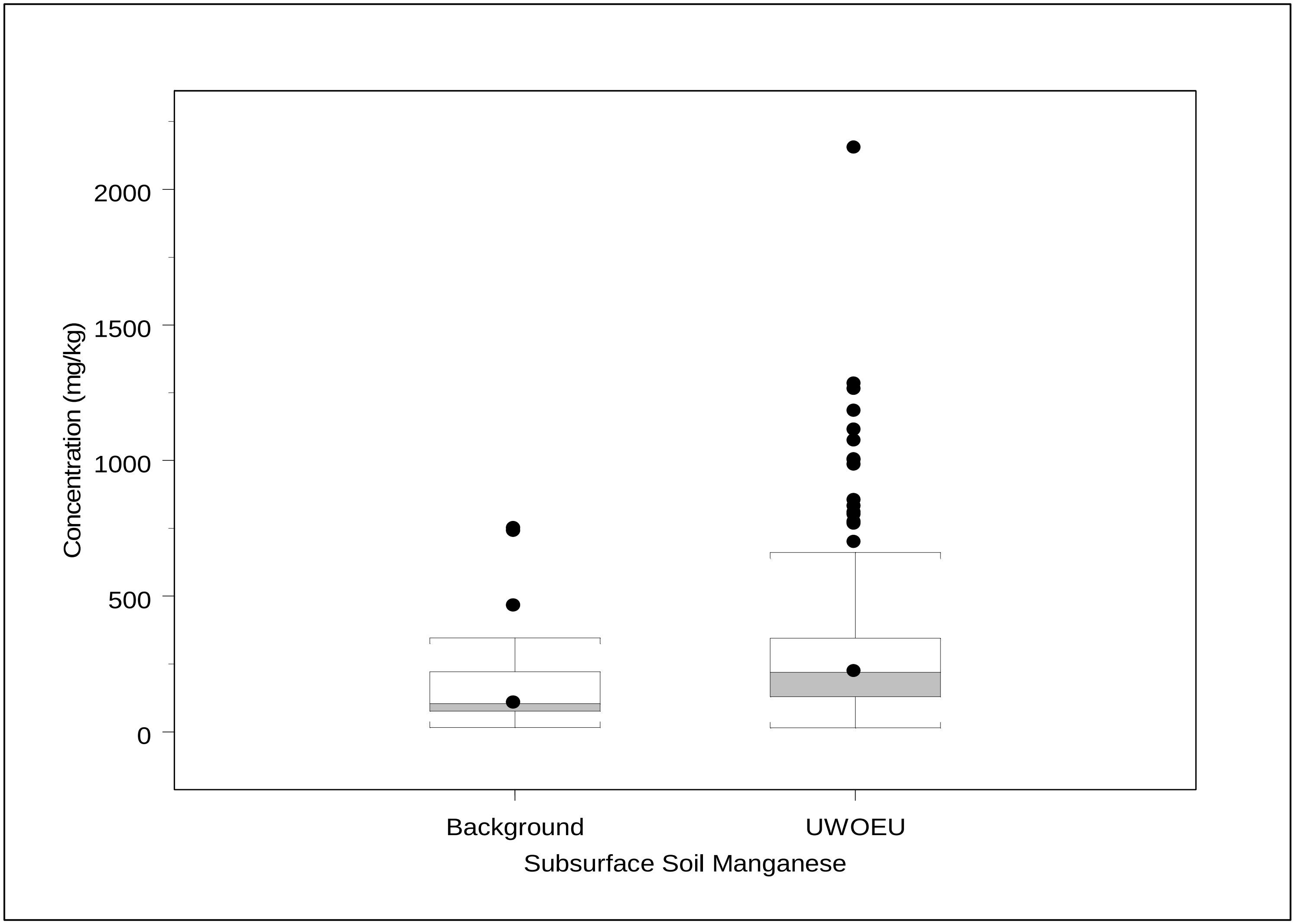
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.23
UWOEU Surface Soil (PMJM) Box Plots for Manganese



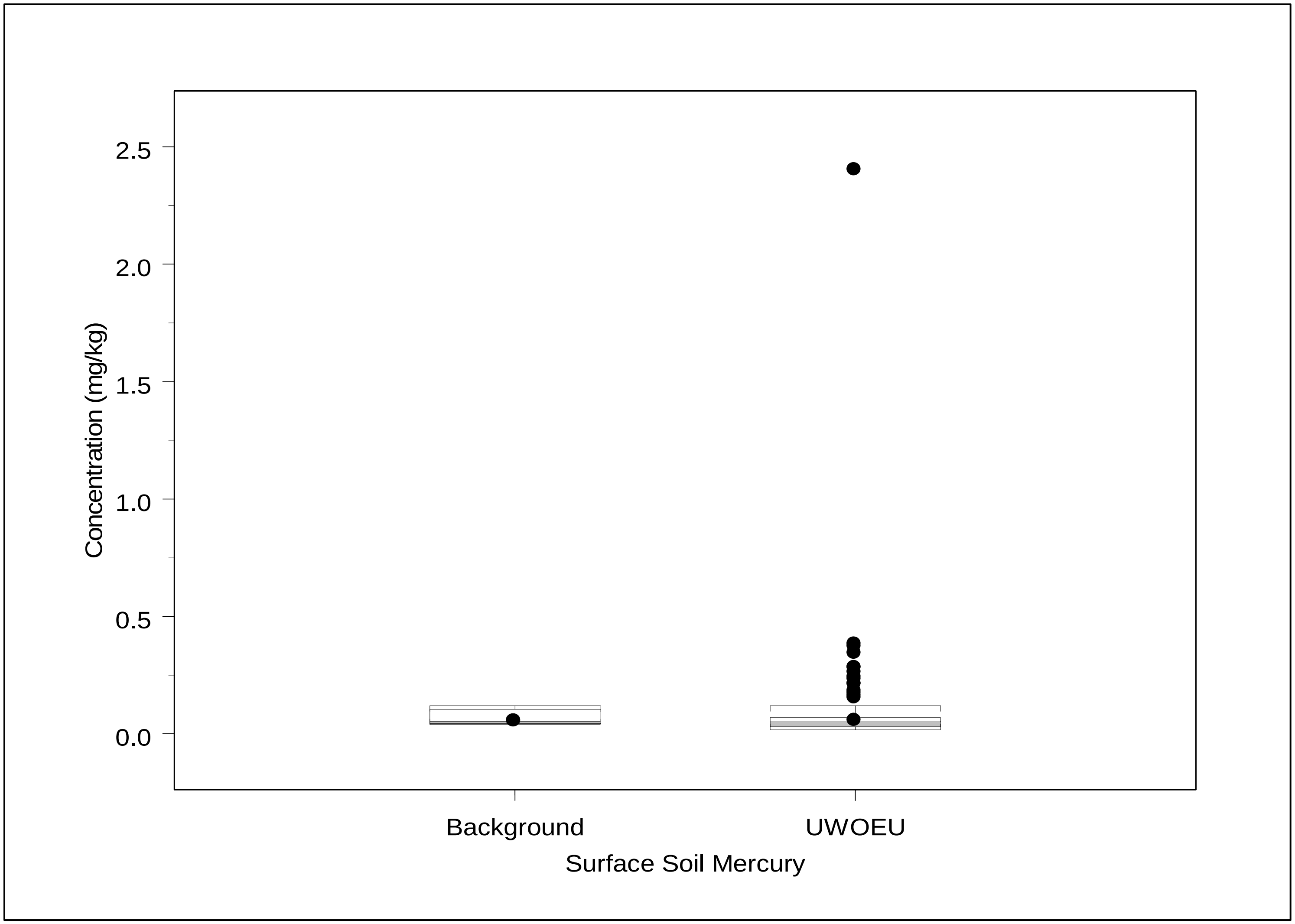
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.24
UWOEU Subsurface Soil Box Plots for Manganese



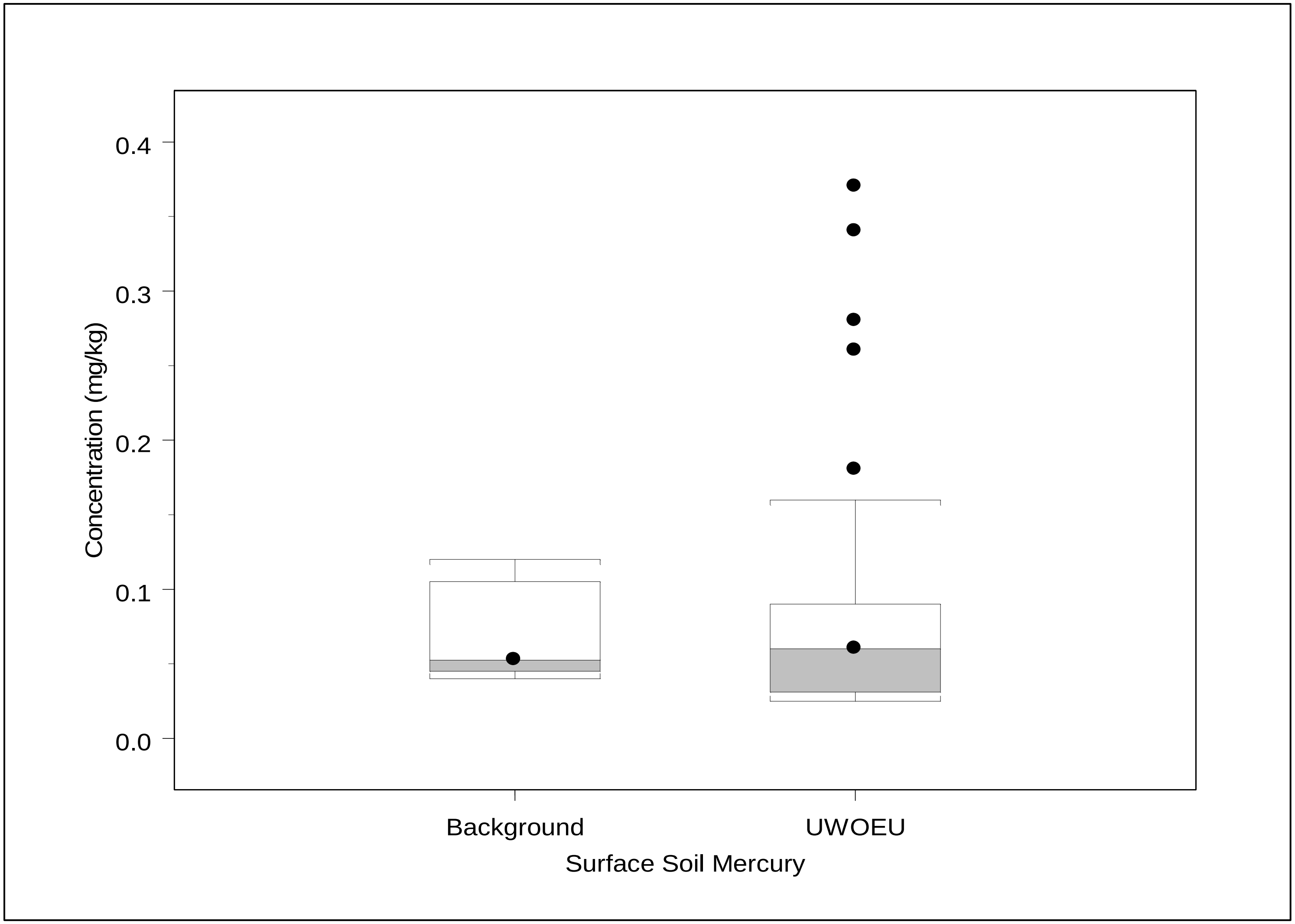
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.25
UWOEU Surface Soil Box Plots for Mercury



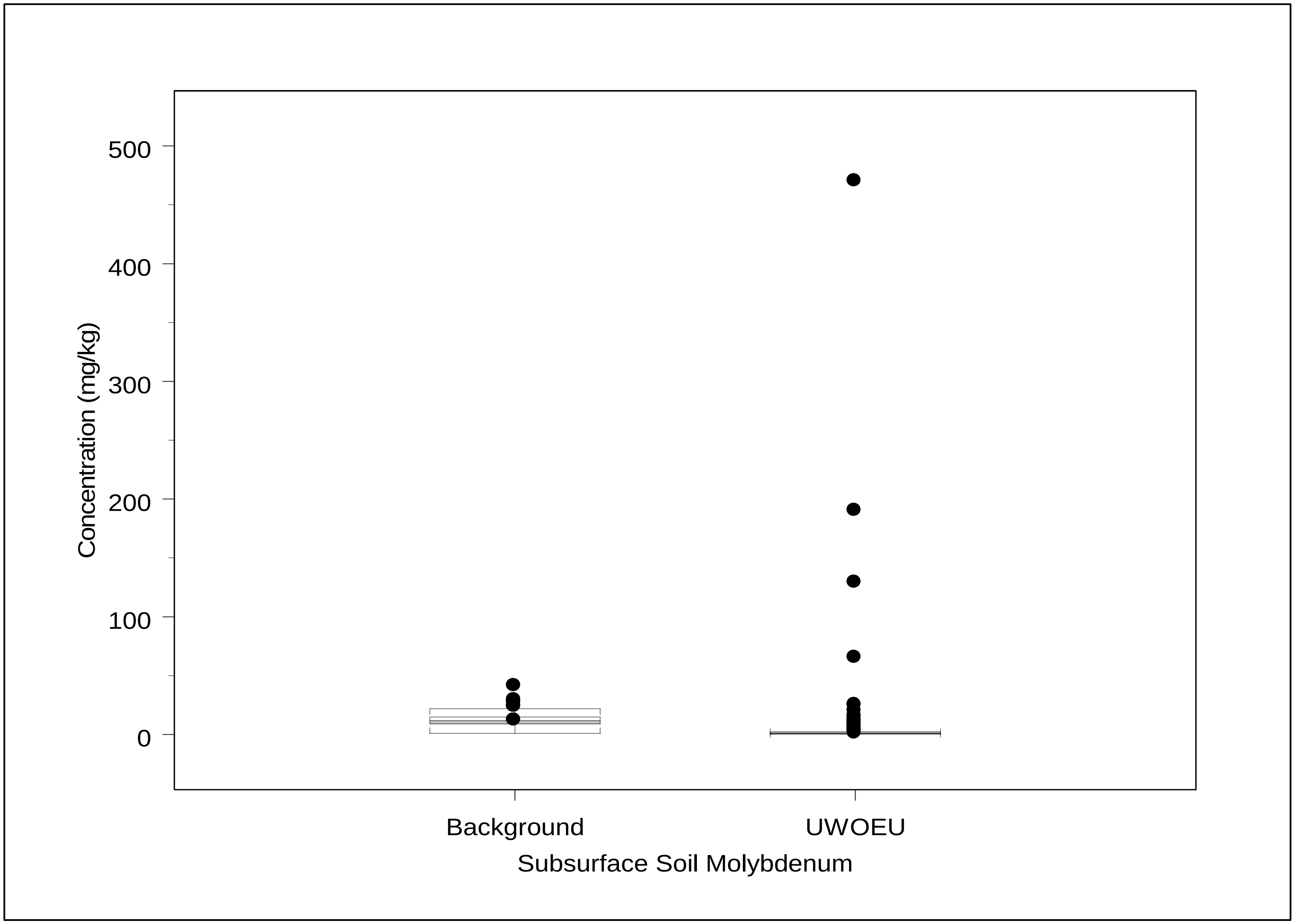
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.26
UWOEU Surface Soil (PMJM) Box Plots for Mercury



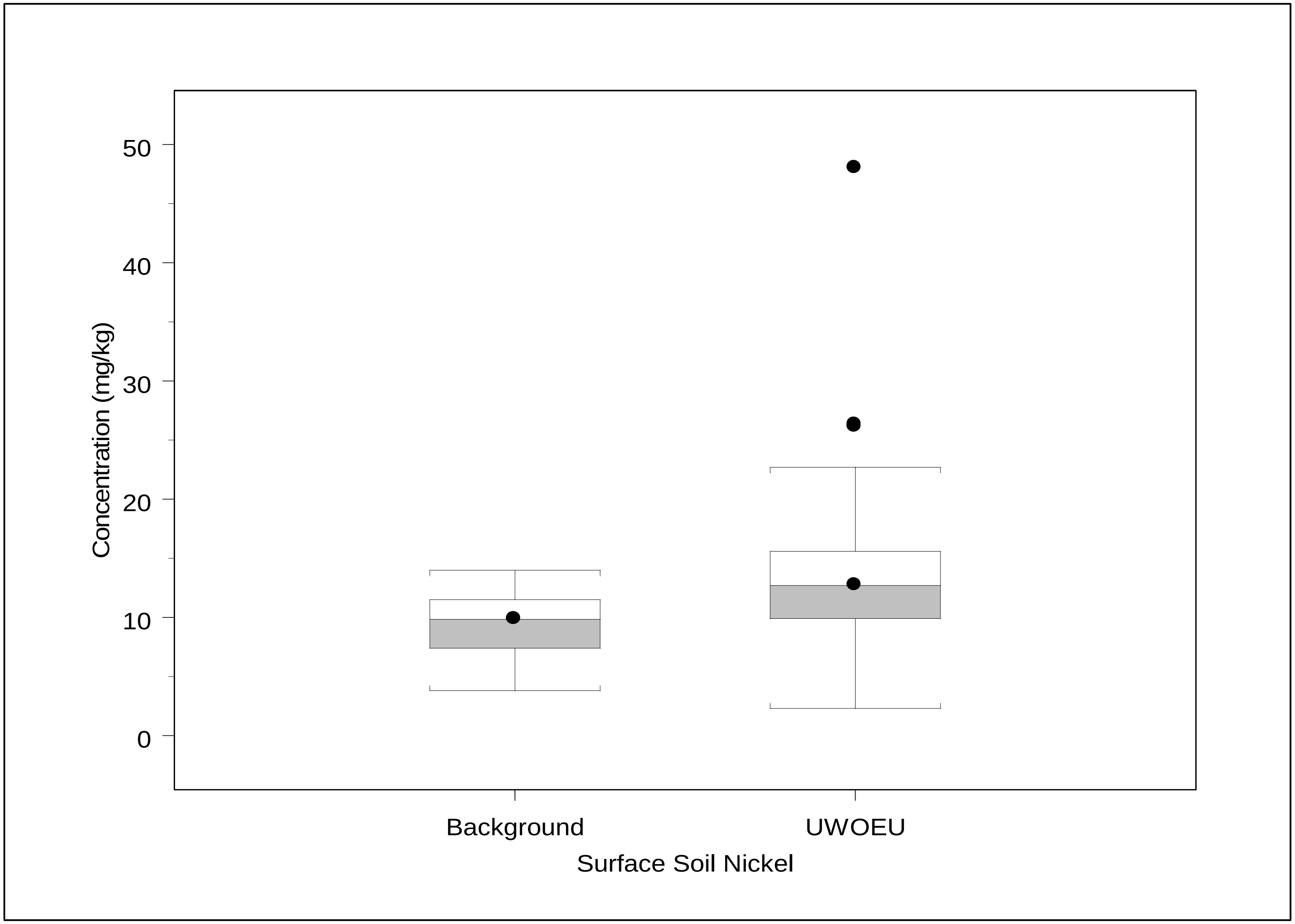
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.27
UWOEU Subsurface Soil Box Plots for Molybdenum



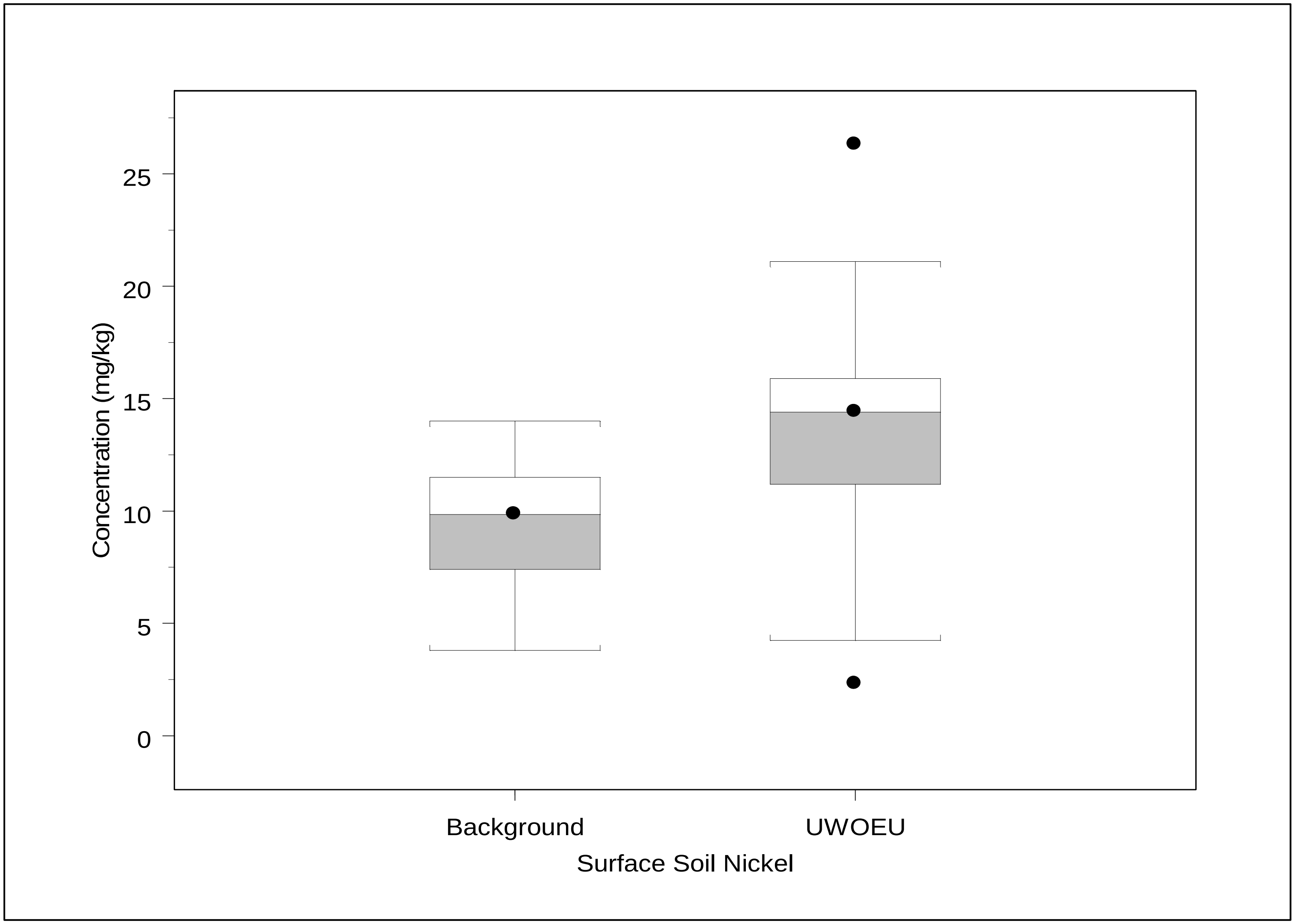
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.28
UWOEU Surface Soil Box Plots for Nickel



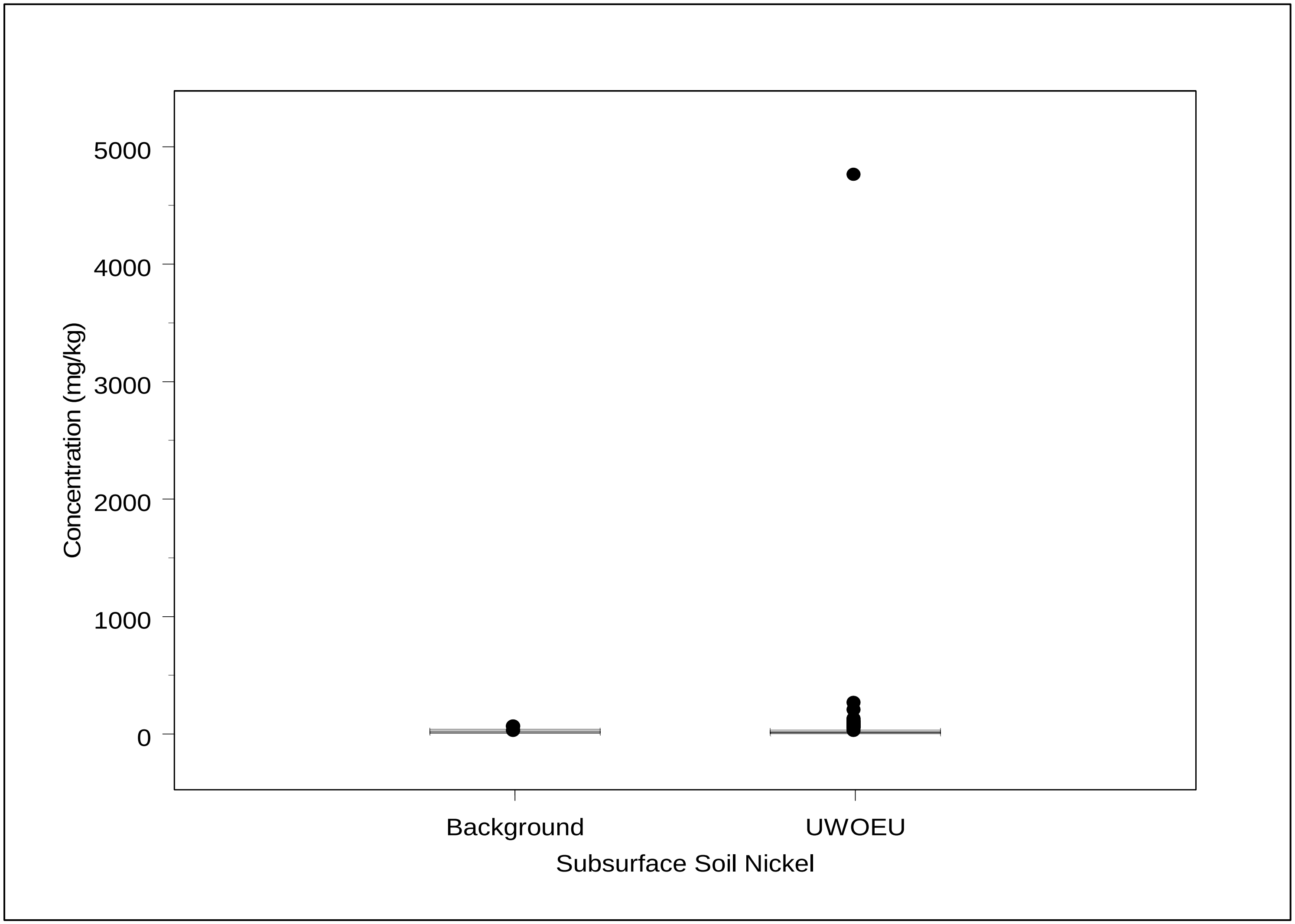
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.29
UWOEU Surface Soil (PMJM) Box Plots for Nickel



