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

Volume 6 of 15
No Name Gulch Drainage Exposure Unit

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ACRONYMS AND ABBREVIATIONS

μg/kg	microgram per kilogram
μg/L	microgram per liter
AEU	Aquatic Exposure Unit
bgs	below ground surface
BZ	Buffer Zone
CAD/ROD	Corrective Action Decision/Record of Decision
CD	compact disc
CDH	Colorado Department of Health
CDPHE	Colorado Department of Public Health and Environment
CMS	Corrective Measures Study
CNHP	Colorado Natural Heritage Program
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
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
HRR	Historical Release Report
IA	Industrial Area
IAG	Interagency Agreement
IHSS	Individual Hazardous Substance Site
kg	kilogram
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effects concentration
MDC	maximum detected concentration
mg	milligram
mg/day	milligram per day
mg/kg	milligram per kilogram
mg/kg BW/day	milligram per kilogram receptor body weight per day
mg/l	milligram per liter
mL	milliliter
mL/day	milliliter per day
msl	mean sea level
N/A	not applicable or not available
NFA	No Further Action
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
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
RCEU	Rock Creek Drainage Exposure Unit
RCRA	Resource Conservation and Recovery Act
RDA	recommended daily allowance
RDI	recommended daily intake
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RI/FS	Remedial Investigation/Feasibility Study
SAP	Sampling and Analysis Plan
SCM	Site Conceptual Model
SEP	Solar Evaporation Ponds
tESL	threshold ESL
TRV	toxicity reference value
UBC	Under Building Contamination
UCL	upper confidence limit

UL	upper limit daily intake
UT	uncertain toxicity
UTL	upper tolerance limit
VOC	volatile organic compound
WAEU	West Area Exposure Unit
WRS	Wilcoxon Rank Sum
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 425-acre No Name Gulch Drainage Exposure Unit (EU) (NNEU) at the Rocky Flats Environmental Technology Site (RFETS). The purpose of this report is to assess potential risks to human health and ecological receptors posed by exposure to all identified contaminants of concern (COCs) and ecological contaminants of potential concern (ECOPCs), respectively, at the NNEU.

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.

Vanadium was selected as the only COC in surface soil/surface sediment for human receptors. No COCs were selected for subsurface soil/subsurface sediment. Results of the risk characterization for the HHRA indicate that estimated non-cancer hazard quotients (HQs), based on both the Tier 1 EPC and the Tier 2 EPC, for the wildlife refuge worker (WRW) and the wildlife refuge visitor (WRV) in the NNEU are 0.1 or less, which is protective of these human receptors (i.e., a HQ less than 1).

The ECOPC identification process streamlines the ecological risk characterization by focusing the assessment on ecological contaminants of interest (ECOIs) that are present in the NNEU. 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, barium, copper, mercury, molybdenum, nickel, tin, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, 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 nickel, vanadium, and zinc. 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 39 (nickel/deer mouse - insectivore) to less than 1 (several ECOPC/receptor pairs). NOAEL or NOEC HQs ranged from 39 (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 had HQs greater than 1 using Tier 1 and Tier 2 EPCs (HQs = 2). However, there is low confidence placed in the ecological screening level (ESL) for antimony. As discussed in Attachment 5, additional NOEC or lowest observed effect concentration (LOEC) values for antimony were not available in the literature. Therefore, risks to populations of terrestrial plants from exposure to antimony in surface soils are likely to be low to moderate but with a high level of uncertainty due to low confidence in the default ESL.

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:

- Nickel/deer mouse (insectivore) – The default LOAEL HQs were equal to 4 using both the Tier 1 and Tier 2 EPCs. 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 – The LOAEL HQ was greater than 1 in Patch #11using default exposure and toxicity assumptions. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, the LOAEL HQ was less than 1 in Patch #11. Using additional TRVs for nickel resulted in NOAEL and LOAEL HQs less than 1 with either BAF in the risk calculations. Based on the 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 2 using the Tier 1 EPC and equal to 3 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 NNEU.

Based on the 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 NNEU. 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 NNEU.

1.0 NO NAME GULCH DRAINAGE EXPOSURE UNIT

This volume of the Comprehensive Risk Assessment (CRA) presents the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) for the No Name Gulch Drainage Exposure Unit (EU) (NNEU) at the Rocky Flats Environmental Technology Site (RFETS) (Figure 1.1).

The HHRA and ERA methods and selection of receptors are described in detail in the Final CRA Work Plan and Methodology, Revision 1 (DOE 2005), hereafter referred to as the CRA Methodology. A summary of the risk assessment methods, including updates made in consultation with the regulatory agencies, are summarized 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).

The anticipated future land use of RFETS is a wildlife refuge. 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 are evaluated in the ERA including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species present at the RFETS.

1.1 No Name Gulch Drainage Exposure Unit Description

This section provides a brief description of the NNEU, 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, Site Physical Characteristics, of the RI/FS Report. This information is also summarized in Appendix A, Volume 2 of the RI/FS Report.

The Historical Release Report (HRR) (DOE 1992a) and annual updates to the HRR provide descriptions of known or suspected releases of hazardous substances that occurred at RFETS. The original HRR 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 referred to as IHSSs). Individual IHSSs and groups of 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 U.S. Department of Energy (DOE) has thoroughly investigated and characterized contamination associated with these IHSSs. 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 OU and IHSS history at RFETS is included in Section 1.0, Site Background 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 This information is also briefly summarized in Volume 2 of Appendix A of the RI/FS Report.

Several historical IHSSs exist within the NNEU (Table 1.1 and Figure 1.2). Figure 2.2 in Appendix A, Volume 2 of the RI/FS Report shows the locations of the IHSSs in the buffer zone, including those in the NNEU. All the IHSSs have regulatory agency approved NFAAs. This is documented in the Annual Updates to the Historical Release Report as noted in Table 1.1. Only two IHSSs required remedial action. The Present Landfill (IHSS 114) is a RCRA interim status unit that was closed in 2005 by construction of an engineered cap for containment of the buried waste. Contamination at the North Firing Range (PAC NW-1505) was addressed through an accelerated action soil removal in 2005. In general, accelerated actions were designed to address 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 425 acre NNEU is located in the north-central portion of RFETS (Figure 1.1). It has the following distinguishing features:

- The NNEU is located within the Buffer Zone (BZ) Operable Unit (OU) and is outside the Industrial Area, where most historically RFETS operations occurred.
- The Present Landfill is a prominent historical potential source area within the NNEU. Closure activities are complete.
- The NNEU includes most of the No Name Gulch Drainage. Approximately one-third of a mile downstream from the eastern boundary of the NNEU is the confluence of No Name Gulch with Walnut Creek.
- The NNEU is generally upwind from the IA and is hydrologically cross-gradient from the IA.

The NNEU is bounded by the Upper Walnut Drainage EU (UWNEU) to the south, the Inter-Drainage EU (IDEU) to the north and west, and the Lower Walnut Drainage EU (LWNEU) to the east.

1.1.2 Topography and Surface Water Hydrology

The NNEU is an eroded alluvial terrace that slopes gently to the northeast. It is drained by No Name Gulch, McKay Ditch, and Dry Creek. No Name Gulch and Dry Creek join Walnut Creek in the UWNEU and LWNEU. McKay Ditch discharges to the McKay Bypass Extension Pipeline, which crosses under Indiana Street, and discharges to Great Western Reservoir.

A recent aerial photograph of the NNEU is shown in Figure 1.3. The most noticeable features of the area are the Present Landfill (the large disturbed area in the western portion of the EU), and the East Landfill Pond. West-southwest of the Present Landfill is the North Firing Range (PAC NW-1505). Upper Church Ditch forms the northern boundary of the NNEU. McKay ditch conveys surface water around the landfill area. Elevations in the NNEU range from 6,035 ft msl at the westernmost point of the NNEU to 5,760 ft msl where No Name Gulch leaves the NNEU and enters the UWNEU.

1.1.3 Flora and Fauna

Vegetation in the NNEU is predominantly grassland. The major components are mesic mixed grasslands, xeric tallgrass prairie (a rare plant community), and disturbed/reclaimed areas (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 steeper hillsides slopes. Many areas around the former landfill were disturbed and have been reclaimed by reseeding or are recovering naturally by invading vegetation (DOE 2004). Recently reseeded areas, especially upon the capped landfill surface, comprise blue grama, western wheatgrass, buffalo grass (*Buchloe dactyloides*), side-oats grama, and sweet clover (*Melilotus* sp) (K-H 2002b). Areas reseeded in the past contain non-native grasses such as smooth brome (*Bromus inermis*), crested wheatgrass (*Agropyron cristatum*) and intermediate wheat grass (*Thinopyrum intermedium*). Naturally recovering areas are in early successional stages and are dominated by weedy species such as diffuse knapweed (*Centaurea diffusa*), St. Johnswort (*Hypericum perforatum*), musk thistle (*Carduus nutans*), and other annual/biennial species.

Below the dam, very little disturbance has occurred and vegetation communities are native. No Name Gulch is found below the dam and contains seasonally wet areas that support wet meadows, short marshlands, short upland shrublands, and riparian woodlands. These areas are only seasonally wet. Uplands are predominantly mesic mixed grasslands.

The NNEU supports grassland habitats important to wildlife, but areas that have been disturbed, especially above the landfill pond dam, are recovering and offer low habitat value. Grasslands and other vegetation communities are in good condition below the dam and offer high quality wildlife habitat.

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 the forktip three-awn (*Aristida basiramea*), mountain-loving sedge (*Carex oreocharis*), carrionflower greenbriar (*Smilax herbacea var. lasioneuron*), and dwarf wild indigo (*Amorpha nana*). Forktip three-awn primarily occurs in disturbed habitat near the western edge of the IAEU. The other three species occur primarily along the piedmont slopes in the Rock Creek drainage (K-H 2002b).

RFETS, including the NNEU, supports a wide variety of terrestrial wildlife: large and small mammals, birds, reptiles, and amphibians. This relatively rich animal community is, in part, due to the isolation of RFETS from the increasing human activity in the surrounding areas. Few specific wildlife surveys have been conducted within the NNEU, except where specified below. Therefore, the information presented is based on what has been found in similar habitats elsewhere at the site. Furthermore, a decade of ecological monitoring across RFETS reveals many insights about general ecosystem health in habitats similar to what is found within the NNEU.

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 may reside in every major drainage at RFETS. The bald eagle occasionally forages at RFETS although no nests have been identified on site.

A number of wildlife species also 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 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*).

The most abundant large mammal is the mule deer (*Odocoileus hemionus*). White-tailed deer (*Odocoileus virginianus*) have also been infrequently observed on RFETS but not within the NNEU likely due to the lack of woody cover that they prefer. Mule deer frequent all parts of RFETS (14 mi^2) year-round and use portions of the NNEU, especially grassland areas below the East Landfill Pond dam. Based on an ecological monitoring program presented in annual wildlife survey reports (K-H 1995 – 2001), the RFETS mule deer population from winter counts is estimated at a mean 125 individuals ($n = 7$) with a density of 14 deer per square mile (K-H 2001, 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). Obviously, the population at RFETS is “open,” with individuals able to move freely on and off site. The mule deer populations from RFETS has been continuing at a steady state with good age/sex distributions (K-H 2001) over time and similar densities 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 deer population is healthy.

Carnivores present at Rocky Flats include coyote (*Canis latrans*), red fox (*Vulpes vulpes*), striped skunk (*Mephitis mephitis*), long-tailed weasel (*Mustela frenata*), and raccoon (*Procyon lotor*). Coyotes are the top mammalian predator at RFETS. Information from annual wildlife surveys reveal that 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 observed having reproduction success with as many as six dens active in one 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, which indicates their prey species continue to be abundant and healthy.

Other mammals present at RFETS include desert cottontail (*Sylvilagus audubonii*), white-tailed jack rabbit (*Lepus townsendii*), and a wide variety of rodents. Small mammal trapping conducted during 1995 and 1996 around the East Landfill Pond documented western harvest mouse (*Reithrodontomys megalotis*), deer mouse (*Peromyscus maniculatus*), meadow vole (*Microtus pennsylvanicus*), prairie vole (*Microtus ochrogaster*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), and house mouse (*Mus musculus*) (K-H 1996). The PMJM was not documented in the vicinity of the Present Landfill although habitat for the mouse is present within the NNEU in isolated locations along No Name Gulch. Trapping and telemetry work conducted in Walnut Creek in 1999 continued to document the absence of PMJM in the vicinity of the landfill area (K-H 2000).

The varied habitats at RFETS support many bird species. Common grassland birds include western meadowlark (*Sturnella neglecta*), horned lark (*Eremophila alpestris*), vesper sparrow (*Pooecetes gramineus*), grasshopper sparrow (*Ammodramus savannarum*), western kingbird (*Tyrannus verticalis*), and eastern kingbird (*Tyrannus tyrannus*). Summarizing songbird surveys over the breeding season, diversity indices for RFETS for all habitats combined over 8 years of observations (1991, 1993-1999) show a steady state in diversity of bird communities (K-H 2000). Among grassland habitats, results were similar. A subgroup of migratory birds is neotropical migrants, which are in a decline 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 to real estate development in North America. However, over the last 5 years on RFETS the declining trends for grassland neotropical migrants have not been observed.

Common birds of prey occurring at RFETS include American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), Swainsons's hawk (*Buteo swainsonii*), and great horned owl (*Bubo virginianus*). Raptors were observed through relative abundance surveys and multi-species surveys (16 permanent transects) that provided species specific site-wide counts as part of the ecological monitoring program. Raptors nest sites were visited repeatedly during the nesting season to confirm nesting success. RFETS three most common raptors are red-tailed hawk, great horned, and American kestrel (K-H 2002a). No raptor nests have ever been recorded in the NNEU likely due to the absence of large trees. All nests typically fledged two young of each species, except kestrels usually fledged two to three young. With one exception, each species had a successful nesting season each year during the monitoring period from 1991 to 1999. The exception was the loss of the red-tail hawk nest in Upper Woman Creek (K-H 1997a, 1998a) due to weather.

RFETS supports several species of reptiles and amphibians. Snake species include bull snake (*Pituophis melanoleucus*), yellow-bellied racer (*Coluber constrictor*), western terrestrial garter snake (*Thamnophis elegans*), and prairie rattlesnake (*Crotalus viridis*). Western painted turtle (*Chrysemys picta*) are also present. Amphibian species include plains leopard frog (*Rana blairi*), Woodhouse's toad (*Bufo woodhousii*), striped chorus frog (*Pseudacris triseriata*), and tiger salamander (*Ambystoma tigrinum*). Boreal chorus frogs have been heard during vocalization surveys at the East Landfill Pond (K-H 1999, 2000, 2001, 2002a). 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 No Name Gulch Drainage Exposure Unit

NNEU supports habitat for the federally protected PMJM. The preferred habitat for the PMJM is the riparian corridors bordering RFETS' streams, ponds, and wetlands with an adjacent thin band of upland grasslands. Although PMJM habitats exist in the NNEU, trapping and radio telemetry studies in Lower Walnut Creek indicate PMJM are absent. The lack of continuously running water along No Name Gulch is undoubtedly a limiting factor to PMJM occurrence.

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 the NNEU. Patches that cross-over into the Lower Walnut Drainage EU are evaluated in the Lower Walnut Drainage EU. 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 NNEU was divided into two habitat patches, each containing habitat capable of supporting at least one PMJM. The patches vary in size and shape dependent on their location within No Name Gulch drainage and discontinuity or habitat quality of surrounding patches. The following is a brief discussion of the two patches within the NNEU (Figure 1.5) and the reasons they are considered distinct:

- Patch #10 – This patch is evaluated in the Lower Walnut Drainage EU and the boundaries for this patch correspond to habitat boundaries mapped earlier (USFWS 2005). This patch contains marginal habitat along McKay Ditch.

Vegetation within the patch is comprised of riparian woodlands and wet meadows. Willow riparian shrubs, cattails, and reclaimed grasslands are also present. Although the proper vegetation characteristics are present, McKay Ditch rarely contains water, therefore, the habitat quality is low. No PMJM have been found in this patch.

- Patch #11A and #11B – This patch is a combination of habitat along No Name Gulch. These areas can be considered one unit based on the hydrological connection and supporting wetlands that bridge the gap between the two habitat areas (USFWS 2005). No trapping for PMJM have been attempted in relation to this patch, and radio telemetry studies in Lower Walnut Creek indicate that PMJM do not use this area. Although the proper vegetation characteristics are present, No Name Gulch rarely contains water; therefore, the habitat quality is low.

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 CDPHE guidance. Surface soil, subsurface soil, surface sediment, subsurface sediment, and groundwater samples were collected from the NNEU. 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. Potential contaminants of concern (PCOCs) and ecological contaminants of interest (ECOIs) that were analyzed for but not detected, or were detected in less than 5 percent of the samples, 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). Only data from June 1991 to the present are used in the CRA because these data meet the approved analytical Quality Assurance/Quality Control (QA/QC) requirements.

In accordance with the CRA Methodology (DOE 2005), only data collected on or after June 28, 1991, and data for subsurface soil and subsurface sediment samples with a start 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, Attachment 2 of the RI/FS Report.

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

The sampling data used for the NNEU 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 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 data were also collected, and 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 NNEU consists of up to 375 samples for various analyte groups. The sediment samples were collected to depths less than 0.5 feet from the sediment surface. The surface soil/surface sediment sample locations are shown on Figure 1.6. All sample locations within the NNEU were not necessarily analyzed for all analyte groups (see Table 1.3). The surface soil/surface sediment samples were collected in the NNEU over several months from July 1991 through October of 1994, and then again in September 1997, February 1998, October 2000, February 2001, May 2002, May 2003, and over several months in 2004, ending in August 2005. The samples collected in 2004 were located on a 30-acre grid, as described in the SAP Addendum #04-01 (DOE 2004). For the grid sampling, five individual samples were collected from each 30-acre cell, one from each quadrant and one in the center, as described in the Addendum. Most of the evenly spaced surface soil sampling locations on Figure 1.6 represent the 30-acre grid samples.

The NNEU surface soil/surface sediment samples were analyzed for inorganics (375 samples), organics (159 samples), and radionuclides (309 samples) (Table 1.2). Detected analytes included many inorganics and organics, and several radionuclides (Table 1.3). A summary of analytes that were not detected or detected in less than 5 percent of samples in surface soil/surface sediment in the NNEU is presented and discussed in Attachment 1.

Subsurface Soil/Subsurface Sediment

The combined subsurface soil/subsurface sediment data set for NNEU consists of up to 295 samples for various analyte groups. The subsurface sediment samples have a starting depth of less than or equal to 8 feet bgs and an ending depth greater than 0.5 feet. The subsurface soil/subsurface sediment sample locations are shown on Figure 1.7. All sample locations within the NNEU were not necessarily analyzed for all analyte groups (see Table 1.4). The samples were collected in the NNEU over several months from February 1992 through October 1994, and then again in August and September 1997, May and June 2002, and over several months in 2004, ending in April 2005.

The NNEU subsurface soil/subsurface sediment samples were analyzed for inorganics (295 samples), organics (196 samples), and radionuclides (264 samples) (Table 1.2). Detected analytes included many inorganics and organics, and several radionuclides (Table 1.4). A summary of analytes that were not detected or detected in less than 5 percent of samples in surface soil/surface sediment in the NNEU is presented and discussed in Attachment 1.

Surface Soil

The surface soil data set for NNEU consists of up to 356 samples for various analyte groups. The samples were collected in the NNEU over several months from July 1991 through October 1994, and then again in September 1997, February 1998, February 2001, May and June 2002, May 2003, and over several months in 2004 ending in August 2005. Sample locations are shown on Figure 1.6. All sample locations within the NNEU were not necessarily analyzed for all analyte groups (see Tables 1.5 and 1.6). 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 from each 30-acre cell, one from each quadrant and one in the center, as described in the Addendum. Most of the evenly spaced surface soil sampling locations on Figure 1.6 represent the 30-acre grid samples.

The NNEU surface soil samples were analyzed for inorganics (356 samples), organics (144 samples), and radionuclides (287 samples) (Table 1.2). Detected analytes included many inorganics, organics, and several radionuclides (Table 1.5). A summary of analytes that were not detected or detected in less than 5 percent of samples in surface soil in the NNEU is presented and discussed in Attachment 1.

The NNEU surface soil samples within PMJM habitat were analyzed for radionuclides (1 sample). In accordance with the CRA Methodology, five additional surface soil samples in the vicinity of the PMJM habitat were pulled into the PMJM data set to improve the data adequacy for risk evaluation. One sample is located to the north, near the edge of the 100 foot buffer, and the other four are clustered near the edge of the 200-foot buffer along the stream to the west (see Figure 1.5). Although somewhat removed from the habitat, these latter four samples were included because they are closest to both the stream feeding the habitat area as well as the habitat. Detected analytes included many inorganics and several radionuclides (Table 1.6).

Subsurface Soil

The subsurface soil data set for NNEU consists of up to 291 samples for various analyte groups. The samples were collected in the NNEU over several months from February 1992 through October 1994, and then again in August and September 1997, May and

June 2002, November 2004, and March and April 2005. Sample locations are shown on Figure 1.7. All sample locations within the NNEU were not necessarily analyzed for all analyte groups (see Table 1.7). Subsurface soil samples to be used in the CRA are defined in the CRA Methodology (DOE 2005) as soil samples with a starting depth less than or equal to 8 feet bgs and an ending depth greater than 0.5 feet.

The NNEU subsurface soil samples were analyzed for inorganics (291 samples), organics (196 samples), and radionuclides (260 samples) (Table 1.2). Detected analytes included many inorganics and organics, and several radionuclides (Table 1.7). A summary of analytes that were not detected or detected in less than 5 percent of samples in subsurface soil in the NNEU 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 NNEU are as follows:

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

- No surface soil samples were collected for dioxins in the NNEU. Although this does not meet the minimal data adequacy guideline, as noted above, dioxins are not expected to have been released in the NNEU and it is possible to make risk management decisions without additional sampling.

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

- With the addition of five samples outside but in the immediate vicinity of the PMJM patches, the number of surface soil samples for the PMJM patches for radionuclide and inorganics meet the data adequacy guidelines. Although there are no organic data for the PMJM patches, organics are not expected to be contaminants in the surface soil because the habitat is located topographically above the No Name Gulch stream bed, and the dominant contaminant migration pathway from potential historical sources in the NNEU is runoff and transport by water into No Name Gulch. Therefore, given this line of evidence, it is possible to make risk management decisions without additional sampling.

- Given the spatial distribution of the PMJM surface soil samples and other lines of evidence, the data can be aggregated for the purpose of conducting a statistical background comparison.

- The number of surface water samples in the NNEU for radionuclides, metals, VOCs, SVOCs, and PCBs meet the data adequacy guideline.

- Because of the ephemeral nature of NNEU surface water, the spatial distribution of the surface water samples, although limited, is adequate for the purposes of the CRA.

- 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. Therefore, it is possible to make risk management decisions without additional sampling.

- One surface water sample was collected for dioxins (influent to the East Landfill Pond), and dioxins were not detected. Although the existing data do not meet the minimal data adequacy guideline, as noted above, it is possible to make risk management decisions without additional sampling.

- 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, very few have detection limits that exceed PRGs/ESLs, and the percent of exceedances and/or the magnitude of the exceedances are relatively low (see Attachment 1). Consequently, the higher detection limits associated with these analytes contribute minimal uncertainty to the overall risk conclusions. There are several analytes in surface soil whose detection limits frequently exceed the ESLs and, in some cases, the upper end of the detection limit ranges significantly exceed the ESLs. However, all of these analytes contribute only minimal uncertainty to the overall risk estimates because process knowledge indicates they are not likely to be ECOPCs in NNEU surface soil even if detection limits had been lower. Although some of the analytes would present a potential for adverse ecological effects if they were detected at their maximum detection limits, because they are not expected to be ECOPCs in NNEU surface soil, uncertainty in the overall risk estimates is low (see Attachment 1 for a more detailed discussion).

1.3 Data Quality Assessment

A data quality assessment (DQA) of the NNEU 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 data quality objectives (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 4.4 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 NNEU. 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 toxicity criteria 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 criteria 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, and upper limit daily intakes (ULs). The estimated daily maximum intakes based on the nutrients' MDCs and a surface soil/surface sediment ingestion rate of 100 mg/day 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 the 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 not evaluated further. Arsenic, vanadium, 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 on 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 and vanadium 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 1.3).

The detection frequency screen was not performed for cesium-134, cesium-137, and radium-228 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, vanadium, cesium-134, cesium-137, and radium-228 is presented in Table 2.3 and discussed in Attachment 3. Box plots for arsenic, vanadium, cesium-134, cesium-137, and radium-228 (both NNEU and background) are provided in Attachment 3. Arsenic and vanadium are the PCOCs that were statistically greater than background at the 0.1 significance level (1-p less than or equal to 0.1), and are evaluated further in the professional judgment section.

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.

Based on the weight of evidence described in Attachment 3, arsenic in surface soil/surface sediment in the NNEU is not considered a COC because the weight of evidence supports the conclusion that arsenic concentrations in surface soil/surface sediment in the NNEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations.

Vanadium is considered a COC in surface soil/surface sediment and is further evaluated in Sections 3.0 through 5.0.

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 toxicity criteria were 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 at the NNEU were 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/subsurface sediment ingestion rate of 100 milligrams per day (mg/day), are less than the DRIs. Therefore, these PCOCs were not evaluated further 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. The MDC and UCL for radium-228 in subsurface soil/subsurface sediment were greater than the PRG and, therefore, radium-228 was retained for further evaluation in the COC selection process in the NNEU.

PRGs were not available for several PCOCs in subsurface soil/subsurface sediment. Analytes without PRGs are listed on 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 was 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 NNEU 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 NNEU data to the background data indicate site concentrations for radium-228 are 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 NNEU and background) are provided in Attachment 3. Radium-228 in subsurface soil/subsurface sediment is further evaluated in the professional judgment section.

2.2.5 Subsurface Soil/Subsurface Sediment Professional Judgment Evaluation

Based on the weight of evidence described in Attachment 3, radium-228 in subsurface soil/subsurface sediment in the NNEU is not considered a COC because the weight of evidence supports the conclusion that radium-228 concentrations in subsurface soil/subsurface sediment in the NNEU are not a result of RFETS activities, but rather are representative of naturally occurring concentrations.

2.3 Contaminant of Concern Selection Summary

A summary of the results of the COC screening process is presented in Table 2.6. Vanadium was the only analyte in surface soil/surface sediment selected as a COC in the NNEU and is further evaluated quantitatively. No analytes were selected as COCs in subsurface soil/subsurface sediment in the NNEU.

3.0 HUMAN HEALTH EXPOSURE ASSESSMENT

The site conceptual model (SCM), presented in Figure 2.1 of the CRA Methodology and is 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 one COC, vanadium, in surface soil/surface sediment for the NNEU. 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. 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 NNEU.

Chemical intakes for WRW and WRV exposure pathways were quantified for vanadium 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 ASSESSMENT

Toxicity criteria are used in the risk calculations in Section 5.0. Table 4.1 presents the toxicity criteria (reference doses [RfDs], and dermal absorption factors) for COCs at the NNEU. 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 Volume 2, Appendix A of the RI/FS Report.

5.1 Wildlife Refuge Worker (WRW)

This section presents the risk characterization for exposure to COCs at the NNEU. The WRW receptor was evaluated for exposure to vanadium in surface soil/surface sediment. The risk estimates for exposure to vanadium 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 vanadium 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 noncancer hazards for Tier 1 and Tier 2 EPCs are calculated and summarized in Tables 5.1 and 5.3. The estimated excess lifetime cancer risks for vanadium were not calculated because cancer toxicity values are not available for vanadium.

Risk Characterization Results Based on Tier 1 EPCs

The total chemical noncancer hazards for potential exposure to surface soil/surface sediment by the WRW, based on the Tier 1 EPC, is 0.1 (Table 5.1). The primary hazard quotient driver is vanadium, which comprises 100 percent of the total chemical noncancer hazard. The hazard is from the ingestion exposure route.

Risk Characterization Results Based on Tier 2 EPCs

The total noncancer hazard for potential exposure to surface soil/surface sediment by the WRW, based on the Tier 2 EPC, is 0.05 (Table 5.1). The primary hazard quotient driver is vanadium, which comprises 100 percent of the total chemical noncancer hazard. The hazard is 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 NNEU.