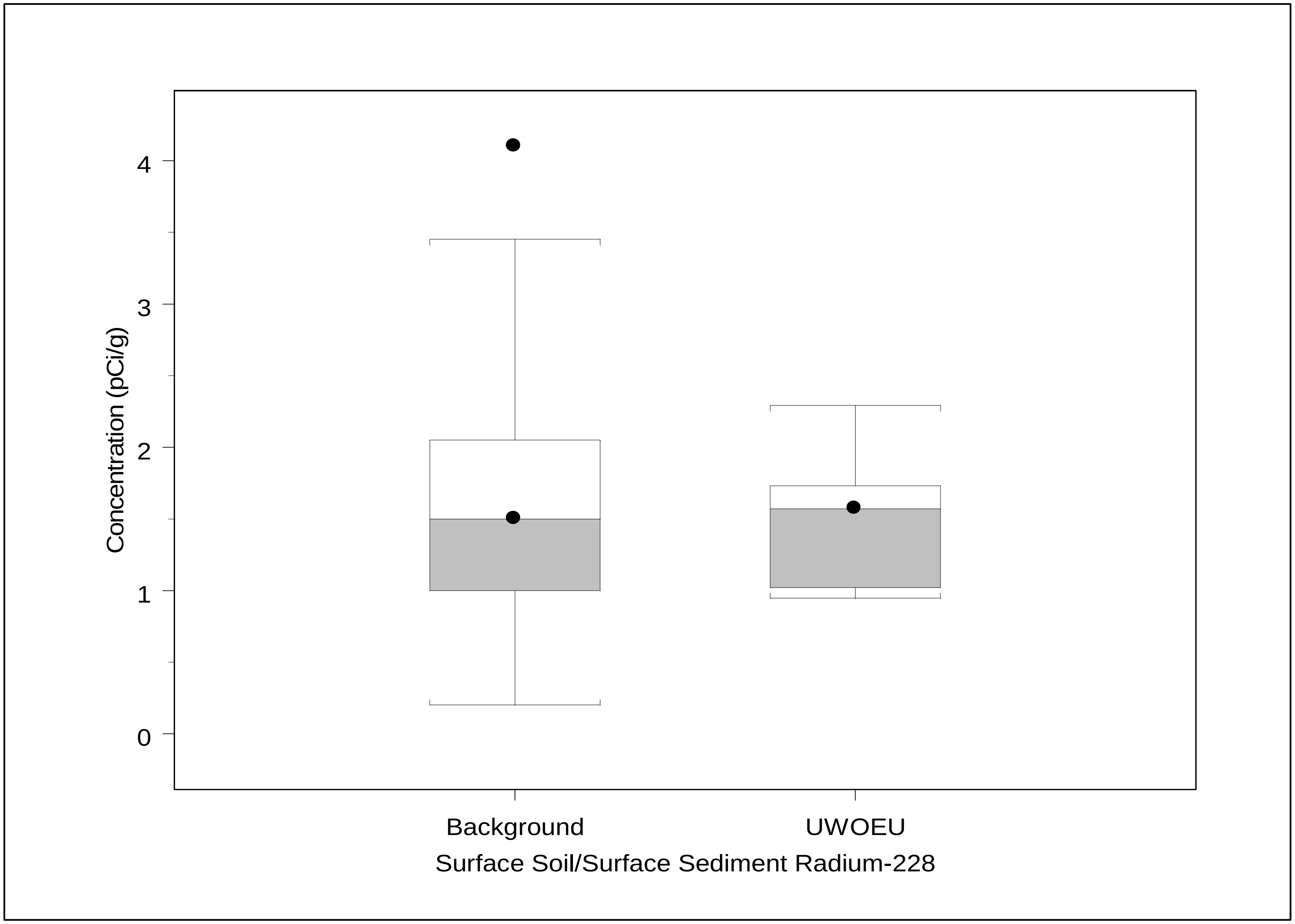
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.30
UWOEU Subsurface Soil Box Plots for Nickel



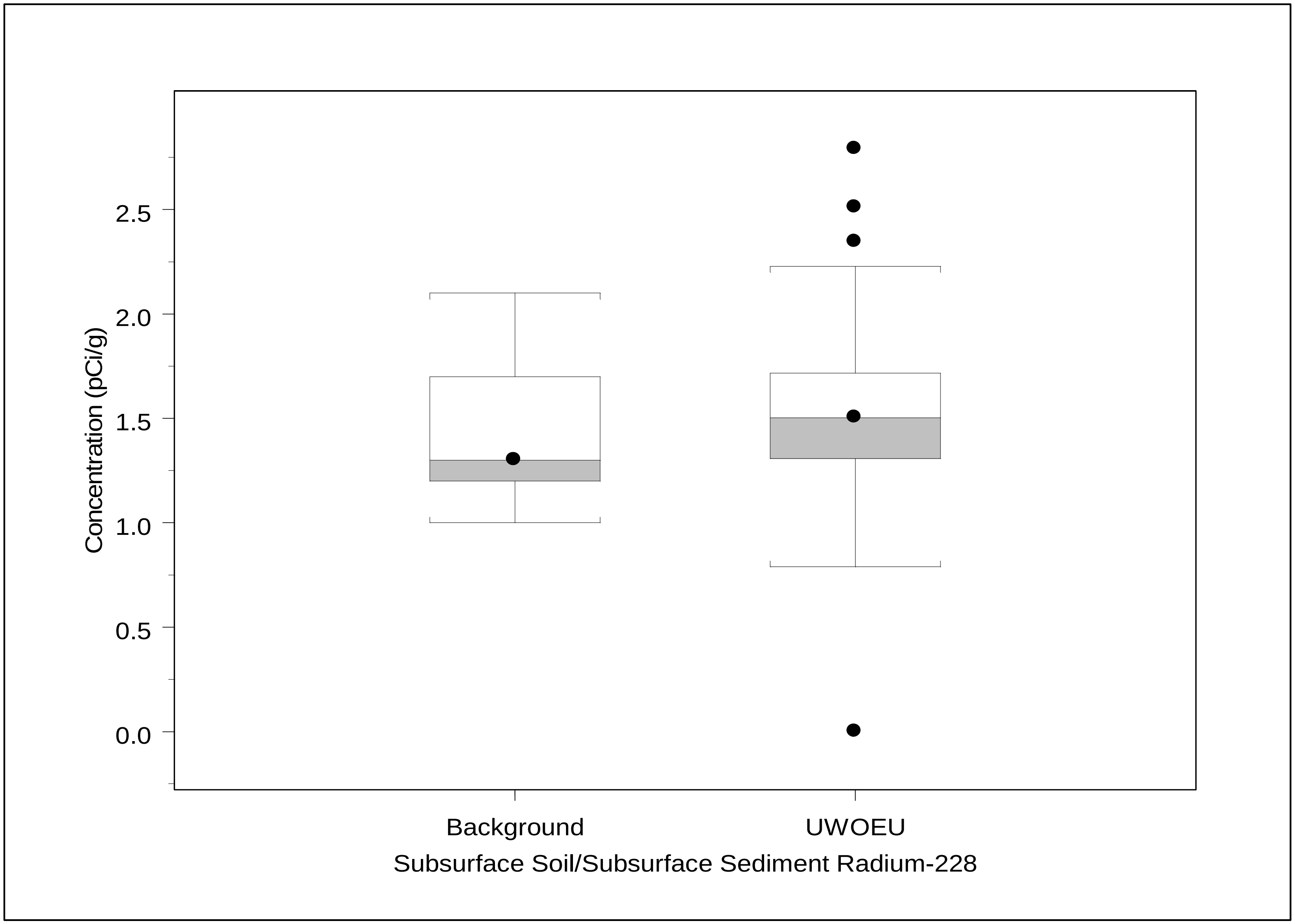
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.31
UWOEU Surface Soil/Surface Sediment Box Plots for Radium-228



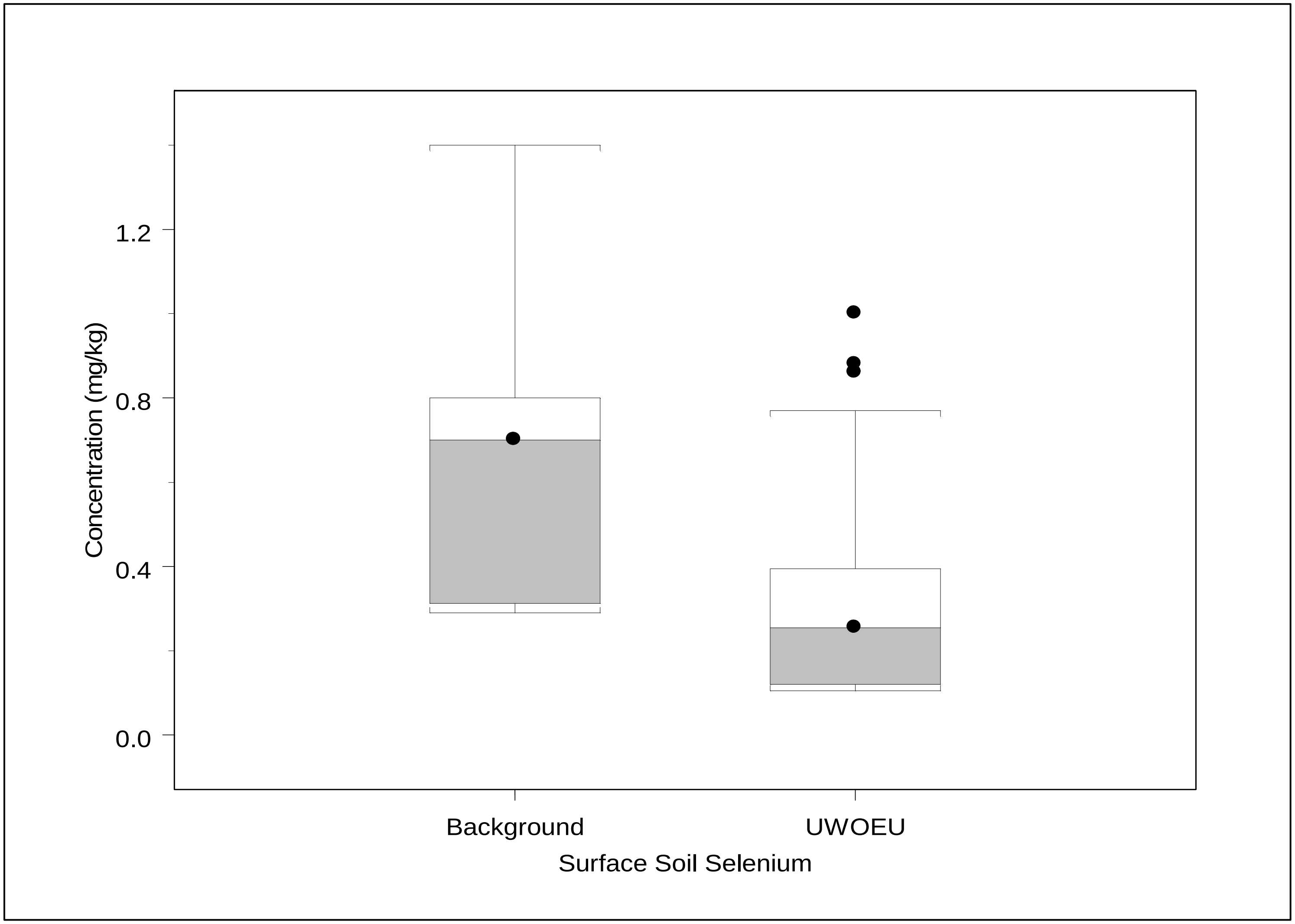
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.32
UWOEU Subsurface Soil/Subsurface Sediment Box Plots for Radium-228



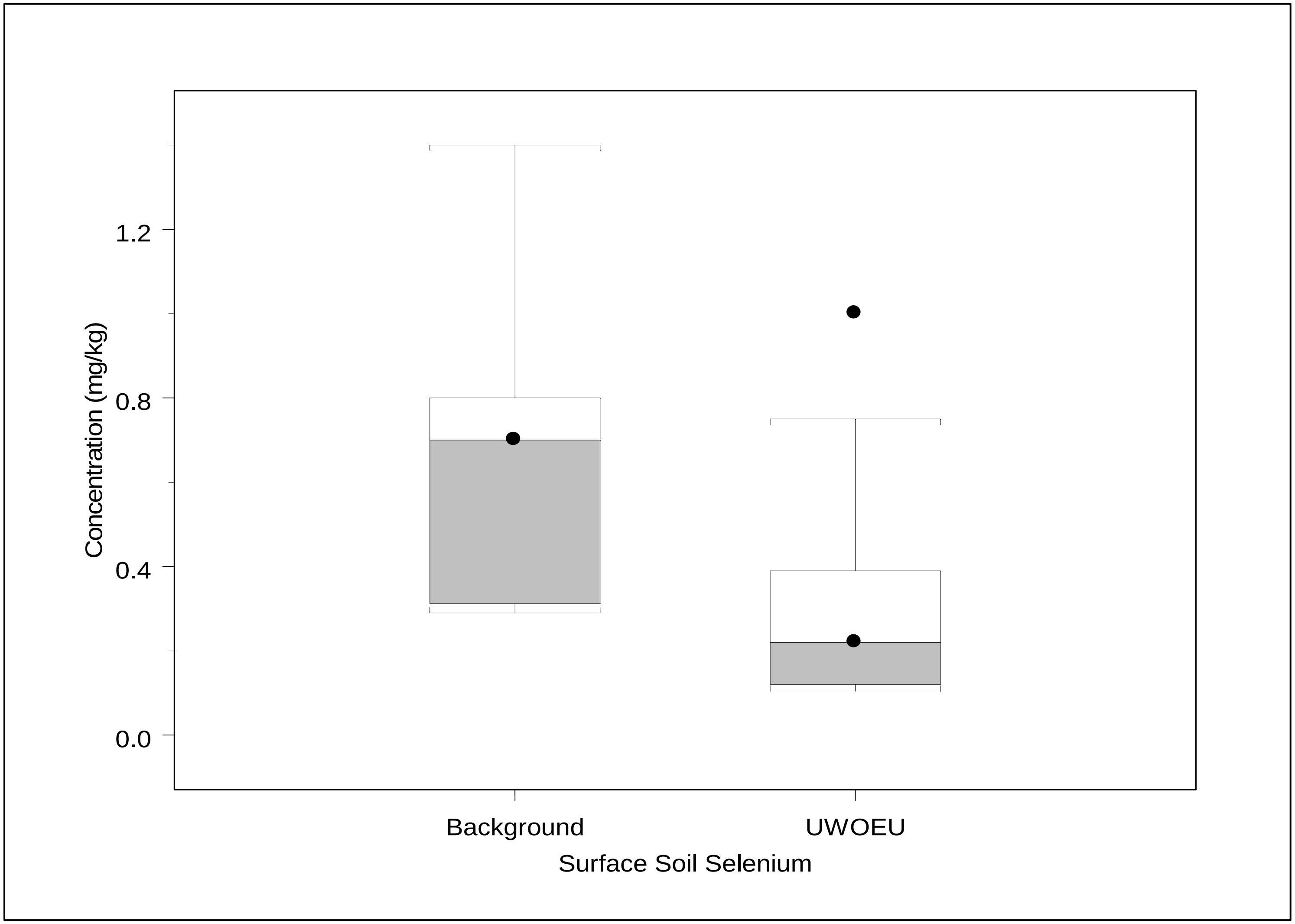
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.33
UWOEU Surface Soil Box Plots for Selenium



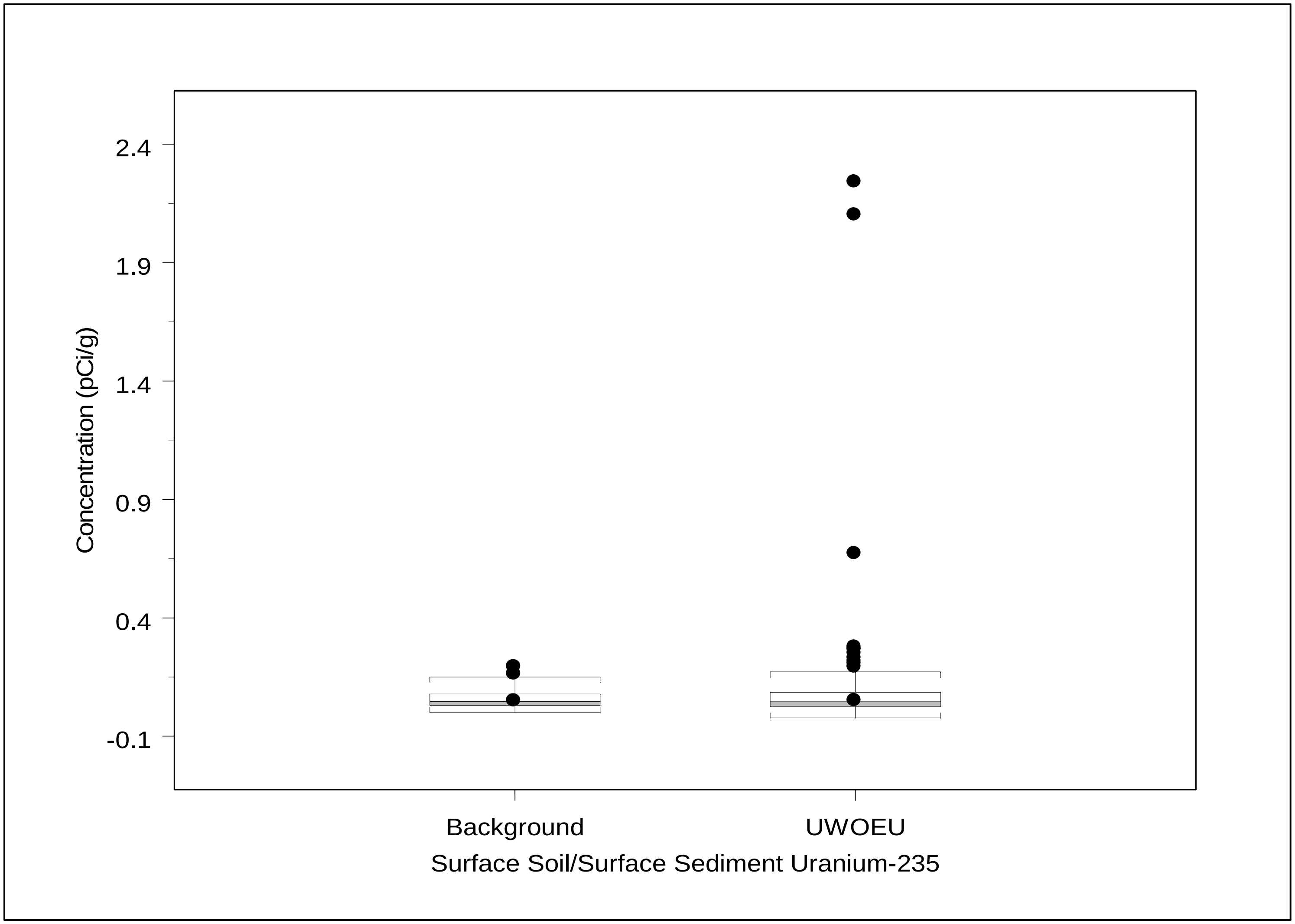
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.34
UWOEU Surface Soil (PMJM) Box Plots for Selenium



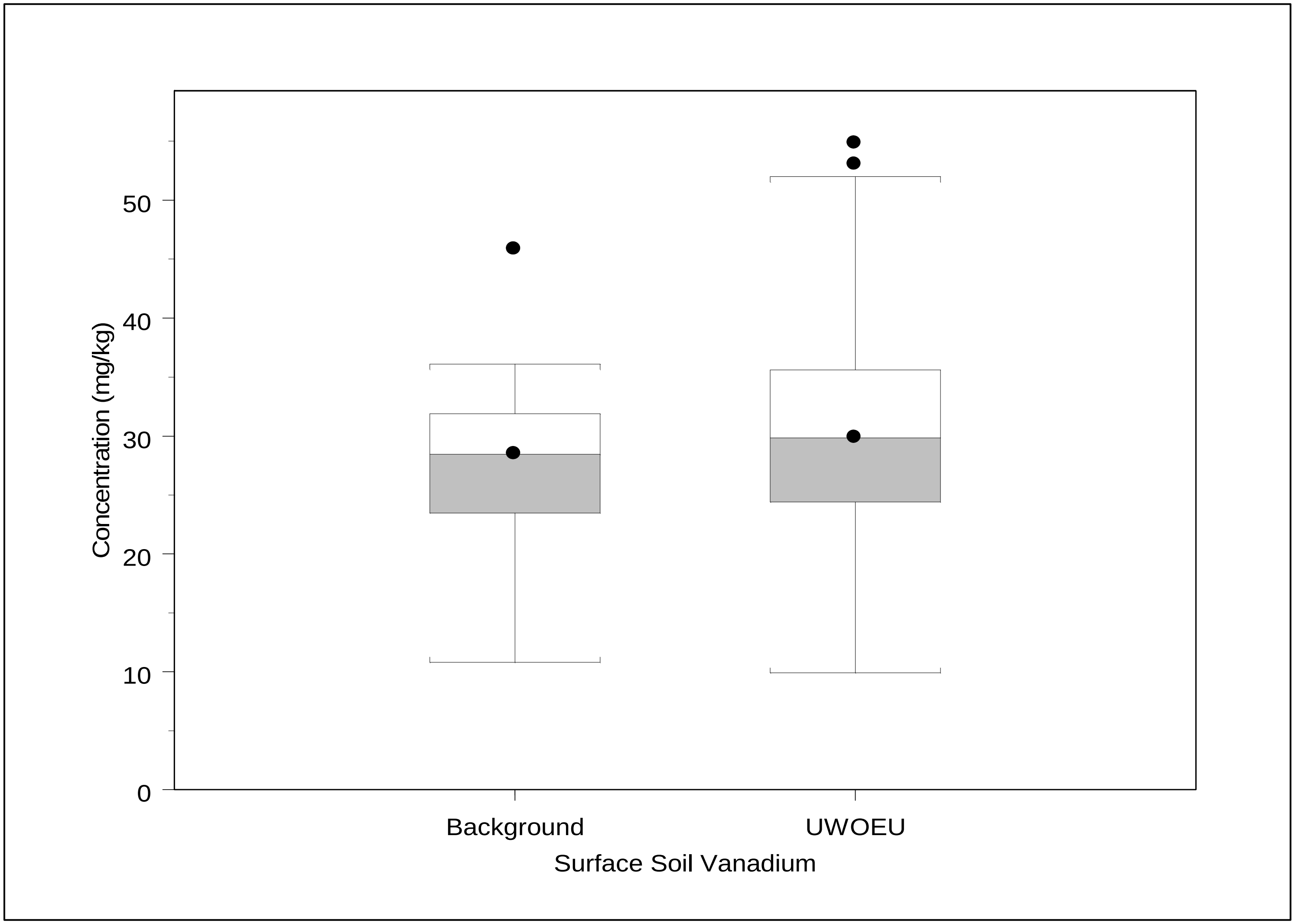
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.35
UWOEU Surface Soil/Surface Sediment Box Plots for Uranium-235



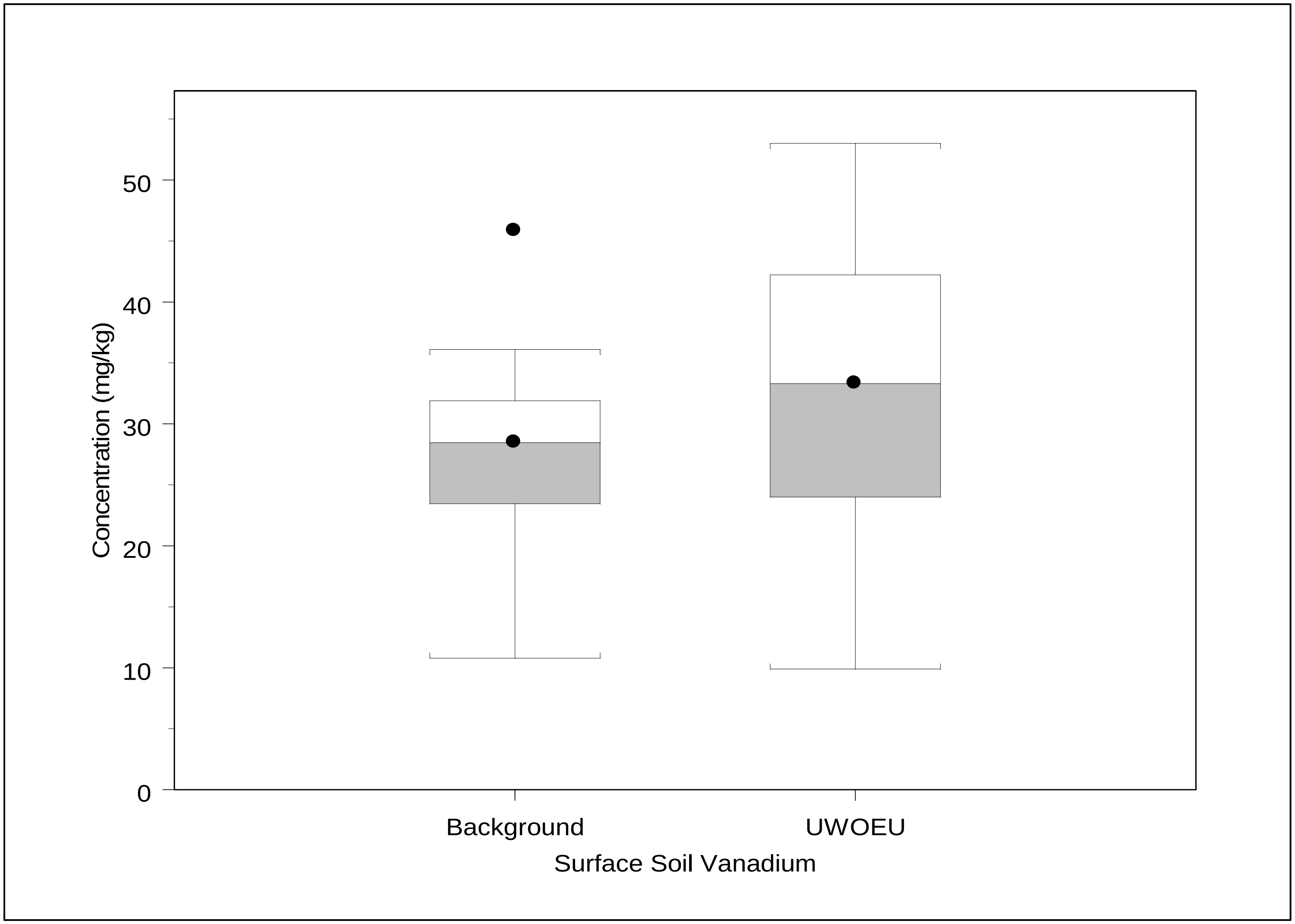
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.36
UWOEU Surface Soil Box Plots for Vanadium



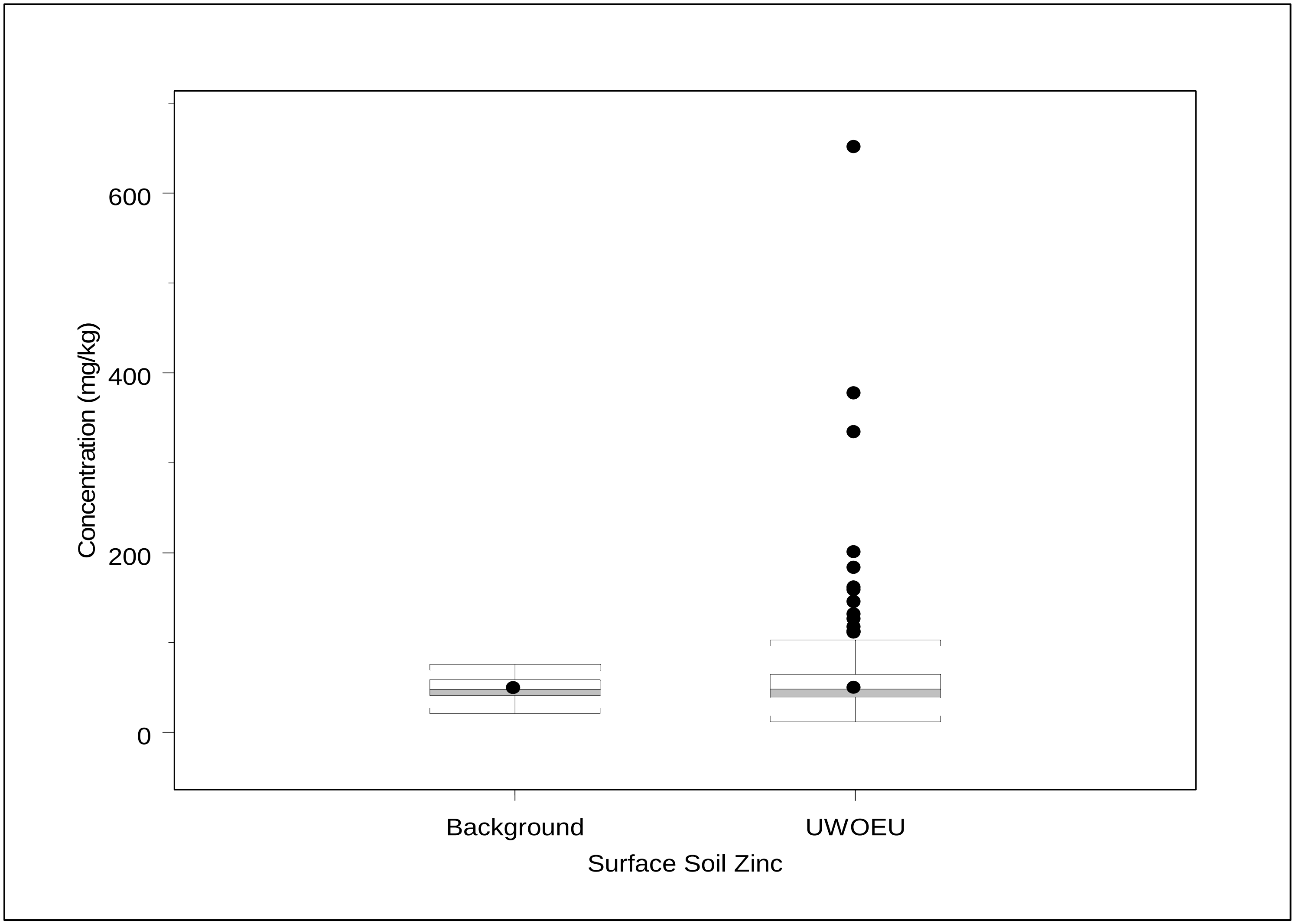
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.37
UWOEU Surface Soil (PMJM) Box Plots for Vanadium



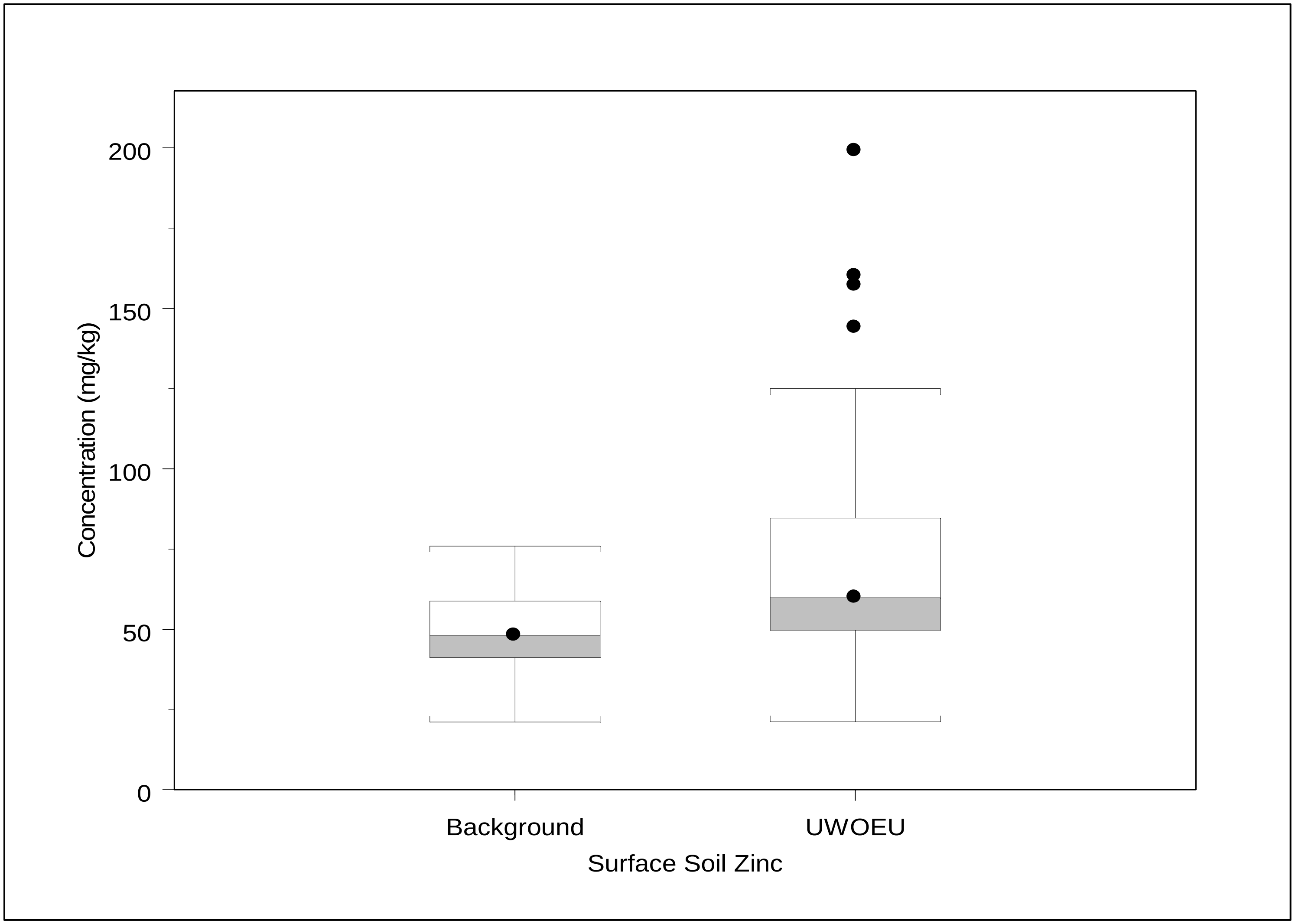
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.38
UWOEU Surface Soil Box Plots for Zinc



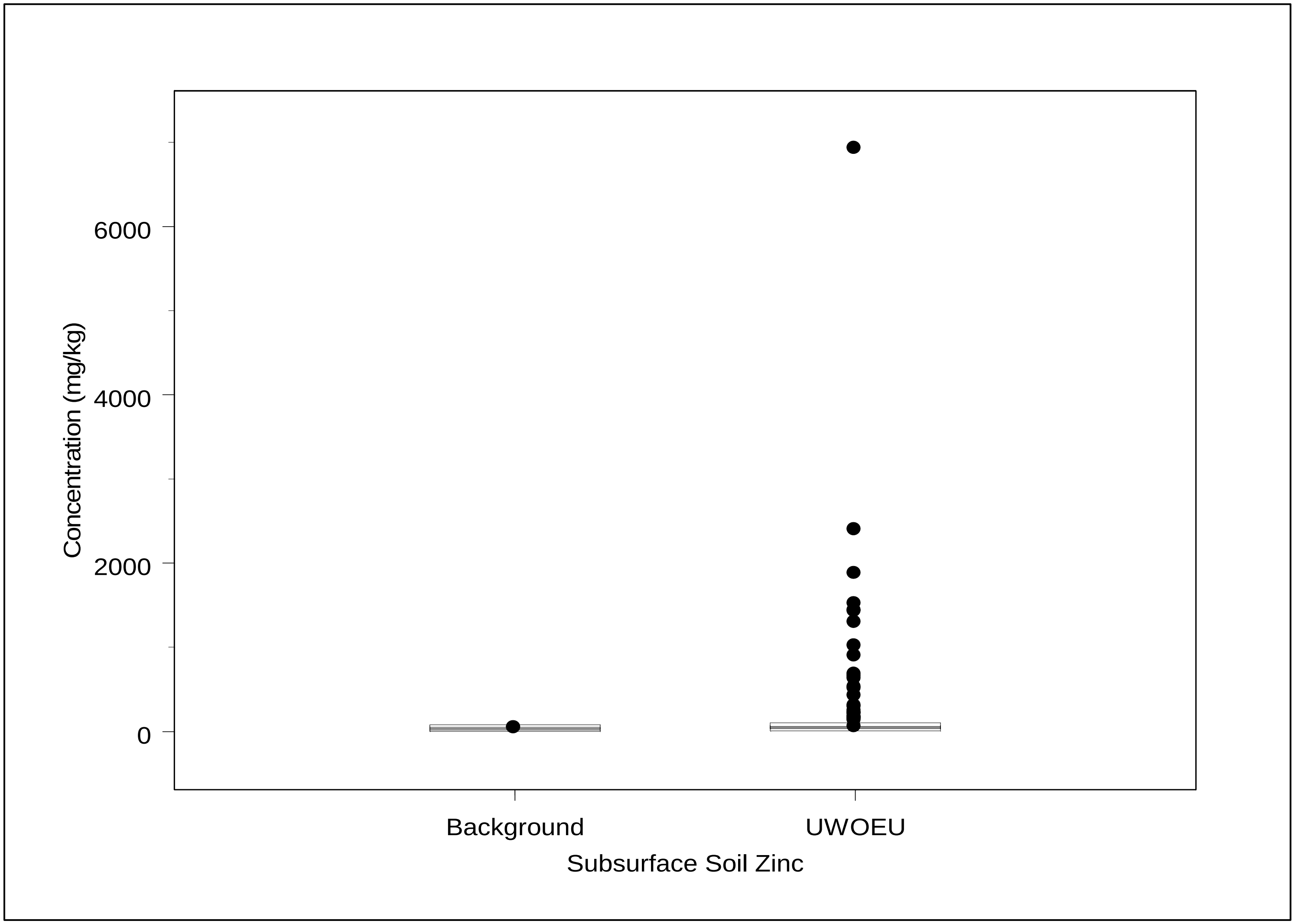
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.39
UWOEU Surface Soil (PMJM) Box Plots for Zinc



Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.40
UWOEU Subsurface Soil Box Plots for Zinc



Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

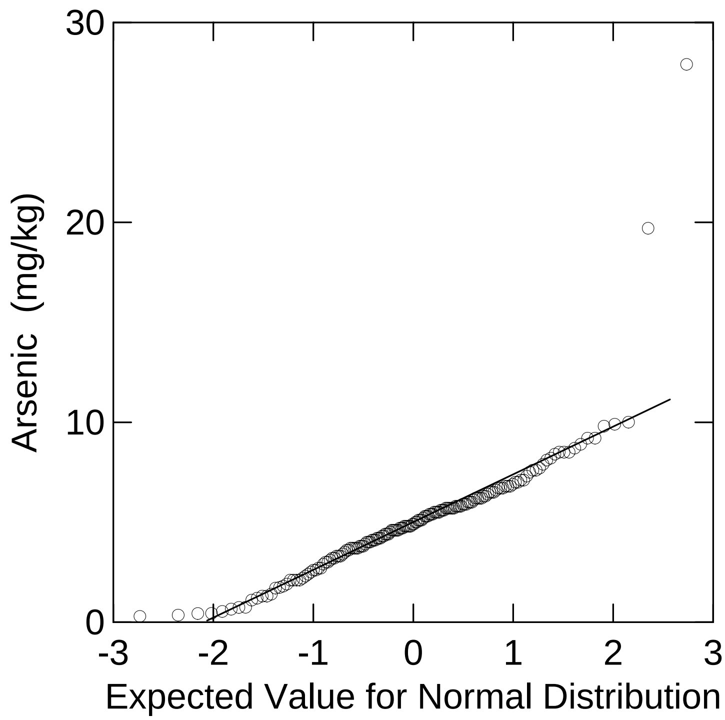


Figure A3.4.1. Probability Plot for Arsenic Concentrations in UWOEU Surface Soil/Surface Sediment

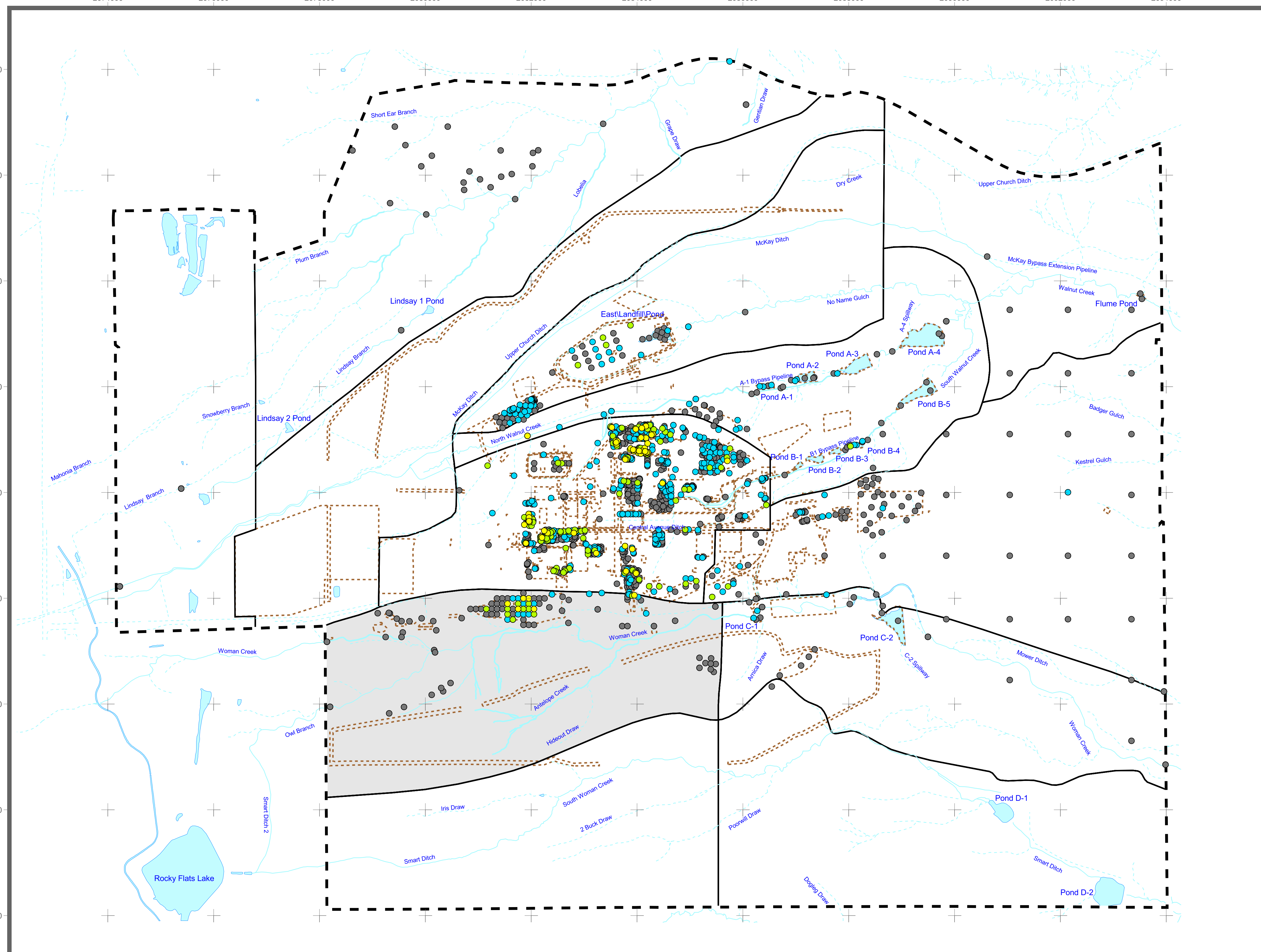


Figure A3.4.2

Benzo(a)pyrene Concentrations in Sitewide Surface Soil/Surface Sediment

KEY

- Concentration > 3x WRW PRG
- Concentration > WRW PRG and <= 3x WRW PRG
- Concentration <= WRW PRG
- Nondetect (ND)

WRW PRG = 379 ug/kg
3 x WRW PRG = 1,137 ug/kg

Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

0 1000 2000 Feet

Scale 1:24,000

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Colorado Central Zone
Datum: NAD 27

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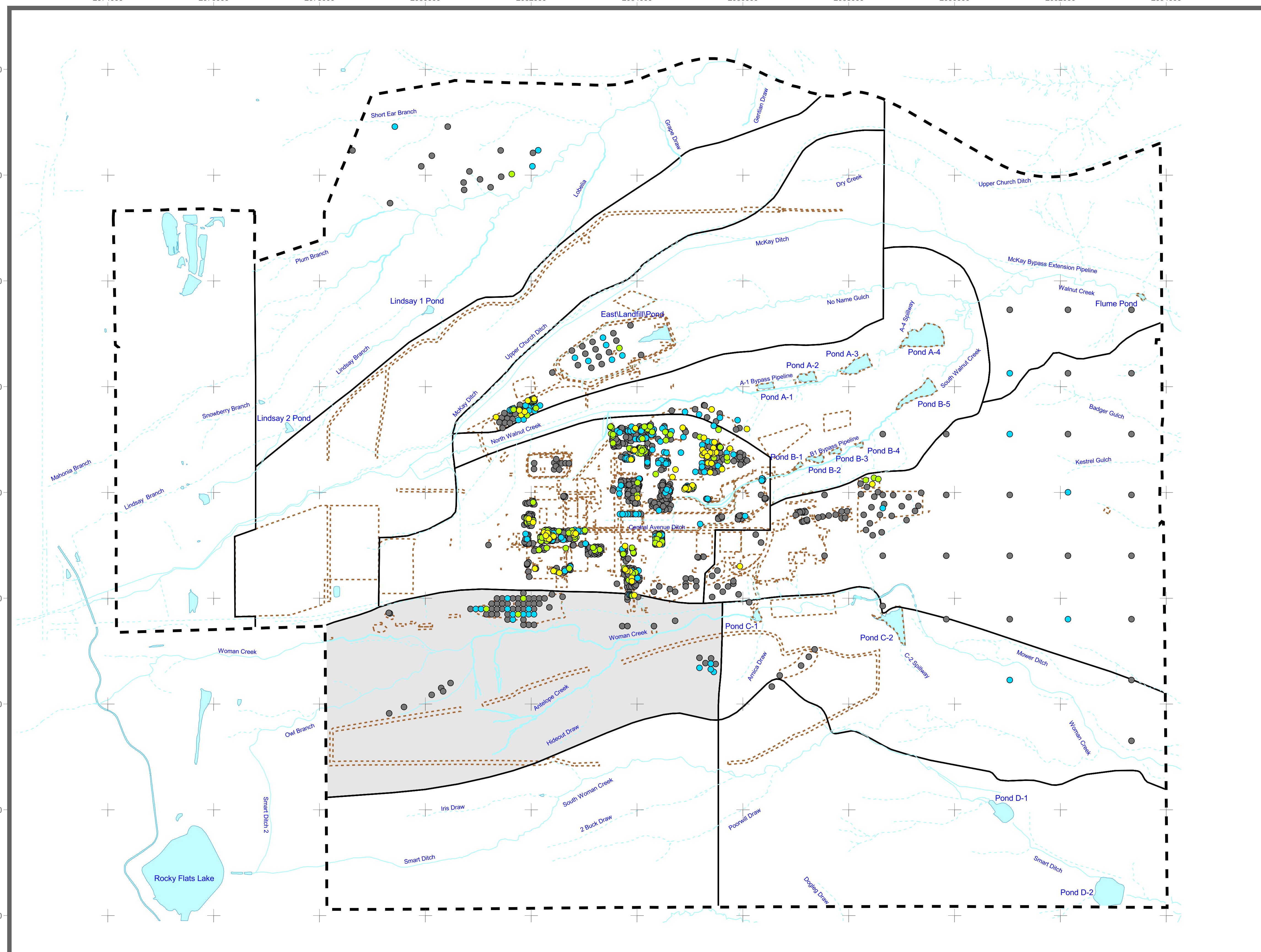

Figure A3.4.3

Bis(2-ethylhexyl)phthalate Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 137 ug/kg
3 x Min. Non-PMJM ESL = 410 ug/kg

Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

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Scale 1:24,000

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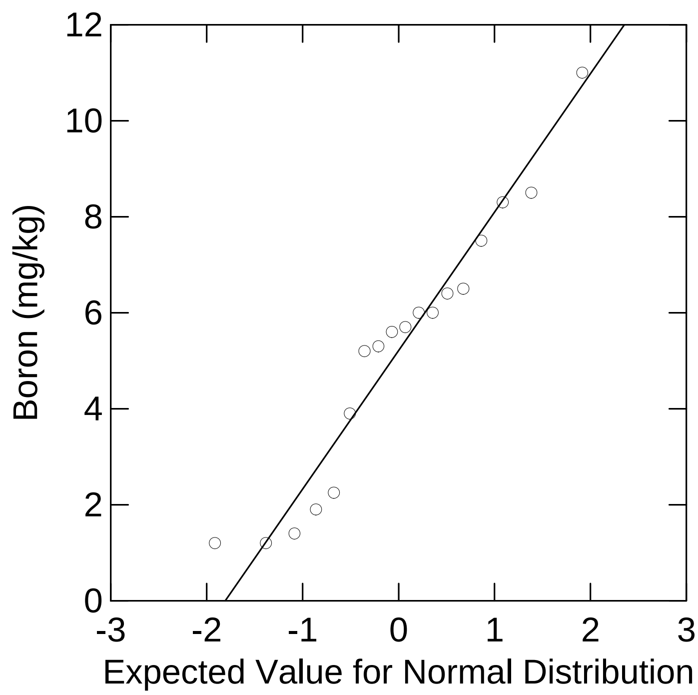
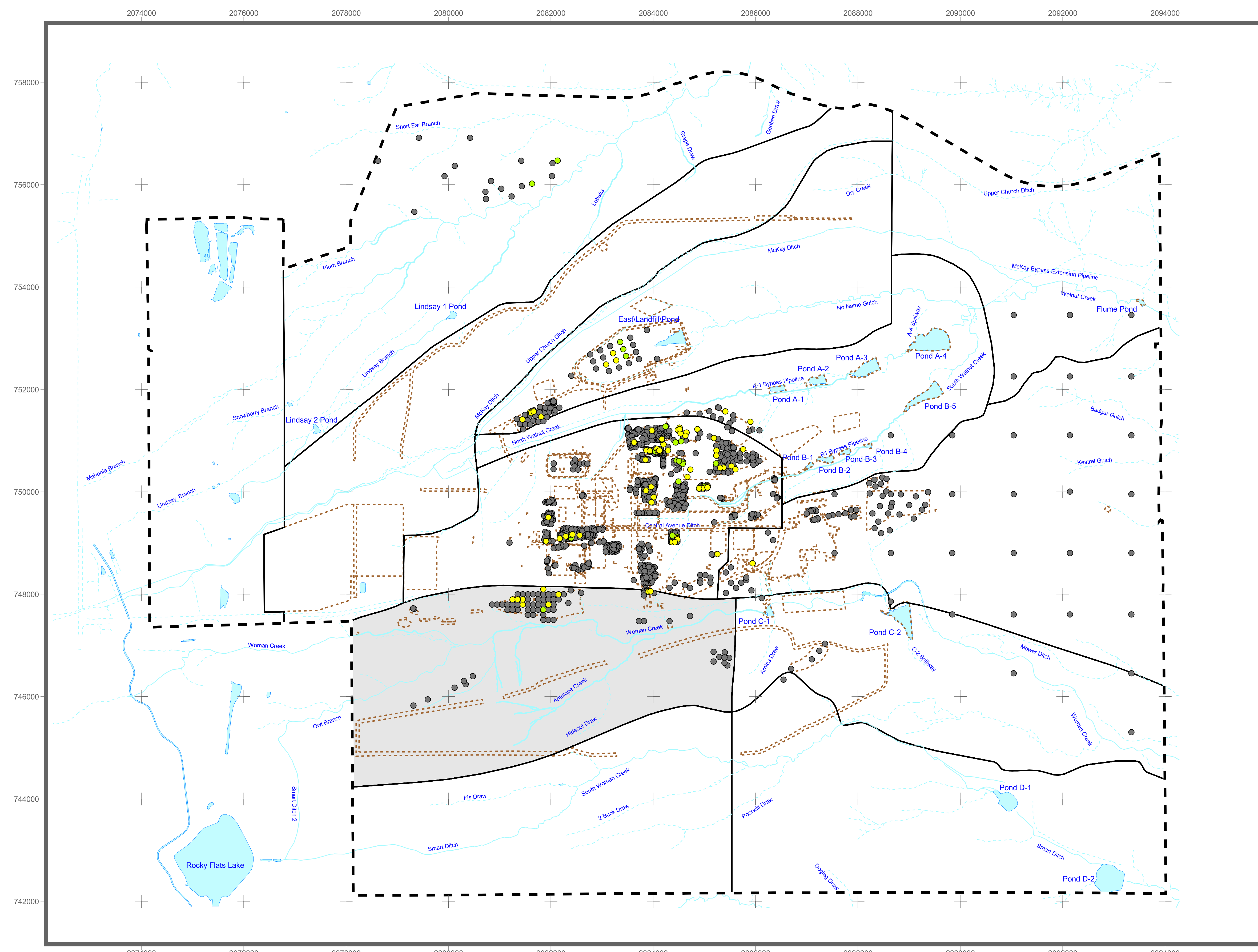