5.1.3 WRW 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 NNEU, vanadium was selected as a COC 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 results in an estimated total noncancer hazard quotient of 0.05, based on a Tier 1 EPC, and 0.1, based on a Tier 2 EPC. Since vanadium was selected as a COC in only one medium, cumulative risks from exposure to multimedia are not calculated for the NNEU.

5.2 Wildlife Refuge Visitor (WRV)

This section presents the results of the risk characterization for exposure of the WRV receptor to vanadium in surface soil/surface sediment at the NNEU. Exposure to subsurface soil/subsurface sediment is not evaluated for WRV. The risk estimates for exposure to vanadium 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 vanadium 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 noncancer hazards for Tier 1 and Tier 2 EPCs are calculated and summarized in Tables 5.2 and 5.3. The estimated excess lifetime cancer risks for vanadium were not calculated because cancer toxicity values are not available for vanadium.

Risk Characterization Results Based on Tier 1 EPCs

The total noncancer hazard for potential exposure to surface soil/surface sediment by the WRV, based on the Tier 1 EPC, is 0.09 (Table 5.2). The primary hazard quotient driver is vanadium, which comprises 100 percent of the total chemical noncancer hazard. The hazard is from the ingestion exposure route.

Risk Characterization Results Based on Tier 2 EPCs

The total chemical noncancer hazard for potential exposure to surface soil/surface sediment by the WRV, based on the Tier 2 EPC, is 0.03 (Table 5.2). The primary hazard quotient driver is vanadium, which comprises 100 percent of the total chemical noncancer hazard. The hazard is from the ingestion exposure route.

5.3 Summary

Risks to the WRW and WRV were evaluated for potential exposure to vanadium in surface soil/surface sediment at the NNEU. 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 the estimated HI is below one (Table 5.3), which indicates that concentrations of vanadium in surface soil/surface sediment are protective of the WRW and WRV.

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 NNEU, data are considered adequate for the characterization of risk at the EU. The environmental samples for the NNEU were collected from 1991 through 2005. The CRA sampling and analysis requirements for the BZ (DOE 2002, 2004) specify that the minimum sampling density requirement for surface soil/surface sediment is one five-sample composite for every 30-acre grid cell. In surface soil/surface sediment, there are up to 375 samples in the NNEU. In subsurface soil/subsurface sediment, there are up to 295 samples in the NNEU.

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 utilized 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 per year for a period of 18.7 years. In addition, a WRW is assumed to be dermally exposed and to 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 NNEU 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 conservatively estimate potential exposures because it is unlikely a WRW will excavate extensively in the NNEU.

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

PCOCs for the NNEU 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. Radionuclide PRGs are available for all detected individual radionuclides. Therefore, the lack of PRGs for the gross alpha and gross beta activities is not expected to affect the results of the HHRA. For the inorganics and organics, uncertainties associated with the lack of PRGs for these analytes are considered low because analytes without toxicity values are often considered to have low toxicity.

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 NNEU and the slightly elevated median value of arsenic in the NNEU is 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.

Radium-228 in subsurface soil/subsurface sediment was eliminated as a COC based on professional judgment. There is no identified source or pattern of release in the NNEU and the slightly elevated median value of radium-228 in the NNEU is most likely due to natural variation. The weight of evidence presented in Attachment 3, Section 4.0 supports the conclusion that concentrations of radium-228 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 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 NNEU 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 ECOIs that are present in the NNEU. ECOIs are defined as any chemical detected in the NNEU 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 NNEU, are 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 NNEU 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 NNEU, 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 NNEU data are used in the CRA:

- A total of 356 surface soil samples were collected and analyzed for inorganics (356 samples), organics (144 samples), and radionuclides (287 samples) (Table 1.2).

- A total of 291 subsurface soil samples were collected and analyzed for inorganics (291 samples), organics (196 samples), and radionuclides (260 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 NNEU 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. Seventy-eight distinct surface water samples were collected in the NNEU and analyzed for inorganics (78 samples), organics (60 samples), and radionuclides (65 samples).

As described in Section 1.1.4, there are five sample locations occurring in or immediately adjacent to PMJM habitat within the NNEU. Surface soil samples were collected and analyzed for inorganics (five samples) and radionuclides (six samples). There were no organic samples collected in PMJM habitat (see Section 1.2). A data summary is provided in Table 1.6 for surface soil in PMJM habitat. Sampling locations and PMJM habitat patches within the NNEU are shown on Figure 1.5. The risk to the PMJM receptor in habitat patch #10, which is partially located within NNEU, is evaluated in the LWNEU.

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 evaluated further.

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 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 uncertain toxicity.

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 evaluated further. Only 4,4’-DDT detected in surface soil at the NNEU had a detection frequency less than 5 percent. Although 4,4’-DDT was detected once in 65 total samples within NNEU (Figure 7.1), 4,4’-DDT has detection limits that exceed the lowest ESL. However, process knowledge and the assessment of ecological risk potential indicate 4,4’-DDT is not likely to be present in NNEU surface soil and does not present a potential for adverse ecological effects even if it was detected at its maximum detection limits (see Attachment 1 to this volume for further details). Therefore, 4,4’- DDT was eliminated as an ECOPC for the NNEU.

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" on 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 in surface soil at the NNEU was not considered ECOPCs for non-PMJM receptors and is not further evaluated quantitatively.

Antimony, barium, copper, mercury, molybdenum, nickel, tin, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, 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.

Nickel, vanadium, and zinc 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 NNEU 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 NNEU 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 NNEU 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 NNEU 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 NNEU 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 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 NNEU 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 NNEU.

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 EPCs is discussed in the CRA Methodology (DOE 2005).

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 NNEU.

7.3.6 Summary of Subsurface Ecological Contaminants of Potential Concern

All subsurface soil ECOIs for burrowing receptors in the NNEU 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 NNEU 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 NNEU were evaluated in the ECOPC identification process for non-PMJM receptors, PMJM receptors, and burrowing receptors. Antimony, barium, copper, mercury, molybdenum, nickel, tin, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and total PCBs were identified as ECOPCs for selected non-PMJM receptors (Table 7.10). Nickel, vanadium, and zinc 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 NNEU 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 2005). 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 (DOE 2005). 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 in Figure 8.2 (nickel), Figure 8.3 (vanadium), and Figure 8.4 (zinc). The UCL concentrations for each ECOPC were used as EPCs to calculate 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 or 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 2005) and are presented in Table 8.5 for the receptors of potential concern carried forward in the ERA for the NNEU.

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 2005). 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 2005) 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. Except for plants and invertebrates, a summary of the exposure estimates is presented in Table 8.6.

- Antimony – Default exposure estimates for the terrestrial plant, deer mouse (herbivore, insectivore), and coyote (insectivore);
- Barium – Default exposure estimates for the mourning dove (herbivore);
- Copper – Default exposure estimates for the mourning dove (herbivore and insectivore);
- Mercury – Default exposure estimates for the mourning dove (insectivore);
- Molybdenum – Default exposure estimates for the terrestrial plant and the deer mouse (insectivore);
- Nickel – Default exposure estimates for American kestrel, mourning dove (insectivore), deer mouse (herbivore and insectivore), and coyote (generalist and insectivore);
- Nickel – Refined exposure estimates for the deer mouse (insectivore);
- Tin – Default exposure estimates for mourning dove (insectivore), 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); and
- Total PCBs – Default exposure estimates for the American kestrel and mourning dove (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:

- Nickel – Default and refined exposure estimates;
- Vanadium – Default exposure estimates; and
- Zinc – 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 2005).

TRVs for ECOPCs identified for NNEU were obtained from the CRA Methodology. The pertinent TRVs for the NNEU 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 2005) 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 NNEU.

Potential risks to terrestrial plants, invertebrates, birds, and mammals are evaluated using a hazard quotient (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 (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 utilizes 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.

- **Exposure Point Concentrations (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.

- **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., $C_{tissue} = BAF * C_{soil}$), 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. 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 CRA Methodology utilized 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 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 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 provides 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 within both of these tables 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. Because 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 indicated 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 NNEU 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 NNEU 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 (herbivore and 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.

For non-PMJM receptors, no vertebrate receptors had LOAEL HQs greater than 1 using the default exposure assumptions and no additional HQs were calculated. For terrestrial plants, LOEC HQs were greater than 1 (HQs = 2) using the Tier 1 and 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. However, a refined analysis could not be performed because additional ESLs for plants were not available.

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 (herbivore and insectivore), and coyote (insectivore). Information on the historical use and a summary of site data and background data is provided in Attachment 3.

Terrestrial Plants

For terrestrial plants, HQs were greater than 1 using the Tier 1 and Tier 2 UTLs (HQs = 2) (Table 10.1). However, Efroymson et al. (1997) places low confidence in the TRV because there are no primary reference data showing toxicity to plants and the NOAEL ESL value 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 EPCs, NOAEL HQs greater than or equal to 1 were calculated for both receptors. A NOAEL HQ greater than 1 was also calculated using a Tier 2 EPC for the deer mouse (insectivore).

The deer mouse (herbivore) had LOAEL HQs less than 1 using both the Tier 1 and Tier 2 EPCs. The deer mouse (insectivore) had LOAEL HQs equal to 1 using both the Tier 1 and Tier 2 EPCs. These results indicate that the potential for adverse effects to populations of small mammals such as the deer mouse (herbivore and insectivore) are likely to be low in the NNEU.

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 29 grid cells (Figure 10.1). NOAEL HQs greater than 1 were calculated in 31 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.

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. NOAEL HQs were greater than 1 using both Tier 1 and Tier 2 EPCs for the coyote (insectivore).

No LOAEL HQs greater than 1 were calculated for the coyote (insectivore) under any exposure scenario. Therefore, the potential for adverse effects to populations of large home range receptors such as the coyote (insectivore) are likely to be low.

10.1.2 Barium

Barium HQs for the mourning dove (herbivore) are presented in Table 10.1. Barium was not identified as an ECOPC in the NNEU for any other receptors. Figure 10.2 shows the spatial distribution of barium in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

For the mourning dove (herbivore), LOAEL HQs were less than 1 using the default exposure assumptions 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.

Barium Risk Description

Barium was identified as an ECOPC for the mourning dove (herbivore) receptor only. Information on the historical use and a summary of site data and background data is provided in Attachment 3.

Non-PMJM Receptors – Small Home-Range

NOAEL HQs calculated using Tier 1 EPCs were greater than 1 (HQ = 2) for the mourning dove (herbivore). The NOAEL HQ for the mourning dove (herbivore) was equal to 1 for the Tier 2 UTL.

All LOAEL HQs were less than 1 for the mourning dove (herbivore). Therefore, the potential for adverse effects to populations of small home-range receptors such as the mourning dove (herbivore) 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, threshold and LOAEL TRVs were used in the HQ calculations. Barium samples were available from 29 grid cells (Figure 10.2). NOAEL and LOAEL HQs less than 1 were calculated in 100 percent of the grid cells for the most sensitive receptor (mourning dove [herbivore]). 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 barium.

10.1.3 Copper

Copper HQs for the mourning dove (herbivore and insectivore) are presented in Table 10.1. Copper was not identified as an ECOPC in the NNEU for any other receptors. Figure 10.3 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.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions 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 only. Information on the historical use and a summary of site data and background data is provided in Attachment 3.

Non-PMJM Receptors – Small Home-Range

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

All LOAEL HQs were less than 1 for both receptors. Therefore, the potential for adverse effects to populations of small home-range receptors such as the mourning dove (herbivore and 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, threshold and LOAEL TRVs were used in the HQ calculations. Copper samples were available from 29 grid cells (Figure 10.3). NOAEL HQs greater than 1 were calculated in 100 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.

10.1.4 Mercury

Mercury HQs for the mourning dove (insectivore) are presented in Table 10.1. Mercury was not identified as an ECOPC in the NNEU for any other receptors. Figure 10.4 shows the spatial distribution of mercury in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

For the mourning dove (insectivore), LOAEL HQs were less than 1 using the default exposure assumptions 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.

Mercury Risk Description

Mercury was identified as an ECOPC for the mourning dove (insectivore) receptor only. Information on the historical use and a summary of site data and background data is provided in Attachment 3.

Non-PMJM Receptors – Small Home-Range

NOAEL HQs calculated using Tier 1 and Tier 2 EPCs were less than 1 for the mourning dove (insectivore). LOAEL HQs were also less than 1 for the mourning dove (insectivore). Therefore, the potential for adverse effects to populations of small home-range receptors such as the mourning dove receptor 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, threshold and LOAEL TRVs were used in the HQ calculations. Mercury samples were available from 29 grid cells (Figure 10.4). NOAEL HQs greater than 1 were calculated in 100 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 mercury.

10.1.5 Molybdenum

Molybdenum HQs for terrestrial plants and deer mouse (insectivore) are presented in Table 10.1. Figure 10.5 shows the spatial distribution of molybdenum in relation to the deer mouse (insectivore) ESL and also presents the data used in the calculation of the Tier 2 EPCs.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions 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 terrestrial plants and the deer mouse (insectivore) receptors only. Information on the historical use and a summary of site data and background data is provided in Attachment 3.

Terrestrial Plants

For terrestrial plants, the HQ was equal to 1 using the Tier 1 UTL and less than 1 using the Tier 2 UTL (Table 10.1). Due to the lack of confidence in the toxicity information on the effects of molybdenum on plants and the HQs were less than or equal to 1, it is unlikely that molybdenum presents a potential for adverse effects to terrestrial plant populations.

Non-PMJM Receptors – Small Home-Range

For the deer mouse (insectivore), the NOAEL HQ was equal to 1 using the Tier 1 UTL and less than 1 using the Tier 2 UTL. LOAEL HQs were less than 1 using both EPCs. Because no HQs greater than 1 were calculated using any effects-based TRV, the potential for adverse effects to populations of small home-range receptors such as the deer mouse (insectivore) are likely to be low from exposure to molybdenum.

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. Molybdenum samples were available from 29 grid cells (Figure 10.5). NOAEL HQs greater than 1 were calculated in 3 percent of the grid cells while 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 molybdenum.

10.1.6 Nickel

Nickel HQs for the mourning dove (insectivore), American kestrel, deer mouse (herbivore and insectivore), and coyote (generalist and insectivore) are presented in Table 10.1. Figure 10.6 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 #11) 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 default 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 Patch #11 indicating a potential for adverse effects based on the default risk calculations. However, as discussed above, the uncertainty analysis presented in Attachment 5 indicated that there were considerable uncertainties in the default nickel 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), American kestrel, 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 is 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 exposure/TRV scenarios (Table 10.1). NOAEL HQs were equal to 1 for the American kestrel and the deer mouse (herbivore). LOAEL HQs for all non-PMJM receptors (except deer mouse [insectivore]) were less than or equal to 1 for all exposure scenarios. The deer mouse (insectivore) had LOAEL HQs greater than 1 under the default exposure scenarios indicating a potential for adverse effects. The potential for adverse effects to populations of the mourning dove (insectivore), American kestrel, and deer mouse (herbivore) are all likely to be low. Risks to the deer mouse (insectivore) using the default HQ calculations may be low to moderate and require more 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 29 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 also calculated in all grid cells for the most sensitive receptor (deer mouse [insectivore]). The results of the grid-cell analysis indicate that 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 adverse effects at UCL and UTL background soil concentrations. For the deer mouse (insectivore), LOAEL HQs in background (UTL and UCL HQs = 3) are similar to those calculated for NNEU surface soils (HQ = 4). These results indicate that risks to insectivorous deer mouse populations within NNEU 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 = 9) and the Tier 2 EPC (HQ = 9). However, LOAEL HQs were less than 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 the potential for adverse effects 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 to populations of small home-range receptors such as the deer mouse (insectivore) are expected to be low.

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

The NOAEL HQ was greater than 1 in Patch #11. The LOAEL HQ was also greater than 1 (HQ = 3) in Patch #11, 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 NNEU surface soils (HQs = 3) in Patch #11. These results indicate that risks to PMJM receptors within NNEU are similar to those offsite.

The LOAEL HQ was less than 1 using the median soil-to-invertebrate BAF in Patch #11. In addition, no HQs (NOAEL or LOAEL) were greater than 1 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 is low in Patch #11 because HQs are similar to those calculated using background data and LOAEL HQs were less than 1 when the median soil-to-invertebrate BAF and additional TRVs were used in the risk calculations. Based on the uncertainty analysis, risks are, therefore, likely to be low for the PMJM receptor in Patch #11.

10.1.7 Tin

Tin HQs for the mourning dove (insectivore), and deer mouse (insectivore) are presented in Table 10.1. Figure 10.7 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.

For non-PMJM receptors, no receptors had LOAEL HQs greater than 1 using the default exposure assumptions 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) and deer mouse (insectivore). Information on the historical use and a summary of site data and background, data is 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). LOAEL HQs for both receptors were less than 1. Therefore, the potential for adverse effects to populations of the mourning dove (insectivore) 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 29 grid cells (Figure 10.7). NOAEL HQs greater than 1 were calculated in 21 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 result in low risk from exposure to tin.

10.1.8 Vanadium

The PMJM receptor is the only receptor of concern for vanadium. A patch-specific HQ for the PMJM receptor (Patch #11) is presented in Table 10.2.

For PMJM receptors, the NOAEL HQ was greater than 1 (HQ = 2) whereas the LOAEL HQ was less than 1 using the default exposure assumptions 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 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, the NOAEL HQ was greater than 1 (HQ = 2) in Patch #11 (Table 10.2). Figure 8.3 presents vanadium sampling locations and a comparison to the PMJM ESL.

The LOAEL HQ was less than 1 using the default exposure scenario. The results indicate that the potential for adverse effects to PMJM receptors from exposure to vanadium are likely to be low in Patch #11. This conclusion is supported by the fact that the MDC in PMJM habitat (42.1 mg/kg) is less than the vanadium Eco-SSL for mammals (280 mg/kg) (EPA 2005).

10.1.9 Zinc

The PMJM receptor is the only receptor of concern for zinc. A patch-specific HQ for the PMJM receptor (Patch #11) is presented in Table 10.2.

The LOAEL HQ was less than 1 for the PMJM receptor in Patch #11 using the default exposure assumptions 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 Receptor

Potential risks to PMJM receptors were evaluated in Patch #11. Zinc sampling locations and comparisons to both background concentrations and the PMJM ESL are presented on Figure 8.4.

The NOAEL HQ was greater than 1 for Patch #11 (Table 10.2). However, the LOAEL HQ was less than 1 for this same patch. Because the LOAEL HQ was less than 1, potential adverse effects to PMJM receptors from zinc exposure are likely to be low in Patch #11.

10.1.10 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.

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

Bis(2-ethylhexyl)phthalate – Risk Description

There is no identified source in the NNEU 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 is provided in Attachment 3.

Non-PMJM Receptors – Small Home-Range

NOAEL HQs using Tier 1 and Tier 2 EPCs were greater than 1 for both receptors (Table 10.1). All LOAEL HQs were less than 1 for both receptors. Because no effects-based TRVs resulted in HQs greater than 1, the potential for adverse effects to populations of small-home range receptors such as the American kestrel and mourning dove (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. Bis(2-ethylhexyl)phthalate samples were available from 7 grid cells (Figure 10.8). NOAEL HQs greater than 1 were calculated in 86 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.

10.1.11 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 greater than 1 (HQs = 2 or 3 using the Tier 1 and Tier 2 EPCs, respectively) were calculated for the mourning dove (insectivore) but were less than 1 for the American kestrel. However, as discussed in the uncertainty analysis, no median BAF or additional TRVs were available for di-n-butylphthalate for a refined risk analysis for the mourning dove (insectivore).

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 NNEU 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 (HQ = 2 using the Tier 1 EPC, HQ = 3 using the Tier 2 EPC) for the mourning dove (insectivore) but were less than 1 for the American kestrel. The potential for adverse effects to populations of the American kestrel are, therefore, likely to be low from exposure to di-n-butylphthalate. However, the potential for adverse effects to the mourning dove (insectivore) requires 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 7 grid cells (Figure 10.9). NOAEL HQs greater than 1 were calculated in 100 percent of the grid cells. Fourteen percent of the LOAEL HQs were less than 1 whereas 86 percent 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. In addition, the NOAEL TRV was estimated from the LOAEL TRV, which is based on the prediction of eggshell-thinning effects in birds. It is unclear where the threshold for effects lies between the NOAEL and the LOAEL TRV. 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.

10.1.12 Total PCBs

HQs for total PCBs for the mourning dove (insectivore) and American kestrel are presented in Table 10.1. Figure 10.10 shows the spatial distribution of PCB (total) in relation to the lowest ESL and also presents the data used in the calculation of the Tier 2 EPCs.

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

PCB (Total) – Risk Description

Total PCBs were identified as an ECOPC for the mourning dove (insectivore) and American kestrel 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). All LOAEL HQs were less than 1 for the mourning dove (insectivore) and American kestrel. Therefore, risks to populations of small home-range receptors such as 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. PCB (total) samples were available from seven grid cells (Figure 10.10). NOAEL HQs greater than 1 were calculated in 100 percent of the grid cells (HQs greater than 1 but less than 5), 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 indicate low risk from exposure to PCB (total).

10.2 Ecosystem Characterization

An ecological monitoring program has been underway since 1991 when baseline data on wildlife species was 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 Rocky Flats ecosystem. Permanent transects through three basic habitats were run monthly for more than a decade (K-H 2002a, 2002b). Observations were recorded concerning the abundance, distribution, and diversity of wide-ranging wildlife species, including observations of migratory birds, raptors, coyotes, and deer.

Migratory birds were tracked during all seasons, but most notably during the breeding season. Over eight 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, 1993-1999) show a steady state in diversity of bird communities (K-H 2000a). 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-tail 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 typically 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-tail hawk nest in Upper Woman Creek (K-H 1997a, 1998a) due to weather. The continued presences of nesting raptors at RFETS (K-H 2002a) indicate 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 2000a).

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), numbers of white-tailed deer were estimated to be between 10 and 15 individuals. White-tailed deer frequent 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 2000a, 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. At RFETS, three to six coyote dens typically 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.

Across the site, small mammal trapping has occurred over several years as a component of the ecological monitoring program especially during studies of the PMJM. Small mammal trapping within the NNEU conducted during 1995 and 1996 around the Present Landfill pond documented western harvest mouse (*Reithrodontomys megalotis*), deer mouse (*Peromyscus maniculatus*), meadow vole (*Microtus pennsylvanicus*), thirteen-lined ground squirrels (*Spermophilus tridecemlineatus*), prairie voles (*Microtus ochrogaster*), and house mice (*Mus musculus*) (K-H 1996). The NNEU has been subjected to much physical disturbance due the Present Landfill activities. The continued disturbances promote weedy vegetation that produces an abundance of seeds. Weedy vegetation promotes habitat for certain small mammal species including deer mouse and house mouse. Other species found in the EU are common in wetter areas including areas surrounding the landfill pond. Any abundance or absence of certain small mammals is most likely due to vegetation conditions limiting available habitats. NNEU supports habitat for the federally protected PMJM (*Zapus hudsonius preblei*). The preferred habitat for the PMJM is the riparian corridors bordering streams, ponds, and wetlands at RFETS with an adjacent thin band of upland grasslands. Trapping in the EU and radio telemetry studies in Walnut Creek indicate PMJM are absent. The lack of continuously running water along No Name Gulch is undoubtedly a limiting factor to PMJM occurrence.

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 1998b, 1999, 2000a, 2000b). 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 NNEU.

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 Volume 2 of Appendix A 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 uncertainty that are specific to the NNEU 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 NNEU, 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 NNEU 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. In general, the data meet the data adequacy guidelines. Because the spatial distribution of surface soil samples in the NNEU for VOCs, SVOCs, and PCBs tends to be clustered in or near historical IHSSs, Tier 1 exposure point concentration calculations will tend to be conservative. Although there are no current PCB surface water data, the existing historical data indicate PCBs are not detected. In addition, although there are no dioxin data for surface soil and only one surface water sample was collected for dioxins (non-detected), based on process knowledge, it is unlikely that dioxins have been released in NNEU surface soil. However, there is some uncertainty in the overall risk estimates for the NNEU as a result of the limited dioxin data for RFETS. Lastly, there are no surface soil organic data for PMJM habitat. However, information on potential historical sources of contamination, migration pathways, and the concentration levels in the media indicate organics are not likely to be of concern in PMJM habitat surface soil. In conclusion, the data either meet the data adequacy guidelines, or where data is limited, other lines of evidence indicate it is possible to make risk management decisions without additional 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. Attachment 1 to this volume provides a detection limit adequacy screen where detection limits for non-detected analytes as well as analytes detected in less than 5 percent of the samples are compared to ESLs. There are several of these analytes in surface soil whose detection limits frequently exceed the ESLs and, in some cases, the upper end of the detection limit ranges significantly exceeds the ESLs. However, all of these analytes contribute only minimal uncertainty to the overall risk estimates because process knowledge indicates they are not likely to be ECOPCs in NNEU surface soil even if detection limits had been lower. Although some of the analytes would present a potential for adverse ecological effects if they were detected at their maximum detection limits, because they are not expected to be ECOPCs in NNEU surface soil, uncertainty in the overall risk estimates is low.

10.3.2 Uncertainties Associated with the Lack of Toxicity Data for Ecological Contaminant of Interest Detected at the No Name Gulch Drainage Exposure Unit

Several ECOIs detected in the NNEU do not have adequate toxicity data for the derivation of ESLs (CRA Methodology [DOE 2005]). 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), molybdenum (invertebrates), tin (invertebrates), vanadium (invertebrates), bis(2-ethylhexyl)phthalate (invertebrates), di-n-butylphthalate (invertebrates), and PCB (total) (invertebrates). The risk 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 NNEU. The weight-of-evidence approach indicates that there is no identified source or pattern of release in the NNEU, and the slightly elevated values of the NNEU 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 NNEU 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 NNEU and have very low potential to be transported from historical sources to the NNEU.

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 NNEU is presented below.

11.1 Data Adequacy

The adequacy of the NNEU 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. In general, the data meet the data adequacy guidelines. Where data adequacy guidelines are not met for some analyte groups, other lines of evidence (information on potential historical sources of contamination, migration pathways, and the concentration levels in the media) indicate the level of uncertainty in the overall risk estimates is low as result of the data limitations. In addition, although some analytes that were eliminated as COCs or ECOPCs because of low detection frequency (i.e., zero to 5 percent) have detection limits that exceed the PRGs and ESLs, several lines of evidence (process knowledge, concentration distributions sitewide, and risk potential) indicate that these analytes are not likely to be COCs/ECOPCs in the NNEU even if detection limits had been lower, and therefore, there is a low level of uncertainty associated with the overall risk estimates as result of the data limitations.

11.2 Human Health Risk

The COC screening analyses compared MDCs and UCLs of chemicals and radionuclides in NNEU media to PRGs for the WRW receptor. PCOCs 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, vanadium was retained as a COC for surface soil/surface sediment. No COCs were identified for subsurface soil/subsurface sediment. The estimated Tier 1 total noncancer hazard for potential exposure of the WRW to surface soil/surface sediment at the NNEU is 0.1, and the Tier 2 risk is 0.05. The estimated total Tier 1 noncancer hazard for potential exposure of the WRV to surface soil/surface sediment based on the Tier 1 EPC is 0.09, and the Tier 2 risk is 0.03.

The risk characterization for exposure of the WRW and WRV to surface soil/surface sediment indicated that the estimated noncancer hazards for both receptor populations were below 1, indicating that concentrations of vanadium in surface soil/surface sediment are protective of the WRW and WRV. The total excess lifetime cancer risks were not estimated because cancer toxicity criteria are not available for vanadium.