Figure A3.4.4. **Probability Plot for Boron Concentrations in the UWOEU Surface Soil**

Figure A3.4.5

Di-n-butylphthalate Concentrations in Sitewide Surface Soil (Non-PMJM)



KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 15.9 ug/kg
3 x Min. Non-PMJM ESL = 47.6 ug/kg

Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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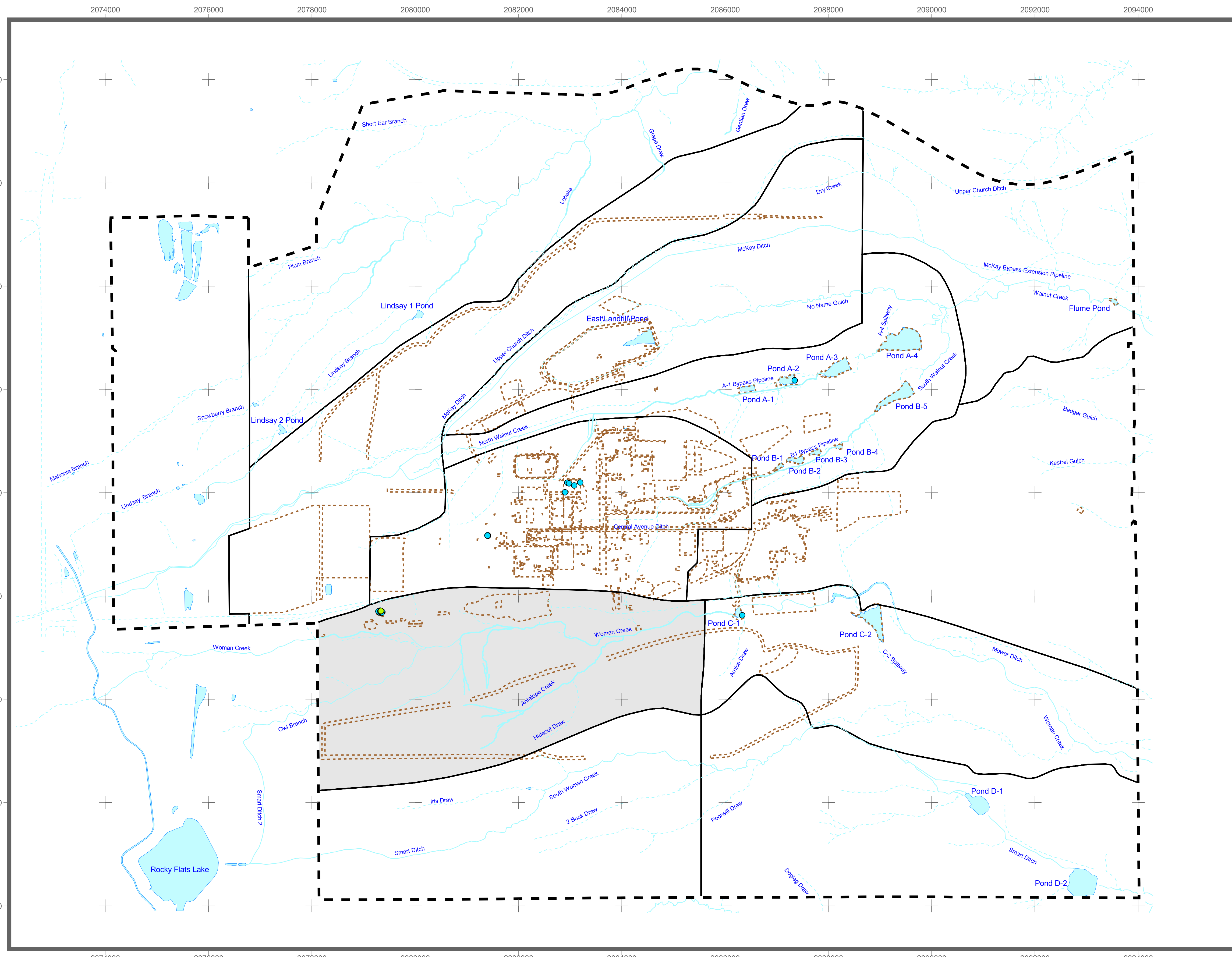

Figure A3.4.6

2,3,7,8-TCDD TEQ Concentrations in Sitewide Surface Soil/Surface Sediment

KEY

- Concentration > 3x WRW PRG
- Concentration > WRW PRG and <= 3x WRW PRG
- Concentration <= WRW PRG
- Nondetect (ND)

WRW PRG = 0.025 ug/kg
3 x WRW PRG = 0.075 ug/kg

Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

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Scale 1:24,000

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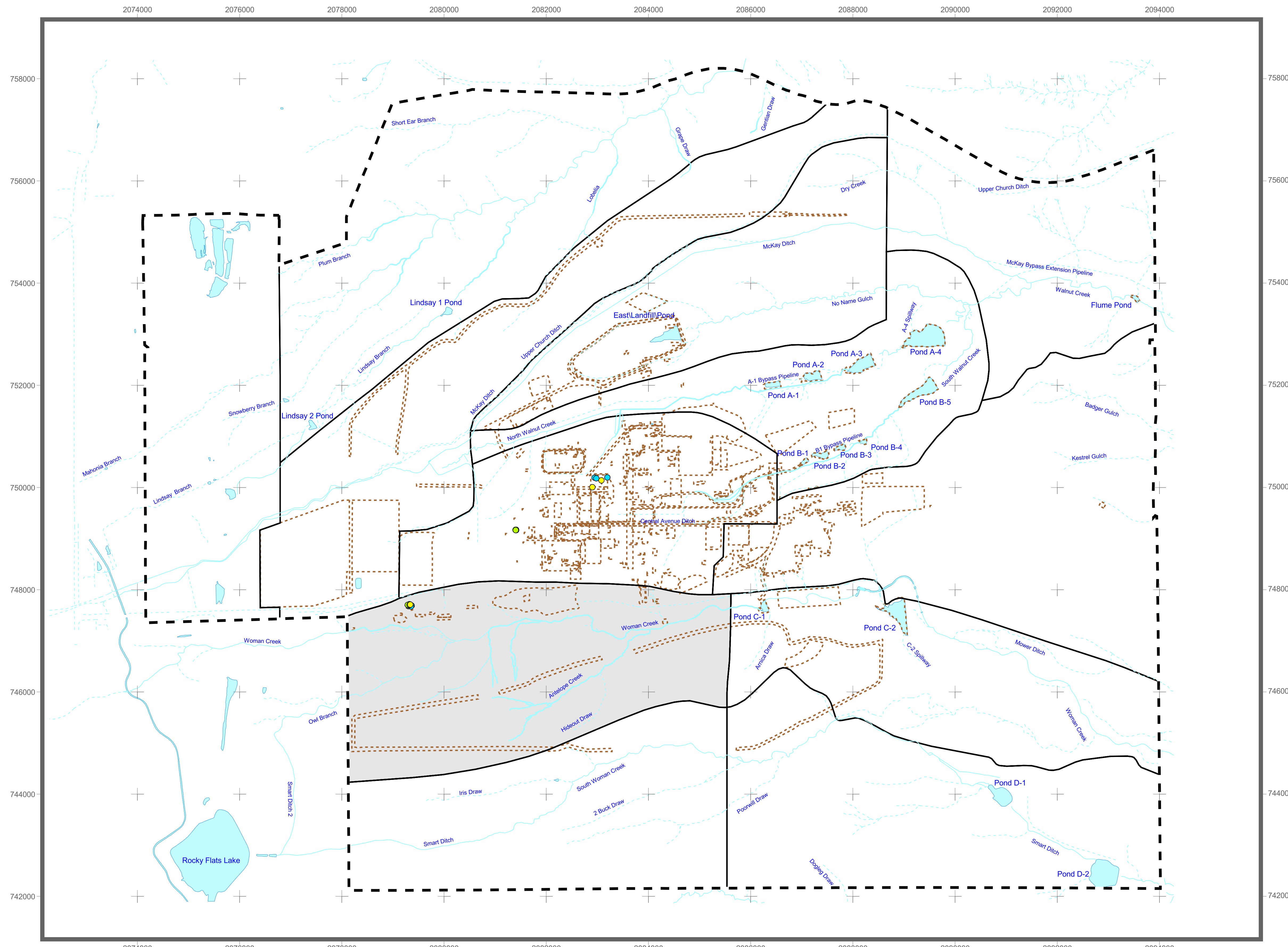
Figure A3.4.7

2,3,7,8-TCDD TEQ (Mammal) Concentrations in Sitewide Surface Soil (Non-PMJM)



KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 0.004 ug/kg
3 x Min. Non-PMJM ESL = 0.012 ug/kg

Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Ephemeral stream
- Intermittent stream
- Perennial stream
- Site boundary

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Scale 1:24,000

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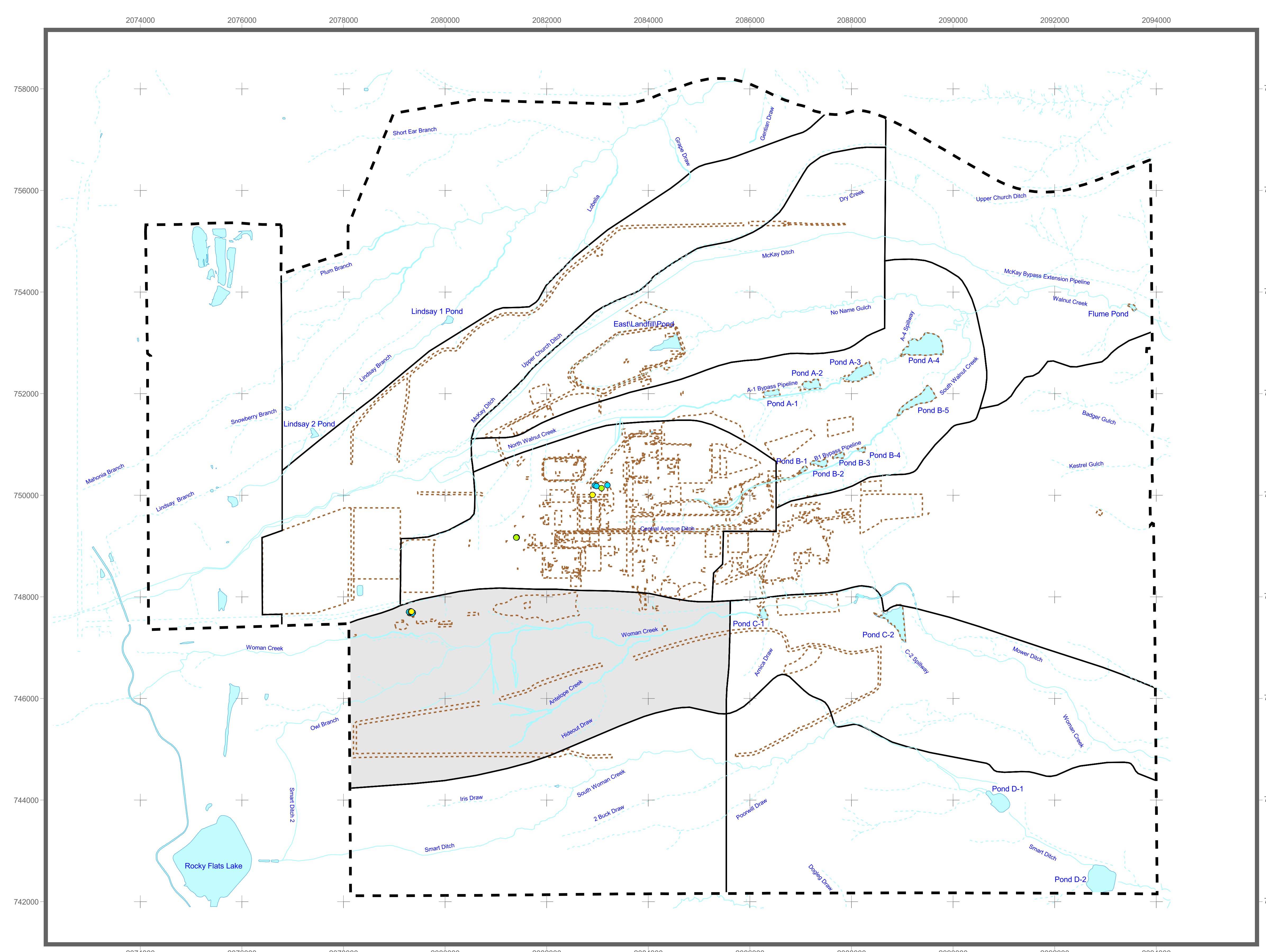

Figure A3.4.8

2,3,7,8-TCDD TEQ (Bird) Concentrations in Sitewide Surface Soil (Non-PMJM)

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 0.013 ug/kg
3 x Min. Non-PMJM ESL = 0.039 ug/kg

Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Ephemeral stream
- Intermittent stream
- Perennial stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

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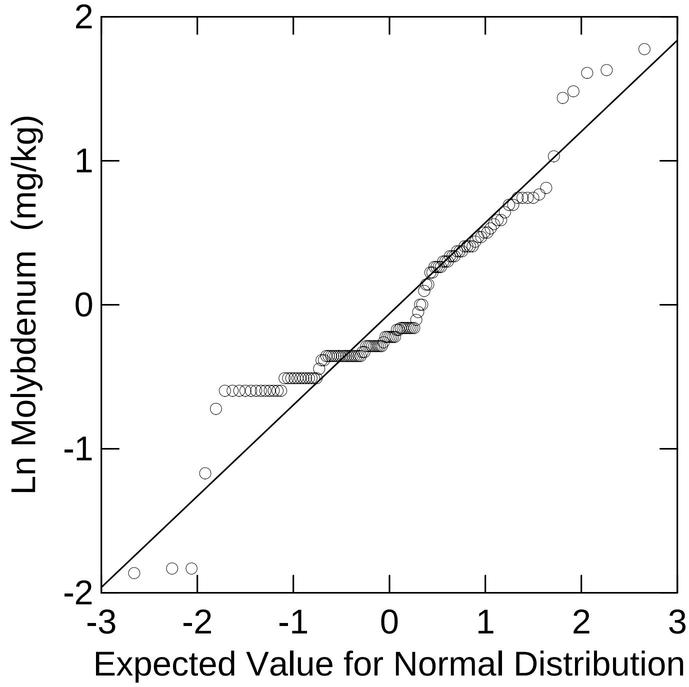
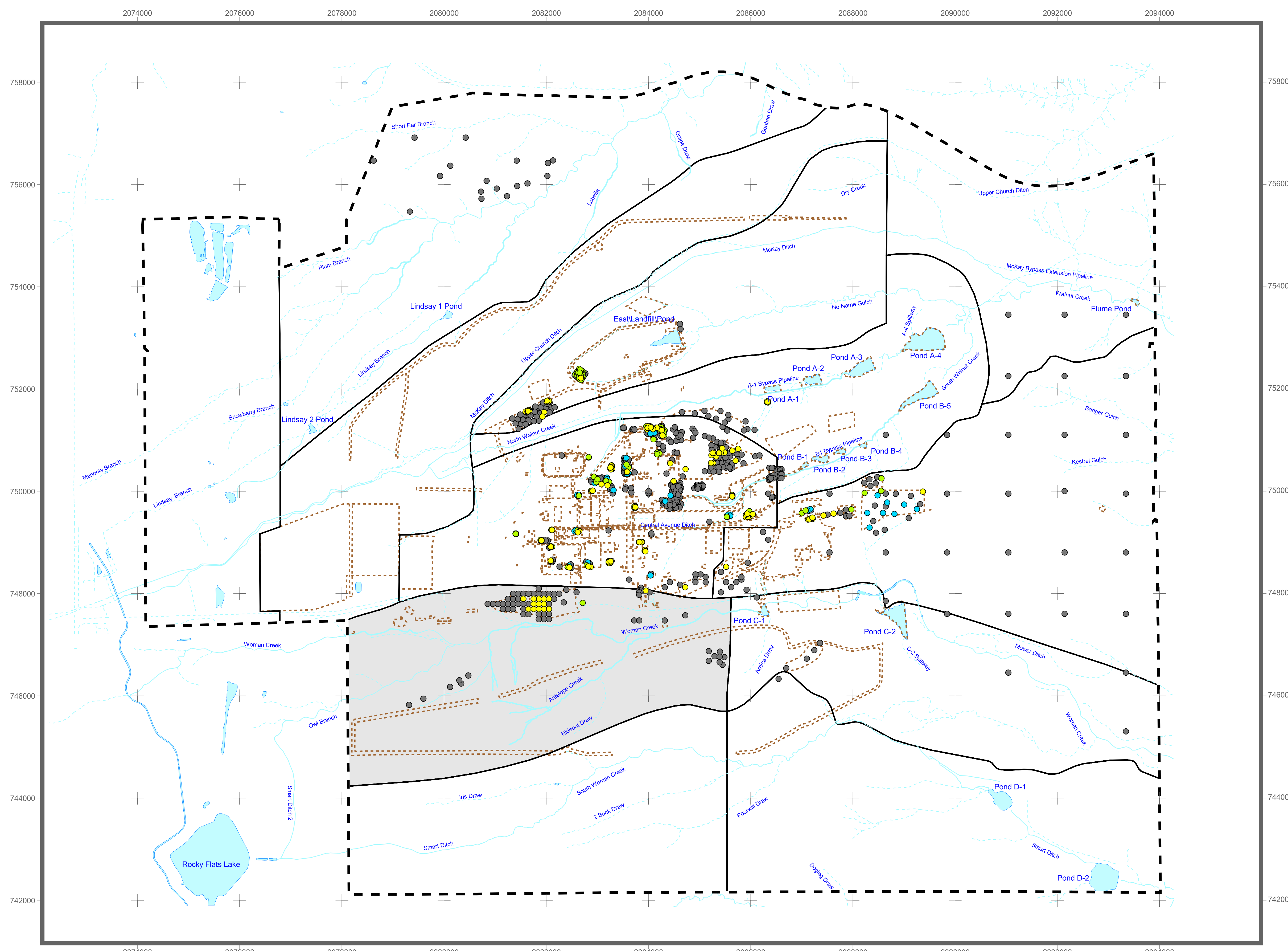


Figure A3.4.9 Probability Plot for Molybdenum (Natural Logarithm) in UWOEU Surface Soil

Figure A3.4.10

Total PCB Concentrations in Sitewide Surface Soil (Non-PMJM)



KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

Min. Non-PMJM ESL = 42.3 ug/kg
3x Min. Non-PMJM ESL = 127 ug/kg

Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N W E S

0 1000 2000 Feet

Scale 1:24,000

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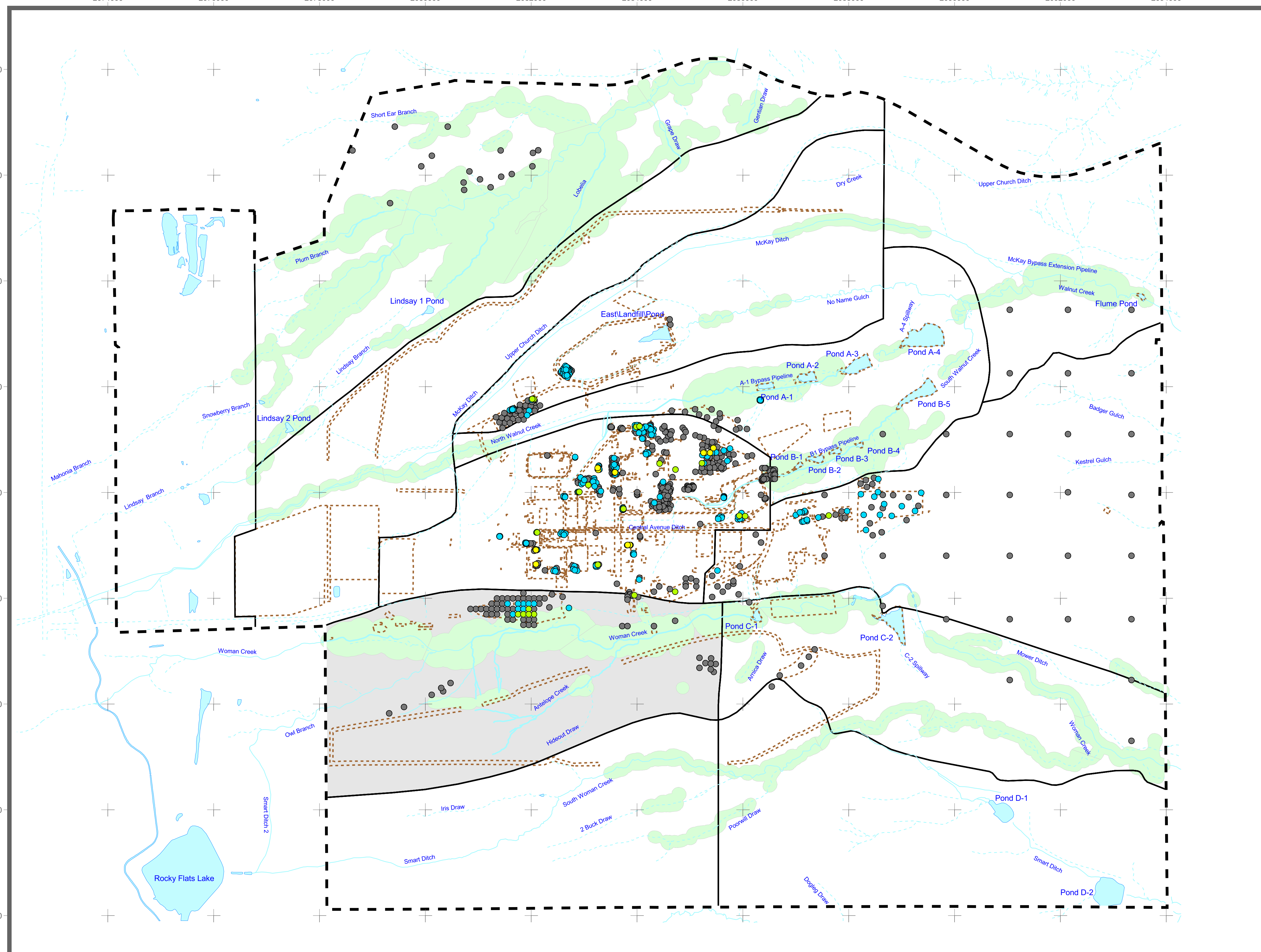

Figure A3.4.11

Total PCB Concentrations in Sitewide Surface Soil (PMJM)

KEY

- Concentration > 3x ESL
- Concentration > ESL and <= 3x ESL
- Concentration <= ESL
- Nondetect (ND)

PMJM ESL = 1350 ug/kg
3x PMJM ESL = 4050 ug/kg

Standard Map Features

- Upper Woman Drainage EU
- Exposure Unit boundaries
- Former building where analyte was used or generated as waste
- PMJM habitat patches
- Historical IHSS/PAC
- Pond
- Perennial stream
- Intermittent stream
- Ephemeral stream
- Site boundary

N S W E

0 1000 2000 Feet

Scale 1:24,000

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COMPREHENSIVE RISK ASSESSMENT

UPPER WOMAN DRAINAGE EXPOSURE UNIT

VOLUME 10: ATTACHMENT 4

Risk Assessment Calculations

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1.0 Human Health Risk Assessment Tables

UPPER WOMAN DRAINAGE EXPOSURE UNIT

2.0 Ecological Risk Assessment Tables

Table A4.1.1

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker using Tier 1 EPCs

Exposure Route	Contaminant of Concern	Tier 1 EPC (mg/kg)	Cancer Risk Calculations: Intake/Exposure Concentration (mg/kg/day)	Cancer Risk Calculations: CSF $(mg/kg/day)^{-1}$	Cancer Risk Calculations: Cancer Risk		Non-Cancer Hazard Calculations: Intake/Exposure Concentration (mg/kg/day)	Non-Cancer Hazard Calculations: RfD (mg/kg/day)	Non-Cancer Hazard Calculations: Hazard Quotient
Surface Soil/Surface Sediment									
Ingestion	Benzo(a)pyrene	2.25	5.41E-07	7.30	3.95E-06		2.02E-06	N/A	NC
	2,3,7,8-TCDD TEQ	5.46E-05	1.31E-11	1.50E05	1.97E-06		4.92E-11	N/A	NC
				Ingestion Total:	**5.92E-06**			**Ingestion Total:**	**NC**
Inhalation - (indoor + outdoor)	Benzo(a)pyrene	2.25	3.20E-09	3.1	9.93E-09		1.20E-08	N/A	NC
	2,3,7,8-TCDD TEQ	5.46E-05	7.78E-14	1.50E05	1.17E-08		2.91E-13	N/A	NC
				Inhalation Total:	**2.16E-08**			**Inhalation Total:**	**NC**
Dermal	Benzo(a)pyrene	2.25	2.71E-07	7.30	1.98E-06		1.02E-06	N/A	NC
	2,3,7,8-TCDD TEQ	5.46E-05	1.52E-12	1.50E05	2.28E-07		5.70E-12	N/A	NC
				Dermal Total:	**2.21E-06**			**Dermal Total:**	**0**
				Surface Soil/Surface Sediment Total:	**8.15E-06**			**Surface Soil/Surface Sediment Total:**	**NC**
				WRW Total:	**8E-06**			**WRW Total:**	**NC**

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

Table A4.1.2

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Worker using Tier 2 EPCs

Exposure Route	Contaminant of Concern	Tier 2 EPC (mg/kg)	Cancer Risk Calculations: Intake/Exposure Concentration (mg/kg/day)	CSF $(mg/kg/day)^{-1}$	Cancer Risk		Non-Cancer Hazard Calculations: Intake/Exposure Concentration (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient
Surface Soil/Surface Sediment									
Ingestion	Benzo(a)pyrene	0.624	1.50E-07	7.30	1.10E-06		5.62E-07	N/A	NC
	2,3,7,8-TCDD TEQ	5.46E-05	1.31E-11	1.50E05	1.97E-06		4.92E-11	N/A	NC
				Ingestion Total:	**3.07E-06**			**Ingestion Total:**	**NC**
Inhalation -	Benzo(a)pyrene	0.624	8.89E-10	3.1	2.76E-09		3.33E-09	N/A	NC
(indoor + outdoor)	2,3,7,8-TCDD TEQ	5.46E-05	7.78E-14	1.50E05	1.17E-08		2.91E-13	N/A	NC
				Inhalation Total:	**1.44E-08**			**Inhalation Total:**	**NC**
Dermal	Benzo(a)pyrene	0.624	7.53E-08	7.30	5.50E-07		2.82E-07	N/A	NC
	2,3,7,8-TCDD TEQ	5.46E-05	1.52E-12	1.50E05	2.28E-07		5.70E-12	N/A	NC
				Dermal Total:	**7.78E-07**			**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**3.86E-06**			**Surface Soil/Surface Sediment Total:**	**NC**
				WRW Total:	**4E-06**			**WRW Total:**	**NC**

N/A = Not applicable or not available.

NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

Table A4.1.3
Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor using Tier 1 EPCs

Exposure Route	Contaminant of Concern	Tier 1 EPC (mg/kg)	Cancer Risk Calculations: Intake/Exposure Concentration (mg/kg/day)	CSF $(mg/kg/day)^{-1}$	Cancer Risk		Non-Cancer Hazard Calculations: Intake/Exposure Concentration (mg/kg/day)	RfD (mg/kg/day)	Hazard Quotient
Surface Soil/Surface Sediment									
Ingestion	Benzo(a)pyrene	2.25	5.03E-07	7.30	3.67E-06		1.17E-06	N/A	NC
	2,3,7,8-TCDD TEQ	5.46E-05	1.22E-11	1.50E05	1.83E-06		2.85E-11	N/A	NC
				Ingestion Total:	**5.51E-06**			**Ingestion Total:**	**NC**
Inhalation -	Benzo(a)pyrene	2.25	2.16E-09	3.1	6.69E-09		5.03E-09	N/A	NC
(outdoor)	2,3,7,8-TCDD TEQ	5.46E-05	5.24E-14	1.50E05	7.86E-09		1.22E-13	N/A	NC
				Inhalation Total:	**1.45E-08**			**Inhalation Total:**	**NC**
Dermal	Benzo(a)pyrene	2.25	4.13E-07	7.30	3.02E-06		9.64E-07	N/A	NC
	2,3,7,8-TCDD TEQ	5.46E-05	2.32E-12	1.50E05	3.47E-07		5.40E-12	N/A	NC
				Dermal Total:	**3.36E-06**			**Dermal Total:**	**NC**
			Surface Soil/Surface Sediment Total:		**8.88E-06**		**Surface Soil/Surface Sediment Total:**		**NC**
				WRV Total:	**9E-06**			**WRV Total:**	**NC**

N/A = Not applicable or not available.
NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

Table A4.1.4

Calculation of Chemical Cancer Risks and Non-Cancer Hazards for the Wildlife Refuge Visitor using Tier 2 EPCs

			Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Exposure Route	**Contaminant of Concern**	**Tier 2 EPC (mg/kg)**	**Intake/Exposure Concentration (mg/kg/day)**	**CSF $(mg/kg/day)^{-1}$**	**Cancer Risk**		**Intake/Exposure Concentration (mg/kg/day)**	**RfD (mg/kg/day)**	**Hazard Quotient**
Surface Soil/Surface Sediment									
Ingestion	Benzo(a)pyrene	0.624	1.40E-07	7.30	1.02E-06		3.26E-07	N/A	NC
	2,3,7,8-TCDD TEQ	0.000	1.22E-11	1.50E05	1.83E-06		2.85E-11	N/A	NC
				Ingestion Total:	**2.85E-06**			**Ingestion Total:**	**NC**
Inhalation - (outdoor)	Benzo(a)pyrene	0.624	5.98E-10	3.1	1.86E-09		1.40E-09	N/A	NC
	2,3,7,8-TCDD TEQ	0.000	5.24E-14	1.50E05	7.86E-09		1.22E-13	N/A	NC
				Inhalation Total:	**9.72E-09**			**Inhalation Total:**	**NC**
Dermal	Benzo(a)pyrene	0.624	1.15E-07	7.30	8.37E-07		2.67E-07	N/A	NC
	2,3,7,8-TCDD TEQ	0.000	2.32E-12	1.50E05	3.47E-07		5.40E-12	N/A	NC
				Dermal Total:	**1.18E-06**			**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**4.05E-06**			**Surface Soil/Surface Sediment Total:**	**NC**
				WRV Total:	**4E-06**			**WRV Total:**	**NC**

N/A = Not applicable or not available.
NC = Not calculated; toxicity factor (CSF or RfD) not available or exposure route was identified as insignificant in the CRA Methodology.

Table A4.2.1
Non-PMJM Intake Estimates for Antimony
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -3.233 + 0.938(lnCs)	1	BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
7.35	Tier 1 UTL	0.26	7.4	0.57	0.021	
7.86	Tier 1 UCL	0.27	7.9	0.61	0.009	
30.9	Tier 2 UTL[a]	0.99	30.9	2.39	0.021	
6.35	Tier 2 UCL	0.22	6.4	0.49	0.009	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.478	N/A	0.00956	0.00399	0.491
Tier 1 UCL	N/A	0.511	N/A	0.0102	0.00171	0.523
Tier 2 UTL[a]	N/A	2.01	N/A	0.0402	0.00399	2.05
Tier 2 UCL	N/A	0.413	N/A	0.00826	0.00171	0.423
Coyote - Insectivore						
Tier 1 UTL	N/A	0.110	N/A	0.00309	0.00168	0.115
Tier 1 UCL	N/A	0.118	N/A	0.00330	7.20E-04	0.122
Tier 2 UTL[a]	N/A	0.464	N/A	0.0130	0.00168	0.478
Tier 2 UCL	N/A	0.0953	N/A	0.00267	7.20E-04	0.0986

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
N/A = Not applicable.

Table A4.2.2
PMJM Intake Estimates for Antimony
Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -3.233 + 0.938(lnCs)	1	BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50)				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
19	8.8	MDC	0.30	8.8	0.68	0.08
19	8.8	UTL[a]	0.30	8.8	0.68	0.021
19	6.61	UCL	0.23	6.6	0.51	0.009
19	4.77	Mean	0.17	4.8	0.37	0.007
20	49.8	MDC	1.54	49.8	3.85	0.08
20	46.4	UTL	1.44	46.4	3.59	0.021
20	18.9	UCL	0.62	18.9	1.46	0.009
20	10.5	Mean	0.36	10.5	0.81	0.007
21	6.5	MDC	0.23	6.5	0.50	0.08
21	6.5	UTL[a]	0.23	6.5	0.50	0.021
21	5.8	UCL	0.21	5.8	0.45	0.009
21	4.38	Mean	0.16	4.4	0.34	0.007
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 19						
MDC	0.0361	0.449	N/A	0.0359	0.0120	0.533
UTL[a]	0.0361	0.449	N/A	0.0359	0.00315	0.524
UCL	0.0276	0.337	N/A	0.0270	0.00135	0.393
Mean	0.0203	0.243	N/A	0.0195	0.00105	0.284
Patch 20						
MDC	0.183	2.54	N/A	0.203	0.0120	2.94
UTL	0.172	2.37	N/A	0.189	0.00315	2.73
UCL	0.0739	0.964	N/A	0.0771	0.00135	1.12
Mean	0.0426	0.536	N/A	0.0428	0.00105	0.622
Patch 21						
MDC	0.0272	0.332	N/A	0.0265	0.0120	0.397
UTL[a]	0.0272	0.332	N/A	0.0265	0.00315	0.388
UCL	0.0244	0.296	N/A	0.0237	0.00135	0.345
Mean	0.0188	0.223	N/A	0.0179	0.00105	0.261

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
N/A = Not applicable or not available.

Table A4.2.3
Terrestrial Plant Hazard Quotients for Antimony

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg)	Hazard Quotients
		Screening ESL	Screening ESL
Terrestrial Plant			
Tier 1 UTL	7.35	5	1
Tier 1 UCL	7.86	5	**2**
Tier 2 UTL[a]	30.9	5	**6**
Tier 2 UCL	6.35	5	1

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate risk.
No alternative TRVs were available for antimony.
Bold = Hazard quotients>1.

Table A4.2.4
Non-PMJM Hazard Quotients for Antimony

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Antimony (Default Exposure)					
Deer Mouse - Insectivore					
Tier 1 UTL	0.491	0.06	0.59	**8**	0.8
Tier 1 UCL	0.523	0.06	0.59	**9**	0.9
Tier 2 UTL[a]	2.05	0.06	0.59	**34**	**3**
Tier 2 UCL	0.423	0.06	0.59	**7**	0.7
Coyote - Insectivore					
Tier 1 UTL	0.115	0.06	0.59	**2**	0.2
Tier 1 UCL	0.122	0.06	0.59	**2**	0.2
Tier 2 UTL[a]	0.478	0.06	0.59	**8**	0.8
Tier 2 UCL	0.0986	0.06	0.59	2	0.2

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
Bold = Hazard quotients>1.

Table A4.2.5
PMJM Hazard Quotients for Antimony

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Antimony (Default Exposure)					
Patch 19					
MDC	0.533	0.06	0.59	**9**	0.9
UTL[a]	0.524	0.06	0.59	**9**	0.9
UCL	0.393	0.06	0.59	**7**	0.7
Mean	0.284	0.06	0.59	**5**	0.5
Patch 20					
MDC	2.94	0.06	0.59	**49**	**5**
UTL	2.73	0.06	0.59	**46**	**5**
UCL	1.12	0.06	0.59	**19**	**2**
Mean	0.622	0.06	0.59	**10**	1
Patch 21					
MDC	0.397	0.06	0.59	**7**	0.7
UTL[a]	0.388	0.06	0.59	**6**	0.7
UCL	0.345	0.06	0.59	**6**	0.6
Mean	0.261	0.06	0.59	**4**	0.4

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.6
PMJM Intake Estimates for Chromium
Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.084	3.162	lnCm = -1.495 + 0.7326(lnCs)				
			Media Concentrations (mg/kg)			
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
19	26	MDC	2.18	82.2	2.44	0.348
19	26	UTL[a]	2.18	82.2	2.44	0.026
19	20.3	UCL	1.71	64.2	2.04	0.02
19	17.2	Mean	1.44	54.4	1.80	0.01
20	24.2	MDC	2.03	76.5	2.31	0.348
20	24.2	UTL[a]	2.03	76.5	2.31	0.026
20	16.4	UCL	1.38	51.9	1.74	0.02
20	14.3	Mean	1.20	45.2	1.57	0.01
21	23.3	MDC	1.96	73.7	2.25	0.348
21	23.3	UTL[a]	1.96	73.7	2.25	0.026
21	18.98	UCL	1.59	60.0	1.94	0.02
21	14.03	Mean	1.18	44.4	1.55	0.01
			Intake Parameters			
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
			Intake Estimates (mg/kg BW day)			
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 19						
MDC	0.260	4.19	N/A	0.106	0.0522	4.61
UTL[a]	0.260	4.19	N/A	0.106	0.00390	4.56
UCL	0.203	3.27	N/A	0.0828	0.00300	3.56
Mean	0.172	2.77	N/A	0.0702	0.00150	3.02
Patch 20						
MDC	0.242	3.90	N/A	0.0987	0.0522	4.30
UTL[a]	0.242	3.90	N/A	0.0987	0.00390	4.25
UCL	0.164	2.64	N/A	0.0669	0.00300	2.88
Mean	0.143	2.31	N/A	0.0583	0.00150	2.51
Patch 21						
MDC	0.233	3.76	N/A	0.0951	0.0522	4.14
UTL[a]	0.233	3.76	N/A	0.0951	0.00390	4.09
UCL	0.190	3.06	N/A	0.0774	0.00300	3.33
Mean	0.140	2.26	N/A	0.0572	0.00150	2.46

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
NA = Not applicable or not available.

Table A4.2.7
PMJM Hazard Quotients for Chromium

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day) Chromium VI NOAEL	Chromium VI LOAEL	Chromium III NOAEL	Chromium III LOAEL	Hazard Quotients Chromium VI NOAEL	Chromium VI LOAEL	Chromium III NOAEL	Chromium III LOAEL
Chromium (Default Exposure)									
Patch 19									
MDC	4.61	3.28	13.14	2737	N/A	1	0.4	0.002	N/A
UTL[a]	4.56	3.28	13.14	2737	N/A	1	0.3	0.002	N/A
UCL	3.56	3.28	13.14	2737	N/A	1	0.3	0.001	N/A
Mean	3.02	3.28	13.14	2737	N/A	0.9	0.2	0.001	N/A
Patch 20									
MDC	4.30	3.28	13.14	2737	N/A	1	0.3	0.002	N/A
UTL[a]	4.25	3.28	13.14	2737	N/A	1	0.3	0.002	N/A
UCL	2.88	3.28	13.14	2737	N/A	0.9	0.2	0.001	N/A
Mean	2.51	3.28	13.14	2737	N/A	0.8	0.2	0.001	N/A
Patch 21									
MDC	4.14	3.28	13.14	2737	N/A	1	0.3	0.002	N/A
UTL[a]	4.09	3.28	13.14	2737	N/A	1	0.3	0.001	N/A
UCL	3.33	3.28	13.14	2737	N/A	1	0.3	0.001	N/A
Mean	2.46	3.28	13.14	2737	N/A	0.8	0.2	0.001	N/A

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.8
Non-PMJM Intake Estimates for Copper
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = 0.669 + 0.394(lnCs)	lnCi = 1.675 + 0.264(lnCs)	lnCsm = 2.042 + .1444(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
68.3	Tier 1 UTL	10.31	16.28	14.18	0.047	
38.5	Tier 1 UCL	8.23	14.00	13.05	0.022	
29.8	Tier 2 UTL	7.44	13.08	12.58	0.047	
18.2	Tier 2 UCL	6.12	11.48	11.72	0.022	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Herbivore						
Tier 1 UTL	2.37	N/A	N/A	1.46	0.00564	3.84
Tier 1 UCL	1.89	N/A	N/A	0.824	0.00264	2.68
Tier 2 UTL	1.71	N/A	N/A	0.637	0.00564	2.35
Tier 2 UCL	1.41	N/A	N/A	0.389	0.00264	1.80
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	3.75	N/A	1.46	0.00564	5.21
Tier 1 UCL	N/A	3.22	N/A	0.824	0.00264	4.00
Tier 2 UTL	N/A	3.01	N/A	0.637	0.00564	3.65
Tier 2 UCL	N/A	2.64	N/A	0.389	0.00264	3.03

NA = Not applicable.

Table A4.2.9
PMJM Intake Estimates for Copper
Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = 0.669 + 0.394(lnCs)	lnCi = 1.675 + 0.264(lnCs)	lnCsm = 2.042 + .1444(lnCs)				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
20	112	MDC	12.53	18.55	15.23	0.259
20	93.5	UTL	11.67	17.69	14.84	0.047
20	45.3	UCL	8.77	14.61	13.37	0.022
20	32.5	Mean	7.70	13.38	12.74	0.014
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 20						
MDC	1.49	0.946	N/A	0.457	0.0389	2.93
UTL	1.39	0.902	N/A	0.381	0.00705	2.68
UCL	1.04	0.745	N/A	0.185	0.00330	1.98
Mean	0.916	0.683	N/A	0.133	0.00210	1.73

NA = Not applicable or not available.

Table A4.2.10
Non-PMJM Hazard Quotients for Copper

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Copper (Default Exposure)					
Mourning Dove - Herbivore					
Tier 1 UTL	3.84	2.3	52.3	**2**	0.07
Tier 1 UCL	2.68	2.3	52.3	1	0.05
Tier 2 UTL	2.35	2.3	52.3	1	0.05
Tier 2 UCL	1.80	2.3	52.3	0.8	0.03
Mourning Dove - Insectivore					
Tier 1 UTL	5.21	2.3	52.3	**2**	0.1
Tier 1 UCL	4.00	2.3	52.3	**2**	0.08
Tier 2 UTL	3.65	2.3	52.3	**2**	0.07
Tier 2 UCL	3.03	2.3	52.3	1	0.06

Bold = Hazard quotients>1.

Table A4.2.11

PMJM Hazard Quotients for Copper

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day) NOAEL	TRV (mg/kg BW day) LOAEL	Hazard Quotients NOAEL	Hazard Quotients LOAEL
Copper (Default Exposure)					
Patch 20					
MDC	2.93	2.67	631.58	1	0.005
UTL	2.68	2.67	631.58	1	0.004
UCL	1.98	2.67	631.58	0.7	0.003
Mean	1.73	2.67	631.58	0.6	0.003

Bold = Hazard quotients>1.

Table A4.2.12
PMJM Intake Estimates for Manganese
Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.234	lnCi = 0.809 + 0.682(lnCs)	0.037				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
19	555	MDC	130	167	20.5	7.77
19	555	UTL[a]	130	167	20.5	0.538
19	400	UCL	94	134	14.8	0.257
19	335	Mean	78	118	12.4	0.215
20	829	MDC	194	220	30.7	7.77
20	617	UTL	144	180	22.8	0.538
20	361	UCL	84	125	13.4	0.257
20	293	Mean	69	108	10.8	0.215
21	476	MDC	111	150	17.6	7.77
21	476	UTL[a]	111	150	17.6	0.538
21	448	UCL	105	144	16.6	0.257
21	358	Mean	84	124	13.2	0.215
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 19						
MDC	15.5	8.52	N/A	2.26	1.17	27.4
UTL[a]	15.5	8.52	N/A	2.26	0.0807	26.3
UCL	11.1	6.82	N/A	1.63	0.0386	19.6
Mean	9.33	6.04	N/A	1.37	0.0323	16.8
Patch 20						
MDC	23.1	11.2	N/A	3.38	1.17	38.8
UTL	17.2	9.16	N/A	2.52	0.0807	28.9
UCL	10.1	6.36	N/A	1.47	0.0386	17.9
Mean	8.16	5.51	N/A	1.20	0.0323	14.9
Patch 21						
MDC	13.3	7.67	N/A	1.94	1.17	24.0
UTL[a]	13.3	7.67	N/A	1.94	0.0807	23.0
UCL	12.5	7.36	N/A	1.83	0.0386	21.7
Mean	9.97	6.32	N/A	1.46	0.0323	17.8

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
NA = Not applicable or not available.

Table A4.2.13
PMJM Hazard Quotients for Manganese

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Manganese (Default Exposure)					
Patch 19					
MDC	27.4	13.7	159.1	**2**	0.2
UTL[a]	26.3	13.7	159.1	**2**	0.2
UCL	19.6	13.7	159.1	1	0.1
Mean	16.8	13.7	159.1	1	0.1
Patch 20					
MDC	38.8	13.7	159.1	**3**	0.2
UTL	28.9	13.7	159.1	**2**	0.2
UCL	17.9	13.7	159.1	1	0.1
Mean	14.9	13.7	159.1	1	0.1
Patch 21					
MDC	24.0	13.7	159.1	**2**	0.2
UTL[a]	23.0	13.7	159.1	**2**	0.1
UCL	21.7	13.7	159.1	**2**	0.1
Mean	17.8	13.7	159.1	1	0.1

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.14
PMJM Intake Estimates for Molybdenum
Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.25	2.09	BAFsm = ((0.5*BAFsp)+(0.5*BAFsi))*0.003*50				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
20	4.4	MDC	1.10	9.20	9.01	0.016
20	3.05	UTL	0.76	6.37	6.24	0.006
20	1.61	UCL	0.40	3.36	3.30	0.003
20	1.22	Mean	0.31	2.55	2.50	0.003
21	2.25	MDC	0.56	4.70	4.61	0.016
21	2.25	UTL[a]	0.56	4.70	N/A	0.006
21	2.22	UCL	0.56	4.64	4.55	0.003
21	1.84	Mean	0.46	3.85	3.77	0.003
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 20						
MDC	0.131	0.469	N/A	0.0180	0.00240	0.620
UTL	0.0907	0.325	N/A	0.0124	9.00E-04	0.429
UCL	0.0479	0.172	N/A	0.00657	4.50E-04	0.227
Mean	0.0363	0.130	N/A	0.00498	4.50E-04	0.172
Patch 21						
MDC	0.0669	0.240	N/A	0.00918	0.00240	0.318
UTL[a]	0.0669	0.240	N/A	0.00918	9.00E-04	0.317
UCL	0.0660	0.237	N/A	0.00906	4.50E-04	0.312
Mean	0.0547	0.196	N/A	0.00751	4.50E-04	0.259

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
NA = Not applicable or not available.

Table A4.2.15
PMJM Hazard Quotients for Molybdenum

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Molybdenum (Default Exposure)					
Patch 20					
MDC	0.620	0.26	2.6	**2**	0.2
UTL	0.429	0.26	2.6	**2**	0.2
UCL	0.227	0.26	2.6	1	0.09
Mean	0.172	0.26	2.6	1	0.07
Patch 21					
MDC	0.318	0.26	2.6	1	0.1
UTL[a]	0.317	0.26	2.6	1	0.1
UCL	0.312	0.26	2.6	1	0.1
Mean	0.259	0.26	2.6	0.995	0.1

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.16
Non-PMJM Intake Estimates for Nickel
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
$\ln C_p = -2.224+0.748(\ln C_s)$	4.73	$\ln C_m = -0.2462 + 0.4658(\ln C_s)$				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
21.1	Tier 1 UTL	1.06	99.8	3.24	0.024	
14	Tier 1 UCL	0.78	66.2	2.67	0.018	
28.1	Tier 2 UTL[a]	1.31	132.9	3.70	0.024	
13.8	Tier 2 UCL	0.77	65.3	2.65	0.018	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	23.0	N/A	0.451	0.00288	23.4
Tier 1 UCL	N/A	15.2	N/A	0.299	0.00216	15.5
Tier 2 UTL[a]	N/A	30.6	N/A	0.601	0.00288	31.2
Tier 2 UCL	N/A	15.0	N/A	0.295	0.00216	15.3
Deer Mouse - Herbivore						
Tier 1 UTL	0.117	N/A	N/A	0.0468	0.00456	0.169
Tier 1 UCL	0.0864	N/A	N/A	0.0311	0.00342	0.121
Tier 2 UTL[a]	0.146	N/A	N/A	0.0624	0.00456	0.213
Tier 2 UCL	0.0855	N/A	N/A	0.0306	0.00342	0.120
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	6.49	N/A	0.0274	0.00456	6.52
Tier 1 UCL	N/A	4.30	N/A	0.0182	0.00342	4.33
Tier 2 UTL[a]	N/A	8.64	N/A	0.0365	0.00456	8.68
Tier 2 UCL	N/A	4.24	N/A	0.0179	0.00342	4.26
Coyote - Generalist						
Tier 1 UTL	N/A	0.374	0.0364	0.0158	0.00192	0.428
Tier 1 UCL	N/A	0.248	0.0301	0.0105	0.00144	0.290
Tier 2 UTL[a]	N/A	0.498	0.0416	0.0211	0.00192	0.563
Tier 2 UCL	N/A	0.245	0.0299	0.0104	0.00144	0.286
Coyote - Insectivore						
Tier 1 UTL	N/A	1.50	N/A	0.00886	0.00192	1.51
Tier 1 UCL	N/A	0.993	N/A	0.00588	0.00144	1.00
Tier 2 UTL[a]	N/A	1.99	N/A	0.0118	0.00192	2.01
Tier 2 UCL	N/A	0.979	N/A	0.00580	0.00144	0.986

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
N/A = Not applicable.

Table A4.2.17
Non-PMJM Intake Estimates for Nickel
Alternate Exposure Scenario (Median BAFs)

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
$\ln Cp = -2.224+0.748(\ln Cs)$	1.059	$\ln Cm = -0.2462 + 0.4658(\ln Cs)$				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
21.1	Tier 1 UTL	1.06	22.3	3.24	0.024	
14	Tier 1 UCL	0.78	14.8	2.67	0.018	
28.1	Tier 2 UTL[a]	1.31	29.8	3.70	0.024	
13.8	Tier 2 UCL	0.77	14.6	2.65	0.018	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.45	N/A	0.0274	0.00456	1.48
Tier 1 UCL	N/A	0.964	N/A	0.0182	0.00342	0.985
Tier 2 UTL[a]	N/A	1.93	N/A	0.0365	0.00456	1.98
Tier 2 UCL	N/A	0.950	N/A	0.0179	0.00342	0.971

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
N/A = Not applicable.