11.3 Ecological Risk

The ECOPC identification process streamlines the ecological risk characterization by focusing the assessment on ECOIs that are present in the NNEU. The ECOPC identification process is described in the CRA Methodology (DOE 2005) and additional details are provided in Appendix A, Volume 2 of the RI/FS Report. Antimony, barium, copper, mercury, molybdenum, nickel, tin, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and total PCBs were identified as ECOPCs for representative populations of non-PMJM receptors in surface soil. ECOPCs for individual PMJM receptors included nickel, vanadium and zinc. Although there are no dioxin data for surface soil, the evaluation of site-wide data indicate dioxins are not expected to be present in NNEU surface soil, however, there is some uncertainty in the overall risk estimates for the NNEU as a result of this data limitation. 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 39 (nickel/deer mouse - insectivore) to less than 1 (several ECOPC/receptor pairs). NOAEL or NOEC HQs ranged from 39 (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 had HQs greater than 1 using Tier 1 and Tier 2 EPCs (HQs = 2). However, there is low confidence placed in the ESL for antimony. As discussed in Attachment 5, additional NOEC or LOEC values for antimony were not available in the literature. Therefore, risks to populations of terrestrial plants from exposure to antimony in surface soils are likely to be low to moderate but with a high level of uncertainty due to low confidence in the default ESL.

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:

- Nickel/deer mouse (insectivore) – The default LOAEL HQs were equal to 4 using both the Tier 1 and Tier 2 EPCs. 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 – The LOAEL HQ was greater than 1 in Patch #11using default exposure and toxicity assumptions. Using a median BAF rather than an upper-bound BAF for the estimation of invertebrate tissue concentrations, the LOAEL HQ was less than 1 in Patch #11. Using additional TRVs for nickel resulted in NOAEL and LOAEL HQs less than 1 with either BAF in the risk calculations. Based on the 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 2 using the Tier 1 EPC and equal to 3 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 NNEU.

Based on the 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 NNEU (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 NNEU.

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TABLES

Table 1.1
NNEU IHSSs

IHSS	OU	PAC	Title	Description	Disposition
114	BZ	NW-114	Present Landfill	The Present Landfill was used for disposal of nonradioactive solid waste, including paper, rags, floor sweepings, cartons, mixed garbage and rubbish, demolition materials, and miscellaneous items. Some hazardous waste were sent to the landfill which may have included paints, solvents, degreasers, oil filters, and metal cuttings and shavings, including mineral and asbestos dust, and miscellaneous metal chips coated with oils and carbon tetrachloride. The east landfill pond was constructed in 1974 to protect downstream surface water quality. In 2005, the east landfill pond was removed and an engineered cover (evapotranspiration or ET cover) was constructed on the Landfill as a final closure measure.	NFAA-2005 HRR
166.1	BZ	NE-166.1	Trench A	Trench A, 30 to 40 ft wide by approximately 200 ft long, was active from prior to 1964 and in 1970. Trenches A and B received uranium- and/or plutonium-contaminated sludge from the Sewage Treatment Plant.	NFAA -2005 HRR
166.2	BZ	NE-166.2	Trench B	Trench B, 30 to 40 ft wide by approximately 200 ft long, was active in 1959 and received uranium- and/or plutonium-contaminated sludge from the Sewage Treatment Plant	NFAA -2005 HRR
166.3	BZ	NE-166.3	Trench C	Trench C, 30 to 40 ft wide by approximately 200 ft long, was active sometime prior to 1964 and in 1970. Materials placed in Trench C were unknown, but it was probable that sewage sludge was placed in Trench C.	NFAA -2005 HRR
167.1	BZ	NE-167.1	Landfill North Area Spray Field	The 172,500-square-foot North Area Spray Field was used from 1972 to 1981 for spray evaporation of landfill leachate from the East and West Landfill Ponds.	NFAA -2005 HRR
167.2	BZ	NE-167.2	Pond Area Spray Field (Center Area)	The 40,000-square-foot Pond Area Spray Field was used from 1972 to 1981 for spray evaporation of landfill leachate from the East and West Landfill Ponds.	NFAA -2005 HRR
167.3	BZ	NE-167.3	South Area Spray Field	The 31,250-square-foot Pond Area Spray Field was used from 1972 to 1981 for spray evaporation of landfill leachate from the East and West Landfill Ponds.	NFAA -2005 HRR
170	BZ	NW-170	PU&D Storage Yard - Waste Spills	Beginning in 1974, The P.U.& D. Storage Yard stored barrels, drums, and cargo boxes, spent batteries, empty dumpsters, dumpsters filled with metal shavings coated with lathe coolant, and drums of spent solvents and waste oils.	NFAA -2005HRR
203	BZ	NW-203	Inactive Hazardous Waste Storage Area	Fifty-five-gallon drums with free liquids were stored within 14 cargo containers at IHSS 203. Stored wastes included solvents, coolants, machining wastes, cuttings, lubricating oils, organics, acids PCB-contaminated soil and debris, and PCB-contaminated oil.	NFAA -2005 HRR
	BZ	000-501	Roadway Spraying	Roadways in the BZ OU were occasionally sprayed with waste oils for dust suppression, but sometimes reverse osmosis brine solutions and footing drain water were also applied	NFAA -2005 HRR
174A	BZ	NW-174A	PU&D Yard Container Storage Area (drum)	The P.U.& D. Storage Yard drum storage area was used to store drums containing hazardous substances, waste paints, and spent paint thinner.	NFAA -2005 HRR
	BZ	NW-174B	PU&D Container Storage Facilities (dumpster)	The P.U.&D. Storage Yard dumpster storage area was used to store stainless-steel chips coated with freon-based or oil-based lathe coolant.	NFAA -2005 HRR
	BZ	NE-1400	Tear Gas Powder Release	A member of Plant Protection dumped approximately five pounds of CS tear gas powder on the roadway in the buffer zone on the evening of August 5, 1987. The powder became airborne the next day when other members of Plant Protection drove through the tear gas powder	NFAA -2005 HRR
	BZ	NW-1500	Diesel Spill at PU&D Yard	Approximately 1.5 gallons of diesel fuel spilled onto the ground at the PU&D storage yard during a routine fueling operation for a fork truck	NFAA -2005 HRR
	BZ	NW-1501	Asbestos Release at PU&D Yard	Approximately 1.5 pounds of asbestos was released to the environment at the PU&D yard when it was discovered that 15 square feet of insulation was missing from a boiler that was stored there.	NFAA -2005 HRR
	BZ	NW-1502	Improper Disposal of Diesel-Contaminated Material at Landfill	Approximately one gallon of diesel fuel spilled onto asphalt pavement while patching Building 850's parking lot.	NFAA -2005 HRR
	BZ	NW-1503	Improper Disposal of Fuel-Contaminated Material at Landfill	On February 26, 1992 empty motor oil containers, used oil filters and oil-stained debris were inadvertently disposed of in the Present Landfill.	NFAA -2005 HRR

Table 1.1
NNEU IHSSs

IHSS	OU	PAC	Title	Description	Disposition
	BZ	NW-1504	Improper Disposal of Thorosilane-Contaminated Material at Landfill	On January 28, 1994 materials potentially contaminated with Thorosilane (an ignitable liquid) were disposed of in the Present Landfill, following a January 27, 1994 Thorosilane spill in Building 551.	NFAA -2005 HRR
	BZ	NW-1505	North Firing Range	A firing range located in the northwest BZ was used for target practice and security officer qualifications from 1986 onward. Potential lead contamination may have resulted from bullets fired int the berm prior to 1993. The North Firing Range was remediated (soil removal) in 2005	NFAA-2005 HRR

Note: The FY2005 Final Historical Release Report (Appendix B to the RI/FS Report) provides the chemicals of potential concern for these IHSSs based on previous investigations.

Table 1.2
Number of Samples Collected 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 Habitat	Subsurface Soil[b]
Inorganic	375	295	356	0[c](5)[d]	291
Organic	159	196	144	0[c](0)[d]	196
Radionuclide	309	264	287	1[c](6)[d]	260

[a] Used in the HHRA.

[b] Used in the ERA.

[c] Number of samples in NNEU PMJM patches.

[d] Total number of samples used in ERA. For NNEU, the data for surface soil samples adjacent to the NNEU PMJM habitat patches are used to complement the samples collected within the patches (see Figure 1.5).

Note: The total number of results (samples) in Tables 1.3 through 1.6 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]
Inorganic (mg/kg)									
Aluminum				375	100	1,580	29,300	10,712	3,934
Antimony	0.28	-	15	360	18.3	0.380	348	4.98	18.6
Arsenic				375	100	1.40	13.2	5.01	1.93
Barium				375	100	18	1,120	143	90.8
Beryllium	0.06	-	2	375	81.3	0.120	5	0.655	0.374
Boron				48	100	1.20	10	4.38	2.05
Cadmium	0.05	-	2	375	25.6	0.0670	12.3	0.548	0.734
Calcium				375	100	439	87,000	7,700	8,500
Cesium	0.5	-	121	159	26.4	0.690	3.90	14.7	21.1
Chromium	10	-	16	375	99.5	3.70	128	12.8	7.64
Cobalt	7.3	-	10	375	97.3	1.10	27.1	6.80	2.74
Copper	10.9	-	23	375	91.2	3.10	640	19.1	36.4
Iron				375	100	2,610	59,600	13,298	4,907
Lead				375	100	0.870	814	38.8	73.4
Lithium	2.9	-	15	207	81.6	2.30	16.4	7.60	3.17
Magnesium				375	100	347	9,690	2,550	1,149
Manganese				375	100	21.1	1,370	241	158
Mercury	0.021	-	0.16	374	19.8	0.0110	0.340	0.0479	0.0262
Molybdenum	0.15	-	5	207	25.6	0.200	9.10	1.12	1.06
Nickel	3.9	-	8	375	96.8	2.90	93.4	11.6	7.22
Nitrate / Nitrite	1	-	1.1	195	71.8	0.638	45	3.84	5.95
Potassium	656	-	2,540	374	98.1	470	5,280	1,953	772
Selenium	0.2	-	3	363	25.1	0.290	2.20	0.383	0.291
Silica				48	100	490	2,000	942	436
Silicon				37	100	120	643	249	131
Silver	0.062	-	3	375	34.4	0.110	64.9	0.851	3.35
Sodium	41.1	-	263	375	69.6	22.6	692	107	96.0
Strontium				207	100	6.40	320	29.6	26.8
Thallium	0.21	-	1	371	8.36	0.240	5.80	0.286	0.347
Tin	0.83	-	48	207	13.5	1.70	72.3	4.53	8.43
Titanium				48	100	49	310	146	70.9
Uranium[c]	0.96	-	8.4	48	2.08	1.10	1.10	1.04	1.15
Vanadium				375	100	7.40	5,300	80.5	375
Zinc				375	100	14	293	54.4	28.1
Organics (µg/kg)									
1,2,4-Trimethylbenzene	1.02	-	6.5	14	42.9	1.40	4.60	2.34	1.29
2-Butanone	9.99	-	61	21	4.76	13	13	10.5	5.83
2-Methylnaphthalene	340	-	3,300	102	0.980	200	200	231	176
4,4'-DDT	16	-	160	70	1.43	26	26	9.93	8.76
4-Chloro-3-methylphenol	340	-	3,300	102	1.96	57	67	268	250
Acenaphthene	340	-	3,300	102	19.6	38	800	198	183
Acenaphthylene	340	-	3,300	102	0.980	38	38	209	165
Acetone	11	-	140	21	47.6	6.10	99	22.8	23.3
Anthracene	340	-	3,300	102	27.5	37	650	194	181
Benzo(a)anthracene	340	-	3,300	102	53.9	39	1,100	220	225
Benzo(a)pyrene	340	-	3,300	102	47.1	42	1,000	232	219
Benzo(b)fluoranthene	340	-	3,300	102	52.0	51	1,400	275	264
Benzo(g,h,i)perylene	340	-	3,300	102	21.6	37	450	217	185
Benzo(k)fluoranthene	340	-	3,300	102	31.4	36	590	216	195
Benzoic Acid	1,600	-	16,000	94	24.5	41	530	973	1,000
beta-BHC	8	-	12	70	2.86	11	11	4.50	1.15
bis(2-ethylhexyl)phthalate	340	-	1,000	102	54.9	36	5,500	300	626
Butylbenzylphthalate	340	-	3,300	102	15.7	37	1,400	237	217
Chrysene	340	-	3,300	102	58.8	43	1,100	239	231
Dibenz(a,h)anthracene	340	-	3,300	102	3.92	61	110	227	178
Dibenzofuran	340	-	3,300	102	3.92	45	350	228	179
Diethylphthalate	340	-	3,300	102	1.96	48	93	229	177
Di-n-butylphthalate	340		3,300	102	12.7	34	260	218	184
Di-n-octylphthalate	340		3,300	102	2.94	40	82	227	178
Fluoranthene	340	-	3,300	102	77.5	40	2,800	343	418

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]
Fluorene	340 - 3,300	102	16.7	37	680	219	191
Heptachlor epoxide	8 - 12	69	1.45	23	23	4.59	2.27
Indeno(1,2,3-cd)pyrene	340 - 3,300	102	24.5	44	490	218	186
Methylene Chloride[c]	1.29 - 57.00	21	52.4	1.50	3.30	5.10	6.37
Naphthalene	1.35 - 3,300	106	7.55	1.70	690	183	184
PCB-1254	84 - 1,600	121	14.9	9.90	3,400	133	388
PCB-1260	84 - 1,600	121	14.0	11	680	88.8	108
Pentachlorophenol	1,600 - 16,000	102	0.980	39	39	1,123	867
Phenanthrene	340 - 3,300	102	67.6	43	3,500	290	419
Pyrene	340 - 3,300	102	75.5	39	2,600	374	423
Tetrachloroethene	1.36 - 30	21	4.76	10	10	3.67	3.19
Toluene	1.31 - 8	21	19.0	8	290	36.3	85.3
Radionuclides (pCi/g)[d]							
Americium-241		283	N/A	-0.0370	1.15	0.0307	0.101
Cesium-134		35	N/A	-0.267	0.167	0.0239	0.0922
Cesium-137		215	N/A	-0.0722	2.27	0.414	0.538
Gross Alpha		250	N/A	1.33	57.9	16.5	5.41
Gross Beta		252	N/A	6.45	53.5	28.4	5.51
Plutonium-239/240		283	N/A	-0.00500	2.31	0.0780	0.197
Radium-226		21	N/A	0.760	1.90	1.14	0.259
Radium-228		56	N/A	0.00100	2.20	1.51	0.371
Strontium-89/90		185	N/A	-0.00400	2.87	0.228	0.261
Uranium-233/234		287	N/A	0.439	1.79	0.914	0.240
Uranium-235		287	N/A	-0.0754	0.276	0.0451	0.0375
Uranium-238		287	N/A	0.386	1.75	0.948	0.242

[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 1.4
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]
Inorganic (mg/kg)							
Aluminum		292	100	1,730	50,500	9,849	5,628
Antimony[c]	0.28 - 14	252	10.7	0.670	22.3	4.72	3.17
Arsenic	0.44 - 2	293	98.6	0.460	23.8	4.47	2.77
Barium		293	100	21	2,970	160	206
Beryllium	0.23 - 1	293	63.8	0.210	2.10	0.658	0.370
Boron	0.39 - 0.39	22	95.5	1.50	6.40	3.04	1.58
Cadmium	0.049 - 1	281	8.54	0.0830	1.20	0.401	0.186
Calcium		292	100	447	191,000	17,464	31,900
Cesium[c]	0.5 - 136	269	22.3	0.650	4.50	26.7	27.2
Chromium	1.2 - 1	293	99.3	1.40	217	13.5	17.3
Cobalt	1.3 - 2	293	96.9	1.40	18.6	6.45	2.97
Copper	4.9 - 12	293	96.2	2.60	1,000	18.8	64.1
Iron		292	100	1,650	46,300	11,645	5,260
Lead	0.45 - 0.45	293	99.7	0.490	990	34.9	114
Lithium	0.8 - 23	286	62.9	1.70	29.2	5.83	3.56
Magnesium		292	100	560	6,090	2,307	829
Manganese		292	100	8.20	915	177	141
Mercury	0.05 - 0.13	293	19.1	0.00740	0.160	0.0456	0.0220
Molybdenum	0.14 - 5	292	16.8	0.190	27.9	1.81	1.93
Nickel	4.7 - 10	293	80.9	3.80	41.5	11.6	5.82
Nitrate / Nitrite	0.55 - 1	112	50	0.550	20,000	180	1,890
Potassium	600 - 1,970	291	75.3	304	3,180	1,178	697
Selenium	0.21 - 3	288	29.5	0.240	4.20	0.370	0.400
Silica[c]		22	100	446	980	706	162
Silicon[c]		116	100	57.6	883	278	151
Silver	0.058 - 2	293	4.10	0.660	1.50	0.547	0.217
Sodium	13 - 127	292	87.0	22	3,000	159	230
Strontium	18.3 - 18	292	99.7	5.80	341	52.4	47.6
Sulfide	9.6 - 28.2	11	9.09	12.5	12.5	10.2	3.56
Thallium	0.21 - 1	283	12.7	0.220	1.50	0.189	0.114
Tin	0.82 - 45	293	12.3	3.60	19.7	6.46	4.20
Titanium		22	100	62	348	141	71.4
Uranium	0.97 - 1.8	22	4.55	1.60	1.60	0.609	0.248
Vanadium	4.6 - 11	293	99.0	2.10	119	25.7	13.0
Zinc	11 - 11	293	99.7	5.50	1,400	46.3	98.8
Organics (µg/kg)							
2-Butanone	10 - 13,000	159	17.0	3	1,600	886	2,147
2-Hexanone	10 - 6,300	163	1.23	18	19	395	1,011
4-Methyl-2-pentanone	10 - 6,300	165	1.21	1	58	410	1,028
4-Methylphenol	350 - 1,700	38	7.89	72	300	207	111
Acenaphthene	350 - 1,700	39	12.8	42	190	197	114
Acetone	10 - 13,000	172	7.56	7.60	750	828	2,083
Anthracene	350 - 1,700	39	17.9	45	250	195	118
Benzene	5 - 740	173	0.578	1	1	45.8	109
Benzo(a)anthracene	350 - 1,700	39	25.6	44	550	211	138
Benzo(a)pyrene	350 - 1,700	39	15.4	70	460	219	120
Benzo(b)fluoranthene	350 - 1,700	39	15.4	93	550	234	137
Benzo(g,h,i)perylene	350 - 1,700	39	12.8	74	310	208	111
Benzo(k)fluoranthene	350 - 1,700	39	12.8	43	240	202	112
Benzoic Acid	1,800 - 8,700	37	2.70	350	350	1,041	571
bis(2-ethylhexyl)phthalate	350 - 1,700	39	20.5	49	130	186	120
Butylbenzylphthalate	350 - 1,700	39	5.13	74	160	205	108
Chlorobenzene	5 - 740	173	0.578	3	3	45.8	109
Chloroform	5 - 740	174	0.575	2	2	47.4	110
Chrysene	350 - 1,700	39	28.2	43	500	210	135
cis-1,2-Dichloroethene	2.6 - 630	23	8.70	0.890	13	261	120
Dibenz(a,h)anthracene	350 - 1,700	39	2.56	100	100	207	107
Dibenzofuran	350 - 1,700	39	5.13	46	62	202	111
Diethylphthalate	350 - 1,700	39	2.56	84	84	206	108
Dimethylphthalate	350 - 1,700	39	2.56	140	140	208	106
Di-n-butylphthalate	350 1,700	39	10.3	51	160	200	114

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]
Ethylbenzene	5	-	740	174	1.72	4	8	47.4	110
Fluoranthene	350	-	1,700	39	33.3	41	1,300	274	258
Fluorene	350	-	1,700	39	7.69	61	130	203	110
Hexachlorobenzene	350	-	1,700	39	2.56	160	160	208	106
Indeno(1,2,3-cd)pyrene	350	-	1,700	39	12.8	82	310	210	110
Methylene Chloride	5	-	3,700	174	16.1	1.60	690	111	337
Monocrotophos				1	100	1,500	1,500	1,500	N/A
Naphthalene	5.1	-	1,700	62	4.84	46	390	225	119
PCB-1254	50	-	180	50	16	18	580	65.0	76.9
PCB-1260	83	-	460	51	1.96	230	230	64.7	43.3
Phenanthrene	350	-	1,700	39	33.3	38	1,000	243	208
Phenol	350	-	1,700	39	2.56	190	190	209	106
Pyrene	350	-	440	39	33.3	57	1,600	278	300
Styrene	5	-	740	174	0.575	1	1	47.4	110
Tetrachloroethene	5	-	740	175	3.43	4	750	55.5	128
Tetraethyl dithiopyrophosphate				1	100	7.70	7.70	7.70	N/A
Toluene	5	-	740	173	78.6	1	7,600	208	643
Trichloroethene	5	-	740	173	2.89	1.60	360	46.2	109
Xylene[d]	5	-	740	175	2.86	2	17	49	112
Radionuclides (pCi/g)[e]									
Americium-241				240	N/A	-0.0141	0.258	0.0107	0.0221
Cesium-134				72	N/A	-0.381	0.110	-0.0385	0.106
Cesium-137				124	N/A	-0.0322	0.957	0.148	0.176
Gross Alpha				248	N/A	0.270	143	14.8	11.2
Gross Beta				258	N/A	3.31	40.3	23.2	5.56
Plutonium-238				10	N/A	-0.00600	0.00200	-9.00E-04	0.00233
Plutonium-239/240				246	N/A	-0.00300	1.32	0.0271	0.0912
Radium-226				14	N/A	0.750	2.28	1.11	0.373
Radium-228				122	N/A	0.690	3.03	1.57	0.337
Strontium-89/90				122	N/A	-0.360	0.500	0.157	0.112
Uranium-233/234				258	N/A	0.251	3.05	0.841	0.310
Uranium-235				258	N/A	-0.0400	0.140	0.0374	0.0286
Uranium-238				258	N/A	0.279	141	1.42	8.73

[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 1.5
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				356	100	1,580	29,300	10,484	3,715
Antimony	0.28	-	15	341	19.4	0.380	348	5.16	19.1
Arsenic				356	100	1.60	13.2	5.00	1.96
Barium				356	100	25	1,120	141	90.3
Beryllium	0.062	-	2	356	80.3	0.120	5	0.642	0.376
Boron				36	100	1.20	7.90	3.72	1.44
Cadmium	0.054	-	2	356	25.8	0.0900	12.3	0.566	0.748
Calcium				356	100	439	87,000	7,441	7,829
Cesium	0.5	-	121	154	26.6	0.690	3.20	13.8	20.6
Chromium	15.7	-	16	356	99.7	4.20	128	12.8	7.71
Cobalt	7.3	-	10	356	97.2	1.10	27.1	6.79	2.77
Copper	10.9	-	23	356	90.7	5.70	640	19.3	37.4
Iron				356	100	2,610	59,600	13,215	4,944
Lead				356	100	0.870	814	39.9	75.2
Lithium	2.9	-	15	190	80	2.30	16.4	7.44	3.12
Magnesium				356	100	347	9,690	2,533	1,157
Manganese				356	100	21.1	1,370	240	154
Mercury	0.021	-	0.16	355	17.5	0.0110	0.340	0.0476	0.0262
Molybdenum	0.15	-	5	190	21.1	0.200	9.10	1.14	1.06
Nickel	3.9	-	8	356	96.6	2.90	93.4	11.5	7.37
Nitrate / Nitrite	1	-	1	188	71.3	1	45	3.92	6.04
Potassium	656	-	2,540	355	98.0	470	5,280	1,969	777
Selenium	0.2	-	3	344	25	0.290	2.20	0.380	0.295
Silica				36	100	490	1,100	742	146
Silicon				32	100	120	643	246	136
Silver	0.062	-	3	356	36.0	0.110	64.9	0.882	3.44
Sodium	47.6	-	263	356	68.5	22.6	692	104	93.5
Strontium				190	100	7.80	80.6	26.2	15.5
Thallium	0.21	-	1	352	6.25	0.240	5.80	0.277	0.335
Tin	0.83	-	23	190	12.6	1.70	72.3	4.54	8.61
Titanium				36	100	49	310	164	72.3
Vanadium				356	100	8.40	5,300	82.9	385
Zinc				356	100	14	293	54.1	28.4
Organics (µg/kg)									
2-Methylnaphthalene	340	-	3,300	87	1.15	200	200	211	178
4,4'-DDT	16	-	160	65	1.54	26	26	9.98	9.09
4-Chloro-3-methylphenol	340	-	3,300	87	2.30	57	67	208	179
Acenaphthene	340	-	3,300	87	23.0	38	800	196	198
Acenaphthylene	340	-	3,300	87	1.15	38	38	209	178
Anthracene	340	-	3,300	87	29.9	41	650	196	195
Benzo(a)anthracene	340	-	3,300	87	56.3	39	1,100	220	236
Benzo(a)pyrene	340	-	3,300	87	52.9	42	1,000	217	227
Benzo(b)fluoranthene	340	-	3,300	87	56.3	51	1,400	273	280
Benzo(g,h,i)perylene	340	-	3,300	87	23.0	37	450	200	186
Benzo(k)fluoranthene	340	-	3,300	87	35.6	36	590	194	197
Benzoic Acid	1,600	-	16,000	80	28.8	41	530	834	994
beta-BHC	8	-	10	65	3.08	11	11	4.49	1.18
bis(2-ethylhexyl)phthalate	340	-	720	87	58.6	36	5,500	303	676
Butylbenzylphthalate	340	-	3,300	87	18.4	37	1,400	218	225
Chrysene	340	-	3,300	87	64.4	43	1,100	233	242
Dibenz(a,h)anthracene	340	-	3,300	87	4.60	61	110	206	179
Dibenzofuran	340	-	3,300	87	4.60	45	350	208	180
Diethylphthalate	340	-	3,300	87	2.30	48	93	208	179
Di-n-butylphthalate	340		3,300	87	13.8	40	260	197	184
Di-n-octylphthalate	340		3,300	87	3.45	40	82	206	180
Fluoranthene	340	-	3,300	87	83.9	40	2,800	359	448
Fluorene	340	-	3,300	87	19.5	37	680	197	194
Heptachlor epoxide	8	-	10	64	1.56	23	23	4.58	2.34
Indeno(1,2,3-cd)pyrene	340	-	3,300	87	26.4	44	490	201	188
Methylene Chloride[c]	1.29	-	30.00	6	16.7	1.50	1.50	3.58	5.67
Naphthalene	1.35	-	3,300	91	5.49	42	690	202	188
PCB-1254	84	-	1,600	116	15.5	9.90	3,400	135	397
PCB-1260	84	-	1,600	116	14.7	11	680	88.6	111
Pentachlorophenol	1,600	-	16,000	87	1.15	39	39	1,019	867
Phenanthrene	340	-	3,300	87	72.4	43	3,500	299	449
Pyrene	340	-	3,300	87	86.2	39	2,600	380	456
Tetrachloroethene	1.36	-	30	6	16.7	10	10	5.02	6.07

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]
Toluene	1.31 - 5	6	33.3	230	290	87.4	135
Radionuclides (pCi/g)[d]							
Americium-241		263	N/A	-0.0301	1.15	0.0311	0.104
Cesium-134		32	N/A	-0.267	0.120	0.0165	0.0920
Cesium-137		208	N/A	-0.0722	2.27	0.417	0.542
Gross Alpha		243	N/A	1.33	57.9	16.5	5.16
Gross Beta		245	N/A	17	53.5	28.6	5.26
Plutonium-239/240		261	N/A	-6.18E-04	2.31	0.0807	0.203
Radium-226		17	N/A	0.760	1.90	1.12	0.261
Radium-228		51	N/A	0.00100	2.20	1.53	0.381
Strontium-89/90		178	N/A	-0.00400	2.87	0.225	0.259
Uranium-233/234		267	N/A	0.439	1.79	0.915	0.241
Uranium-235		267	N/A	-0.0754	0.276	0.0435	0.0367
Uranium-238		267	N/A	0.386	1.75	0.950	0.242