Table A4.2.18
PMJM Intake Estimates for Nickel
Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -2.224+0.748(lnCs)	4.73	lnCm = -0.2462 + 0.4658(lnCs)				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
19	19.3	MDC	0.99	91.3	3.10	0.272
19	19.3	UTL[a]	0.99	91.3	3.10	0.024
19	16.02	UCL	0.86	75.8	2.85	0.018
19	12.88	Mean	0.73	60.9	2.57	0.01
20	26.3	MDC	1.25	124.4	3.59	0.272
20	23.37	UTL	1.14	110.5	3.39	0.024
20	16.59	UCL	0.88	78.5	2.89	0.018
20	14.74	Mean	0.81	69.7	2.74	0.01
21	21.1	MDC	1.06	99.8	3.24	0.272
21	21.1	UTL[a]	1.06	99.8	3.24	0.024
21	16.45	UCL	0.88	77.8	2.88	0.018
21	12.05	Mean	0.70	57.0	2.49	0.01
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 19						
MDC	0.118	4.66	N/A	0.0787	0.0408	4.89
UTL[a]	0.118	4.66	N/A	0.0787	0.00360	4.86
UCL	0.103	3.86	N/A	0.0654	0.00270	4.04
Mean	0.0871	3.11	N/A	0.0526	0.00150	3.25
Patch 20						
MDC	0.149	6.34	N/A	0.107	0.0408	6.64
UTL	0.136	5.64	N/A	0.0953	0.00360	5.87
UCL	0.105	4.00	N/A	0.0677	0.00270	4.18
Mean	0.0963	3.56	N/A	0.0601	0.00150	3.71
Patch 21						
MDC	0.126	5.09	N/A	0.0861	0.0408	5.34
UTL[a]	0.126	5.09	N/A	0.0861	0.00360	5.31
UCL	0.105	3.97	N/A	0.0671	0.00270	4.14
Mean	0.0828	2.91	N/A	0.0492	0.00150	3.04

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
NA = Not applicable or not available.

Table A4.2.19
PMJM Intake Estimates for Nickel
Alternate Exposure Scenario (Median BAFs)

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -2.224+0.748(lnCs)	1.059	lnCm = -0.2462 + 0.4658(lnCs)				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
19	19.3	MDC	0.99	20.4	3.10	0.272
19	19.3	UTL[a]	0.99	20.4	3.10	0.024
19	16.02	UCL	0.86	17.0	2.85	0.018
19	12.88	Mean	0.73	13.6	2.57	0.01
20	26.3	MDC	1.25	27.9	3.59	0.272
20	23.37	UTL	1.14	24.7	3.39	0.024
20	16.59	UCL	0.88	17.6	2.89	0.018
20	14.74	Mean	0.81	15.6	2.74	0.01
21	21.1	MDC	1.06	22.3	3.24	0.272
21	21.1	UTL[a]	1.06	22.3	3.24	0.024
21	16.45	UCL	0.88	17.4	2.88	0.018
21	12.05	Mean	0.70	12.8	2.49	0.01
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 19						
MDC	0.118	1.04	N/A	0.0787	0.0408	1.28
UTL[a]	0.118	1.04	N/A	0.0787	0.00360	1.24
UCL	0.103	0.865	N/A	0.0654	0.00270	1.04
Mean	0.0871	0.696	N/A	0.0526	0.00150	0.837
Patch 20						
MDC	0.149	1.42	N/A	0.107	0.0408	1.72
UTL	0.136	1.26	N/A	0.0953	0.00360	1.50
UCL	0.105	0.896	N/A	0.0677	0.00270	1.07
Mean	0.0963	0.796	N/A	0.0601	0.00150	0.954
Patch 21						
MDC	0.126	1.14	N/A	0.0861	0.0408	1.39
UTL[a]	0.126	1.14	N/A	0.0861	0.00360	1.36
UCL	0.105	0.888	N/A	0.0671	0.00270	1.06
Mean	0.0828	0.651	N/A	0.0492	0.00150	0.784

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
N/A = Not applicable or not available.

Table A4.2.20
Non-PMJM Hazard Quotients for Nickel

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day) NOAEL	TRV LOAEL	TRV Sample et al. (1996) NOAEL	TRV Sample et al. (1996) LOAEL	Hazard Quotients NOAEL	Hazard Quotients LOAEL	Hazard Quotients Sample et al. (1996) NOAEL	Hazard Quotients Sample et al. (1996) LOAEL
Nickel (Default Exposure)									
Mourning Dove - Insectivore									
Tier 1 UTL	23.4	1.38	55.26	77.4	107	**17**	0.4	0.3	0.2
Tier 1 UCL	15.5	1.38	55.26	77.4	107	**11**	0.3	0.2	0.1
Tier 2 UTL[a]	31.2	1.38	55.26	77.4	107	**23**	0.6	0.4	0.3
Tier 2 UCL	15.3	1.38	55.26	77.4	107	**11**	0.3	0.2	0.1
Deer Mouse - Herbivore									
Tier 1 UTL	0.169	0.133	1.33	40	80	1	0.1	0.004	0.002
Tier 1 UCL	0.121	0.133	1.33	40	80	0.9	0.09	0.003	0.002
Tier 2 UTL[a]	0.213	0.133	1.33	40	80	**2**	0.2	0.005	0.003
Tier 2 UCL	0.120	0.133	1.33	40	80	0.9	0.09	0.003	0.001
Deer Mouse - Insectivore									
Tier 1 UTL	6.52	0.133	1.33	40	80	**49**	**5**	0.2	0.08
Tier 1 UCL	4.33	0.133	1.33	40	80	**33**	**3**	0.1	0.05
Tier 2 UTL[a]	8.68	0.133	1.33	40	80	**65**	**7**	0.2	0.1
Tier 2 UCL	4.26	0.133	1.33	40	80	**32**	**3**	0.1	0.05
Coyote - Generalist									
Tier 1 UTL	0.428	0.133	1.33	40	80	**3**	0.3	0.01	0.01
Tier 1 UCL	0.290	0.133	1.33	40	80	**2**	0.2	0.007	0.004
Tier 2 UTL[a]	0.563	0.133	1.33	40	80	**4**	0.4	0.014	0.007
Tier 2 UCL	0.286	0.133	1.33	40	80	**2**	0.2	0.007	0.004
Coyote - Insectivore									
Tier 1 UTL	1.51	0.133	1.33	40	80	**11**	1	0.04	0.02
Tier 1 UCL	1.00	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Tier 2 UTL[a]	2.01	0.133	1.33	40	80	**15**	**2**	0.05	0.03
Tier 2 UCL	0.986	0.133	1.33	40	80	**7**	0.7	0.02	0.01
Nickel (Alternative Exposure Scenario; Median BAFs)									
Deer Mouse - Insectivore									
Tier 1 UTL	1.48	0.133	1.33	40	80	**11**	1	0.04	0.02
Tier 1 UCL	0.985	0.133	1.33	40	80	**7**	0.7	0.02	0.01
Tier 2 UTL[a]	1.98	0.133	1.33	40	80	**15**	1	0.05	0.02
Tier 2 UCL	0.971	0.133	1.33	40	80	**7**	0.7	0.02	0.01

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
Bold = Hazard quotients>1.

Table A4.2.21
PMJM Hazard Quotients for Nickel

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day) NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	Hazard Quotients NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Nickel (Default Exposure)									
Patch 19									
MDC	4.89	0.133	1.33	40	80	**37**	**4**	0.1	0.06
UTL[a]	4.86	0.133	1.33	40	80	**37**	**4**	0.1	0.06
UCL	4.04	0.133	1.33	40	80	**30**	**3**	0.1	0.05
Mean	3.25	0.133	1.33	40	80	**24**	**2**	0.08	0.04
Patch 20									
MDC	6.64	0.133	1.33	40	80	**50**	**5**	0.2	0.08
UTL	5.87	0.133	1.33	40	80	**44**	**4**	0.1	0.07
UCL	4.18	0.133	1.33	40	80	**31**	**3**	0.1	0.05
Mean	3.71	0.133	1.33	40	80	**28**	**3**	0.09	0.05
Patch 21									
MDC	5.34	0.133	1.33	40	80	**40**	**4**	0.1	0.07
UTL[a]	5.31	0.133	1.33	40	80	**40**	**4**	0.1	0.07
UCL	4.14	0.133	1.33	40	80	**31**	**3**	0.1	0.05
Mean	3.04	0.133	1.33	40	80	**23**	**2**	0.08	0.04
Nickel (Alternative Exposure Scenario; Median BAFs)									
Patch 19									
MDC	1.28	0.133	1.33	40	80	**10**	0.96	0.03	0.02
UTL[a]	1.24	0.133	1.33	40	80	**9**	0.9	0.03	0.02
UCL	1.04	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Mean	0.837	0.133	1.33	40	80	**6**	0.6	0.02	0.01
Patch 20									
MDC	1.72	0.133	1.33	40	80	**13**	1	0.04	0.02
UTL	1.50	0.133	1.33	40	80	**11**	1	0.04	0.02
UCL	1.07	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Mean	0.954	0.133	1.33	40	80	**7**	0.7	0.02	0.01
Patch 21									
MDC	1.39	0.133	1.33	40	80	**10**	1	0.03	0.02
UTL[a]	1.36	0.133	1.33	40	80	**10**	1	0.03	0.02
UCL	1.06	0.133	1.33	40	80	**8**	0.8	0.03	0.01
Mean	0.784	0.133	1.33	40	80	**6**	0.6	0.02	0.01

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.22
Terrestrial Plant Hazard Quotients for Silver

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg)	Hazard Quotients
		Screening ESL	Screening ESL
Terrestrial Plant			
Tier 1 UTL	3.3	2	**2**
Tier 1 UCL	9.69	2	**5**
Tier 2 UTL	2.77	2	1
Tier 2 UCL	1.35	2	0.7

Bold = Hazard quotients>1.

Table A4.2.23
Non-PMJM Intake Estimates for Tin
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.03	1	0.21				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
21.1	Tier 1 UTL	0.63	21.10	4.43	0.019	
12.7	Tier 1 UCL	0.38	12.70	2.67	0.008	
35.8	Tier 2 UTL[a]	1.07	35.80	7.52	0.019	
8.45	Tier 2 UCL	0.25	8.45	1.77	0.008	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	4.85	N/A	0.451	0.00228	5.31
Tier 1 UCL	N/A	2.92	N/A	0.272	9.60E-04	3.19
Tier 2 UTL[a]	N/A	8.23	N/A	0.766	0.00228	9.00
Tier 2 UCL	N/A	1.94	N/A	0.181	9.60E-04	2.13
American Kestrel						
Tier 1 UTL	N/A	0.388	0.326	0.0971	0.00228	0.814
Tier 1 UCL	N/A	0.234	0.196	0.0584	9.60E-04	0.489
Tier 2 UTL[a]	N/A	0.659	0.553	0.165	0.00228	1.38
Tier 2 UCL	N/A	0.155	0.131	0.0389	9.60E-04	0.326
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.37	N/A	0.0274	0.00361	1.40
Tier 1 UCL	N/A	0.826	N/A	0.0165	0.00152	0.844
Tier 2 UTL[a]	N/A	2.33	N/A	0.0465	0.00361	2.38
Tier 2 UCL	N/A	0.549	N/A	0.0110	0.00152	0.562

[a]Tier soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
NA = Not applicable.

Table A4.2.24
PMJM Intake Estimates for Tin
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.03	1	0.21				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
19	66.9	MDC	2.0	66.9	14.0	0.049
19	66.9	UTL[a]	2.0	66.9	14.0	0.019
19	26.7	UCL	0.8	26.7	5.6	0.008
19	13.4	Mean	0.4	13.4	2.8	0.005
21	47.6	MDC	1.4	47.6	10.0	0.049
21	47.6	UTL[a]	1.4	47.6	10.0	0.019
21	34.4	UCL	1.0	34.4	7.2	0.008
21	21.8	Mean	0.7	21.8	4.6	0.005
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 19						
MDC	0.239	3.41	N/A	0.273	0.00735	3.93
UTL[a]	0.239	3.41	N/A	0.273	0.00285	3.93
UCL	0.0953	1.36	N/A	0.109	0.00120	1.57
Mean	0.0478	0.683	N/A	0.0547	7.50E-04	0.79
Patch 21						
MDC	0.170	2.43	N/A	0.194	0.00735	2.80
UTL[a]	0.170	2.43	N/A	0.194	0.00285	2.79
UCL	0.123	1.75	N/A	0.140	0.00120	2.02
Mean	0.0778	1.11	N/A	0.0889	7.50E-04	1.28

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
N/A = Not applicable or not available.

Table A4.2.25
Non-PMJM Hazard Quotients for Tin

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day) NOAEL	TRV (mg/kg BW day) LOAEL	Hazard Quotients NOAEL	Hazard Quotients LOAEL
Tin (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 UTL	5.31	0.73	18.34	**7**	0.3
Tier 1 UCL	3.19	0.73	18.34	**4**	0.2
Tier 2 UTL[a]	9.00	0.73	18.34	**12**	0.5
Tier 2 UCL	2.13	0.73	18.34	**3**	0.1
American Kestrel					
Tier 1 UTL	0.814	0.73	18.34	1	0.04
Tier 1 UCL	0.489	0.73	18.34	0.7	0.03
Tier 2 UTL[a]	1.38	0.73	18.34	**2**	0.08
Tier 2 UCL	0.326	0.73	18.34	0.4	0.02
Deer Mouse - Insectivore					
Tier 1 UTL	1.40	0.25	15	**6**	0.09
Tier 1 UCL	0.844	0.25	15	**3**	0.06
Tier 2 UTL[a]	2.38	0.25	15	**10**	0.2
Tier 2 UCL	0.562	0.25	15	**2**	0.04

[a]Tier soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.26
PMJM Hazard Quotients for Tin

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Tin (Default Exposure)					
Patch 19					
MDC	3.93	0.25	15	**16**	0.3
UTL[a]	3.93	0.25	15	**16**	0.3
UCL	1.57	0.25	15	**6**	0.1
Mean	0.787	0.25	15	**3**	0.05
Patch 21					
MDC	2.80	0.25	15	**11**	0.2
UTL[a]	2.79	0.25	15	**11**	0.2
UCL	2.02	0.25	15	**8**	0.1
Mean	1.28	0.25	15	**5**	0.09

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.27
Terrestrial Plant Hazard Quotients for Uranium

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg)	Hazard Quotients
		Screening ESL	Screening ESL
Terrestrial Plant			
Tier 1 UTL[a]	85	5	**17**
Tier 1 UCL	55.8	5	**11**
Tier 2 UTL[b]	18.5	5	**4**
Tier 2 UCL[b]	18.5	5	**4**

[a]Tier 1 soil UTL was greater than the maximum detected concentration (MDC), or could not be calculated due to low numbers of samples, so the MDC was used to estimate risk.

[b]Tier 2 soil UTL and/or UCL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate

Bold = Hazard quotients>1.

Table A4.2.28
Non-PMJM Intake Estimates for Vanadium
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.0097	0.088	0.0131				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
47	Tier 1 UTL	0.5	4.1	0.6	0.747	
32.1	Tier 1 UCL	0.3	2.8	0.4	0.052	
46.1	Tier 2 UTL	0.4	4.1	0.6	0.043	
35.4	Tier 2 UCL	0.3	3.1	0.5	0.021	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.269	N/A	0.0611	0.142	0.472
Tier 1 UCL	N/A	0.184	N/A	0.0417	0.00988	0.235
Tier 2 UTL	N/A	0.264	N/A	0.0599	0.00817	0.332
Tier 2 UCL	N/A	0.202	N/A	0.0460	0.00399	0.252

NA = Not applicable.

Table A4.2.29
PMJM Intake Estimates for Vanadium
Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.0097	0.088	0.0131				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
19	53	MDC	0.5	4.7	0.7	0.747
19	53	UTL[a]	0.5	4.7	0.7	0.052
19	44.9	UCL	0.4	4.0	0.6	0.043
19	39	Mean	0.4	3.4	0.5	0.021
20	43.6	MDC	0.4	3.8	0.6	0.747
20	43.6	UTL[a]	0.4	3.8	0.6	0.052
20	32.6	UCL	0.3	2.9	0.4	0.043
20	29.4	Mean	0.3	2.6	0.4	0.021
21	47	MDC	0.5	4.1	0.6	0.747
21	47	UTL[a]	0.5	4.1	0.6	0.052
21	46.1	UCL	0.4	4.1	0.6	0.043
21	36	Mean	0.3	3.2	0.5	0.021
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 19						
MDC	0.0612	0.238	N/A	0.216	0.112	0.627
UTL[a]	0.0612	0.238	N/A	0.216	0.00780	0.523
UCL	0.0518	0.202	N/A	0.183	0.00645	0.443
Mean	0.0450	0.175	N/A	0.159	0.00315	0.382
Patch 20						
MDC	0.0503	0.196	N/A	0.178	0.112	0.536
UTL[a]	0.0503	0.196	N/A	0.178	0.00780	0.432
UCL	0.0376	0.146	N/A	0.133	0.00645	0.323
Mean	0.0339	0.132	N/A	0.120	0.00315	0.289
Patch 21						
MDC	0.0543	0.211	N/A	0.192	0.112	0.569
UTL[a]	0.0543	0.211	N/A	0.192	0.00780	0.465
UCL	0.0532	0.207	N/A	0.188	0.00645	0.455
Mean	0.0416	0.162	N/A	0.147	0.00315	0.353

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
NA = Not applicable or not available.

Table A4.2.30

Terrestrial Plant Hazard Quotients for Vanadium

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg)		Hazard Quotients	
		Screening ESL	Alternate LOEC	Screening ESL	Alternate LOEC
Terrestrial Plant					
Tier 1 UTL	47	2	50	**24**	0.9
Tier 1 UCL	32.1	2	50	**16**	0.6
Tier 2 UTL	46.1	2	50	**23**	0.9
Tier 2 UCL	35.4	2	50	**18**	0.7

Bold = Hazard quotients>1.

Table A4.2.31
Non-PMJM Hazard Quotients for Vanadium

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Vanadium (Default Exposure)					
Deer Mouse - Insectivore					
Tier 1 UTL	0.472	0.21	2.1	**2**	0.2
Tier 1 UCL	0.235	0.21	2.1	1	0.1
Tier 2 UTL	0.332	0.21	2.1	**2**	0.2
Tier 2 UCL	0.252	0.21	2.1	1	0.1

Bold = Hazard quotients>1.

Table A4.2.32
PMJM Hazard Quotients for Vanadium

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Vanadium (Default Exposure)					
Patch 19					
MDC	0.627	0.21	2.1	**3**	0.3
UTL[a]	0.523	0.21	2.1	**2**	0.2
UCL	0.443	0.21	2.1	**2**	0.2
Mean	0.382	0.21	2.1	**2**	0.2
Patch 20					
MDC	0.536	0.21	2.1	**3**	0.3
UTL[a]	0.432	0.21	2.1	**2**	0.2
UCL	0.323	0.21	2.1	**2**	0.2
Mean	0.289	0.21	2.1	1	0.1
Patch 21					
MDC	0.569	0.21	2.1	**3**	0.3
UTL[a]	0.465	0.21	2.1	**2**	0.2
UCL	0.455	0.21	2.1	**2**	0.2
Mean	0.353	0.21	2.1	**2**	0.2

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.33
PMJM Intake Estimates for Zinc
Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
$\ln Cp = 1.575 + 0.554 (\ln Cs)$	$\ln Ci = 4.449 + 0.328 (\ln Cs)$	$\ln Csm = 4.4987 + 0.0745 (\ln Cs)$				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
19	160	MDC	80.37	451.99	131.21	1.39
19	160	UTL[a]	80.37	451.99	131.21	0.395
19	102	UCL	62.63	389.94	126.88	0.168
19	75.6	Mean	53.05	353.45	124.08	0.107
20	199	MDC	90.69	485.51	133.36	1.39
20	168	UTL	82.57	459.28	131.69	0.395
20	99.5	UCL	61.77	386.78	126.65	0.168
20	81.3	Mean	55.23	361.98	124.76	0.107
21	72	MDC	51.64	347.84	123.63	1.39
21	72	UTL[a]	51.64	347.84	123.63	0.395
21	63.7	UCL	48.25	334.14	122.51	0.168
21	51	Mean	42.66	310.64	120.50	0.107
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 19						
MDC	9.56	23.1	N/A	0.653	0.209	33.5
UTL[a]	9.56	23.1	N/A	0.653	0.0593	33.3
UCL	7.45	19.9	N/A	0.416	0.0252	27.8
Mean	6.31	18.0	N/A	0.308	0.0161	24.7
Patch 20						
MDC	10.8	24.8	N/A	0.812	0.209	36.6
UTL	9.83	23.4	N/A	0.685	0.0593	34.0
UCL	7.35	19.7	N/A	0.406	0.0252	27.5
Mean	6.57	18.5	N/A	0.332	0.0161	25.4
Patch 21						
MDC	6.15	17.7	N/A	0.294	0.209	24.4
UTL[a]	6.15	17.7	N/A	0.294	0.0593	24.2
UCL	5.74	17.0	N/A	0.260	0.0252	23.1
Mean	5.08	15.8	N/A	0.208	0.0161	21.1

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
NA = Not applicable or not available.

Table A4.2.34
PMJM Hazard Quotients for Zinc

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Zinc (Default Exposure)					
Patch 19					
MDC	33.5	9.61	411.4	**3**	0.08
UTL[a]	33.3	9.61	411.4	**3**	0.08
UCL	27.8	9.61	411.4	**3**	0.07
Mean	24.7	9.61	411.4	**3**	0.06
Patch 20					
MDC	36.6	9.61	411.4	**4**	0.09
UTL	34.0	9.61	411.4	**4**	0.08
UCL	27.5	9.61	411.4	**3**	0.07
Mean	25.4	9.61	411.4	**3**	0.06
Patch 21					
MDC	24.4	9.61	411.4	**3**	0.06
UTL[a]	24.2	9.61	411.4	**3**	0.06
UCL	23.1	9.61	411.4	**2**	0.06
Mean	21.1	9.61	411.4	**2**	0.05

[a]Soil UTL was greater than the MDC or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.35
Non-PMJM Intake Estimates for Bis(2-ethylhexyl)phthalate
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.15	34.9	28.81				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
0.41	Tier 1 UTL	0.0615	14.3	11.8	0.0225	
0.443	Tier 1 UCL	0.0665	15.5	12.8	0.0165	
0.373	Tier 2 UTL[a]	0.0560	13.0	10.7	0.0225	
0.282	Tier 2 UCL	0.0423	9.84	8.12	0.0165	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	3.29	N/A	0.00877	0.00270	3.30
Tier 1 UCL	N/A	3.56	N/A	0.00948	0.00198	3.57
Tier 2 UTL[a]	N/A	2.99	N/A	0.00798	0.00270	3.00
Tier 2 UCL	N/A	2.26	N/A	0.00603	0.00198	2.27
American Kestrel						
Tier 1 UTL	N/A	0.263	0.869	0.00189	0.00270	1.14
Tier 1 UCL	N/A	0.284	0.939	0.00204	0.00198	1.23
Tier 2 UTL[a]	N/A	0.240	0.791	0.00172	0.00270	1.03
Tier 2 UCL	N/A	0.181	0.598	0.00130	0.00198	0.782

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
N/A = Not applicable.

Table A4.2.36
Non-PMJM Hazard Quotients for Bis(2-ethylhexyl)phthalate

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Bis(2-ethylhexyl)phthalate (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 UTL	3.30	1.1	214	**3**	0.02
Tier 1 UCL	3.57	1.1	214	**3**	0.02
Tier 2 UTL[a]	3.00	1.1	214	**3**	0.01
Tier 2 UCL	2.27	1.1	214	**2**	0.01
American Kestrel					
Tier 1 UTL	1.14	1.1	214	1	0.01
Tier 1 UCL	1.23	1.1	214	1	0.01
Tier 2 UTL[a]	1.03	1.1	214	0.9	0.005
Tier 2 UCL	0.782	1.1	214	0.7	0.004

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.37

Non-PMJM Intake Estimates for Di-n-butylphthalate
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.39	30.1	28.43				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
0.41	Tier 1 UTL	0.160	12.3	11.7	0.008	
0.302	Tier 1 UCL	0.118	9.09	8.59	0.00509	
0.373	Tier 2 UTL[a]	0.145	11.2	10.6	0.006	
0.283	Tier 2 UCL	0.110	8.52	8.05	0.00487	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	2.84	N/A	0.00877	9.60E-04	2.85
Tier 1 UCL	N/A	2.09	N/A	0.00646	6.11E-04	2.10
Tier 2 UTL[a]	N/A	2.58	N/A	0.00798	7.20E-04	2.59
Tier 2 UCL	N/A	1.96	N/A	0.00605	5.84E-04	1.97
American Kestrel						
Tier 1 UTL	N/A	0.227	0.858	0.00189	9.60E-04	1.09
Tier 1 UCL	N/A	0.167	0.632	0.00139	6.11E-04	0.801
Tier 2 UTL[a]	N/A	0.207	0.780	0.00172	7.20E-04	0.990
Tier 2 UCL	N/A	0.157	0.592	0.00130	5.84E-04	0.751

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.

N/A = Not applicable.

Table A4.2.38
Non-PMJM Hazard Quotients for Di-n-butylphthalate

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Di-n-butylphthalate (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 UTL	2.85	0.11	1.1	**26**	**3**
Tier 1 UCL	2.10	0.11	1.1	**19**	**2**
Tier 2 UTL[a]	2.59	0.11	1.1	**24**	**2**
Tier 2 UCL	1.97	0.11	1.1	**18**	**2**
American Kestrel					
Tier 1 UTL	1.09	0.11	1.1	**10**	0.99
Tier 1 UCL	0.801	0.11	1.1	**7**	0.7
Tier 2 UTL[a]	0.990	0.11	1.1	**9**	0.9
Tier 2 UCL	0.751	0.11	1.1	**7**	0.7

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
Bold = Hazard quotients>1.