[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 within PMJM Habitat

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		5	100	9,690	16,400	14,418	2,813
Arsenic		5	100	5.70	8	6.76	0.820
Barium		5	100	120	243	183	44.7
Beryllium[c]		5	20	0.900	0.900	0.670	0.144
Boron		1	100	2.90	2.90	2.90	N/A
Cadmium		5	20	0.350	0.350	0.400	0.0302
Calcium		5	100	3,700	8,170	6,914	1,825
Chromium[c]		5	100	10.5	18.4	15.3	3.37
Cobalt		5	100	6.40	9.80	8.18	1.27
Copper		5	100	13	20.9	17.9	2.94
Iron		5	100	13,000	18,400	15,320	2,447
Lead		5	100	27.6	41.9	32.6	5.71
Lithium		5	80	12	16.4	12.0	4.49
Magnesium		5	100	2,600	3,340	3,018	368
Manganese		5	100	162	348	272	76.5
Mercury		5	100	0.0300	0.0800	0.0640	0.0195
Molybdenum		5	20	0.620	0.620	0.704	0.0532
Nickel		5	100	12	14.8	13.8	1.12
Nitrate / Nitrite		4	100	1.67	5.99	3.51	1.89
Potassium		5	60	2,750	3,000	2,111	1,077
Silica[c]		1	100	730	730	730	N/A
Strontium		5	100	32	64.5	53.5	12.7
Titanium[c]		1	100	68	68	68	N/A
Vanadium		5	100	30	42.1	37.5	5.59
Zinc		5	100	54	87.4	76.5	13.9
Radionuclides (pCi/g)[d]							
Americium-241		5	N/A	0.0127	0.0500	0.0325	0.0137
Cesium-134		4	N/A	0.0910	0.120	0.102	0.0126
Cesium-137		4	N/A	0.490	1.10	0.838	0.254
Gross Alpha		4	N/A	13	24	16.8	4.92
Gross Beta		4	N/A	23	35	29.3	5.06
Plutonium-239/240		6	N/A	0.0266	0.130	0.0918	0.0404
Radium-226		4	N/A	0.970	1.30	1.14	0.141
Radium-228		4	N/A	1.70	2.20	1.93	0.222
Strontium-89/90		4	N/A	0.160	0.380	0.280	0.0909
Uranium-233/234		5	N/A	0.798	1.40	1.16	0.291
Uranium-235		5	N/A	0.0280	0.0820	0.0460	0.0211
Uranium-238		5	N/A	1.10	1.65	1.43	0.205

[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				288	100	1,730	50,500	9,827	5,621
Antimony[c]	0.28	-	14	248	10.9	0.670	22.3	4.75	3.17
Arsenic	0.44	-	2	289	98.6	0.460	23.8	4.46	2.78
Barium				289	100	25.1	2,970	160	207
Beryllium	0.23	-	1	289	63.7	0.210	2.10	0.657	0.370
Boron	0.39	-	0.39	20	95	1.70	5.80	2.95	1.42
Cadmium	0.049	-	1	277	7.94	0.350	1.20	0.402	0.187
Calcium				288	100	447	191,000	17,210	31,396
Cesium[c]	0.5	-	136	267	22.5	0.650	4.50	26.7	27.2
Chromium	1.2	-	1	289	99.3	1.40	217	13.5	17.4
Cobalt	1.3	-	2	289	96.9	1.40	18.6	6.44	2.96
Copper	4.9	-	12	289	96.2	2.60	1,000	18.9	64.5
Iron				288	100	1,650	46,300	11,649	5,262
Lead	0.45	-	0.45	289	99.7	0.490	990	35.1	114
Lithium	0.8	-	23	282	62.8	1.70	29.2	5.80	3.52
Magnesium				288	100	648	6,090	2,302	815
Manganese				288	100	8.20	915	178	142
Mercury	0.05	-	0.130	289	18.3	0.00740	0.150	0.0451	0.0208
Molybdenum	0.14	-	5	288	16.3	0.200	27.9	1.83	1.94
Nickel	4.7	-	10	289	80.6	4.70	41.5	11.6	5.83
Nitrate / Nitrite	0.55	-	1	110	50	0.550	20,000	184	1,907
Potassium	600	-	1,970	287	75.3	304	3,180	1,178	697
Selenium	0.21	-	3	284	29.6	0.240	4.20	0.369	0.402
Silica[c]				20	100	446	980	702	153
Silicon[c]				115	100	57.6	883	278	151
Silver	0.058	-	2	289	4.15	0.660	1.50	0.551	0.214
Sodium	13	-	127	288	87.2	22	3,000	159	232
Strontium	18.3	-	18	288	99.7	8.60	341	52.1	47.3
Sulfide	9.6	-	28.2	11	9.09	12.5	12.5	10.2	3.56
Thallium	0.21	-	1	279	12.9	0.220	1.50	0.189	0.114
Tin	1.4	-	45	289	12.1	3.60	19.7	6.47	4.16
Titanium				20	100	76	348	144	72.7
Uranium	0.97	-	1.80	20	5	1.60	1.60	0.616	0.259
Vanadium	4.6	-	11	289	99.0	2.10	119	25.7	13.0
Zinc	11	-	11	289	99.7	5.50	1,400	46.3	99.5
Organics (µg/kg)									
2-Butanone	10	-	13,000	159	17.0	3	1,600	886	2,147
2-Hexanone	10	-	6,300	163	1.23	18	19	395	1,011
4-Methyl-2-pentanone	10	-	6,300	165	1.21	1	58	410	1,028
4-Methylphenol	350	-	1,700	38	7.89	72	300	207	111
Acenaphthene	350	-	1,700	39	12.8	42	190	197	114
Acetone	10	-	13,000	172	7.56	7.60	750	828	2,083
Anthracene	350	-	1,700	39	17.9	45	250	195	118
Benzene	5	-	740	173	0.578	1	1	45.8	109
Benzo(a)anthracene	350	-	1,700	39	25.6	44	550	211	138
Benzo(a)pyrene	350	-	1,700	39	15.4	70	460	219	120
Benzo(b)fluoranthene	350	-	1,700	39	15.4	93	550	234	137
Benzo(g,h,i)perylene	350	-	1,700	39	12.8	74	310	208	111
Benzo(k)fluoranthene	350	-	1,700	39	12.8	43	240	202	112
Benzoic Acid	1,800	-	8,700	37	2.70	350	350	1,041	571
bis(2-ethylhexyl)phthalate	350	-	1,700	39	20.5	49	130	186	120
Butylbenzylphthalate	350	-	1,700	39	5.13	74	160	205	108
Chlorobenzene	5	-	740	173	0.578	3	3	45.8	109
Chloroform	5	-	740	174	0.575	2	2	47.4	110
Chrysene	350	-	1,700	39	28.2	43	500	210	135
cis-1,2-Dichloroethene	2.6	-	630	23	8.70	0.890	13	261	120
Dibenz(a,h)anthracene	350	-	1,700	39	2.56	100	100	207	107
Dibenzofuran	350	-	1,700	39	5.13	46	62	202	111
Diethylphthalate	350	-	1,700	39	2.56	84	84	206	108
Dimethylphthalate	350	-	1,700	39	2.56	140	140	208	106
Di-n-butylphthalate	350	-	1,700	39	10.3	51	160	200	114
Ethylbenzene	5	-	740	174	1.72	4	8	47.4	110
Fluoranthene	350	-	1,700	39	33.3	41	1,300	274	258
Fluorene	350	-	1,700	39	7.69	61	130	203	110
Hexachlorobenzene	350	-	1,700	39	2.56	160	160	208	106
Indeno(1,2,3-cd)pyrene	350	-	1,700	39	12.8	82	310	210	110
Methylene Chloride	5	-	3,700	174	16.1	1.60	690	111	337

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]
Monocrotophos		1	100	1,500	1,500	1,500	N/A
Naphthalene	5.1 - 1,700	62	4.84	46	390	225	119
PCB-1254	50 - 180	50	16	18	580	65.0	76.9
PCB-1260	83 - 460	51	1.96	230	230	64.7	43.3
Phenanthrene	350 - 1,700	39	33.3	38	1,000	243	208
Phenol	350 - 1,700	39	2.56	190	190	209	106
Pyrene	350 - 440	39	33.3	57	1,600	278	300
Styrene	5 - 740	174	0.575	1	1	47.4	110
Tetrachloroethene	5 - 740	175	3.43	4	750	55.5	128
Tetraethyl dithiopyrophosphate		1	100	7.70	7.70	7.70	N/A
Toluene	5 - 740	173	78.6	1	7,600	208	643
Trichloroethene	5 - 740	173	2.89	1.60	360	46.2	109
Xylene[d]	5 - 740	175	2.86	2	17	49	112
Radionuclides (pCi/g)[e]							
Americium-241		236	N/A	-0.00300	0.258	0.0108	0.0222
Cesium-134		70	N/A	-0.381	0.110	-0.0409	0.106
Cesium-137		122	N/A	-0.0322	0.957	0.148	0.177
Gross Alpha		246	N/A	0.270	143	14.8	11.2
Gross Beta		256	N/A	3.31	40.3	23.3	5.58
Plutonium-238		10	N/A	-0.00600	0.00200	-9.00E-04	0.00233
Plutonium-239/240		242	N/A	-0.00300	1.32	0.0272	0.0920
Radium-226		13	N/A	0.750	2.28	1.11	0.389
Radium-228		120	N/A	0.690	3.03	1.58	0.336
Strontium-89/90		120	N/A	-0.360	0.500	0.157	0.112
Uranium-233/234		254	N/A	0.251	3.05	0.841	0.309
Uranium-235		254	N/A	-0.0188	0.140	0.0374	0.0279
Uranium-238		254	N/A	0.279	141	1.43	8.80

[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 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	87,000	8.70	500-1,200	2,500	No
Magnesium	9,690	0.969	80-420	65-110	No
Potassium	5,280	0.528	2,000-3,500	N/A	No
Sodium	692	0.0692	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, 2004

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	29,300	Yes	11,047	No	No
Antimony	44.4	348	Yes	11.1	No	No
Arsenic	**2.41**	**13.2**	**Yes**	**5.17**	**Yes**	**Yes**
Barium	2,872	1,120	No	--	--	No
Beryllium	100	5	No	--	--	No
Boron	9,477	10	No	--	--	No
Cadmium	91.4	12.3	No	--	--	No
Cesium	N/A	3.90	UT	--	--	UT
Chromium[c]	28.4	128	Yes	13.5	No	No
Cobalt	122	27.1	No	--	--	No
Copper	4,443	640	No	--	--	No
Iron	33,326	59,600	Yes	13,716	No	No
Lead	1,000	814	No	--	--	No
Lithium	2,222	16.4	No	--	--	No
Manganese	419	1,370	Yes	276	No	No
Mercury	32.9	0.340	No	--	--	No
Molybdenum	555	9.10	No	--	--	No
Nickel	2,222	93.4	No	--	--	No
Nitrate / Nitrite[d]	177,739	45	No	--	--	No
Selenium	555	2.20	No	--	--	No
Silica	N/A	2,000	UT	--	--	UT
Silicon	N/A	643	UT	--	--	UT
Silver	555	64.9	No	--	--	No
Strontium	66,652	320	No	--	--	No
Thallium	7.78	5.80	No	--	--	No
Tin	66,652	72.3	No	--	--	No
Titanium	169,568	310	No	--	--	No
Uranium	333	1.10	No	--	--	No
Vanadium	**111**	**5,300**	**Yes**	**165**	**Yes**	**Yes**
Zinc	33,326	293	No	--	--	No
Organics (µg/kg)						
1,2,4-Trimethylbenzene	132,620	4.60	No	--	--	No
2-Butanone	4.64E+07	13	No	--	--	No
2-Methylnaphthalene	320,574	200	No	--	--	No
4,4'-DDT	10,927	26	No	--	--	No
4-Chloro-3-methylphenol	N/A	67	UT	--	--	UT
Acenaphthene	4.44E+06	800	No	--	--	No
Acenaphthylene	N/A	38	UT	--	--	UT
Acetone	1.00E+08	99	No	--	--	No
Anthracene	2.22E+07	650	No	--	--	No
Benzo(a)anthracene	3,793	1,100	No	--	--	No
Benzo(a)pyrene	379	1,000	Yes	327	No	No
Benzo(b)fluoranthene	3,793	1,400	No	--	--	No
Benzo(g,h,i)perylene	N/A	450	UT	--	--	UT
Benzo(k)fluoranthene	37,927	590	No	--	--	No
Benzoic Acid	3.21E+08	530	No	--	--	No
beta-BHC	1,995	11	No	--	--	No
bis(2-ethylhexyl)phthalate	213,750	5,500	No	--	--	No
Butylbenzylphthalate	1.60E+07	1,400	No	--	--	No
Chrysene	379,269	1,100	No	--	--	No
Dibenz(a,h)anthracene	379	110	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?
Dibenzofuran	222,174	350	No	--	--	No
Diethylphthalate	6.41E+07	93	No	--	--	No
Di-n-butylphthalate	8.01E+06	260	No	--	--	No
Di-n-octylphthalate	3.21E+06	82	No	--	--	No
Fluoranthene	2.96E+06	2,800	No	--	--	No
Fluorene	3.21E+06	680	No	--	--	No
Heptachlor epoxide	329	23	No	--	--	No
Indeno(1,2,3-cd)pyrene	3,793	490	No	--	--	No
Methylene Chloride	271,792	3.30	No	--	--	No
Naphthalene	1.40E+06	690	No	--	--	No
PCB-1254	1,349	3,400	Yes	287	No	No
PCB-1260	1,349	680	No	--	--	No
Pentachlorophenol	17,633	39	No	--	--	No
Phenanthrene	N/A	3,500	UT	--	--	No
Pyrene	2.22E+06	2,600	No	--	--	UT
Tetrachloroethene	6,705	10	No	--	--	No
Toluene	3.09E+06	290	No	--	--	No
Radionuclides (pCi/g)						
Americium-241	7.69	1.15	No	--	--	No
Cesium-134	**0.0800**	**0.167**	**Yes**	**0.0918**	**Yes**	**Yes**
Cesium-137	**0.221**	**2.27**	**Yes**	**0.574**	**Yes**	**Yes**
Gross Alpha	N/A	57.9	UT	--	--	UT
Gross Beta	N/A	53.5	UT	--	--	UT
Plutonium-239/240	9.80	2.31	No	--	--	No
Radium-226	2.69	1.90	No	--	--	No
Radium-228	**0.111**	**2.20**	**Yes**	**1.60**	**Yes**	**Yes**
Strontium-89/90	13.2	2.87	No	--	--	No
Uranium-233/234	25.3	1.79	No	--	--	No
Uranium-235	1.05	0.276	No	--	--	No
Uranium-238	29.3	1.75	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.
N/A = Not available.
UT = Uncertain toxicity; no PRG available (assessed in Section 6.0).
Bold = Analyte retained for further consideration in the next COC selection step.
-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.

Table 2.3

Statistical Distributions and Comparison to Background for NNEU[a]

Analyte	Statistical Distribution Testing Results						Background		
	Background			NNEU					
	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	**73**	**GAMMA**	**92**	**375**	**GAMMA**	**100**	**WRS**	**6.64E-09**	**Yes**
Vanadium	**72**	**NORMAL**	**96**	**375**	**NON-PARAMETRIC**	**100**	**WRS**	**5.98E-09**	**Yes**
Cesium-134	77	NON-PARAMETRIC	100	35	NON-PARAMETRIC	100	WRS	1.000	No
Cesium-137	105	NON-PARAMETRIC	100	215	NON-PARAMETRIC	100	WRS	1.000	No
Radium-228	40	GAMMA	100	56	NORMAL	100	WRS	0.300	No
Subsurface Soil/Subsurface Sediment									
Radium-228	**31**	**GAMMA**	**100**	**122**	**NORMAL**	**100**	**WRS**	**0.0230**	**Yes**

[a] EU data for background comparison do not include data from background locations.

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

WRS = Wilcoxon Rank Sum.

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	191,000	19.1	500-1,200	2,500	No
Magnesium	6,090	0.609	80-420	65-110	No
Potassium	3,180	0.318	2,000-3,500	N/A	No
Sodium	3,000	0.300	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 200, 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	50,500	No	--	--	No
Antimony	511	22.3	No	--	--	No
Arsenic	27.7	23.8	No	--	--	No
Barium	33,033	2,970	No	--	--	No
Beryllium	1,151	2.10	No	--	--	No
Boron	108,980	6.40	No	--	--	No
Cadmium	1,051	1.20	No	--	--	No
Cesium	N/A	4.50	UT	--	--	UT
Chromium[c]	327	217	No	--	--	No
Cobalt	1,401	18.6	No	--	--	No
Copper	51,100	1,000	No	--	--	No
Iron	383,250	46,300	No	--	--	No
Lead	1,000	990	No	--	--	No
Lithium	25,550	29.2	No	--	--	No
Manganese	4,815	915	No	--	--	No
Mercury	379	0.160	No	--	--	No
Molybdenum	6,388	27.9	No	--	--	No
Nickel	25,550	41.5	No	--	--	No
Nitrate / Nitrite[d]	2.04E+06	20,000	No	--	--	No
Selenium	6,388	4.20	No	--	--	No
Silica	N/A	980	UT	--	--	UT
Silicon	N/A	883	UT	--	--	UT
Silver	6,388	1.50	No	--	--	No
Strontium	766,500	341	No	--	--	No
Sulfide	N/A	12.5	UT	--	--	UT
Thallium	89.4	1.50	No	--	--	No
Tin	766,500	19.7	No	--	--	No
Titanium	1.95E+06	348	No	--	--	No
Uranium	3,833	1.60	No	--	--	No
Vanadium	1,278	119	No	--	--	No
Zinc	383,250	1,400	No	--	--	No
Organics (ug/kg)						
2-Butanone	5.33E+08	1,600	No	--	--	No
2-Hexanone	N/A	19	UT	--	--	UT
4-Methyl-2-pentanone	9.57E+08	58	No	--	--	No
4-Methylphenol	4.61E+06	300	No	--	--	No
Acenaphthene	5.10E+07	190	No	--	--	No
Acetone	1.15E+09	750	No	--	--	No
Anthracene	2.55E+08	250	No	--	--	No
Benzene	270,977	1	No	--	--	No
Benzo(a)anthracene	43,616	550	No	--	--	No
Benzo(a)pyrene	4,357	460	No	--	--	No
Benzo(b)fluoranthene	43,616	550	No	--	--	No
Benzo(g,h,i)perylene	N/A	310	UT	--	--	UT
Benzo(k)fluoranthene	436,159	240	No	--	--	No
Benzoic Acid	3.69E+09	350	No	--	--	No
bis(2-ethylhexyl)phthalate	2.46E+06	130	No	--	--	No
Butylbenzylphthalate	1.84E+08	160	No	--	--	No
Chlorobenzene	7.67E+06	3	No	--	--	No
Chloroform	90,270	2	No	--	--	No
Chrysene	4.36E+06	500	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?
cis-1,2-Dichloroethene	1.28E+07	13	No	--	--	No
Dibenz(a,h)anthracene	4,362	100	No	--	--	No
Dibenzofuran	2.56E+06	62	No	--	--	No
Diethylphthalate	7.37E+08	84	No	--	--	No
Dimethylphthalate	9.22E+09	140	No	--	--	No
Di-n-butylphthalate	9.22E+07	160	No	--	--	No
Ethylbenzene	6.19E+07	8	No	--	--	No
Fluoranthene	3.40E+07	1,300	No	--	--	No
Fluorene	3.69E+07	130	No	--	--	No
Hexachlorobenzene	21,508	160	No	--	--	No
Indeno(1,2,3-cd)pyrene	43,616	310	No	--	--	No
Methylene Chloride	3.13E+06	690	No	--	--	No
Monocrotophos	N/A	1,500	UT	--	--	UT
Naphthalene	1.61E+07	390	No	--	--	No
PCB-1254	15,514	580	No	--	--	No
PCB-1260	15,514	230	No	--	--	No
Phenanthrene	N/A	1,000	UT	--	--	UT
Phenol	2.76E+08	190	No	--	--	No
Pyrene	2.55E+07	1,600	No	--	--	No
Styrene	1.59E+08	1	No	--	--	No
Tetrachloroethene	77,111	750	No	--	--	No
Tetraethyl dithiopyrophosphate	460,830	7.70	No	--	--	UT
Toluene	3.56E+07	7,600	No	--	--	No
Trichloroethene	20,354	360	No	--	--	No
Xylene	1.22E+07	17	No	--	--	No
Radionuclides (pCi/g)						
Americium-241	88.4	0.258	No	--	--	No
Cesium-134	0.910	0.110	No	--	--	No
Cesium-137	2.54	0.957	No	--	--	No
Gross Alpha	N/A	143	UT	--	--	UT
Gross Beta	N/A	40.3	UT	--	--	UT
Plutonium-238	68.7	0.002	No	--	--	No
Plutonium-239/240	112	1.32	No	--	--	No
Radium-226	31.0	2.28	No	--	--	No
Radium-228	**1.28**	**3.03**	**Yes**	**1.62**	**Yes**	**Yes**
Strontium-89/90	152	0.500	No	--	--	No
Uranium-233/234	291	3.05	No	--	--	No
Uranium-235	12.1	0.140	No	--	--	No
Uranium-238	337	141	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.

N/A = Not available.

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

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

-- = Screen not performed because analyte was eliminated from further consideration in a previous 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							
Aluminum	Yes	No	--	--	--	--	No
Antimony	Yes	No	--	--	--	--	No
Arsenic	Yes	Yes	Yes	N/A	Yes	No	No
Chromium	Yes	No	--	--	--	--	No
Iron	Yes	No	--	--	--	--	No
Manganese	Yes	No	--	--	--	--	No
Vanadium	**Yes**	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**
Benzo(a)pyrene	Yes	No	--	--	--	--	No
PCB-1254	Yes	No	--	--	--	--	No
Cesium-134	Yes	Yes	Yes	N/A	No	--	No
Cesium-137	Yes	Yes	Yes	N/A	No	--	No
Radium-228	Yes	Yes	Yes	N/A	No	--	No
Subsurface Soil/Subsurface Sediment							
Radium-228	Yes	Yes	Yes	N/A	Yes	No	No

[a] All radionuclide values are considered detects.
-- = Screen not performed because analyte was eliminated from further consideration in a previous COC selection step.
N/A = Not applicable.
Bold = Contaminant of concern

Table 3.1
Exposure Point Concentrations

Analyte	Unit	MDC[a]	UCL Value[b]	UCL Type	Distribution	EPC[c]
Tier 1						
Surface Soil/Surface Sediment						
Vanadium	mg/kg	5,300	165	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	165
Tier 2						
Surface Soil/Surface Sediment						
Vanadium	mg/kg	257.8	56.2	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	56.2

[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.

[b] UCL = upper confidence limit.

[c] The UCL is used as the EPC, unless the UCL exceeds the MDC, then the MDC is used for the EPC.

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	1.3	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	0.5	--	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	1.3	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

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	ETwss	8	hr/day	EPA et al. 2002
Exposure Time Fraction, indoor	ETFi	0.5	--	EPA et al. 2002
Dilution Factor, indoor inhalation	DFi	0.7	--	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

[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).

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	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	3.7	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	2.4	m^3/hr	EPA et al. 2002

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
Air Inhalation Rate - child	IRa_cvss	1.6	m^3/hr	EPA et al. 2002
Exposure Time	Etvss	2.5	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
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).

Table 4.1
Chemical Non-Cancer Reference Doses, Target Organs, and Effects for COCs

Contaminant of Concern	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
Vanadium	7440-62-2	0.001	P	N/A	N/A	N/A	N/A	N/A	Decreased hair cystine	OR

[a] Dermal ABS from EPA 2001
N/A = Not available or not applicable.
P = EPA-NCEA provisional value (EPA 2003).
OR = EPA Region 3 PRGs (EPA 2003), source not cited.

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										
Vanadium	NC	NC	NC	0	--	0.148	NC	NC	0.1	100%
Surface Soil/Surface Sediment Total:				**0**	**0%**				**0.1**	**100%**
Tier 1 WRW Total:				**0**					**0.1**	
Tier 2										
Surface Soil/Surface Sediment										
Vanadium	NC	NC	NC	0	--	0.0506	NC	NC	0.05	100%
Surface Soil/Surface Sediment Total:				**0**	**0%**				**0.05**	**100%**
Tier 2 WRW Total:				**0**					**0.05**	

-- = Exposure route is not complete because no COCs identified or exposure route was identified as insignificant in the CRA Methodology.

NC = Not calculated, cancer or 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					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										
Vanadium	NC	NC	NC	0	--	0.0861	NC	NC	0.1	100%
Surface Soil/Surface Sediment Total:				**0**	**0%**				**0.1**	**100%**
Tier 1 WRV Total:				**0**					**0.1**	
Tier 2										
Surface Soil/Surface Sediment										
Vanadium	NC	NC	NC	0	--	0.0293	NC	NC	0.03	100%
Surface Soil/Surface Sediment Total:				**0**	**0%**				**0.03**	**100%**
Tier 2 WRV Total:				**0**					**0.03**	

-- = Exposure route is not complete because no COCs identified or exposure route was identified as insignificant in the CRA Methodology.

NC = Not calculated, cancer or 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	NC	{No COCs exhibit cancer-causing effects.}	0.1	Vanadium (100%)
Tier 2 EPC				
Surface Soil/Surface Sediment	NC	{No COCs exhibit cancer-causing effects.}	0.05	Vanadium (100%)
Wildlife Refuge Visitor (WRV)				
Tier 1 EPC				
Surface Soil/Surface Sediment	NC	{No COCs exhibit cancer-causing effects.}	0.09	Vanadium (100%)
Tier 2 EPC				
Surface Soil/Surface Sediment	NC	{No COCs exhibit cancer-causing effects.}	0.029	Vanadium (100%)

NC = Not calculated, cancer toxicity criteria were not available.

Table 6.1

Summary of Detected PCOCs without PRGs in Each Medium by Analyte Suite[a]

PCOC	Surface Soil/Surface Sediment	Subsurface Soil/Subsurface Sediment
Inorganics		
Cesium	X	X[b]
Silica	X	X[b]
Silicon	X	X[b]
Sulfide	N/A	X
Organics		
2-Hexanone	N/A	X
4-Chloro-3-methylphenol	X	N/A
Acenaphthylene	X	N/A
Benzo(g,h,i)perylene	X	X
Monocrotophos	N/A	X
Phenanthrene	X	X
Radionuclides		
Gross Alpha	X	X
Gross Beta	X	X

[a] Does not include essential nutrients. Essential nutrients without PRGs were evaluated by comparing estimated intakes to recommended intakes.