Table A4.2.39
Non-PMJM Intake Estimates for Total Dioxin (Birds)
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.22	Ci = 3.533 + 1.182(lnC	lnCsm = 0.8113 + 1.0993(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
0.000126	Tier 1 UTL[a]	2.77E-05	8.41E-04	1.16E-04	0	
0.000096	Tier 1 UCL	2.11E-05	6.10E-04	8.62E-05	0	
0.000000398	Tier 2 UTL[b]	8.76E-08	9.32E-07	2.07E-07	0	
0.000000398	Tier 2 UCL[b]	8.76E-08	9.32E-07	2.07E-07	0	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Insectivore						
Tier 1 UTL[a]	N/A	1.94E-04	N/A	2.70E-06	0	1.96E-04
Tier 1 UCL	N/A	1.40E-04	N/A	2.05E-06	0	1.42E-04
Tier 2 UTL[b]	N/A	2.14E-07	N/A	8.51E-09	0	2.23E-07
Tier 2 UCL[b]	N/A	2.14E-07	N/A	8.51E-09	0	2.23E-07
American Kestrel						
Tier 1 UTL[a]	N/A	1.55E-05	8.56E-06	5.80E-07	0	2.46E-05
Tier 1 UCL	N/A	1.12E-05	6.35E-06	4.42E-07	0	1.80E-05
Tier 2 UTL[b]	N/A	1.71E-08	1.53E-08	1.83E-09	0	3.42E-08
Tier 2 UCL[b]	N/A	1.71E-08	1.53E-08	1.83E-09	0	3.42E-08

[a]Tier 1 soil UTL was greater than the maximum detected concentration (MDC), or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

[b]Tier 2 soil UTL and/or UCL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.

N/A = Not applicable or not available.

Table A4.2.40
Non-PMJM Intake Estimates for Total Dioxin (Mammals)
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.22	lnCi = 3.533 + 1.182(lnCs)	lnCsm = 0.8113 + 1.0993(lnCs)				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
0.000074	Tier 1 UTL[a]	1.63E-05	4.49E-04	6.48E-05	0	
0.000055	Tier 1 UCL	1.21E-05	3.16E-04	4.67E-05	0	
0.000000398	Tier 2 UTL[b]	8.76E-08	9.32E-07	2.07E-07	0	
0.000000398	Tier 2 UCL[b]	8.76E-08	9.32E-07	2.07E-07	0	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Deer Mouse - Herbivore	0.111	0.19	0.002	1	0	0
Deer Mouse - Insectivore	0.065	0.19	0.001	0	1	0
Coyote - Generalist	0.015	0.08	0.001	0	0.25	0.75
Coyote - Insectivore	0.015	0.08	0.0004	0	1	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Deer Mouse - Herbivore						
Tier 1 UTL[a]	1.81E-06	N/A	N/A	1.64E-07	0	1.97E-06
Tier 1 UCL	1.34E-06	N/A	N/A	1.22E-07	0	1.47E-06
Tier 2 UTL[b]	9.72E-09	N/A	N/A	8.84E-10	0	1.06E-08
Tier 2 UCL[b]	9.72E-09	N/A	N/A	8.84E-10	0	1.06E-08
Deer Mouse - Insectivore						
Tier 1 UTL[a]	N/A	2.92E-05	N/A	9.62E-08	0	2.93E-05
Tier 1 UCL	N/A	2.05E-05	N/A	7.15E-08	0	2.06E-05
Tier 2 UTL[b]	N/A	6.06E-08	N/A	5.17E-10	0	6.11E-08
Tier 2 UCL[b]	N/A	6.06E-08	N/A	5.17E-10	0	6.11E-08
Coyote - Generalist						
Tier 1 UTL[a]	N/A	1.68E-06	7.29E-07	5.55E-08	0	2.47E-06
Tier 1 UCL	N/A	1.18E-06	5.26E-07	4.13E-08	0	1.75E-06
Tier 2 UTL[b]	N/A	3.50E-09	2.33E-09	2.99E-10	0	6.13E-09
Tier 2 UCL[b]	N/A	3.50E-09	2.33E-09	2.99E-10	0	6.13E-09
Coyote - Insectivore						
Tier 1 UTL[a]	N/A	6.73E-06	N/A	3.11E-08	0	6.76E-06
Tier 1 UCL	N/A	4.74E-06	N/A	2.31E-08	0	4.76E-06
Tier 2 UTL[b]	N/A	1.40E-08	N/A	1.67E-10	0	1.41E-08
Tier 2 UCL[b]	N/A	1.40E-08	N/A	1.67E-10	0	1.41E-08

[a]Tier 1 soil UTL was greater than the maximum detected concentration (MDC), or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.
[b]Tier 2 soil UTL and/or UCL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
N/A = Not applicable or not available.

Table A4.2.41
Non-PMJM Hazard Quotients for Total Dioxin

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Total Dioxin (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 UTL[a]	1.96E-04	0.000014	0.00014	**14**	1
Tier 1 UCL	1.42E-04	0.000014	0.00014	**10**	1
Tier 2 UTL[b]	2.23E-07	0.000014	0.00014	0.02	0.002
Tier 2 UCL[b]	2.23E-07	0.000014	0.00014	0.02	0.002
American Kestrel					
Tier 1 UTL[a]	2.46E-05	0.000014	0.00014	**2**	0.2
Tier 1 UCL	1.80E-05	0.000014	0.00014	1	0.13
Tier 2 UTL[b]	3.42E-08	0.000014	0.00014	0.002	0.0002
Tier 2 UCL[b]	3.42E-08	0.000014	0.00014	0.002	0.0002
Deer Mouse - Herbivore					
Tier 1 UTL[a]	1.97E-06	0.000001	0.00001	**2**	0.20
Tier 1 UCL	1.47E-06	0.000001	0.00001	1	0.15
Tier 2 UTL[b]	1.06E-08	0.000001	0.00001	0.01	0.001
Tier 2 UCL[b]	1.06E-08	0.000001	0.00001	0.01	0.001
Deer Mouse - Insectivore					
Tier 1 UTL[a]	2.93E-05	0.000001	0.00001	**29**	**3**
Tier 1 UCL	2.06E-05	0.000001	0.00001	**21**	**2**
Tier 2 UTL[b]	6.11E-08	0.000001	0.00001	0.06	0.01
Tier 2 UCL[b]	6.11E-08	0.000001	0.00001	0.06	0.01
Coyote - Generalist					
Tier 1 UTL[a]	2.47E-06	0.000001	0.00001	**2**	0.2
Tier 1 UCL	1.75E-06	0.000001	0.00001	**2**	0.2
Tier 2 UTL[b]	6.13E-09	0.000001	0.00001	0.01	0.001
Tier 2 UCL[b]	6.13E-09	0.000001	0.00001	0.01	0.001
Coyote - Insectivore					
Tier 1 UTL[a]	6.76E-06	0.000001	0.00001	**7**	0.68
Tier 1 UCL	4.76E-06	0.000001	0.00001	**5**	0.48
Tier 2 UTL[b]	1.41E-08	0.000001	0.00001	0.01	0.001
Tier 2 UCL[b]	1.41E-08	0.000001	0.00001	0.01	0.001

[a]Tier 1 soil UTL was greater than the maximum detected concentration (MDC), or could not be calculated due to low numbers of samples, so the MDC was used to estimate intake.

[b]Tier 2I soil UTL and/or UCL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.42
Non-PMJM Intake Estimates for Total PCBs
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.25	lnCe = 1.41 + 1.361(lnCs)	log(Csm) = 0.246 * ((0.5*0.25)+(0.5*Cinv/Csoil))				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
1.3	Tier 1 UTL	0.33	5.9	1.79	0	
0.727	Tier 1 UCL	0.18	2.7	1.62	0	
0.799	Tier 2 UTL[a]	0.20	3.0	1.64	0	
0.51	Tier 2 UCL	0.13	1.6	1.53	0	
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$** (kg/kg BW day)	**$IR_{(soil)}$** (kg/kg BW day)	**P_{plant}**	**P_{invert}**	**P_{mammal}**
Mourning Dove - Herbivore	0.23	0.12	0.021	1	0	0
Mourning Dove - Insectivore	0.23	0.12	0.021	0	1	0
American Kestrel	0.092	0.12	0.005	0	0.2	0.8
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Herbivore						
Tier 1 UTL	0.0748	NA	N/A	0.0278	0	0.103
Tier 1 UCL	0.0418	NA	N/A	0.0156	0	0.0574
Tier 2 UTL[a]	0.0459	NA	N/A	0.0171	0	0.0630
Tier 2 UCL	0.0293	NA	N/A	0.0109	0	0.0402
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	1.35	N/A	0.0278	0	1.37
Tier 1 UCL	N/A	0.610	N/A	0.0156	0	0.626
Tier 2 UTL[a]	N/A	0.694	N/A	0.0171	0	0.711
Tier 2 UCL	N/A	0.377	N/A	0.0109	0	0.388
American Kestrel						
Tier 1 UTL	N/A	0.108	0.132	0.00598	0	0.246
Tier 1 UCL	N/A	0.0488	0.119	0.00334	0	0.171
Tier 2 UTL[a]	N/A	0.0555	0.121	0.00368	0	0.180
Tier 2 UCL	N/A	0.0301	0.113	0.00235	0	0.145

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.
NA = Not applicable.

Table A4.2.43
PMJM Intake Estimates for Total PCBs

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.25	lnCe = 1.41 + 1.361(lnCs)	log(Csm) = 0.246 * ((0.5*0.25)+(0.5*Cinv/Csoil))				
Media Concentrations (mg/kg)						
Patch	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
20	3.9	MDC	1.0	26.1	2.35	0
20	3.18	UTL	0.8	19.8	2.22	0
20	1.31	UCL	0.3	5.9	1.80	0
20	0.791	Mean	0.2	3.0	1.64	0
Intake Parameters						
	$IR_{(food)}$ (kg/kg BW day)	**$IR_{(water)}$ (kg/kg BW day)**	**$IR_{(soil)}$ (kg/kg BW day)**	**P_{plant}**	**P_{invert}**	**P_{mammal}**
PMJM	0.17	0.15	0.004	0.7	0.3	0
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Patch 20						
MDC	0.116	1.33	N/A	0.0159	N/A	1.46
UTL	0.0946	1.01	N/A	0.0130	N/A	1.12
UCL	0.0390	0.302	N/A	0.00534	N/A	0.346
Mean	0.0235	0.152	N/A	0.00323	N/A	0.179

NA = Not applicable or not available.

Table A4.2.44
Non-PMJM Hazard Quotients for Total PCBs

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Total PCBs (Default Exposure)					
Mourning Dove - Herbivore					
Tier 1 UTL	0.103	0.09	1.27	1	0.1
Tier 1 UCL	0.0574	0.09	1.27	0.6	0.05
Tier 2 UTL[a]	0.0630	0.09	1.27	0.7	0.05
Tier 2 UCL	0.0402	0.09	1.27	0.4	0.03
Mourning Dove - Insectivore					
Tier 1 UTL	1.37	0.09	1.27	**15**	1
Tier 1 UCL	0.626	0.09	1.27	**7**	0.5
Tier 2 UTL[a]	0.711	0.09	1.27	**8**	0.6
Tier 2 UCL	0.388	0.09	1.27	**4**	0.3
American Kestrel					
Tier 1 UTL	0.246	0.09	1.27	**3**	0.2
Tier 1 UCL	0.171	0.09	1.27	**2**	0.1
Tier 2 UTL[a]	0.180	0.09	1.27	**2**	0.1
Tier 2 UCL	0.145	0.09	1.27	**2**	0.1

[a]Tier 2 soil UTL was greater than the maximum grid mean, or could not be calculated due to low numbers of samples, so the maximum grid mean was used to estimate intake.

Bold = Hazard quotients>1.

Table A4.2.45
PMJM Hazard Quotients for Total PCBs

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Total PCBs (Default Exposure)					
Patch 20					
MDC	1.46	0.36	0.71	**4**	**2**
UTL	1.12	0.36	0.71	**3**	**2**
UCL	0.346	0.36	0.71	0.96	0.5
Mean	0.179	0.36	0.71	0.5	0.3

Bold = Hazard quotients>1.

COMPREHENSIVE RISK ASSESSMENT

UPPER WOMAN DRAINAGE EXPOSURE UNIT

VOLUME 10: ATTACHMENT 5

Chemical-Specific Uncertainty Analysis

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

BAF	Bioaccumulation Factors
BW	body weight
CMS	Corrective Measures Study
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
ECOPC	ecological contaminant of potential concern
Eco-SSL	Ecological Soil Screening Level
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ESL	ecological screening level
FS	Feasibility Study
HQ	hazard quotient
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
mg/kg	milligrams per kilogram
mg/kg BW/day	milligrams per kilogram per receptor body weight per day
NOAEL	no observed adverse effect level
PMJM	Preble’s meadow jumping mouse
PRC	PRC Environmental Management, Inc.
RCRA	Resource Conservation and Recovery Act
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study

TRV	toxicity reference value
UCL	upper confidence limit
UTL	upper tolerance limit

1.0 INTRODUCTION

One potential limitation of the hazard quotient (HQ) approach is that calculated HQ values may sometimes be uncertain due to simplifications and assumptions in the underlying exposure and toxicity data used to derive the HQs. Where possible, this risk assessment provides information on two potential sources of uncertainty, described below.

- **Bioaccumulation Factors (BAFs).** For wildlife receptors, concentrations of contaminants in dietary items were estimated from surface soil using uptake equations. When the uptake equation was based on a simple linear model (e.g., Ctissue = BAF * Csoil), the default exposure scenario used a high-end estimate of the BAF (the 90th percentile BAF). However, the use of high-end BAFs may tend to overestimate tissue concentrations in some dietary items. In order to estimate more typical tissue concentrations, where necessary, an alternate exposure scenario calculated total chemical intake using a 50th percentile (median) BAF and HQs were calculated. The use of the median BAF is consistent with the approach used in the ecological soil screening level (Eco-SSL) guidance (EPA 2005).
- **Toxicity Reference Values (TRVs).** The Comprehensive Risk Assessment (CRA) Methodology (U.S. Department of Energy [DOE] 2005), hereafter referred to as the CRA Methodology, utilized an established hierarchy to identify the most appropriate default TRVs for use in the ecological contaminant of potential concern (ECOPC) selection. However, in some instances, the default TRV selected may be overly conservative with regard to characterizing population-level risks. The determination of whether the default TRVs are thought to yield overly conservative estimates of risk is addressed in the uncertainty sections below on a chemical-by-chemical basis in the following subsections. When an alternate TRV is identified, the chemical-specific subsections provide a discussion of why the alternate TRV is thought to be appropriate to provide an alternative estimate of toxicity (e.g., endpoint relevance, species relevance, data quality, chemical form, etc.), and HQs were calculated using both default and alternate TRVs where necessary.

The influences of each of these uncertainties on the calculated HQs are discussed for each ECOPC in the following subsections.

1.1 Antimony

Plant Toxicity

Toxicity information on the effects of antimony to plants is extremely limited. The summary of antimony toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants and the lowest observed effect concentration (LOEC) ecological screening level (ESL) value is based on unspecified toxic effects. No additional TRVs were available in the literature. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated by using the default toxicity value.

Bioaccumulation Factors

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Antimony has two types of BAFs used in the intake calculations. For the soil-to-plant BAF, a regression equation from EPA (2003) was used to estimate plant tissue concentrations. Confidence placed in this value is high; however, uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. In many cases, regression-based models are the best available predictor of tissue concentrations but may still overestimate or underestimate plant tissue concentrations of antimony to an unknown degree.

Considerable uncertainty is placed in the soil-to-invertebrate and soil-to-small mammal BAFs for antimony. No soil-to-invertebrate BAF was identified in the CRA Methodology and, therefore, a default value of 1 was used as the BAF. As a result, all intake calculations assume that antimony concentrations in terrestrial invertebrate tissues are equal to concentrations in surface soils. Because antimony is not typically a bioaccumulative compound, this assumption is likely to overestimate antimony concentrations and subsequent risk estimations to an unknown degree.

The soil-to-small mammal BAF utilizes both the soil-to-plant and soil-to-invertebrate BAFs in addition to a food-to-small mammal BAF to estimate small mammal tissue concentrations. Given the uncertainties associated with the soil-to-invertebrate TRV and the added uncertainty of the food-to-small mammal BAF, the total uncertainty related to the soil-to-small mammal BAF is large. However, it is unclear as to whether the BAF overestimates or underestimates the concentration of antimony in small mammal tissues, and the degree of effects that the uncertainty has on the intake calculations is unknown.

Toxicity Reference Values

For mammalian receptors, review of the toxicity data provided in EPA (2003) indicates that only one bounded lowest observed adverse effect level (LOAEL), used in the risk estimation, is lower than the geometric mean of growth and reproduction no observed adverse effect level (NOAEL) TRVs. All other bounded LOAEL TRVs for growth, reproduction, and mortality are more than an order of magnitude greater than the NOAEL and LOAEL used as the default TRVs. The default NOAEL and LOAEL TRVs for antimony are based on a decrease in rat progeny weight, and the effect of a predicted decrease in birth weight on the mammalian receptors in the UWOEU is unknown. Since the endpoint for the LOAEL TRV is based on an acceptable endpoint as defined by the CRA methodology, the overall uncertainty related to the antimony TRVs should be considered to be low. However, the combination of the TRV endpoint of questionable applicability toward measuring the assessment endpoint and the review of the entire TRV database that indicated the LOAEL concentration is significantly lower than the remainder of the applicable effects-based TRVs reviewed by EPA (2003) suggests that the uncertainties should be carefully considered in risk management decisions.

Background Risk Calculations

Antimony was not detected in background surface soils. Therefore, background risks were not calculated for antimony in Appendix A, Volume 2, Attachment 9 of the Resource Conservation and Recovery Act (RCRA) Facility Investigation-Remedial Investigation (RI)/Corrective Measures Study (CMS)-Feasibility Study (FS) Report (hereafter referred to as the RI/FS Report).

1.2 Chromium

Bioaccumulation Factors

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Chromium has two types of bioaccumulation factors used in the intake calculations. For the soil-to-small mammal BAF, a regression equation was used to estimate tissue concentrations. Confidence placed in this value is high; however, uncertainty is unavoidable when using even high quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of chromium to an unknown degree.

The soil-to-invertebrate and soil-to-plant BAFs used to estimate invertebrate tissue concentrations are both based on screening-level upper-bound (90th percentile) BAFs presented in Sample et al. (1998a) and ORNL (1998). These values provide conservative estimates of uptake from soils to invertebrate and plant tissues. This conservative estimate may serve to overestimate chromium concentrations in tissues. For this reason, the median BAFs presented in the same documents were used as alternative BAFs to estimate invertebrate and plant tissue concentrations as recommended in U.S. Environmental Protection Agency (EPA) Eco-SSL guidance (EPA 2005a). It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

Toxicity Reference Values

For mammals, both a NOAEL and LOAEL TRVs were available for chromium VI, but only a NOAEL TRV was available for chromium III. All of the mammalian TRVs were obtained from Sample et al. (1996) and relate to reproduction and mortality endpoints. For chromium III, The NOAEL TRV (2,737 mg/kg BW/day) represents a dose at which no effects on reproduction or longevity were noted. For chromium VI, the NOAEL TRV (3.28 mg/kg BW/day) represents a dose at which no body weight or food consumption effects were noted in rats. The LOAEL TRV (13.14 mg/kg BW/day) for chromium VI, which was derived from a different study than the NOAEL TRV, represents the dose at which mortality effects were noted in rats. Both the chromium III and chromium VI TRVs were used in the default analysis. However, as noted above, chromium III is likely to be the chemical form present in soils at Rocky Flats Environmental Technology Site (RFETS). Since both chromium III and chromium VI TRVs were based on acceptable effects endpoints, no alternative TRVs were identified.

Since the completion of the TRV derivation process in the CRA Methodology, EPA has derived Eco-SSLs for mammals (chromium III and chromium VI) (EPA 2005b). While the Eco-SSL TRVs were not utilized in the default analysis, a comparison of Eco-SSL TRVs to those selected by Sample et al. (1996) which were used in the default analysis provides information on the applicability of and underlying uncertainties in the selected TRVs. For mammals, the Eco-SSL dose-based TRV derived for chromium III (2.4 mg/kg BW/day) was based on the geomean of all growth and reproduction NOAELs. As seen, the Eco-SSL TRV is more than 1000 times lower than the NOAEL TRV selected by Sample et al. (1996). Inspection of the toxicity dataset for chromium III provided in EPA (2005b) shows that there are several unbounded LOAELs below the NOAEL TRV selected by Sample et al. (1996). Therefore, the uncertainty associated with the mammalian chromium III NOAEL TRV utilized in the default analysis is high. The mammalian dose-based TRV derived for chromium VI (5.66 mg/kg BW/day) was based on the highest bounded NOAEL below the lowest bounded LOAEL for growth, reproduction, or survival, and is similar to the chromium VI TRVs identified by Sample et al. (1996) utilized in the default analysis. However, chromium III is likely to be the chemical form present in soils at RFETS, so HQs based on a TRV for chromium VI are also uncertain.

Background Risks

Chromium was detected in Rocky Flats Environmental Technology Site (RFETS) background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the PMJM were calculated using both the upper confidence limit (UCL) and upper tolerance limit (UTL) of background soils. NOAEL HQs less than one were calculated for the PMJM using either the UCL or UTL, for both chromium VI and chromium III.

1.3 Copper

Bioaccumulation Factors

For the soil-to-plant, soil-to-invertebrate, and soil-to-small mammal BAFs, regression equations were used to estimate plant tissue concentrations. Confidence placed in these values is high; however, uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of copper to an unknown degree.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for birds were obtained from PRC Environmental Management, Inc. (PRC) (1994). The PRC document reviewed the available effects database for avian effects from copper. The NOAEL TRV represents a dose of copper at which no growth, developmental, reproductive, or mortality effects were noted. The LOAEL TRV represents a dose rate at which an increase in the erosion of chicken gizzards was noted. The CRA Methodology noted that the nature of the effect predicted by the LOAEL TRV is not likely to cause significant effects on growth, reproduction, or survival in birds and, subsequently, calculated a threshold TRV. The threshold TRV represents an estimate of the point between the NOAEL and LOAEL TRVs where effects related to the LOAEL TRV may begin to occur. This point is uncertain and it is impossible to accurately estimate where the threshold for effects lies given the available data. Therefore, the calculation of the threshold TRV may overestimate or underestimate the calculated risks by a degree less than half of the difference between the NOAEL and LOAEL TRVs. In addition, the ability of the LOAEL TRV endpoint to predict effects to populations of avian receptors at RFETS under the assessment endpoints used in this CRA is uncertain. The effect that gizzard erosion in birds has on population-level endpoints is unclear, but risk estimations are likely to be conservative and over-predict risk. However, Sample et al. (1996), a CRA Methodology-approved TRV source, provides avian TRVs for growth and mortality endpoints to neonate chickens that are very similar to the LOAEL TRV from PRC (PRC - LOAEL = 52.3 milligram per kilogram per receptor body weight per day (mg/kg BW/day); Sample - LOAEL = 61.7 mg/kg BW/day). Because the two LOAEL values are similar, the uncertainty in the PRC LOAEL is reduced and no alternative TRVs are provided to calculate risk to the mourning dove receptors. The PRC value is considered to be protective of growth and mortality effects in birds. Although it may over-predict risks, the degree is likely to be small.

The NOAEL and LOAEL TRVs for mammals were obtained from PRC Environmental Management, Inc. (PRC) (1994). The PRC document reviewed the available effects database for mammalian effects from copper. The NOAEL TRV represents a dose of copper at which no growth, developmental, reproductive, or mortality effects were noted. The LOAEL TRV represents a dose at which increased mortality and decreased body weight were noted in mice. No threshold TRV was calculated due to both the mortality endpoint of the LOAEL TRV and the lack of specific data necessary to calculate the TRV. Since the endpoint for the LOAEL TRV is based on an acceptable endpoint as defined by the CRA methodology, the overall uncertainty related to the mammalian TRVs for copper should be considered to be low. The TRVs may overestimate or underestimate risk to an unknown degree.

Background Risks

Copper was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the mourning dove (herbivore and insectivore) were calculated using both the UCL and UTL of background soils. NOAEL HQs equal to 1 were calculated for the mourning dove (insectivore) with both the UCL and UTL EPCs. HQs less than one were calculated using the LOAEL TRVs. NOAEL HQs for the mourning dove (herbivore) are less than one for the UCL and UTL EPCs.

Risks to the PMJM were calculated using both the UCL and UTL of background soils. NOAEL HQs less than one were calculated for the PMJM using either the UCL or UTL.

1.4 Manganese

Bioaccumulation Factors

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Manganese has two types of bioaccumulation factors used in the intake calculations. For the soil-to-invertebrate BAF, a regression equation was used to estimate tissue concentrations. Confidence placed in this value is high; however, uncertainty is unavoidable when using even high quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate invertebrate tissue concentrations of manganese to an unknown degree.

The soil-to-plant and soil-to-small mammal BAFs used to estimate tissue concentrations are based on screening-level upper bound (90th percentile) BAFs presented in ORNL (1998) and Sample et al. (1998b). These values provide conservative estimates of uptake from soils to tissues. This conservative estimate may serve to overestimate manganese concentrations in plant and small mammal tissues. For this reason, the median BAFs presented in the same document were used as alternative BAFs to estimate tissue concentrations. It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of plant and small mammal tissue concentrations, but the likelihood of overestimation of risks is reduced. In addition, the conservative nature of the upper-bound soil-to-plant BAF directly affects the conservatisms in the soil-to-small mammal BAF that uses the both the soil-to-plant and soil-to-invertebrate BAFs in its calculation. It is unclear to what degree and direction that uncertainty can be estimated for the soil-to-small mammal BAF, but the uncertainty associated with the estimated small mammal tissue concentrations is high.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from PRC (1994), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which a decrease in testical weight in mice was noted. The NOAEL TRV was taken from the same study and represents an intake rate at which no effects on testicular weight was noted. No threshold TRV was identified in the CRA Methodology, so it is unknown where the threshold for effects lies at intake rates lower than the LOAEL

TRV. In addition, no relationship appears to have been identified between decreased testicular weight to reductions in reproductive success. This introduces some uncertainty into the risk assessment. However, since the endpoint for the LOAEL TRV is based on potential reproductive effects, the uncertainty is likely to be limited. Risks predicted by the LOAEL TRV may be overestimated, but the degree of uncertainty is low.