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

X = 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 NNEU

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	29,300	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 Plants	Yes
Antimony	348	5	Yes	78	Yes	N/A	N/A	N/A	N/A	N/A	N/A	9.89	Yes	0.905	Yes	18.7	Yes	57.6	Yes	138	Yes	13.2	Yes	3.85	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
Arsenic	13.2	10	Yes	60	No	20	No	164	No	1,030	No	2.57	Yes	51.4	No	9.35	Yes	13	Yes	709	No	341	No	293	No	N/A	N/A	Deer Mouse Herbivore	Yes
Barium	1,120	500	Yes	330	Yes	159	Yes	357	Yes	1,320	No	930	Yes	4,430	No	3,220	No	4,760	No	24,900	No	19,800	No	18,400	No	N/A	N/A	Mourning Dove Herbivore	Yes
Beryllium	5	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	7.9	0.5	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 Plants	Yes
Cadmium	12.3	32	No	140	No	28.1	No	0.705	Yes	15	No	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	87,000	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
Cesium	3.20	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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]	128	1	Yes	0.4	Yes	24.6	Yes	1.34	Yes	14	Yes	281	No	15.9	Yes	703	No	1,460	No	4,170	No	250	No	68.5	Yes	N/A	N/A	Terrestrial Invertebrates	Yes
Cobalt	27.1	13	Yes	N/A	N/A	278	No	87	No	440	No	1,480	No	363	No	2,460	No	7,900	No	3,780	No	2,490	No	1,520	No	N/A	N/A	Terrestrial Plants	Yes
Copper	640	100	Yes	50	Yes	28.9	Yes	8.25	Yes	164	Yes	295	Yes	605	Yes	838	No	4,120	No	5,460	No	3,000	No	4,640	No	N/A	N/A	Mourning Dove Insectivore	Yes
Iron	59,600	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
Lead	814	110	Yes	1,700	No	49.9	Yes	12.1	Yes	95.8	Yes	1,340	No	242	Yes	1,850	No	97,800	No	8,930	No	3,070	No	1,390	No	N/A	N/A	Mourning Dove Insectivore	Yes
Lithium	16.4	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	Terrestrial Plants	Yes
Magnesium	9,690	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	1,370	500	Yes	N/A	N/A	1,030	Yes	2,630	No	9,920	No	486	Yes	4,080	No	1519	No	2,510	No	14,100	No	10,900	No	19,100	No	N/A	N/A	Deer Mouse Herbivore	Yes
Mercury	0.340	0.3	Yes	0.1	Yes	0.197	Yes	0.0001	Yes	1.57	No	0.439	No	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	9.1	2	Yes	N/A	N/A	44.4	No	6.97	Yes	76.7	No	8.68	Yes	1.9	Yes	27.1	No	44.3	No	275	No	28.9	No	8.18	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
Nickel	93.4	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	Yes	6.02	Yes	1.86	Yes	N/A	N/A	Deer Mouse Insectivore	Yes
Nitrate / Nitrite	45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,480	No	7,650	No	16,200	No	22,700	No	32,900	No	32,200	No	32,900	No	N/A	N/A	Deer Mouse Herbivore	No
Potassium	5,280	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	2.2	1	Yes	70	No	1.61	Yes	1	Yes	8.48	No	0.872	Yes	0.754	Yes	2.8	No	3.82	No	32.5	No	12.2	No	5.39	No	N/A	N/A	Deer Mouse Insectivore	Yes
Silica	1,100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	643	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	64.9	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 Plants	Yes
Sodium	692	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	80.6	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	5.8	1	Yes	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 Plants	Yes
Tin	72.3	50	Yes	N/A	N/A	26.1	Yes	2.9	Yes	18.9	Yes	45	Yes	3.77	Yes	80.6	No	242	No	**70**	Yes	36.1	Yes	16.2	Yes	N/A	N/A	Mourning Dove Insectivore	Yes
Titanium	310	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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
Vanadium	5,300	2	Yes	N/A	N/A	503	Yes	274	Yes	1,510	Yes	63.7	Yes	29.9	Yes	83.5	Yes	358	Yes	341	Yes	164	Yes	121	Yes	N/A	N/A	Terrestrial Plants	Yes
Zinc	293	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	No	N/A	N/A	Mourning Dove Insectivore	Yes
Organics (µg/kg)																														
2-Methylnaphthalene	200	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	No	319,000	No	471,000	No	12,300	No	12,200	No	12,000	No	N/A	N/A	Deer Mouse Insectivore	No
4,4'-DDT	26	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-Chloro-3-methylphenol	67	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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
Acenaphthene	800	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	N/A	N/A	Terrestrial Plants	No
Acenaphthylene	38	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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
Anthracene	650	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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)anthracene	1,100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	1,000	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	No	2,970	No	2,760	No	N/A	N/A	Deer Mouse Insectivore	Yes
Benzo(b)fluoranthene	1,400	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	450	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	590	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	530	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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
beta-BHC	11	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8,070	Yes	207	Yes	27,400	No	41,000	No	938	Yes	927	Yes	898	Yes	N/A	N/A	Deer Mouse Insectivore	No
bis(2-ethylhexyl)phthalate	5,500	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	1,400	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
Chrysene	1,100	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	260	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	82	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	110	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	350	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
Diethylphthalte	93	100	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6.27E+07	No	2.53E+06	No	2.21E+08	No	3.18E+08	No	1.08E+07	No	1.08E+07	No	1.10E+07	No	N/A	N/A	Deer Mouse Insectivore	No
Fluoranthene	2,800	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	680	200,000	No	30,000	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 Invertebrates	No
Heptachlor epoxide	23	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	490	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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
Methylene Chloride	1.5	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	690	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	No	1.60E+07	No	5.57E+07	No	104,000	No	107,000	No	118,000	No	N/A	N/A	Deer Mouse Insectivore	No
Total PCBs	3,400	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	5190	No	3,320	Yes	3,680	No	N/A	N/A	Mourning Dove Insectivore	Yes
Pentachlorophenol	39	3,000	No	6,000	No	N/A	N/A	N/A	N/A	N/A	N/A	5,500	No	122	No	184	No	27,900	No	562	No	553	No	528	No	N/A	N/A	Deer Mouse Insectivore	No
Phenanthrene	3,500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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 NNEU

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	
Pyrene	2,600	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
Tetrachloroethene	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	290	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
Radionuclides (pCi/g)																													
Americium-241	1.147	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3890	No	Terrestrial Receptors	No
Cesium-134	0.12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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-137	2.27	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	57.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	53.5	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	N/A	N/A	N/A	UT
Plutonium-239/240	2.307	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6110	No	Terrestrial Receptors	No
Radium-226	1.895	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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	2.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	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
Stontium-89/90	2.87	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	22.5	No	Terrestrial Receptors	No
Uranium-233/234	1.786	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4980	No	Terrestrial Receptors	No
Uranium-235	0.276	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2770	No	Terrestrial Receptors	No
Uranium-238	1.749	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1580	No	Terrestrial Receptors	No

[a] Radionuclide ESLs are not receptor-specific. They are considered protective of all terrestrial ecological species.
[b] ESLs for chromium were developed based on available toxicity data and are based on chromium III (birds) and chromium VI (plants, invertebrates, and mammals).
N/A = Indicates no ESL 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 NNEU

Analyte	Terrestrial Plant Exceedance?	Terrestial Invertebrate Exceedance?	Terrestrial Vertebrate Exceedance?
Inorganics			
Aluminum	**Yes**	UT	UT
Antimony	**Yes**	**Yes**	**Yes**
Arsenic	**Yes**	No	**Yes**
Barium	**Yes**	**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	**Yes**	UT	No
Tin	**Yes**	UT	**Yes**
Titanium	UT	UT	UT
Vanadium	**Yes**	UT	**Yes**
Zinc	**Yes**	**Yes**	**Yes**
Organics			
2-Methylnaphthalene	UT	UT	No
4,4'-DDT	UT	UT	**Yes**
4-Chloro-3-methyphenol	UT	UT	UT
Acenaphthene	No	UT	UT
Acenaphthylene	UT	UT	UT
Anthracene	UT	UT	UT
Benzo(a)anthracene	UT	UT	UT
Benzo(a)pyrene	UT	UT	**Yes**

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

Analyte	Terrestrial Plant Exceedance?	Terrestial Invertebrate Exceedance?	Terrestrial Vertebrate Exceedance?
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
beta-BHC	UT	UT	No
bis(2-ethylhexyl)phthalate	UT	UT	**Yes**
Butylbenzylphthalate	UT	UT	No
Chrysene	UT	UT	UT
delta-BHC	UT	UT	No
Di-n-butylphthalate	No	UT	**Yes**
Di-n-octylphthalate	UT	UT	No
Dibenz(a,h)anthracene	UT	UT	UT
Dibenzofuran	UT	UT	No
Diethylphthalate	UT	UT	No
Fluoranthene	UT	UT	UT
Fluorene	No	No	UT
Heptachlor epoxide	UT	UT	No
Indeno(1,2,3-cd)pyrene	UT	UT	UT
Methylene Chloride	UT	UT	No
Naphthalene	UT	UT	No
Total PCBs	No	UT	**Yes**
Pentachlorophenol	No	No	No
Phenanthrene	UT	UT	UT
Pyrene	UT	UT	UT
Tetrachloroethene	UT	UT	UT
Toluene	No	UT	No
Radionuclides			
Americium-241	UT	UT	No
Cesium-134	UT	UT	UT
Cesium-137	UT	UT	No
Gross Alpha	UT	UT	UT
Gross Beta	UT	UT	UT
Plutonium-239/240	UT	UT	No
Radium-226	UT	UT	No
Radium-228	UT	UT	No
Strontium-89/90	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).
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 NNEU

Analyte	MDC	PMJM NOAEL ESL	MDC> PMJM ESL?
Inorganics (mg/kg)			
Aluminum	16,400	N/A	UT
Arsenic	**8**	**2.21**	**Yes**
Barium	243	743	No
Beryllium	0.9	8.16	No
Boron	2.9	52.7	No
Cadmium	0.35	1.75	No
Calcium	8,170	N/A	UT
Chromium[a]	18.4	19.3	No
Cobalt	9.8	340	No
Copper	20.9	95.0	No
Iron	18,400	N/A	UT
Lead	41.9	220	No
Lithium	16.4	519	No
Magnesium	3,340	N/A	UT
Manganese	348	388	No
Mercury	**0.08**	**0.052**	**Yes**
Molybdenum	0.62	1.84	No
Nickel	**14.8**	**0.51**	**Yes**
Nitrate / Nitrite	5.99	2,910	No
Potassium	3,000	N/A	UT
Silica	730	N/A	UT
Strontium	64.5	833	No
Titanium	68	N/A	UT
Vanadium	**42.1**	**21.6**	**Yes**
Zinc	**87.4**	**6.41**	**Yes**
Radionuclides (pCi/kg)			
Americium-241	0.05	3,890	No
Cesium-134	0.12	N/A	UT
Cesium-137	1.1	20.8	No
Gross Alpha	24	N/A	UT
Gross Beta	35	N/A	UT
Plutonium-239/240	0.13	6,110	No
Radium-226	1.3	50.6	No
Radium-228	2.2	43.9	No
Strontium-89/90	0.38	22.5	No
Uranium-233/234	1.4	4,980	No
Uranium-235	0.082	2,770	No
Uranium-238	1.65	1,580	No

[a] Chromium ESL is based on Chromium (VI).
UT = Uncertain toxicity; no ESLs available (assessed in Section 10).
N/A = No ESL available for the ECOI/receptor pair.
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 NNEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			NNEU					
	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	356	NON-PARAMETRIC	100	WRS	0.334	No
Antimony	**20**	**NON-PARAMETRIC**	**0**	**341**	**NON-PARAMETRIC**	**19**	**N/A**	**N/A**	**Yes**[a]
Arsenic	20	NORMAL	100	356	GAMMA	100	WRS	0.993	No
Barium	**20**	**NORMAL**	**100**	**356**	**LOGNORMAL**	**100**	**WRS**	**0.018**	**Yes**
Boron	**N/A**	**N/A**	**N/A**	**36**	**NORMAL**	**100**	**N/A**	**N/A**	**Yes**[a]
Cadmium	20	NON-PARAMETRIC	65	356	NON-PARAMETRIC	26	WRS	0.984	No
Chromium	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.168	No
Cobalt	20	NORMAL	100	356	NON-PARAMETRIC	97	WRS	0.930	No
Copper	**20**	**NON-PARAMETRIC**	**100**	**356**	**NON-PARAMETRIC**	**91**	**WRS**	**0.031**	**Yes**
Lead	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.996	No
Lithium	20	NORMAL	100	190	GAMMA	80	WRS	0.836	No
Manganese	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.792	No
Mercury	**20**	**NON-PARAMETRIC**	**40**	**355**	**NON-PARAMETRIC**	**17**	**N/A**	**N/A**	**Yes**[a]
Molybdenum	**20**	**NORMAL**	**0**	**190**	**NON-PARAMETRIC**	**21**	**N/A**	**N/A**	**Yes**[a]
Nickel	**20**	**NORMAL**	**100**	**356**	**NON-PARAMETRIC**	**97**	**WRS**	**0.048**	**Yes**
Selenium	20	NON-PARAMETRIC	60	344	NON-PARAMETRIC	25	WRS	1.00	No
Silver	**20**	**NORMAL**	**0**	**356**	**NON-PARAMETRIC**	**36**	**N/A**	**N/A**	**Yes**[a]
Thallium	**14**	**NORMAL**	**0**	**352**	**NON-PARAMETRIC**	**6**	**N/A**	**N/A**	**Yes**[a]
Tin	**20**	**NORMAL**	**0**	**190**	**NON-PARAMETRIC**	**13**	**N/A**	**N/A**	**Yes**[a]
Vanadium	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.123	No
Zinc	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.404	No

[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.
Test: WRS = Wilcoxon Rank Sum
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 NNEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			NNEU					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Inorganics									
Arsenic	20	NORMAL	100	5	NORMAL	100	t-Test N	0.236	No
Mercury	20	NON-PARAMETRIC	40	5	NON-PARAMETRIC	100	WRS	0.555	No
Nickel	**20**	**NORMAL**	**100**	**5**	**NORMAL**	**100**	**t-Test N**	**9.78E-04**	**Yes**
Vanadium	**20**	**NORMAL**	**100**	**5**	**NORMAL**	**100**	**t-Test N**	**0.007**	**Yes**
Zinc	**20**	**NORMAL**	**100**	**5**	**NORMAL**	**100**	**t-Test N**	**1.43E-04**	**Yes**

Test: WRS = Wilcoxon Rank Sum, t-Test_N = Student's t-test using normal data
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table 7.6
Statistical Concentrations in Surface Soil in the NNEU[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	341	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	5.16	3.00	4.95	14.4	9.67	10.1	348
Barium	356	95% H-UCL	LOGNORMAL	141	122	173	280	148	258	1,120
Boron	36.0	95% Student's-t UCL	NORMAL	3.72	3.40	4.33	6.13	4.13	6.21	7.90
Copper	356	95% Student's-t UCL	NON-PARAMETRIC	19.3	14.6	17.0	37.9	22.6	28.1	640
Mercury	355	95% Student's-t UCL	NON-PARAMETRIC	0.048	0.048	0.056	0.070	0.050	0.070	0.340
Molybdenum	190	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	1.14	0.750	1.80	2.33	1.47	2.25	9.10
Nickel	356	95% Student's-t UCL	NON-PARAMETRIC	11.5	10.8	13.7	17.2	12.2	16.6	93.4
Silver	356	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	0.882	0.600	0.933	1.80	1.68	1.60	64.9
Thallium	352	95% Student's-t UCL	NON-PARAMETRIC	0.277	0.215	0.355	0.440	0.306	0.410	5.80
Tin	190	97.5% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	4.54	1.75	6.75	11.2	8.44	10.9	72.3
Organics (µg/kg)										
Benzo(a)pyrene	87	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	217	175	190	640	323	700	1,650
bis(2-ethylhexyl)phthalate	87	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	303	175	188	971	619	980	5,500
Di-n-butylphthalate	87	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	197	175	183	244	283	260	1,650
Total PCBs	116	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	224	170	170	666	396	580	3,490

[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 NNEU

Analyte	Small Home Range Receptors			Large Home Range Receptors		
	EPC (UTL)	Limiting ESL[a]	EPC>ESL?	EPC (UCL)	Limiting ESL[b]	EPC>ESL?
Inorganics (mg/kg)						
Antimony	10.1	0.900	**Yes**	9.67	3.85	**Yes**
Barium	258	222	**Yes**	148	4,766	No
Boron	6.21	0.500	**Yes**	4.13	314	No
Copper	28.1	8.25	**Yes**	22.6	3,000	No
Mercury	0.070	1.00E-04	**Yes**	0.050	7.56	No
Molybdenum	2.25	1.90	**Yes**	1.47	8.18	No
Nickel	16.6	0.430	**Yes**	12.2	1.86	**Yes**
Silver	1.60	2.00	No	1.68	N/A	N/A
Thallium	0.410	1.00	No	0.306	31.0	No
Tin	10.9	2.90	**Yes**	8.44	16.0	No
Organics (µg/kg)						
Benzo(a)pyrene	700	3,160	No	323	13,800	No
bis(2-ethylhexyl)phthalate	980	137	**Yes**	619	34,967	No
Di-n-butylphthalate	260	15.9	**Yes**	283	1.22E+06	No
Total PCBs	580	42.3	**Yes**	396	1,180	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 NNEU

Analyte	Small Home Range Receptor UTL	Receptor-Specific ESLs[a]							
		Terrestrial Invertebrate	Terrestrial Plant	American Kestrel	Mourning Dove (herbivore)	Mourning Dove (insectivore)	Deer Mouse (herbivore)	Deer Mouse (Insectivore)	Prairie Dog
Inorganics (mg/kg)									
Antimony	10.1	78.0	**5.00**	N/A	N/A	N/A	**10.0**	**0.900**	19.0
Barium	258	330	500	1,860	**222**	506	930	4,427	3,224
Boron	6.21	N/A	**0.500**	167	30.0	115	62.0	422	237
Copper	28.1	50.0	100	164	**29.0**	**8.25**	295	605	838
Mercury	0.070	0.100	0.300	1.57	0.200	**0.0001**	0.440	0.180	3.15
Molybdenum	2.25	N/A	**2.00**	77.0	44.0	6.97	8.68	**1.90**	27.0
Nickel	16.6	200	30.0	**13.0**	44.0	**1.24**	**16.0**	**0.430**	38.0
Tin	10.9	N/A	50.0	19.0	26.0	**2.90**	45.0	**3.77**	81.0
Organics (µg/kg)									
bis(2-ethylhexyl)phthalate	980	N/A	N/A	**398**	19,547	**137**	960,345	8,071	2.76E+06
Di-n-butylphthalate	260	N/A	200,000	**41.5**	989	**15.9**	1.21E+07	281,000	4.06E+07
Total PCBs	580	N/A	40,000	**42.3**	1,140	**172**	11,900	1,240	38,000

[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 NNEU

Analyte	Large Home Range Receptor UCL	Receptor-Specific ESLs[a]			
		Mule Deer	Coyote (carnivore)	Coyote (generalist)	Coyote (insectivore)
Inorganics (mg/kg)					
Antimony	9.67	57.6	138	13.2	**3.85**
Nickel	12.2	124	90.9	**6.02**	**1.86**

[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 NNEU

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	--
Antimony	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Terrestrial plant** **Deer mouse (herbivore)** **Deer mouse (insectivore)** **Coyote (insectivore)**
Arsenic	Yes	Yes	No	--	--	No	--
Barium	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Mourning dove (herbivore)**
Beryllium	Yes	Yes	No	--	--	No	--
Boron	Yes	Yes	N/A	Yes	No	No	--
Cadmium	Yes	Yes	No	--	--	No	--
Calcium	UT	--	--	--	--	No	--
Cesium	UT	--	--	--	--	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	UT	--	--	--	--	No	--
Lead	Yes	Yes	No	--	--	No	--
Lithium	Yes	Yes	No	--	--	No	--
Magnesium	UT	--	--	--	--	No	--
Manganese	Yes	Yes	No	--	--	No	--
Mercury	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Mourning dove (insectivore)**
Molybdenum	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Terrestrial plant** **Deer mouse (insectivore)**
Nickel	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**American kestrel** **Mourning dove (insectivore)** **Deer mouse (herbivore)** **Deer mouse (insectivore)** **Coyote (generalist)** **Coyote (insectivore)**
Nitrate / Nitrite	No	--	--	--	--	No	--
Potassium	UT	--	--	--	--	No	--
Selenium	Yes	Yes	No	--	--	No	--
Silica	UT	--	--	--	--	No	--

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

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
Silicon	UT	--	--	--	--	No	--
Silver	Yes	Yes	N/A	No	--	No	--
Sodium	UT	--	--	--	--	No	--
Strontium	No	--	--	--	--	No	--
Thallium	Yes	Yes	N/A	No	--	No	--
Tin	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**Mourning dove (insectivore)** **Deer mouse (insectivore)**
Titanium	UT	--	--	--	--	No	--
Vanadium	Yes	Yes	No	--	--	No	--
Zinc	Yes	Yes	No	--	--	No	--
Organics							
2-Methylnaphthalene	No	--	--	--	--	No	--
4,4'-DDT	Yes	No	--	--	--	No	--
4-Chloro-3-methylphenol	UT	--	--	--	--	No	--
Acenaphthene	No	--	--	--	--	No	--
Acenaphthylene	UT	--	--	--	--	No	--
Anthracene	UT	--	--	--	--	No	--
Benzo(a)anthracene	UT	--	--	--	--	No	--
Benzo(a)pyrene	Yes	Yes	N/A	No	--	No	--
Benzo(b)fluoranthene	UT	--	--	--	--	No	--
Benzo(g,h,i)perylene	UT	--	--	--	--	No	--
Benzo(k)fluoranthene	UT	--	--	--	--	No	--
Benzoic Acid	UT	--	--	--	--	No	--
beta-BHC	No	--	--	--	--	No	--
bis(2-ethylhexyl)phthalate	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel** **Mourning dove (insectivore)**
Butylbenzylphthalate	No	--	--	--	--	No	--
Chrysene	UT	--	--	--	--	No	--
delta-BHC	No	--	--	--	--	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	UT	--	--	--	--	No	--
Dibenzofuran	No	--	--	--	--	No	--
Diethylphthalate	No	--	--	--	--	No	--

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

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
Fluoranthene	UT	--	--	--	--	No	--
Fluorene	No	--	--	--	--	No	--
Heptachlor epoxide	No	--	--	--	--	No	--
Indeno(1,2,3-cd)pyrene	UT	--	--	--	--	No	--
Methylene Chloride	No	--	--	--	--	No	--
Naphthalene	No	--	--	--	--	No	--
Total PCBs	**Yes**	**Yes**	**N/A**	**Yes**	**Yes**	**Yes**	**American kestrel** **Mourning dove (insectivore)**
Pentachlorophenol	No	--	--	--	--	No	--
Phenanthrene	UT	--	--	--	--	No	--
Pyrene	UT	--	--	--	--	No	--
Tetrachloroethene	UT	--	--	--	--	No	--
Toluene	No	--	--	--	--	No	--
Radionuclides							
Americium-241	No	--	--	--	--	No	--
Cesium-134	UT	--	--	--	--	No	--
Cesium-137	No	--	--	--	--	No	--
Gross Alpha	UT	--	--	--	--	No	--
Gross Beta	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 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 NNEU

Analyte	Exceed PMJM NOAEL ESL?	Exceeds Background?	Professional Judgment - Retain?	ECOPC?
Inorganics				
Aluminum	UT	--	--	No
Arsenic	Yes	No	--	No
Barium	No	--	--	No
Beryllium	No	--	--	No
Boron	No	--	--	No
Cadmium	No	--	--	No
Calcium	UT	--	--	No
Chromium	No	--	--	No
Cobalt	No	--	--	No
Copper	No	--	--	No
Iron	UT	--	--	No
Lead	No	--	--	No
Lithium	No	--	--	No
Magnesium	UT	--	--	No
Manganese	No	--	--	No
Mercury	Yes	No	--	No
Molybdenum	No	--	--	No
Nickel	**Yes**	**Yes**	**Yes**	**Yes**
Nitrate / Nitrite	No	--	--	No
Potassium	UT	--	--	No
Silica	UT	--	--	No
Silver	UT	--	--	No
Sodium	UT	--	--	No
Strontium	No	--	--	No
Thallium	No	--	--	No
Tin	No	--	--	No
Titanium	UT	--	--	No
Vanadium	**Yes**	**Yes**	**Yes**	**Yes**
Zinc	**Yes**	**Yes**	**Yes**	**Yes**
Radionuclides				
Americium-241	No	--	--	No
Cesium-134	UT	--	--	No
Cesium-137	No	--	--	No
Gross Alpha	UT	--	--	No
Gross Beta	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

-- = Screen not performed because ECOI was eliminated from further consideration in a previous step.
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 NNEU

Analyte	MDC	Prairie Dog NOAEL ESL	MDC > ESL?
Inorganics (mg/kg)			
Aluminum	50,500	N/A	UT
Antimony	22.3	18.7	**Yes**
Arsenic	23.8	9.35	**Yes**
Barium	2,970	3,220	No
Beryllium	2.1	211	No
Boron	5.8	237	No
Cadmium	1.2	198	No
Calcium	191,000	N/A	UT
Cesium	4.5	N/A	UT
Chromium[a]	217	703	No
Cobalt	18.6	2,460	No
Copper	1,000	838	**Yes**
Iron	46,300	N/A	UT
Lead	990	1,850	No
Lithium	29.2	3,180	No
Magnesium	6,090	N/A	UT
Manganese	915	1519	No
Mercury	0.15	3.15	No
Molybdenum	27.9	27.1	**Yes**
Nickel	41.5	38.3	**Yes**
Nitrate/Nitrite	20,000	16,200	**Yes**
Potassium	3,180	N/A	UT
Selenium	4.20	2.80	**Yes**
Silica	980	N/A	UT
Silicon	883	N/A	UT
Silver	1.50	N/A	UT
Sodium	3,000	N/A	UT
Strontium	341	3,520	No
Sulfide	12.5	N/A	UT
Thallium	1.50	204	No
Tin	19.7	80.6	No
Titanium	348	N/A	UT
Uranium	1.60	1,230	No
Vanadium	119	83.5	**Yes**
Zinc	1,400	1,170	**Yes**
Organics (µg/kg)			
2-Butanone	1,600	N/A	UT
2-Hexanone	19	N/A	UT
4-Methyl-2-pentanone	58	859,000	No
4-Methylphenol	300	N/A	UT
Acenaphthene	190	N/A	UT
Acetone	750	248,000	No
Anthracene	250	N/A	UT
Benzene	1	1.10E+06	No
Benzo(a)anthracene	550	N/A	UT
Benzo(a)pyrene	460	503,000	No
Benzo(b)fluoranthene	550	N/A	UT
Benzo(g,h,i)perylene	310	N/A	UT
Benzo(k)fluoranthene	240	N/A	UT

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

Analyte	MDC	Prairie Dog NOAEL ESL	MDC > ESL?
Benzoic Acid	350	N/A	UT
bis(2-ethylhexyl)phthalate	130	2.76E+06	No
Butylbenzylphthalate	160	3.37E+06	No
Chlorobenzene	3	414,000	No
Chloroform	2	560,000	No
Chrysene	500	N/A	UT
cis-1,2-Dichloroethene	13	133,000	No
Di-n-butylphthalate	160	4.06E+07	No
Dibenz(a,h)anthracene	100	N/A	UT
Dibenzofuran	62	2.44E+06	No
Diethylphthalate	84	2.21E+08	No
Dimethylphthalate	140	1.35E+07	No
Ethylbenzene	8	N/A	UT
Fluoranthene	1,300	N/A	UT
Fluorene	130	N/A	UT
Hexachlorobenzene	160	190,000	No
Indeno(1,2,3-cd)pyrene	310	N/A	UT
Methylene Chloride	690	210,000	No
Monocrotophos	1,500	N/A	UT
Naphthalene	390	1.60E+07	No
PCB-1254	580	38,000	No
PCB-1260	230	38,000	No
Phenanthrene	1,000	N/A	UT
Phenol	190	1.49E+06	No
Pyrene	1,600	N/A	UT
Styrene	1	1.53E+06	No
Tetrachloroethane	750	N/A	UT
Tetraethyl dithiopyrophosphate	7.7	N/A	UT
Toluene	7,600	1.22E+06	No
Trichloroethene	360	32,400	No
Xylene	17	112,000	No
Radionuclides (pCi/g)			
Americium-241	0.258	3,890	No
Cesium-134	0.11	N/A	UT
Cesium-137	0.957	20.8	No
Gross Alpha	143	N/A	UT
Gross Beta	40.27	N/A	UT
Plutonium-238	0.002	N/A	UT
Plutonium-239/240	1.315	6,110	No
Radium-226	2.277	50.6	No
Radium-228	3.033	43.9	No
Strontium-89/90	0.5	22.5	No
Uranium-233/234	3.05	4,980	No
Uranium-235	0.14	2,770	No
Uranium-238	141	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 NNEU

Analyte	Statistical Distribution Testing Results						Background Comparison Test		
	Background			NNEU					
	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)	Test	1 - p	Retain as ECOI?
Antimony	**28**	**NON-PARAMETRIC**	**7.0**	**248**	**NON-PARAMETRIC**	**11**	**N/A**	**N/A**	**Yes[a]**
Arsenic	45	NON-PARAMETRIC	93.0	289	NON-PARAMETRIC	99	WRS	0.863	No
Copper	45	NORMAL	96.0	289	NON-PARAMETRIC	96	WRS	0.300	No
Molybdenum	**45**	**NON-PARAMETRIC**	**67.0**	**288**	**NON-PARAMETRIC**	**16**	**N/A**	**N/A**	**Yes[a]**
Nickel	44	GAMMA	100.0	289	NON-PARAMETRIC	81	WRS	1.000	No
Nitrate/Nitrite	44	NON-PARAMETRIC	61.0	110	NON-PARAMETRIC	50	WRS	0.984	No
Selenium	**38**	**LOGNORMAL**	**0.0**	**284**	**NON-PARAMETRIC**	**30**	**N/A**	**N/A**	**Yes[a]**
Vanadium	45	NORMAL	98.0	289	NON-PARAMETRIC	99	WRS	1.000	No
Zinc	44	NORMAL	100	289	NON-PARAMETRIC	100	WRS	0.504	No