Background Risks

Manganese was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to all receptors were calculated using both the UCL and UTL of background soils. NOAEL HQs greater than 1 were calculated for the mourning dove (herbivore and insectivore. NOAEL HQs equaled 5 and 4 respectively when calculated using the background UTL as the EPC. No HQs greater than 1 were calculated for any receptor using LOAEL TRVs. These results indicate that HQs calculated in the risk estimation are not overly conservative in terms of predicting risk at natural background concentrations.

1.5 Molybdenum

Bioaccumulation Factors

The soil-to-invertebrate BAF used to estimate invertebrate tissue concentrations for the deer mouse (insectivore) is based on a screening-level upper bound (90th percentile) BAF presented in Sample et al. (1998a). This value provides a conservative estimate of uptake from soils to invertebrate tissues. This conservative estimate may serve to overestimate molybdenum concentrations in invertebrate tissues. For this reason, the median BAF presented in the same document (Sample et al. 1998b) can be as an alternative BAF to estimate invertebrate tissue concentrations. It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from Sample et al. (1996), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which an increased incidence of runts in mouse litters was noted. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks and the LOAEL

TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

Background Risk Calculations

Molybdenum was not detected in background surface soils. Therefore, background risks were not calculated for molybdenum in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.6 Nickel

Bioaccumulation Factors

There are several important uncertainties associated with the intake and HQ calculations for vertebrate receptors. Nickel has two types of bioaccumulation factors used in the intake calculations. For the soil-to-plant and soil-to-small mammal BAFs, regression equations were used to estimate tissue concentrations. Confidence placed in these values is high; however, uncertainty is unavoidable when using even high quality models to predict tissue concentrations. In cases without available measurements of tissue concentrations, regression-based models are generally the best available predictor of tissue concentrations. However, the regression-based BAFs may still overestimate or underestimate tissue concentrations of nickel to an unknown degree.

The soil-to-invertebrate BAF used to estimate invertebrate tissue concentrations is based on a screening-level upper bound (90th percentile) BAF presented in Sample et al. (1998a). This value provides a conservative estimate of uptake from soils to invertebrate tissues. This conservative estimate may serve to overestimate nickel concentrations in invertebrate tissues. For this reason, the median BAF presented in the same document (Sample et al. 1998b) can be used as an alternative BAF to estimate invertebrate tissue concentrations.

It is unclear whether the use of median BAFs reduces the uncertainty involved in the estimation of invertebrate tissue concentrations, but the likelihood of overestimation of risks is reduced.

Toxicity Reference Values

Uncertainty is also present in the TRVs used in the default HQ calculations for nickel. The NOAEL-based ESL calculated for the deer mouse (insectivore) was equal to 0.431 mg/kg, a concentration less than all site-specific background samples (minimum background concentration = 3.8 mg/kg). The NOAEL TRV used to calculate the ESL was estimated from the LOAEL TRV in the CRA Methodology by dividing by a factor of 10. The LOAEL TRV for mammals (1.33 mg/kg BW/day) is based on pup mortality in rats. Given that the LOAEL TRV is 10 times the NOAEL TRV, a back-calculated soil concentration using the LOAEL TRV equals 3.8 mg/kg. This concentration is equal to the minimum detected concentration of nickel in background soils and would be exceeded by 19 of the 20 site-specific background soil concentrations.

For avian receptors, there is also uncertainty in the quality of the TRVs selected in the CRA Methodology to predict population-level effects to birds at RFETS. The TRVs selected by PRC (1994) relate to the prediction of edema and swelling in leg and foot joints in mallard ducks. The CRA Methodology noted that the nature of the effect predicted by the LOAEL TRV is not likely to cause significant effects on growth, reproduction, or survival in birds and, subsequently, calculated a threshold TRV. The threshold TRV represents an estimate of the point between the NOAEL and LOAEL TRVs where effects related to the LOAEL TRV may begin to occur. This point is uncertain and it is impossible to accurately estimate where the threshold for effects lies. Therefore, the calculation of the threshold TRV may overestimate or underestimate the calculated risks by a degree less than half of the difference between the NOAEL and LOAEL TRVs. In addition, the ability of the LOAEL TRV endpoint to predict effects to populations of avian receptors at RFETS under the assessment endpoints used in this CRA is also uncertain. The effect that swelling of leg and toe joints in birds has on population-level endpoints is unclear and risk estimations are likely to be conservative and over-predict risks related to the assessment endpoints.

Given the uncertainties related to the TRVs for both mammals and birds, a further review of TRVs was conducted to provide additional toxicologically-based information for use in the risk characterization. The CRA Methodology prescribed a hierarchy of TRV sources from which TRVs could be identified and used without modification. TRVs were selected first from EPA EcoSSL guidance (EPA 2003) from which no nickel TRVs were available. The second Tier TRV source was PRC (1994), from which the TRVs were obtained. Due to the uncertain nature of predicting potential risk at even the lowest end of the range of background concentrations in an uncontaminated background area, additional TRVs were identified from the third tier TRV source (Sample et al. 1996). Sample et al. (1996) presents TRVs for birds and mammals that provide useful comparison points to the default TRVs identified in the CRA Methodology.

For mammals, the alternative TRVs were derived from a multi-generational study of rat reproduction and changes due to nickel contamination in food items. At a dose level equal to 80 mg/kg BW/day (LOAEL), significant decreases were noted in offspring weight in rats. No effects were noted at 40 mg/kg BW/day (NOAEL). The effect-endpoint is questionable in terms of predicting population level effects based on the assessment endpoint, but was identified as an acceptable endpoint in the CRA Methodology. These values can be used in conjunction with the alternative BAFs discussed above to provide risk managers with another valuable line of evidence to be used in making risk management decisions.

For birds, the alternative TRVs were derived from a chronic exposure study on mallard ducklings exposed to nickel in food items. No growth, reproductive or mortality-based effects were noted at the 77.4 mg/kg BW/day dose level (NOAEL) but significant decreased in growth rate and increased in mortality were noted at the 107 mg/kg BW/day dose level (LOAEL). As with the mammalian alternative TRVs, these values can be used in conjunction with the alternative BAFs discussed above to provide risk managers with another valuable line of evidence to be used in making risk management decisions.

The use of these alternative risk calculations serves to provide an estimate of risk using a reasonable, yet reduced, level of conservatism for all receptors and a reduction of uncertainty (to an unknown extent) for the deer mouse (insectivore) and PMJM receptors.

Background Risks

Nickel was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the PMJM, deer mouse (insectivore and herbivore), coyote (generalist and insectivore), American kestrel, and mourning dove (insectivore) were calculated using both the UCL and UTL of background soils and default NOAEL, threshold (American kestrel and mourning dove only), and LOAEL TRVs.

NOAEL HQs greater or equal to 1 for all receptors were calculated using both the UCL and UTL background surface soil concentrations. NOAEL HQs ranged from 1 for the deer mouse (herbivore) to 27 for the PMJM. LOAEL HQs were less than 1 for the deer mouse (herbivore), mourning dove (insectivore) and both coyote receptors but greater than 1 for the PMJM (HQ = 3), and deer mouse (insectivore) (HQ = 3). Site-specific background concentrations of nickel do not appear to be elevated as the maximum detected concentration in background surface soil samples equaled 14.0 mg/kg which is lower than the mean concentration of nickel in Colorado and bordering states (18.8 mg/kg) as discussed in Attachment 3.

1.7 Silver

Plant Toxicity

The summary of silver toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants and the ESL value is based on unspecified toxic effects. The only additional TRV information available in the literature was an ESL soil screening benchmark from EPA Region 5. Low confidence is also placed in this benchmark value because no effects are specified and the benchmark is based on the lowest receptor-specific ESL for either plants, invertebrates, or mammals. The uncertainty associated with the lack of toxicity data for silver is high. It is unclear whether risks are overestimated or underestimated by using the default or additional benchmark from EPA Region 5. However, overestimation is the more likely scenario because the default and Region 5 benchmark are termed screening levels and represent unclear effects. Because of the uncertainties associated with the Region 5 benchmark, no refined analysis using this benchmark is presented in Section 10.1.7 of the main text.

Background Risk Calculations

Silver was not detected in background surface soils. Therefore, background risks were not calculated for silver in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.8 Tin

Bioaccumulation Factors

The primary source of uncertainty in the risk estimation for tin is in the estimation of tissue concentrations. No high-quality regression models or BAF data were available for any of the three soil-to-tissue pathways. As a result, plant tissue concentrations are estimated using a biotransfer factor from soil-to-plant tissue from Baes et al. (1984). The values presented in Baes et al. (1984) were the lowest tier for data quality in the CRA Methodology and represent the most uncertain BAF available. It is unclear whether the Baes et al. (1984) BAFs overestimate or underestimate uptake into plant tissues, and the magnitude of uncertainty is also unknown but could be high.

No data were available to estimate invertebrate concentrations from soil. As a result, a default value of 1 was used. This value assumes that the concentration in invertebrate tissues is equal to the surface soil concentration. There is a large degree of uncertainty in this assumption. Because tin is not expected to bioaccumulate in the food chain, invertebrate tissue concentrations are likely to be overestimated to an unknown degree using this BAF. The lack of quality soil-to-plant and soil-to-invertebrate BAFs directly affects the quality of the soil-to-small mammal BAF that uses the previous two values in its calculation. Compounding the uncertainty for this BAF is a food-to-tissue BAF, again from Baes et al. (1984). It is unclear to what degree and direction that uncertainty can be estimated for the soil-to-small mammal BAF, but the uncertainty associated with the estimated small mammal tissue concentrations is high.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from PRC (1994). The selected NOAEL TRV is protective of systemic effects in mice. These effects are not associated with the assessment endpoints for mammalian receptors at RFETS and, therefore, are overly conservative for use in the CRA. However, the LOAEL TRV selected by PRC (1994) is from a proper endpoint for use in the CRA and is described by PRC (1994) as predictive of a mid-range of effects less than mortality. Therefore, while the uncertainty related to the NOAEL TRV for mammals is high, the uncertainty for the LOAEL TRV is considerably lower. For this reason, no alternative TRVs are recommended in the uncertainty analysis.

For avian receptors, the TRVs selected for use in the CRA were also obtained from PRC (1994) and represent a paired NOAEL and LOAEL from a study on Japanese quail reproduction. No effects on reproduction were noted at the NOAEL, while reduced reproduction was noted at the LOAEL intake rate. Because the endpoints represented by the TRVs are appropriate for use in the CRA, the uncertainty in the avian TRVs for tin is considered to be low.

All of the TRVs used for tin were based on toxicity to tributyl tin. Tributyl tin compounds are commonly regarded as the most toxic forms of tin while inorganic tins are likely to be among the least toxic forms. In terrestrial environments, organic forms of tin, such as tributyl tin, on which the TRVs are based are not generally found in elevated concentrations unless a source of them is nearby. No known source of organic tin is present at RFETs. It is likely that much of the tin detected in soil samples is either inorganic tin or in compounds less toxic than tributytin. The use of tributyltin TRVs likely overestimates risks from tin to an unknown degree.

Background Risk Calculations

Tin was not detected in background surface soils, therefore, background risks were not calculated for tin in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.9 Uranium

Plant Toxicity

The summary of plant toxicity in Efroymson et al. (1997a) places low confidence in the uranium value because it is based on only one study that showed a reduction in root weight for Swiss chard in sandy soil. The only additional TRV in the literature was a LOEC ESL. Low confidence is also placed on this additional value because no effects are specified. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated by using the default or additional toxicity values but overestimation is the more likely scenario because both are termed screening levels and represent unclear effects.

Background Risk Calculations

Uranium was not detected in background surface soils. Therefore, background risks were not calculated for uranium in Appendix A, Volume 2, Attachment 9 of the RI/FS Report

1.10 Vanadium

Plant Toxicity

The summary of vanadium toxicity in Efroymson et al. (1997a) places low confidence in the value because there are no primary reference data showing toxicity to plants and the ESL value is based on unspecified toxic effects. An additional ESL was available as cited in Efroymson et al. (1997a) and was based again on unspecified effects of vanadium added to soil at a concentration of 50 mg/kg. No information regarding the baseline concentration of vanadium in the soil was available. Low confidence is also placed on this additional LOEC value. The uncertainty associated with the lack of toxicity data for terrestrial plants is high. It is unclear whether risks are overestimated or underestimated using the default or LOEC values, but overestimation is the more likely scenario. The additional LOEC value may reduce that uncertainty to an unknown degree.

Bioaccumulation Factors

The soil-to-invertebrate and soil-to-plant BAFs used to estimate invertebrate tissue concentrations are both based on screening-level upper-bound (90th percentile) BAFs presented in Sample et al. (1998a) and ORNL (1998). These values provide conservative estimates of uptake from soils to invertebrate and plant tissues. This estimate may serve to overestimate vanadium concentrations in tissues.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from Sample et al. (1996), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which a decrease in reproductive success in mice was noted. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is also unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

Background Risks

Vanadium was detected in RFETS background surface soils. Because risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the terrestrial plant, PMJM and deer mouse (insectivore) were calculated using both the UCL and UTL of background soils and default NOAEL and LOAEL TRVs.

HQs equal to 23 and 15 were calculated for the terrestrial plant receptor using UTL and UCL EPCs respectively. NOAEL HQs greater or equal to 1 were calculated using both the UCL and UTL background surface soil concentrations for the PMJM and deer mouse (insectivore) receptors. NOAEL HQs ranged from 1 for both receptors using the UCL to 2 for both receptors using the UTL EPCs. LOAEL HQs were less than 1 for both receptors.

1.11 Zinc

Bioaccumulation Factors

For the soil-to-plant, soil-to-invertebrate, and soil-to-small mammal BAFs, regression equations were used to estimate plant tissue concentrations. Confidence placed in these values is high. Uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. However, in cases without available measurements of tissue concentrations, regression-based models are the best available predictor of tissue concentrations. The regression-based BAFs may overestimate or underestimate tissue concentrations of zinc to an unknown degree.

Toxicity Reference Values

The NOAEL and LOAEL TRVs for mammalian receptors were obtained from PRC (1994), a CRA Methodology-approved source of TRVs. The LOAEL TRV represents an intake rate at which an increased incidence of fetal developmental effects in rats. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited because the LOAEL TRV is of sufficient quality to assess risks and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated but the degree of uncertainty is low.

Background Risks

Zinc was detected in RFETS background surface soils. Since risks are generally not expected at naturally occurring background levels, it is important to calculate the risks that would be predicted at naturally occurring concentrations using the same assumptions and models as used in the CRA. This provides information necessary to gauge the predictive ability of the risk assessment models used in the CRA. In addition, risks calculated using background data can provide additional information on the magnitude of potentially site-related risks.

Risks to the PMJM receptor were calculated using both the UCL and UTL of background soils and default NOAEL and LOAEL TRVs. NOAEL HQs greater than 1 for were calculated using both the UCL and UTL background surface soil concentrations for the PMJM receptor. LOAEL HQs were less than 1 for the PMJM receptor.

1.12 Bis(2-ethylhexyl)phthalate

Bioaccumulation Factors

Invertebrate tissue concentrations for bis(2-ethylhexyl)phthalate were estimated using uptake models based on the log Kow of bis(2-ehtylhexyl)phthalate. As cited in the CRA Methodology, if organic ECOIs with no empirically calculated BAFs available in the first two sources, log K_{ow} equations are used (as presented and modified in the EPA Eco-SSL [EPA 2003a]). Log K_{ow}-based values are more uncertain than empirically based BAFs and are likely to overestimate tissue concentrations to an unknown degree.

This uncertainty is compounded in the soil-to-small mammal BAF, which uses both the soil-to-invertebrate and the soil-to-plant BAFs (also log K_{ow}-based) to estimate the diet of the small mammal. A second model (based on the log K_{ow}) is the used to estimate the amount of ECOI transferred from first trophic-level food items to the second trophic-level prey tissues that are ingested by the predator. This compounded uncertainty may overestimate the concentrations of bis(2-ethylhexyl)phthalate by a larger degree than noted for the soil-to-invertebrate pathway.

Toxicity Reference Values

Appendix B of the CRA Methodology (DOE 2005) presents only a NOAEL TRV for avian effects from bis(2-ethylhexyl)phthalate. No reproductive effects were noted in ring doves at a dose of 1.1 mg/kg/BW/day. Because no effects were noted at the highest dose level in the study presented in the CRA Methodology, EPA's Ecotox database was searched for an alternative study. The following study was identified as applicable for use in the risk characterization.

European starlings were fed a concentration of 0, 25, and 250-mg/kg bis(2ethylhexyl)phthalate via diet daily (O'Shea and Stafford 1980). Significant increases in body weight were noted at the 25-mg/kg level, which was identified as the LOAEL. The water content of the food was assumed to be 5 percent.

The effect of increased body weight on the health of bird populations is questionable. Bis(2-ethylhexyl)phthalate commonly causes an increase in liver weight in mammals, thus, it can be assumed that the same may be true in birds. Therefore, the resulting TRV can be used as the LOAEL for the risk characterization assuming that any predicted increase in body weight may be attributable to increases in organ weight. It is unknown what effect the increase of organ weight in birds may have on the assessment endpoints, however, LOAEL-based HQs serve to provide risk managers with an additional line of evidence with which to make risk management decisions. Potential adverse effects predicted for bird populations from exposure to bis(2-ethylhexyl)phthalate are uncertain and should be reviewed in terms of the quality of toxicological information available.

No food ingestion rates for the animals used in the study were provided in the Ecotox database, so they were estimated. The ingestion rate for the American robin (EPA 1993) was used as a surrogate (food ingestion rate = 1.52 g/g BW/day). Converting the 25-mg/kg concentration to a dose resulted in a LOAEL TRV equal to 31.6 mg/kg BW day.

Dose = Cdiet · CF · IRfood = 25 · (1 - 0.05) · 1.52 = 36.1 mg/kg BW/d

Where:
Dose = exposure dose (mg/kg BW/d)
Cdiet = exposure concentration in diet (mg/kg food dry weight)
CF = dry weight to wet weight conversion factor [equal to 1- percent moisture]
IRfood = food ingestion rate (kg food wet weight/kg BW/d)

Given the questionable endpoint used in the LOAEL study, risks calculated using the LOAEL are likely to be overestimated to an unknown degree. However, the results of the LOAEL HQ calculations should be viewed in terms of the NOAEL HQs to provide an additional line of evidence regarding the lack of toxicity to bird species from bis(2-ethylhexyl)phthalate. The overall uncertainty associated with the TRVs used to assess risk to avian receptors from bis(2-ethylhexyl)phthalate is high.

Background Risk Calculations

Bis(2-ethylhexyl)phthalate was not analyzed for in background surface soils. Therefore, background risks were not calculated for bis(2-ethylhexyl)phthalate in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.13 Di-n-butylphthalate

Bioaccumulation Factors

Invertebrate tissue concentrations for di-n-butylphthalate were estimated using uptake models based on the log K_{ow} of di-n-butylphthalate. As cited in the CRA Methodology, if organic ECOIs with no empirically calculated BAFs available in the first two sources, log K_{ow} equations are used (as presented and modified in the EPA Eco-SSL [EPA 2003]). Log K_{ow}-based values are more uncertain than empirically based BAFs and are likely to overestimate tissue concentrations to an unknown degree.

This uncertainty is compounded in the soil-to-small mammal BAF, which uses both the soil-to-invertebrate and the soil-to-plant BAFs (also log K_{ow}-based) to estimate the diet of the small mammal. A second model (based on the log K_{ow}) is the used to estimate the amount of ECOI transferred from first trophic-level food items to the second trophic-level prey tissues that are ingested by the predator. This compounded uncertainty may overestimate the concentrations of di-n-butylphthalate by a larger degree than noted for the soil-to-invertebrate pathway.

Toxicity Reference Values

The TRV used was obtained from Sample et al. (1996) from a study of reproductive effects in ring doves. Changes in eggshell thickness were noted at the LOAEL intake rate. No NOAEL TRV was available, so the NOAEL TRV was estimated from the LOAEL TRV by dividing by a factor of 10. The estimation of the NOAEL TRV from the LOAEL TRV introduces uncertainty into the risk characterization process. It is unknown where the threshold for effects lies at intake rates lower than the LOAEL TRV; therefore, it is unclear at which intake-rate the true NOAEL lies. However, this source of uncertainty is limited since LOAEL TRV is of sufficient quality to assess risks and the LOAEL TRV endpoint may be predictive of population risks. Risks predicted by the LOAEL TRV may be overestimated or underestimated, but the degree of uncertainty is low.

Background Risk Calculations

Di-n-butylphthalate was not analyzed for in background surface soils. Therefore, background risks were not calculated for di-n-butylphthalate in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.14 Dioxin (Total)

Bioaccumulation Factors

The soil-to-plant BAF used to estimate tissue concentrations are based on screening-level upper bound (90th percentile) BAFs presented in ORNL (1998) and Sample et al. (1998b). This BAF provides a conservative estimate of uptake from soils to plant tissue. For the soil-to-invertebrate and soil-to-small mammal BAFs, regression equations were used to estimate invertebrate and small mammal tissue concentrations, respectively. Confidence placed in these values is high. Uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. However, in cases without available measurements of tissue concentrations, regression-based models are the best available predictor of tissue concentrations. The regression-based BAFs may overestimate or underestimate tissue concentrations of total PCBs to an unknown degree.

Toxicity Reference Values

For avian receptors, TRVs were obtained from the database of TRVs from Sample et al. (1996). The LOAEL TRV was derived from a study of reproductive effects in pheasants. At the LOAEL intake rate, a significant decrease in egg production and hatchability was noted. The NOAEL intake rate suggested that there was no effect on pheasant egg production and hatchability. Because the original study was not reviewed and not enough information is presented in Sample et al. (1996) to meet threshold criterion, no threshold TRV has been calculated for birds. The estimation of the NOAEL TRV from a LOAEL TRV introduces uncertainty in the NOAEL TRV. However, because the LOAEL TRV is based on endpoints appropriate for use by receptors in the UWOEU, the uncertainty associated with the TRVs is considered low. The TRVs may overestimate or underestimate risk to an unknown degree.

For mammalian receptors, TRVs were also obtained from the database of TRVs from Sample et al. (1996). The LOAEL TRV was derived from a study of reproductive effects in rats over three generations. At the LOAEL intake rate, a significant decrease in fertility and neonatal survival was noted. The NOAEL TRV is set at an intake rate that showed potential effects on rat reproduction. No threshold TRV was calculated due to the limited information provided in Sample et al. (1996), making the threshold for effects between the NOAEL and LOAEL TRV uncertain. Both the NOAEL and LOAEL TRVs are based on appropriate endpoints for use in the risk characterization and the uncertainty related to the TRVs is low. No alternative TRVs are provided.

Background Risk Calculations

Dioxins were not analyzed for in background surface soils. Therefore, background risks were not calculated for dioxin in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

1.15 Polychlorinated Biphenyls (Total)

Bioaccumulation Factors

For the soil-to-invertebrate BAF, regression equations were used to estimate invertebrate tissue concentrations. Confidence placed in this value is high. Uncertainty is unavoidable when using even high-quality models to predict tissue concentrations. However, in cases without available measurements of tissue concentrations, regression-based models are the best available predictor of tissue concentrations. The regression-based BAF may overestimate or underestimate tissue concentrations of total polychlorinated biphenyls (PCBs) to an unknown degree.

Plant tissue concentrations for total PCBs were estimated using uptake models based on its log K_{ow} (Aroclor 1254 used as a surrogate) . As cited in the CRA Methodology, if organic ECOIs with no empirically calculated BAFs available in the first two sources, log K_{ow} equations are used (as presented and modified in EPA EcoSSL guidance [EPA 2003]). Log K_{ow}-based values are more uncertain than empirically based BAFs and are likely to overestimate tissue concentrations to an unknown degree.

This uncertainty is compounded in the soil-to-small mammal BAF, which uses both the soil-to-invertebrate regression model and the soil-to-plant BAF to estimate the diet of the small mammal. A second model (based on the log K_{ow}) is used to estimate the amount of ECOI transferred from first trophic-level food items to the second trophic-level prey tissues that are ingested by the predator. This compounded uncertainty may overestimate the concentrations of total PCBs by a larger degree than noted for the soil-to-invertebrate pathway.

Toxicity Reference Values

For avian receptors, total PCB TRVs were obtained from the database of TRVs from PRC (1994). The LOAEL TRV was derived from a study of reproductive effects in chickens. At the LOAEL intake rate, a significant decrease in egg hatchability was noted. The NOAEL TRV is set at an intake rate that showed potential effects on egg hatchability in chickens and then reduced by one-tenth to convert the concentration to a NOAEL. Because the NOAEL and LOAEL TRVs came from two different studies with different methods and the NOAEL TRV was estimated from an effect-based TRV, no threshold TRV has been calculated for birds. The estimation of the NOAEL TRV from a LOAEL TRV introduces uncertainty in the NOAEL TRV. However, because the LOAEL TRV is based on endpoints appropriate for use by receptors in the UWOEU, the uncertainty associated with the TRVs is considered low. The TRVs may overestimate or underestimate risk to an unknown degree.

The NOAEL and LOAEL TRVs for mammals were obtained from PRC Environmental Management, Inc. (PRC) (1994). The PRC document reviewed the available effects database for mammalian effects from PCBs. The NOAEL TRV represents a dose of PCBs at which no decreases in mouse liver weight were noted. The LOAEL TRV represents a dose at which a decreased reproductive capacity was noted in mice. The threshold TRV represents an estimate of the point between the NOAEL and LOAEL TRVs where effects related to the LOAEL TRV may begin to occur. This point is uncertain and it is impossible to accurately estimate where the threshold for effects lies given the available data. Therefore, the calculation of the threshold TRV may overestimate or underestimate the calculated risks by a degree less than half of the difference between the NOAEL and LOAEL TRVs. Since the endpoint for the LOAEL TRV is based on an acceptable endpoint as defined by the CRA methodology, the overall uncertainty related to the mammalian TRVs for PCBs should be considered to be low. The TRVs may overestimate or underestimate risk to an unknown degree.

Background Risk Calculations

PCBs were not analyzed for in background surface soils. Therefore, background risks were not calculated for PCB in Appendix A, Volume 2, Attachment 9 of the RI/FS Report.

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<u>COMPREHENSIVE RISK ASSESSMENT</u>

UPPER WOMAN DRAINAGE EXPOSURE UNIT

VOLUME 10: ATTACHMENT 6

CRA Analytical Data Set