[a] Statistical comparisons to background cannot be performed. The analyte is retained as an ECOI for further evaluation.
Test: WRS = Wilcoxon Rank Sum
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 NNEU

Analyte	Number of Samples	UCL Recommended by ProUCL	Distribution Recommended by ProUCL	Mean	Median	75^{th} Percentile	95^{th} Percentile	UCL	UTL	MDC
Inorganics (mg/kg)										
Antimony	248	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	4.75	4.35	6.31	7.02	5.63	6.85	22.3
Molybdenum	288	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	1.83	1.80	2.2	3.17	2.32	2.60	27.9
Selenium	284	95% Chebyshev (Mean, Sd) UCL	NON-PARAMETRIC	0.37	0.23	0.41	1.14	0.473	0.83	4.2

[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 NNEU

Analyte	Burrowing Receptor		
	EPC (UTL)	tESL[a]	EPC>ESL?
Inorganics (mg/kg)			
Antimony	6.85	18.7	No
Molybdenum	2.60	27.1	No
Selenium	0.83	2.8	No

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

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

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	No	--	--	--	--	No
Boron	No	--	--	--	--	No
Cadmium	No	--	--	--	--	No
Calcium	UT	--	--	--	--	No
Cesium	UT	--	--	--	--	No
Chromium	No	--	--	--	--	No
Cobalt	No	--	--	--	--	No
Copper	Yes	Yes	No	--	--	No
Iron	UT	--	--	--	--	No
Lead	No	--	--	--	--	No
Lithium	No	--	--	--	--	No
Magnesium	UT	--	--	--	--	No
Manganese	Yes	Yes	No	--	--	No
Mercury	No	--	--	--	--	No
Molybdenum	Yes	Yes	N/A	No	--	No
Nickel	Yes	Yes	No	--	--	No
Nitrate/Nitrite	Yes	Yes	No	--	--	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
Sulfide	UT	--	--	--	--	No
Thallium	No	--	--	--	--	No
Tin	No	--	--	--	--	No
Titanium	UT	--	--	--	--	No
Uranium	No	--	--	--	--	No
Vanadium	Yes	Yes	No	--	--	No
Zinc	Yes	Yes	No	--	--	No
Organics						

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

Analyte	Exceed Prairie Dog NOAEL ESL ?	Frequency of Detection >5%?	Exceeds Background?[a]	Upper Bound EPC > Limiting ESL?	Professional Judgment - Retain?	Retain as ECOPC?
2-Butanone	UT	--	--	--	--	No
2-Hexanone	UT	--	--	--	--	No
4-Methyl-2-pentanone	No	--	--	--	--	No
4-Methylphenol	UT	--	--	--	--	No
Acenaphthene	UT	--	--	--	--	No
Acetone	No	--	--	--	--	No
Anthracene	UT	--	--	--	--	No
Benzene	No	--	--	--	--	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
Benzoic Acid	UT	--	--	--	--	No
bis(2-ethylhexyl)phthalate	No	--	--	--	--	No
Butylbenzylphthalate	No	--	--	--	--	No
Chlorobenzene	No	--	--	--	--	No
Chloroform	No	--	--	--	--	No
Chrysene	UT	--	--	--	--	No
cis-1,2-Dichloroethene	No	--	--	--	--	No
Di-n-butylphthalate	No	--	--	--	--	No
Dibenz(a,h)anthracene	UT	--	--	--	--	No
Dibenzofuran	No	--	--	--	--	No
Diethylphthalate	No	--	--	--	--	No
Dimethylphthalate	No	--	--	--	--	No
Ethylbenzene	UT	--	--	--	--	No
Fluoranthene	UT	--	--	--	--	No
Fluorene	UT	--	--	--	--	No
Hexachlorobenzene	No	--	--	--	--	No
Indeno(1,2,3-cd)pyrene	UT	--	--	--	--	No
Methylene Chloride	No	--	--	--	--	No
Monocrotophos	UT	--	--	--	--	No
Naphthalene	No	--	--	--	--	No
PCB-1254	No	--	--	--	--	No
PCB-1260	No	--	--	--	--	No
Phenanthrene	UT	--	--	--	--	No
Phenol	No	--	--	--	--	No

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

Analyte	Exceed Prairie Dog NOAEL ESL ?	Frequency of Detection >5%?	Exceeds Background?[a]	Upper Bound EPC > Limiting ESL?	Professional Judgment - Retain?	Retain as ECOPC?
Pyrene	UT	--	--	--	--	No
Styrene	No	--	--	--	--	No
Tetrachloroethane	UT	--	--	--	--	No
Tetraethyl dithiopyrophosphate	UT	--	--	--	--	No
Toluene	No	--	--	--	--	No
Trichloroethene	No	--	--	--	--	No
Xylene	No	--	--	--	--	No
Radionuclides						
Americium-241	No	--	--	--	--	No
Cesium-134	UT	--	--	--	--	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 (herbivore) Deer mouse (insectivore) Coyote (insectivore)
Barium	Mourning dove (herbivore)
Copper	Mourning dove (herbivore) Mourning dove (insectivore)
Mercury	Mourning dove (insectivore)
Molybdenum	Terrestrial plant Deer mouse (insectivore)
Nickel	American kestrel Mourning dove (insectivore) Deer mouse (herbivore) Deer mouse (insectivore) Coyote (generalist) Coyote (insectivore)
Tin	Mourning dove (insectivore) Deer mouse (insectivore)
Bis(2-ethylhexyl)phthalate	American kestrel Mourning dove (insectivore)
Di-n-butylphthalate	American kestrel Mourning dove (insectivore)
PCB (Total)	American kestrel Mourning dove (insectivore)
Surface Soil - PMJM	
Nickel	PMJM
Vanadium	PMJM
Zinc	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	10.1	9.67	9.83	7.70
Barium	258	148	176	136
Copper	28.1	22.6	43.8	20.2
Mercury	0.07	0.05	0.0636	0.0392
Molybdenum	2.25	1.47	1.80	1.03
Nickel	16.6	12.2	16.8	13.8
Tin	10.9	8.44	9.55	4.49
Organics (ug/kg)				
Bis(2-ethylhexyl)phthalate	980	619	553[a]	405
Di-n-butylphthalate	260	283	408[a]	346
PCB (Total)	580	396	428[a]	318

[a]Tier 2 soil UTL was greater than the maximum grid mean,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 11								
Nickel	5	5	100%	12	14.8	13.8	N/A	N/A
Vanadium	5	5	100%	30	42.1	37.5	N/A	N/A
Zinc	5	5	100%	54	87.4	76.5	N/A	N/A

[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.
N/A = Calculated UCL and/or UTL were greater than the maximum detected concentration or could not be calculated due to low number of samples.

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

ECOPC	MDC	95th UTL	95th UCL	Mean
Inorganics (mg/L)				
Antimony	0.0230	0.0211	0.0127	0.00713
Barium	0.820	0.643	0.360	0.253
Copper	0.0444	0.0115	0.00526	0.00453
Mercury	5.40E-04	2.70E-04	1.40E-04	9.38E-05
Molybdenum	0.0213	0.00820	0.00382	0.00308
Nickel	0.0363	0.0258	0.0114	0.00733
Tin	0.0569	0.0360	0.0180	0.00782
Vanadium	0.0951	0.0434	0.0203	0.00766
Zinc	2.22	2.20	1.06	0.262
Organics (ug/L)				
Bis(2-ethylhexyl)phthalate	34	34	12.1	5.81
Di-n-butylphthalate	48	48	14.9	6.08
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 - Herbivore						
Tier 1 UTL	0.0383	N/A	N/A	0.0224	0.00401	0.0647
Tier 2 UTL	0.0373	N/A	N/A	0.0218	0.00401	0.0632
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.657	N/A	0.0131	0.00401	0.674
Tier 2 UTL	N/A	0.639	N/A	0.0128	0.00401	0.656
Coyote - Insectivore						
Tier 1 UCL	N/A	0.145	N/A	0.00406	0.00102	0.150
Tier 2 UCL	N/A	0.116	N/A	0.00323	0.00102	0.120
Barium						
Mourning Dove - Herbivore						
Tier 1 UTL	26.5	N/A	N/A	5.52	0.0772	32.1
Tier 2 UTL	18.1	N/A	N/A	3.76	0.0772	21.9
Copper						
Mourning Dove - Herbivore						
Tier 1 UTL	1.67	N/A	N/A	0.601	0.00138	2.27
Tier 2 UTL	1.99	N/A	N/A	0.937	0.00138	2.93
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	2.96	N/A	0.601	0.00138	3.56
Tier 2 UTL	N/A	3.33	N/A	0.937	0.00138	4.27
Mercury						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	0.00309	N/A	0.00150	3.24E-05	0.00462
Tier 2 UTL	N/A	0.00281	N/A	0.00136	3.24E-05	0.00420
Molybdenum						
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.306	N/A	0.00293	0.00156	0.310
Tier 2 UTL	N/A	0.245	N/A	0.00234	9.50E-04	0.248
Nickel						
American Kestrel						
Tier 1 UTL	N/A	1.44	0.213	0.0764	0.00310	1.74
Tier 2 UTL	N/A	1.46	0.214	0.0773	0.00310	1.76
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	18.1	N/A	0.355	0.00310	18.4
Tier 2 UTL	N/A	18.3	N/A	0.359	0.00310	18.6
Deer Mouse - Herbivore						
Tier 1 UTL	0.0982	N/A	N/A	0.0369	0.00490	0.140
Tier 2 UTL	0.0991	N/A	N/A	0.0373	0.00490	0.141
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	5.10	N/A	0.0216	0.00490	5.13
Tier 2 UTL	N/A	5.17	N/A	0.0218	0.00490	5.19
Coyote - Generalist						
Tier 1 UCL	N/A	0.216	0.0282	0.00915	9.09E-04	0.255
Tier 2 UCL	N/A	0.245	0.0299	0.0104	9.09E-04	0.286
Coyote - Insectivore						
Tier 1 UCL	N/A	0.866	N/A	0.00512	9.09E-04	0.872
Tier 2 UCL	N/A	0.979	N/A	0.00580	9.09E-04	0.986
Tin						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	2.51	N/A	0.00432	2.74	2.74
Tier 2 UTL	N/A	2.20	N/A	0.204	0.00432	2.41
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.709	N/A	0.00684	0.730	0.730
Tier 2 UTL	N/A	0.621	N/A	0.0124	0.00684	0.640

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						
Bis(2-ethylhexyl)phthalate						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	7.87	N/A	0.0210	0.00408	7.89
Tier 2 UTL[a]	N/A	4.44	N/A	0.0118	0.00408	4.45
American Kestrel						
Tier 1 UTL	N/A	0.629	2.08	0.00451	0.00408	2.72
Tier 2 UTL[a]	N/A	0.355	1.17	0.00254	0.00408	1.53
Di-n-butylphthalate						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	1.80	N/A	0.00576	1.81	1.81
Tier 2 UTL[a]	N/A	2.82	N/A	0.00873	0.00576	2.84
American Kestrel						
Tier 1 UTL	N/A	0.144	0.544	0.00576	0.695	0.695
Tier 2 UTL[a]	N/A	0.226	0.854	0.00188	0.00576	1.09
PCB (Total)						
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	0.449	N/A	0.0124	0	0.461
Tier 2 UTL[a]	N/A	0.297	N/A	0.00915	0	0.306
American Kestrel						
Tier 1 UTL	N/A	0.0359	0.115	0.00267	0	0.153
Tier 2 UTL[a]	N/A	0.0237	0.110	0.00197	0	0.136
Alternative Exposure Estimates						
Nickel						
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	1.14	N/A	0.0216	0.00490	1.17
Tier 2 UTL	N/A	1.16	N/A	0.0218	0.00490	1.18

[a]Tier 2 soil UTL was greater than the maximum grid mean,so the maximum grid mean was used as to calculate intake.
N/A = Not applicable or no value available.

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						
Nickel						
Patch 11						
UCL[a]	0.0966	3.57	N/A	0.0604	0.00170	3.73
Vanadium						
Patch 11						
UCL[a]	0.0486	0.189	N/A	0.172	0.00304	0.412
Zinc						
Patch 11						
UCL[a]	6.84	18.9	N/A	0.357	0.160	26.3
Alternative Exposure Estimates						
Nickel						
Patch 19						
UCL[a]	0.0966	0.799	N/A	0.0604	0.00170	0.958

[a] - Not enough samples were available to calculate a UCL. The MDC was used as a default.
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.
Molybdenum	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.

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										
Barium	20.8	No mortality noted in chicks.	41.7	5% mortality in chicks.	Sample et al. (1996)	1	20.8	29.45	The magnitude of the response was small. Thus, the data satisfy the requirements described in the text for calculating a threshold.	High
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
Mercury	0.039	NOAEL was estmated from a LOAEL.	0.18	Increase in mortality in mallards.	PRC (1994)	1	0.039	N/A	NOAEL was estimated from the LOAEL.	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
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

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
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	N/A	Threshold was not calculated.	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

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	Based on Refined Analysis
Antimony	Terrestrial Plants	N/A	Tier 1	UTL = 2	No alternative TRVs identified.
			Tier 2	UTL = 2	No alternative TRVs identified.
	Deer Mouse (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 11 ***LOAEL*** UTL = 1	Not Calculated
			Tier 2	***NOAEL*** UTL = 11 ***LOAEL*** UTL = 1	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Coyote (Insectivore)	Default	Tier 1	***NOAEL*** UCL = 3 ***LOAEL*** UCL = 0.3	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
Barium	Mourning Dove (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 2 ***LOAEL*** UTL = 0.8	Not Calculated
			Tier 2	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.5	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
Copper	Mourning Dove (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 0.99 ***LOAEL*** UTL = 0.04	Not Calculated
			Tier 2	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.06	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 = 0.1	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Mercury	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 0.2 ***LOAEL*** UTL = 0.02	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.2 ***LOAEL*** UTL = 0.02	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Molybdenum	Terrestrial Plants	N/A	Tier 1	UTL = 1	Not Calculated
			Tier 2	UTL = 0.9	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 0.95 ***LOAEL*** UTL = 0.1	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
Nickel	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 13 ***LOAEL*** UTL = 0.3	Not Calculated
			Tier 2	***NOAEL*** UTL = 14 ***LOAEL*** UTL = 0.2	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 = 0.03	Not Calculated
			Tier 2	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.03	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Herbivore)	Default	Tier 1	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 1 ***LOAEL*** UTL = 0.1	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 39 ***LOAEL*** UTL = 4	***NOAEL*** UTL = 0.1 ***LOAEL*** UTL = 0.06
			Tier 2	***NOAEL*** UTL = 39 ***LOAEL*** UTL = 4	***NOAEL*** UTL = 0.1 ***LOAEL*** UTL = 0.6
		Median	Tier 1	***NOAEL*** UTL = 9 ***LOAEL*** UTL = 0.9	***NOAEL*** UTL = 0.03 ***LOAEL*** UTL = 0.01
			Tier 2	***NOAEL*** UTL = 9 ***LOAEL*** UTL = 0.9	***NOAEL*** UTL = 0.03 ***LOAEL*** UTL = 0.01

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)	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 = 7 ***LOAEL*** UCL = 0.7	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
Tin	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 4 ***LOAEL*** UTL = 0.1	Not Calculated
			Tier 2	***NOAEL*** UTL = 3 ***LOAEL*** UTL = 0.1	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	Deer Mouse (Insectivore)	Default	Tier 1	***NOAEL*** UTL = 3 ***LOAEL*** UTL = 0.05	Not Calculated
			Tier 2	***NOAEL*** UTL = 3 ***LOAEL*** UTL = 0.04	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
Bis(2-ethylhexyl)phthalate	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL[a] = 7 ***LOAEL*** UTL[a] = 0.04	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 4 ***LOAEL*** UTL[a] = 0.02	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] = 0.01	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 1 ***LOAEL*** UTL[a] = 0.007	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
Di-n-butylphthalate	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL[a] = 16 ***LOAEL*** UTL[a] = 2	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 26 ***LOAEL*** UTL[a] = 3	Not Calculated
		Median	Tier 1	Not Calculated	Not Calculated
			Tier 2	Not Calculated	Not Calculated
	American Kestrel	Default	Tier 1	***NOAEL*** UTL[a] = 6 ***LOAEL*** UTL[a] = 0.6	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 10 ***LOAEL*** UTL[a] = 0.99	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
PCB (total)	Mourning Dove (Insectivore)	Default	Tier 1	***NOAEL*** UTL[a] = 5 ***LOAEL*** UTL[a] = 0.4	Not Calculated
			Tier 2	***NOAEL*** UTL[a] = 3 ***LOAEL*** UTL[a] = 0.2	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] = 0.1	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]Tier 2 soil UTL was greater than the maximum grid mean,so the maximum grid mean was used as to calculate 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 is 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
Nickel	Patch 11	Default	UCL[a]	NOAEL = 28 LOAEL = 3	NOAEL = 0.1 LOAEL = 0.05
		Median	UCL[a]	NOAEL = 7 LOAEL = 0.7	NOAEL = 0.02 LOAEL = 0.01
Vanadium	Patch 11	Default	UCL[a]	NOAEL = 2 LOAEL = 0.2	Not Calculated
		Median	UCL[a]	Not Calculated	Not Calculated
Zinc	Patch 11	Default	UCL[a]	NOAEL = 3 LOAEL = 0.1	Not Calculated
		Median	UCL[a]	Not Calculated	Not Calculated

[a] - Not enough samples were available to calculate a UCL. The MDC was used as a default.

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 NNEU

ECOPC	Most Sensitive Receptor	Number of Grid Cells	Percent of Tier 2 Grid Cell Mean Concentrations: NOAEL TRV HQ < 1	NOAEL TRV HQ > 1 <5	NOAEL TRV HQ > 5 <10	NOAEL TRV HQ > 10	Threshold TRV HQ < 1	Threshold TRV HQ > 1 <5	Threshold TRV HQ > 5 <10	Threshold TRV HQ > 10	LOAEL TRV HQ < 1	LOAEL TRV HQ > 1 <5	LOAEL TRV HQ > 5 <10	LOAEL TRV HQ > 10
Inorganics														
Antimony	Deer Mouse - Insectivore	29	69	14	10	7	N/A	N/A	N/A	N/A	100	0	0	0
Barium	Mourning Dove - Insectivore	29	100	0	0	0	100	0	0	0	100	0	0	0
Copper	Mourning Dove - Insectivore	29	0	93	7	0	100	0	0	0	100	0	0	0
Mercury	Mourning Dove - Insectivore	29	0	0	0	100	N/A	N/A	N/A	N/A	100	0	0	0
Molybdenum	Deer Mouse - Insectivore	29	97	3	0	0	N/A	N/A	N/A	N/A	100	0	0	0
Nickel	Deer Mouse - Insectivore	29	0	0	0	100	N/A	N/A	N/A	N/A	0	100	0	0
Tin	Mourning Dove - Insectivore	29	79	21	0	0	N/A	N/A	N/A	N/A	100	0	0	0
Organics														
Bis(2-ethylhexyl)phthalate	Mourning Dove - Insectivore	7	14	86	0	0	N/A	N/A	N/A	N/A	100	0	0	0
Di-N-Butylphthalate	Mourning Dove - Insectivore	7	0	0	14	86	N/A	N/A	N/A	N/A	14	86	0	0
PCBs-Total	Mourning Dove - Insectivore	7	0	100	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 NNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Surface Soil Non-PMJM Receptors			
Antimony	Terrestrial plants	Tier 1 and Tier 2 HQs > 1.	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)	NOAEL HQs = 1 for default exposure scenarios and TRVs. LOAEL HQs <1 for default exposure scenarios and TRVs.	Low Risk
	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)	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
Barium	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 for default exposure scenarios Tier 2 NOAEL HQ = 1 for default exposure scenarios LOAEL HQs < 1 for default exposure scenarios.	Low Risk
	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
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)	NOAEL HQ < = 1 using default exposure scenarios LOAEL and threshold HQs < 1 using default exposure scenarios.	Low Risk
	Mourning dove (insectivore)	NOAEL HQ > 1 using default exposure scenarios (HQ =2) LOAEL and threshold 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

Table 11.1
Summary of Risk Characterization Results for the NNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Mercury	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 and LOAEL HQs < 1.	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
Molybdenum	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.	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)	Tier 1 NOAEL HQs = 1 for default exposure scenarios. Tier 2 NOAEL HQs <1 for default exposure scenarios. LOAEL HQs < 1 for default exposure scenarios.	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
Nickel	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	Terrestrial invertebrate	Not an ECOPC.	Not an ECOPC
	American kestrel	NOAEL HQs <= 1 for default exposure scenarios LOAEL and threshold HQs < 1 for default exposure scenarios.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	NOAEL HQs > 1 for default exposure scenarios and TRVs. Threshold HQs > 1 for default exposure scenarios and TRVs (HQs = 2). 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. All 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. All HQs < 1 for alternative exposure scenarios and alternative TRVs.	Low 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. LOAEL HQs < 1 for default exposure scenarios and TRVs.	Low Risk
	Mule Deer	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the NNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
Tin	Terrestrial plants	Not an ECOPC.	Not an ECOPC
	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)	NOAEL HQs > 1 for default exposure scenarios. LOAEL HQs < 1 for all default exposure scenarios.	Low Risk
	Deer mouse (herbivore)	Not an ECOPC.	Not an ECOPC
	Deer mouse (Insectivore)	NOAEL HQs > 1 for default exposure scenarios. LOAEL HQs < 1 for all default exposure scenarios.	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
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 HQs >= 1 for default exposure scenarios. LOAEL HQs < 1 for all default exposure scenarios.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	NOAEL HQs > 1 for default exposure scenarios. LOAEL HQs < 1 for all 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
Di-n-butylphthalate	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. LOAEL HQs < 1 for all default exposure scenarios.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC
	Mourning dove (insectivore)	NOAEL HQs > 1 for default exposure scenarios LOAEL HQs > 1 for 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
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 scenarios. LOAEL HQ < 1 for default exposure scenarios.	Low Risk
	Mourning dove (herbivore)	Not an ECOPC.	Not an ECOPC

Table 11.1
Summary of Risk Characterization Results for the NNEU

Analyte	Ecological Receptors	Result of Risk Characterization	Risk Description Conclusion
	Mourning dove (insectivore)	NOAEL HQs > 1 for default exposure scenario. LOAEL HQs < 1 for 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
Surface Soil - PMJM Receptors			
Nickel	Patch 11	NOAEL and LOAEL HQs > 1 for default exposure scenarios. Alternative NOAEL and LOAEL HQs < 1 for default exposure scenarios. NOAEL HQ > 1 for alternative exposure scenarios using default TRVs. LOAEL HQ < 1 for alternative exposure scenarios using default TRVs. Alternative NOAEL and LOAEL HQs < 1 for alternative exposure scenarios.	Low Risk
Vanadium	Patch 11	NOAEL HQ > 1 (HQ = 2) for default exposure scenarios. LOAEL HQ < 1 for default exposure scenarios.	Low Risk
Zinc	Patch 11	NOAEL HQ > 1 (HQ = 3) under default exposure scenario. LOAEL HQ < 1 under default exposure scenarios.	Low Risk
Subsurface Soil			
None	Prairie dog	No ECOPCs.	No ECOPCs

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

FIGURES

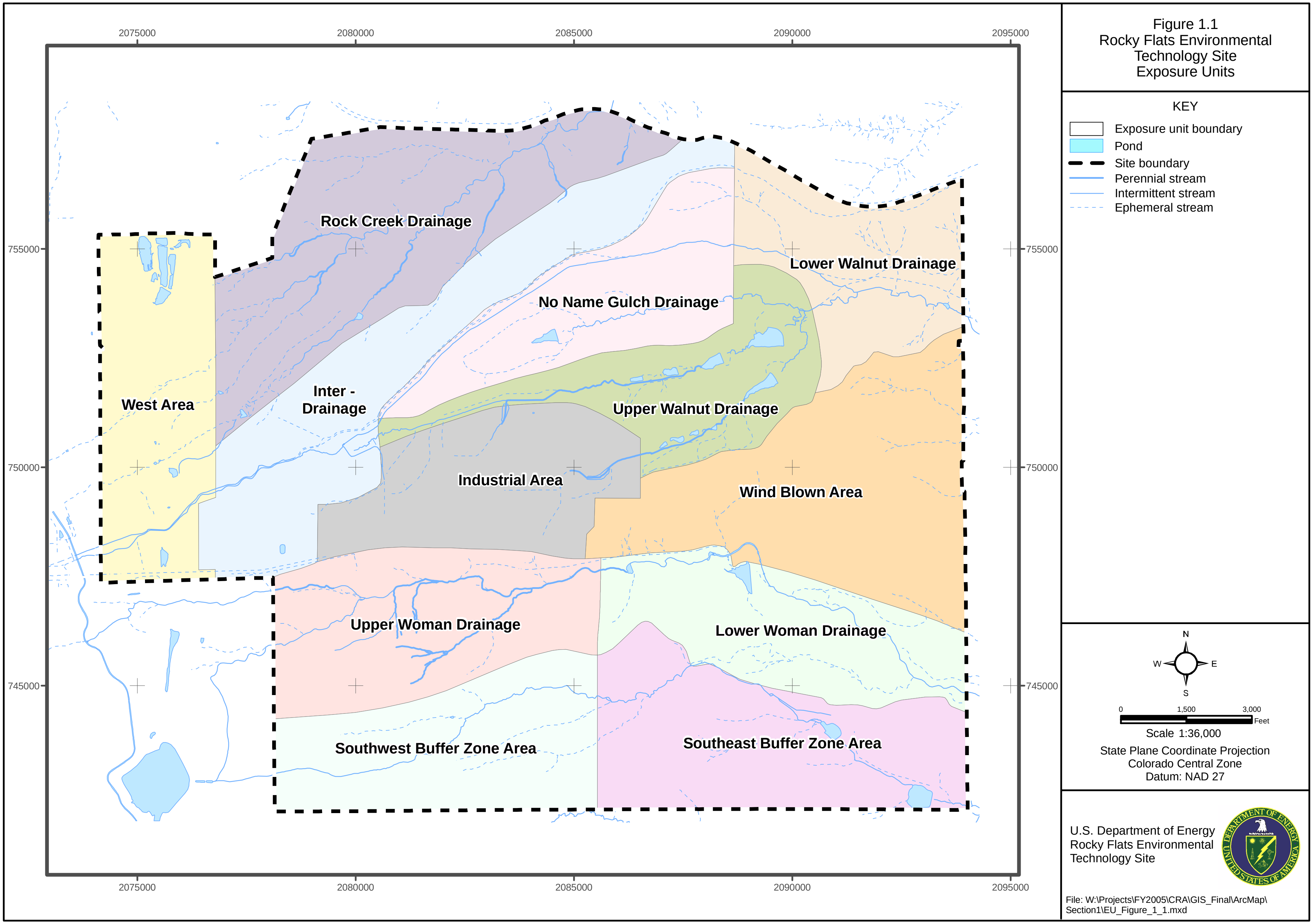

Figure 1.1
Rocky Flats Environmental
Technology Site
Exposure Units
KEY
Exposure unit boundary
Pond
Site boundary
Perennial stream
Intermittent stream
Ephemeral stream
2075000
2080000
2085000
2090000
2095000
755000
750000
745000
Rock Creek Drainage
Lower Walnut Drainage
No Name Gulch Drainage
West Area
Inter - Drainage
Upper Walnut Drainage
Industrial Area
Wind Blown Area
Upper Woman Drainage
Lower Woman Drainage
Southwest Buffer Zone Area
Southeast Buffer Zone Area
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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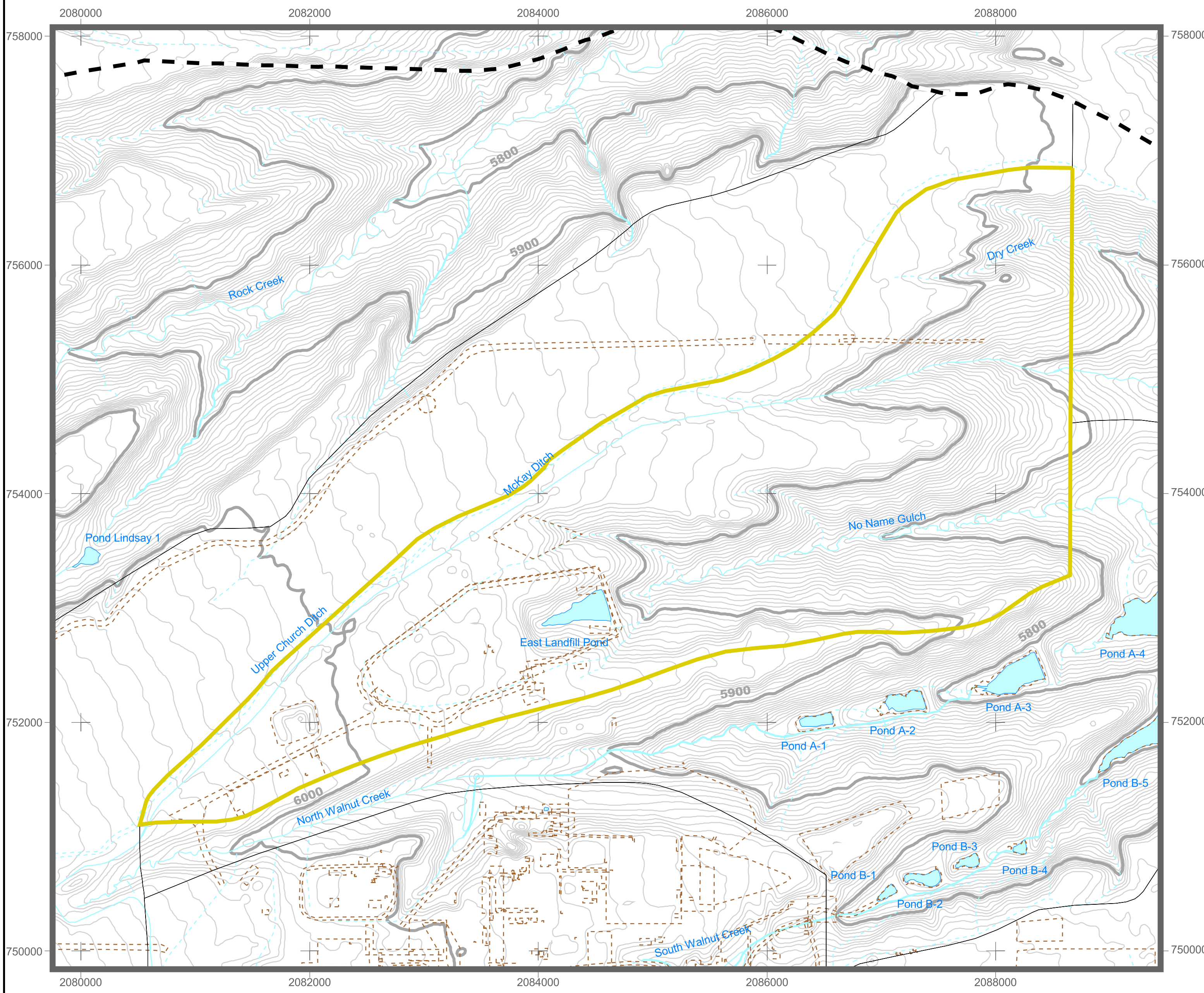

Figure 1.2
Topography and Historical IHSS Locations in the No Name Gulch Drainage Exposure Unit

KEY

- No Name Gulch 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 W E S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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

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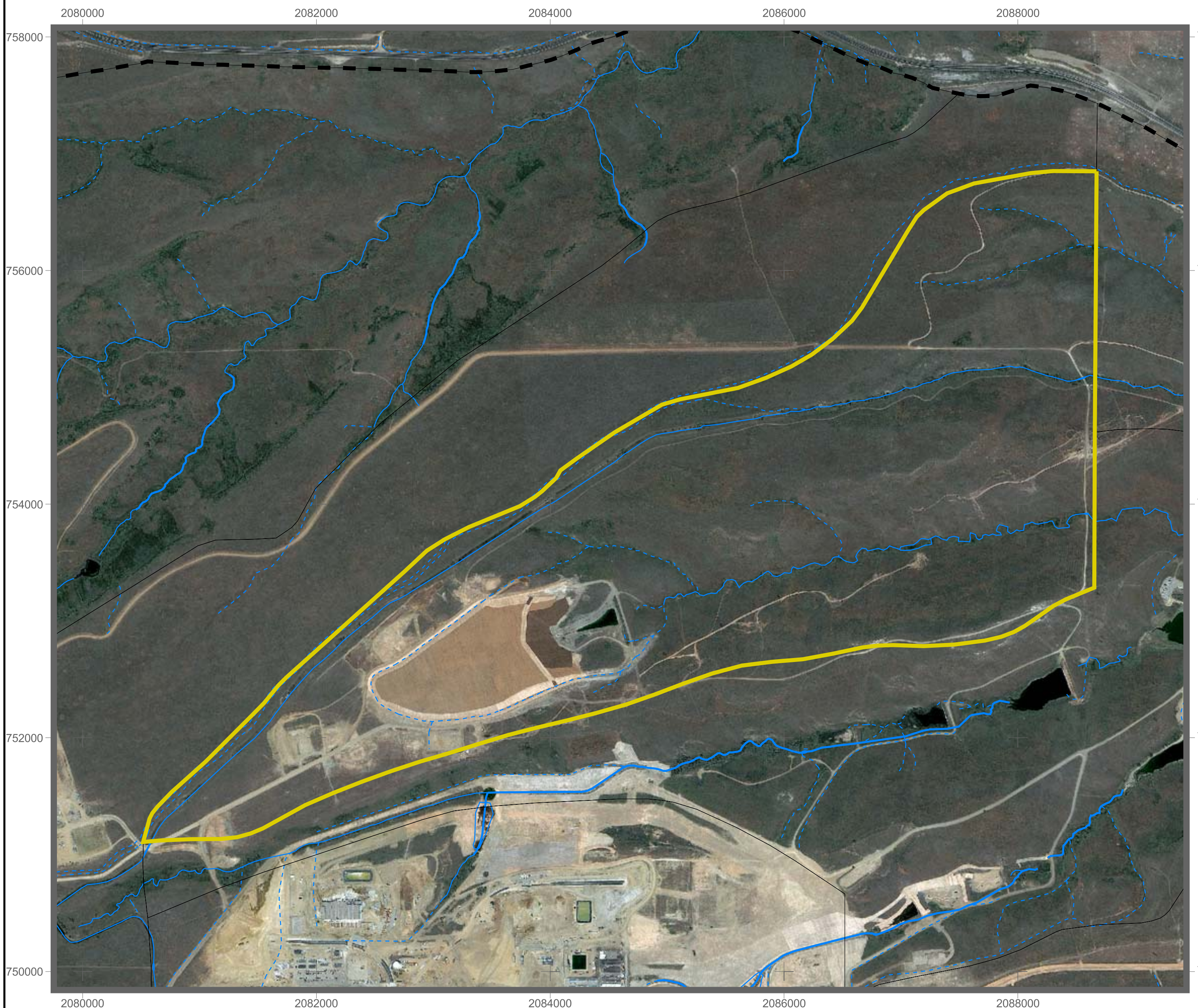

Figure 1.3
Aerial Photograph of the
No Name Gulch Drainage
Exposure Unit
July 2005

KEY

No Name Gulch Drainage EU

Standard Map Features

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

N
W
E
S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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

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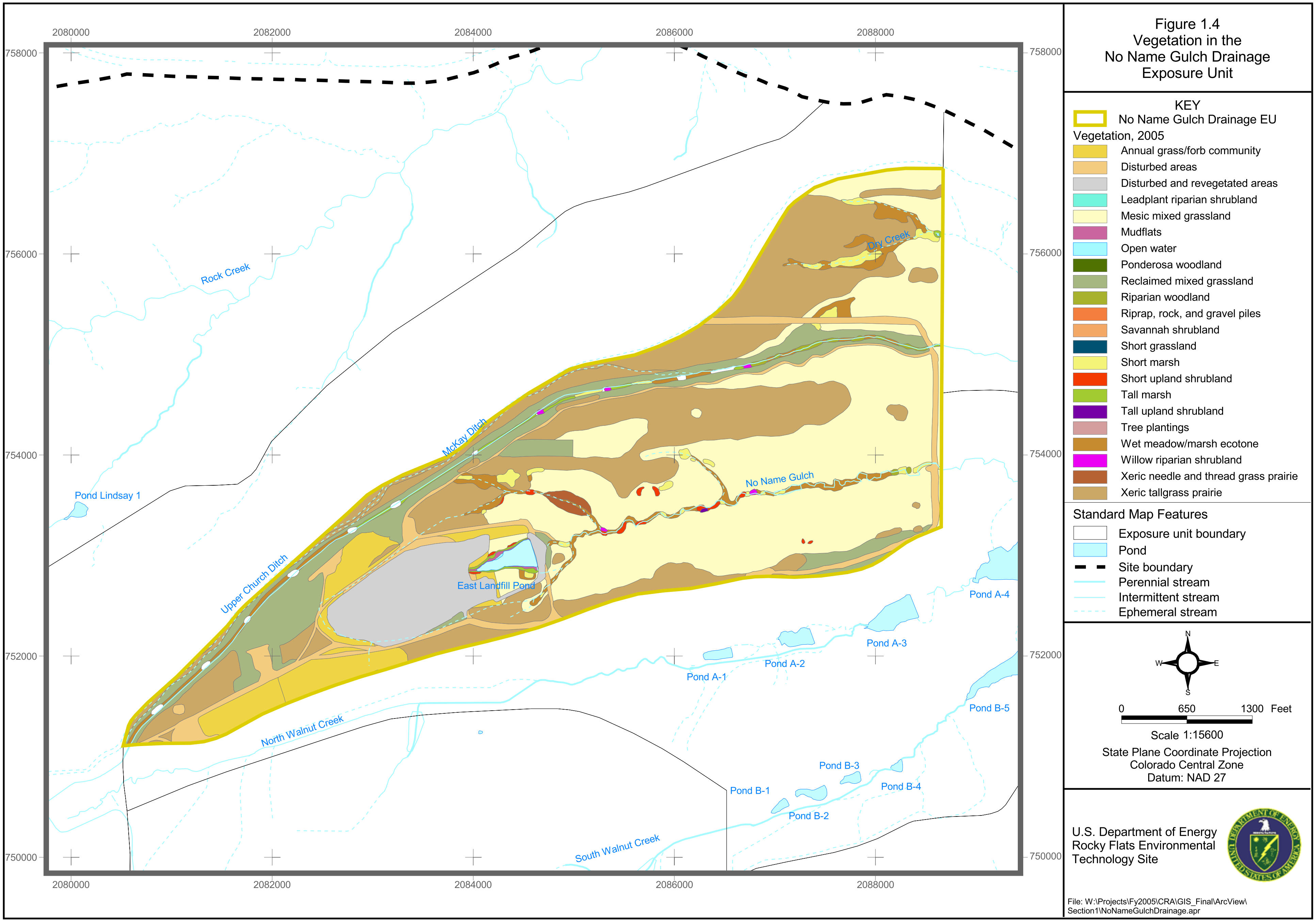

Figure 1.4
Vegetation in the
No Name Gulch Drainage
Exposure Unit
KEY
No Name Gulch Drainage EU
Vegetation, 2005
Annual grass/forb community
Disturbed areas
Disturbed and revegetated areas
Leadplant riparian shrubland
Mesic mixed grassland
Mudflats
Open water
Ponderosa woodland
Reclaimed mixed grassland
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
E
S
W
0
650
1300 Feet
Scale 1:15600
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\
Section1\NoNameGulchDrainage.apr
2080000
2082000
2084000
2086000
2088000
758000
756000
754000
752000
750000
Rock Creek
Dry Creek
McKay Ditch
No Name Gulch
Upper Church Ditch
East Landfill Pond
Pond Lindsay 1
North Walnut Creek
South Walnut Creek
Pond A-1
Pond A-2
Pond A-3
Pond A-4
Pond B-1
Pond B-2
Pond B-3
Pond B-4
Pond B-5

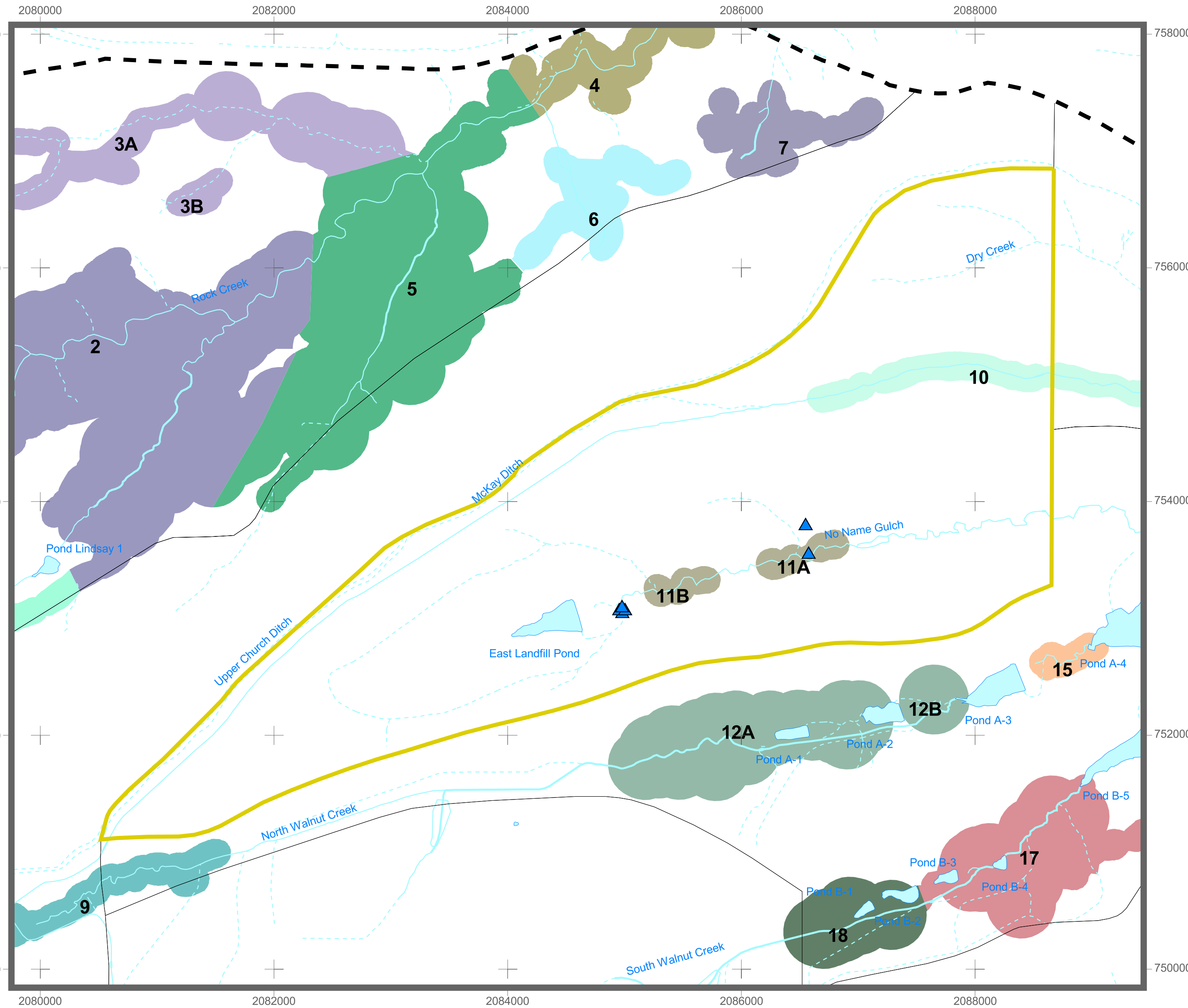

Figure 1.5
Preble's Meadow Jumping Mouse Habitat and Surface Soil Sample Locations in the No Name Gulch Drainage Exposure Unit

KEY

- Surface soil sample location
- No Name Gulch Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

Note: Not all analyte groups were analyzed at every sample location.

Standard Map Features

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

N W E S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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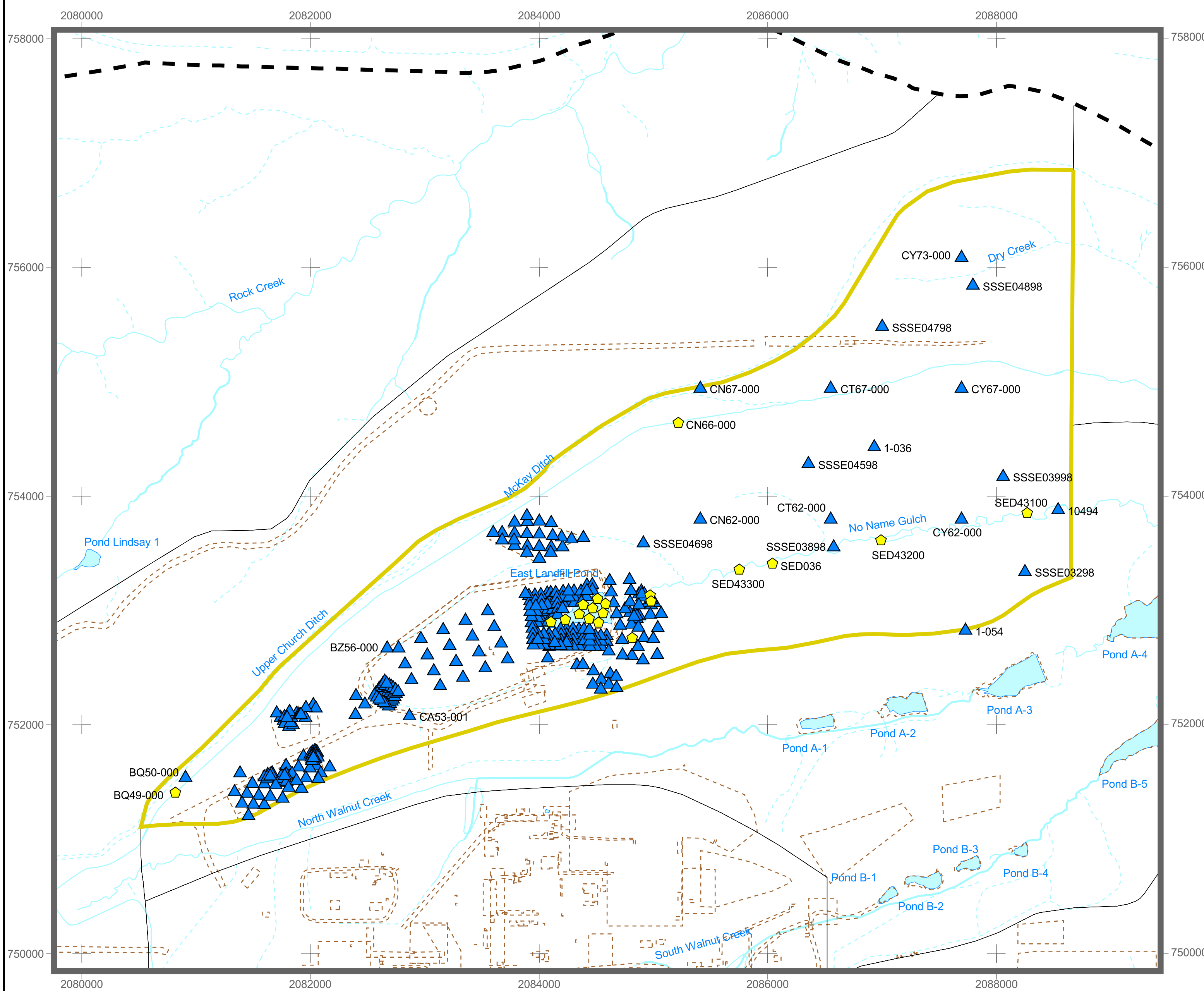
Rocky Flats Environmental Technology Site

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

Figure 1.6
No Name Gulch Drainage Exposure Unit Surface Soil and Surface Sediment Sample Locations



KEY

Sample location
- Surface sediment sample location
- Surface soil sample location
- No Name Gulch Drainage EU
- Historical IHSS/PAC

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

N E S W

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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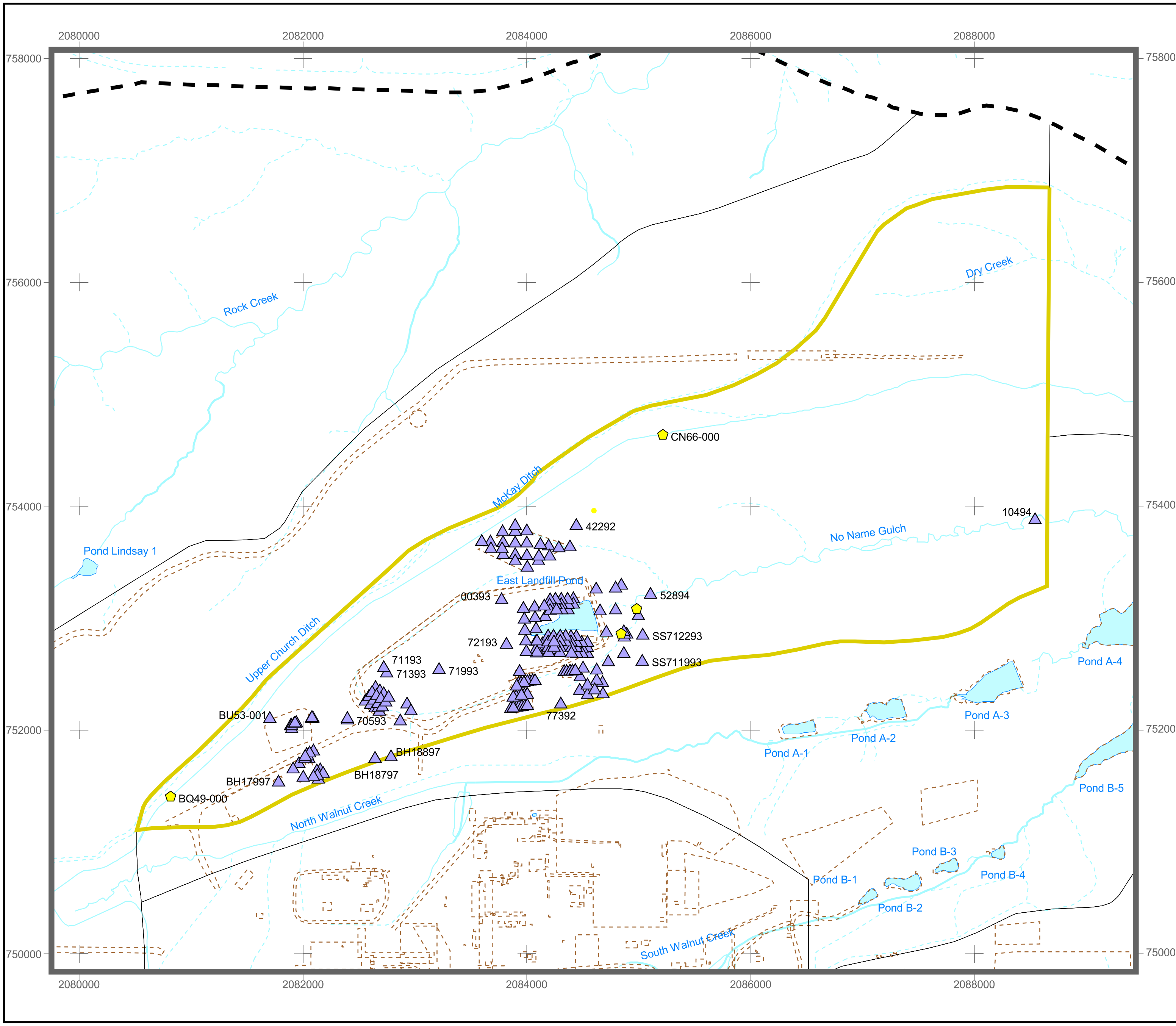

Figure 1.7
No Name Gulch Drainage Exposure Unit Subsurface Soil and Subsurface Sediment Sample Locations

KEY

Sample location
- Subsurface sediment sample location
- Subsurface soil sample location
- No Name Gulch Drainage EU
- Historical IHSS/PAC

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

N E S W

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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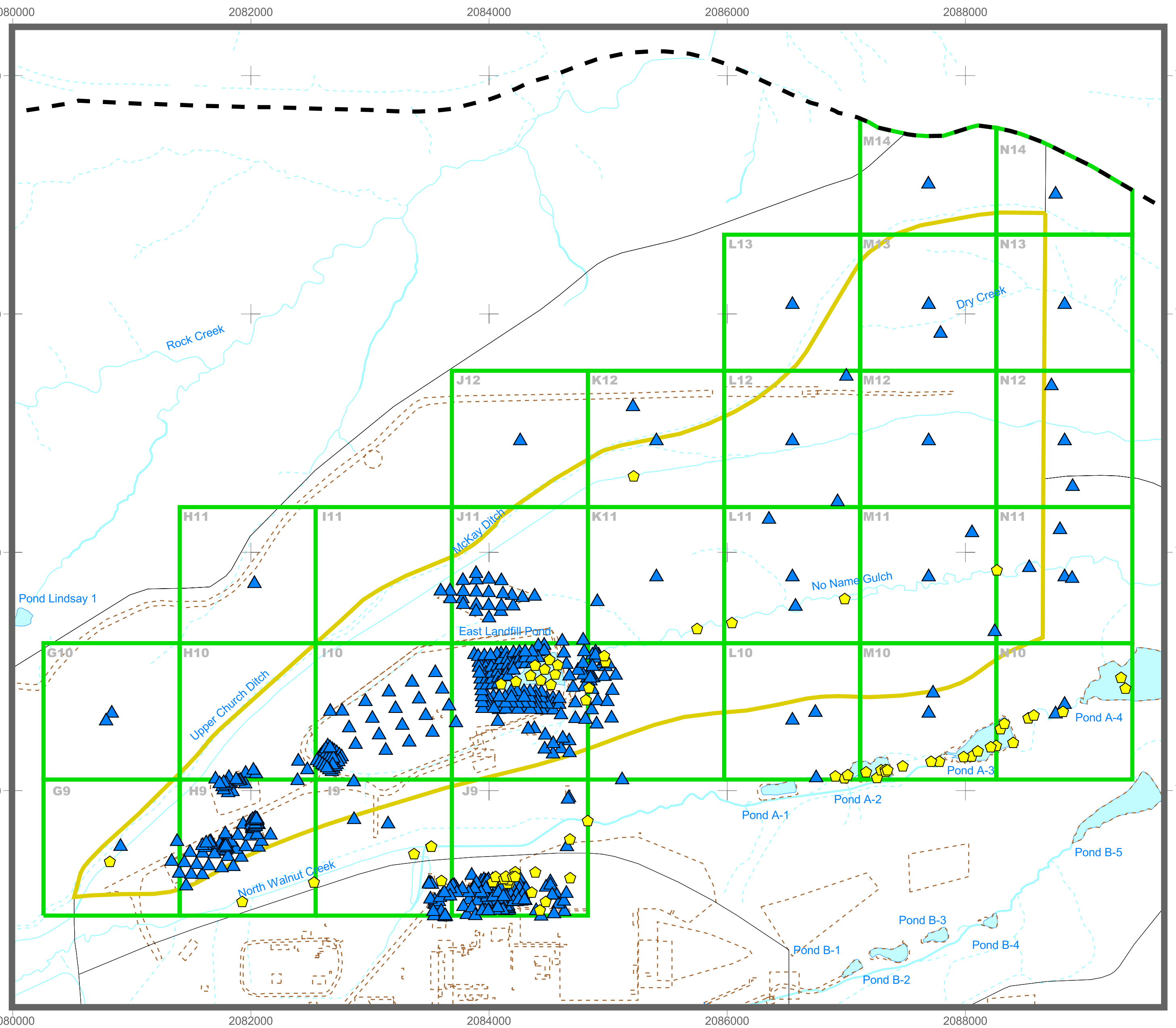

Figure 3.1
Tier 2 EPC 30-acre Grids
with Surface Soil and Surface
Sediment Sample Locations

KEY

- Surface sediment sample location
- Surface soil sample location
- No Name Gulch 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 S E W

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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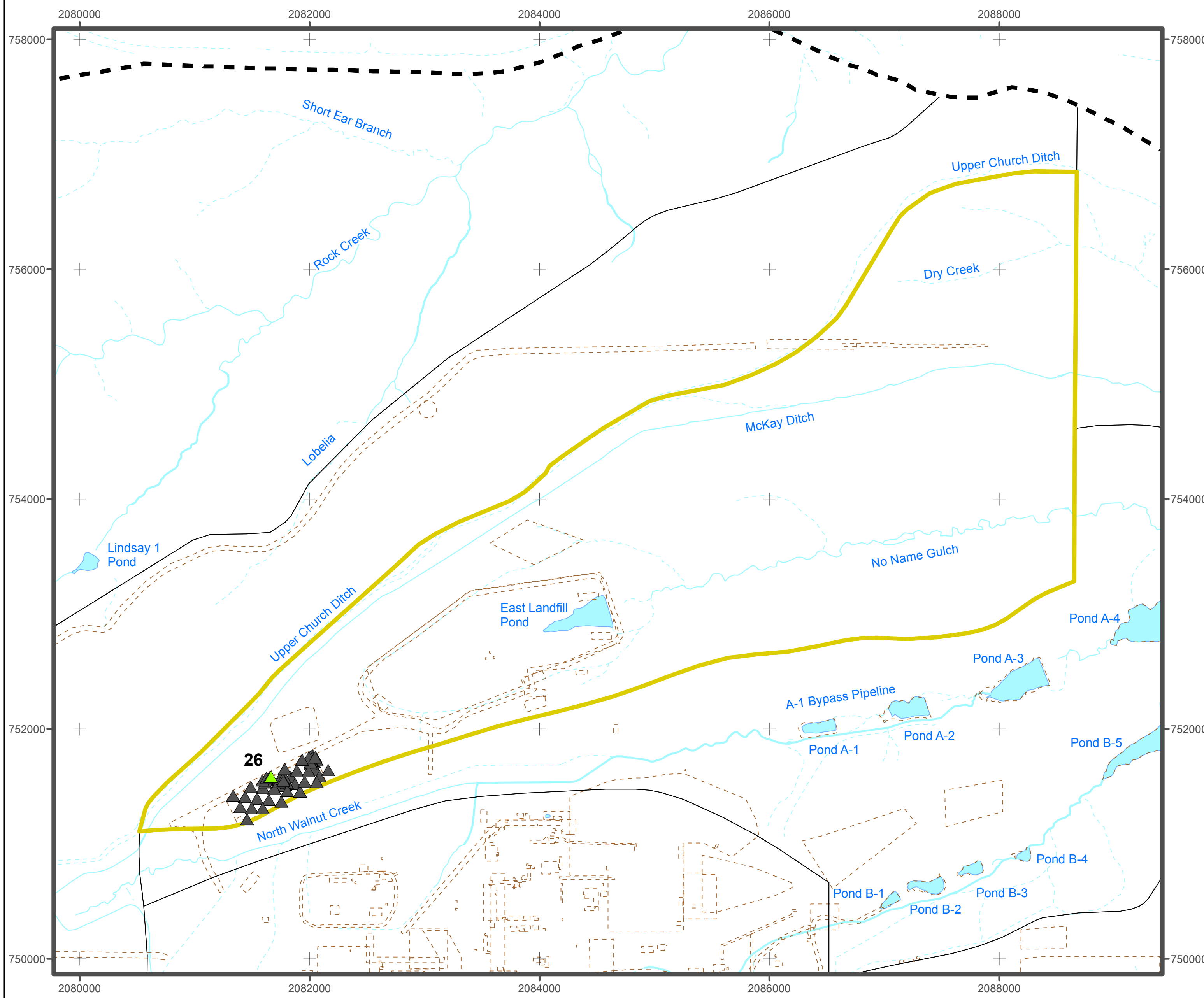

Figure 7.1
No Name Gulch Drainage EU
Surface Soil Results
for 4,4-DDT

KEY

Sample location
- Detect
- Nondetect
- No Name Gulch 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

0 650 1,300 Feet

Scale 1:15,600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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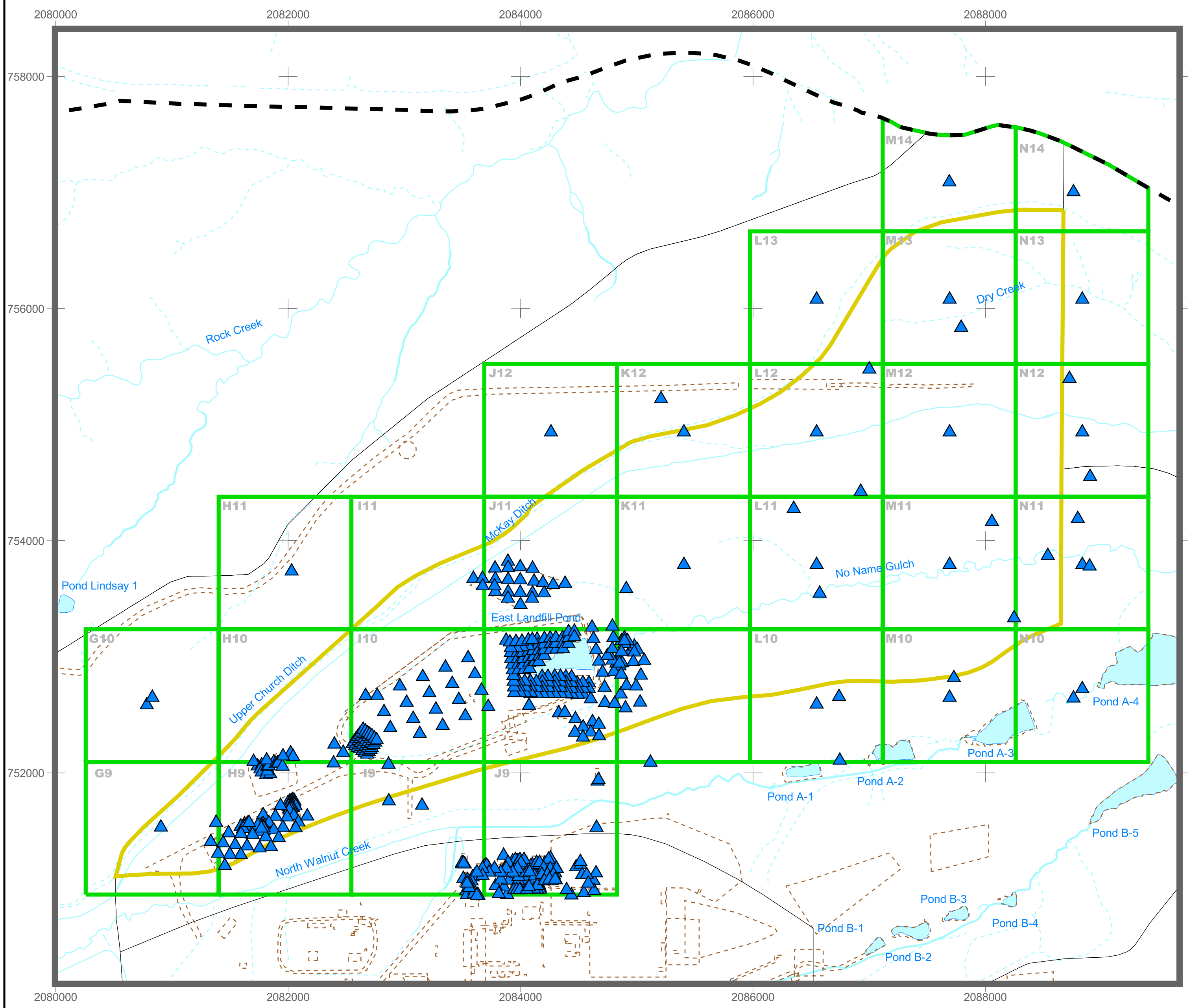

Figure 8.1
Tier 2 EPC 30-acre Grids
with Surface Soil
Sample Locations

KEY

Surface soil sample location
No Name Gulch 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 S W E

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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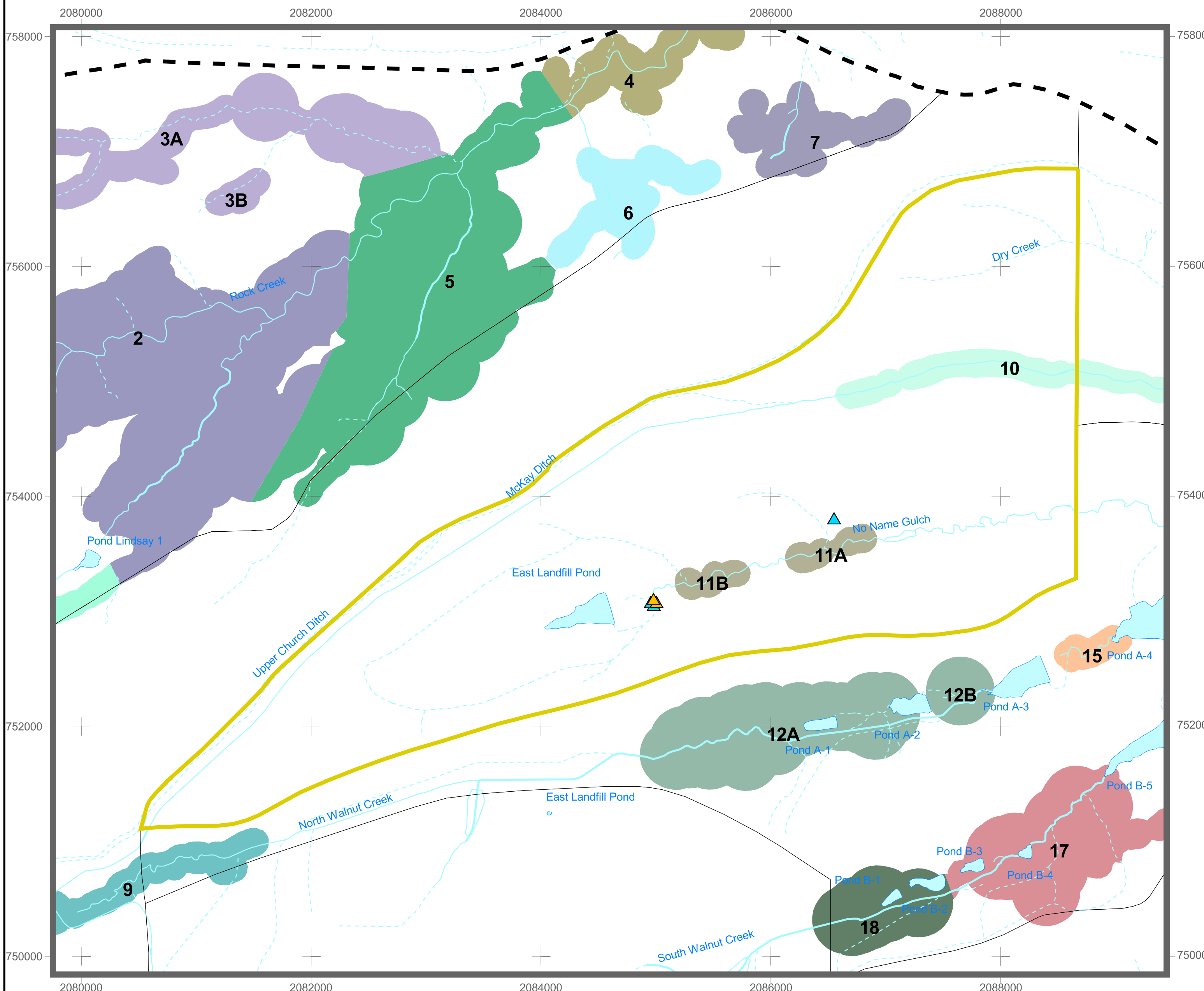
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\NoNameGulchDrainage.apr

Figure 8.2
No Name Gulch 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
- No Name Gulch 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
W
E
S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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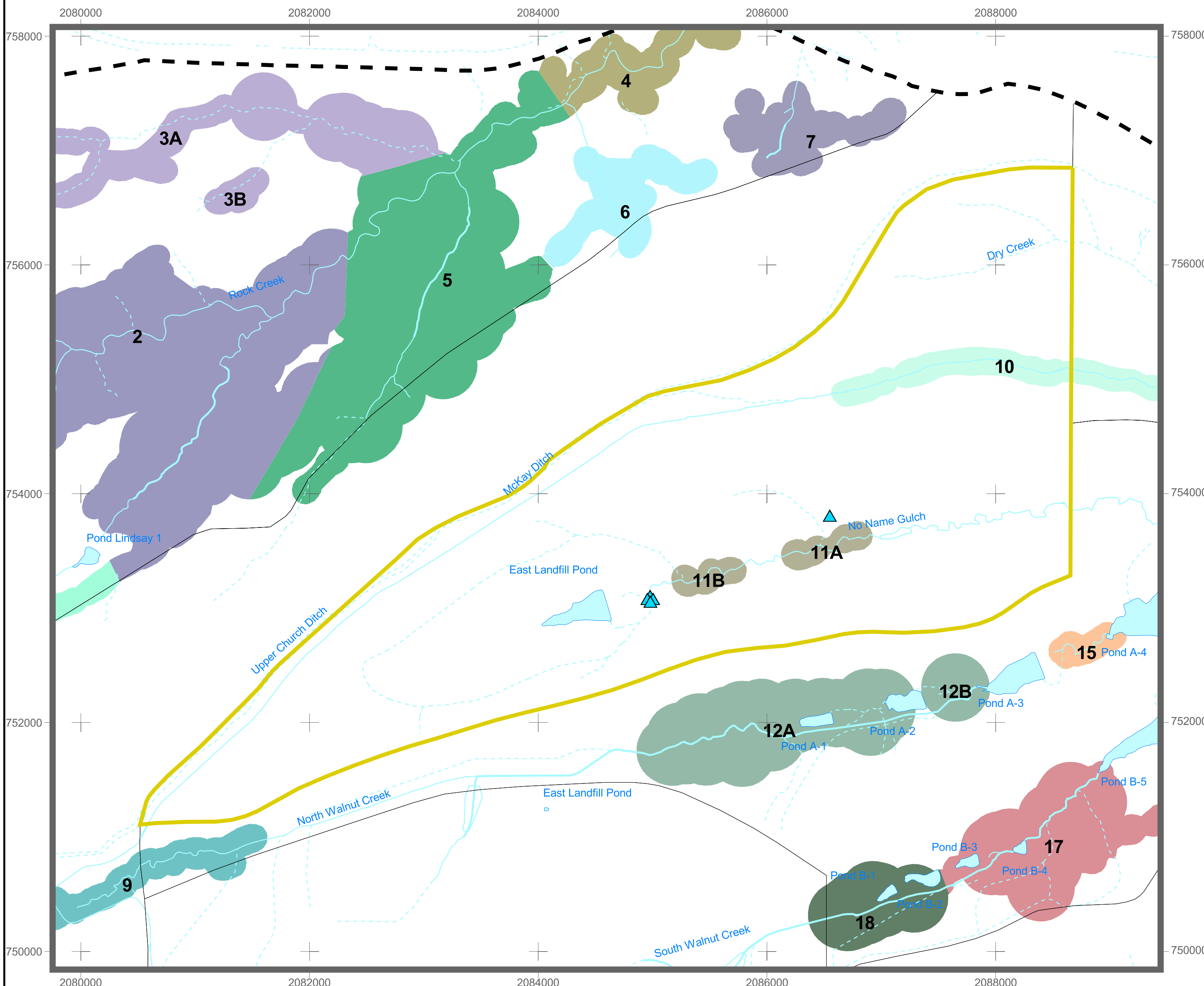

Figure 8.3
No Name Gulch Drainage
Exposure Unit
Surface Soil Sample Locations
in PMJM Habitat for Vanadium

KEY

Surface soil sample location

- Detect >= Maximum background >= 3 x ESL
- Detect >= Maximum background >= ESL
- Detect >= Maximum background < ESL
- Detect < Maximum background
- Nondetect
- No Name Gulch Drainage EU
- PMJM habitat patch
- 1 PMJM habitat patch ID

ESL: 21.59 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

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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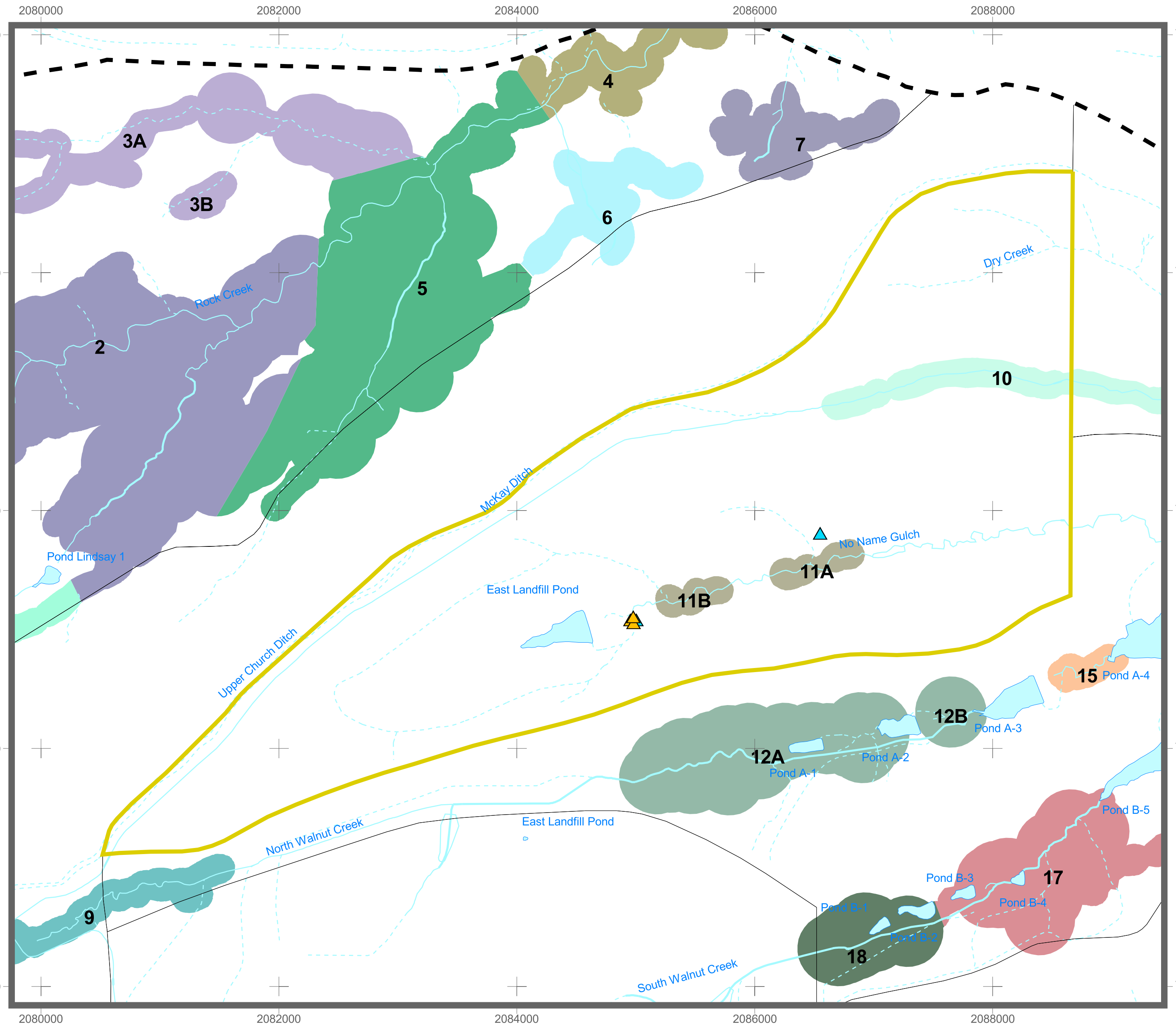
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\NoNameGulchDrainage.apr

Figure 8.4
No Name Gulch 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
- No Name Gulch 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

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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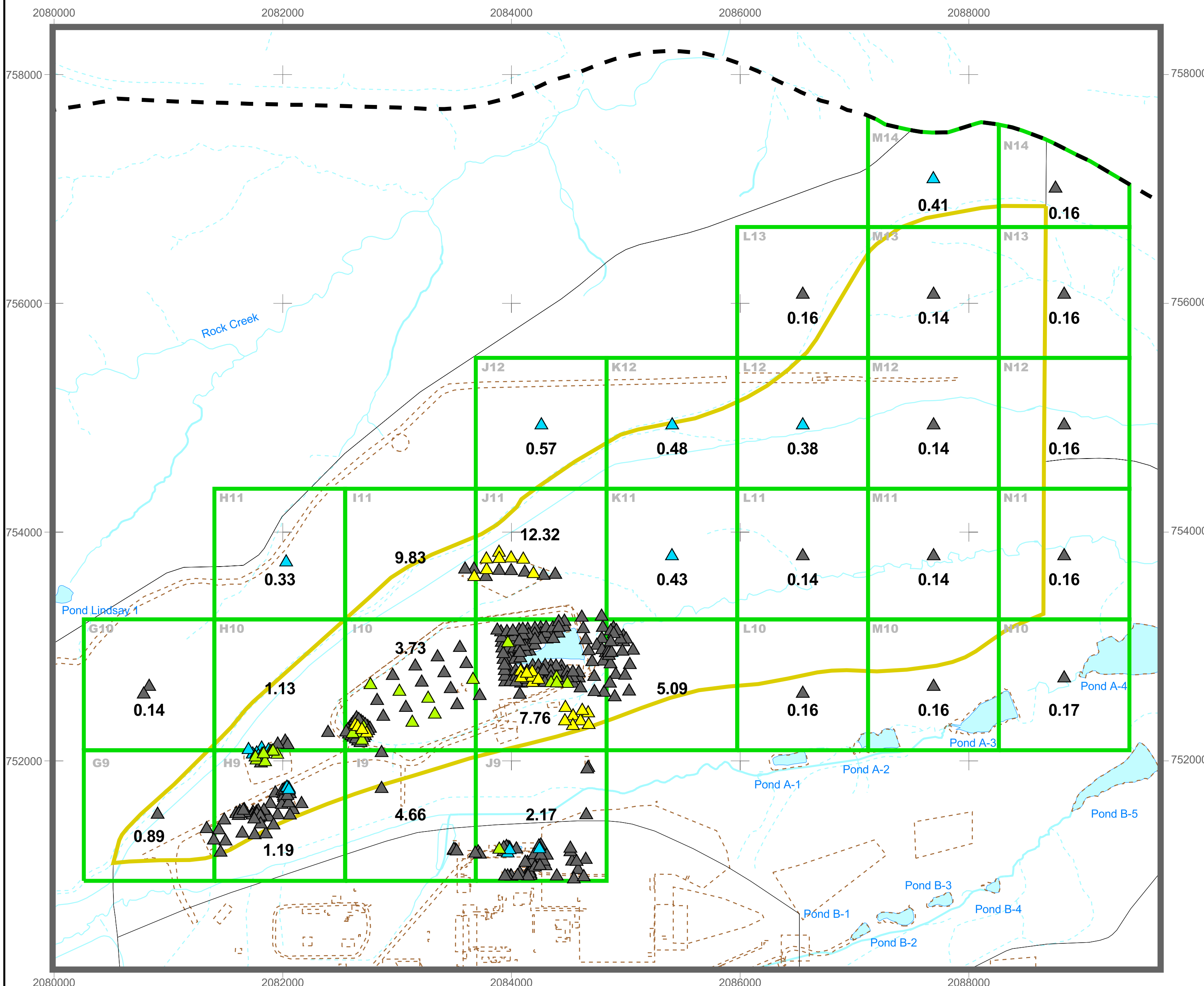
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section8\NoNameGulchDrainage.apr

Figure 10.1
No Name Gulch 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
- No Name Gulch 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
W
E
S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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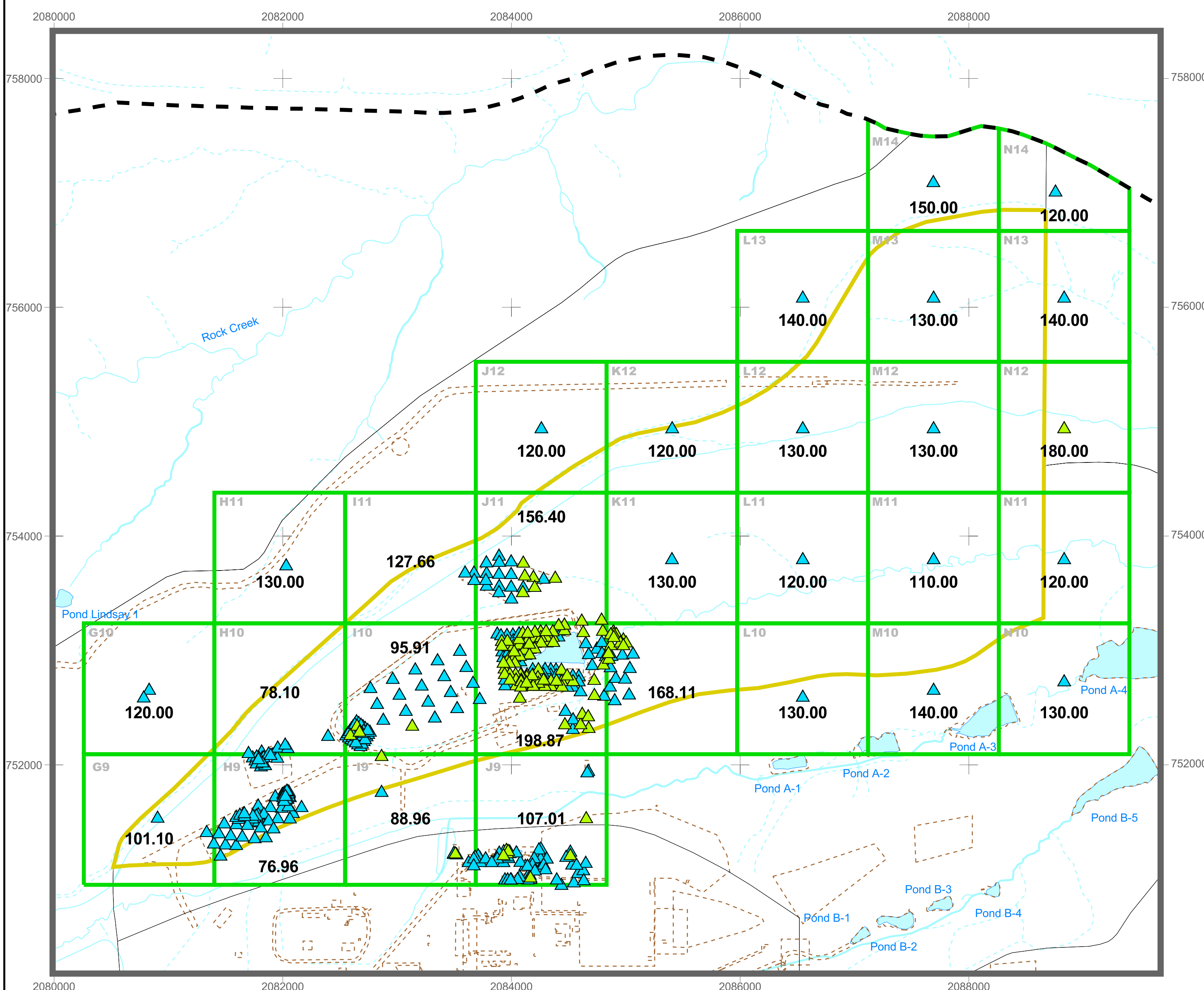
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\NoNameGulchDrainage.apr

Figure 10.2
No Name Gulch Drainage
Exposure Unit Sample-by-Sample
Comparison to the Limiting ESL -
Barium



KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- No Name Gulch Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 159 mg/kg
Receptor: Mourning Dove (Herbivore)
95th UCL background: 110 mg/kg
Maximum background concentration: 134 mg/kg

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

N
W
E
S

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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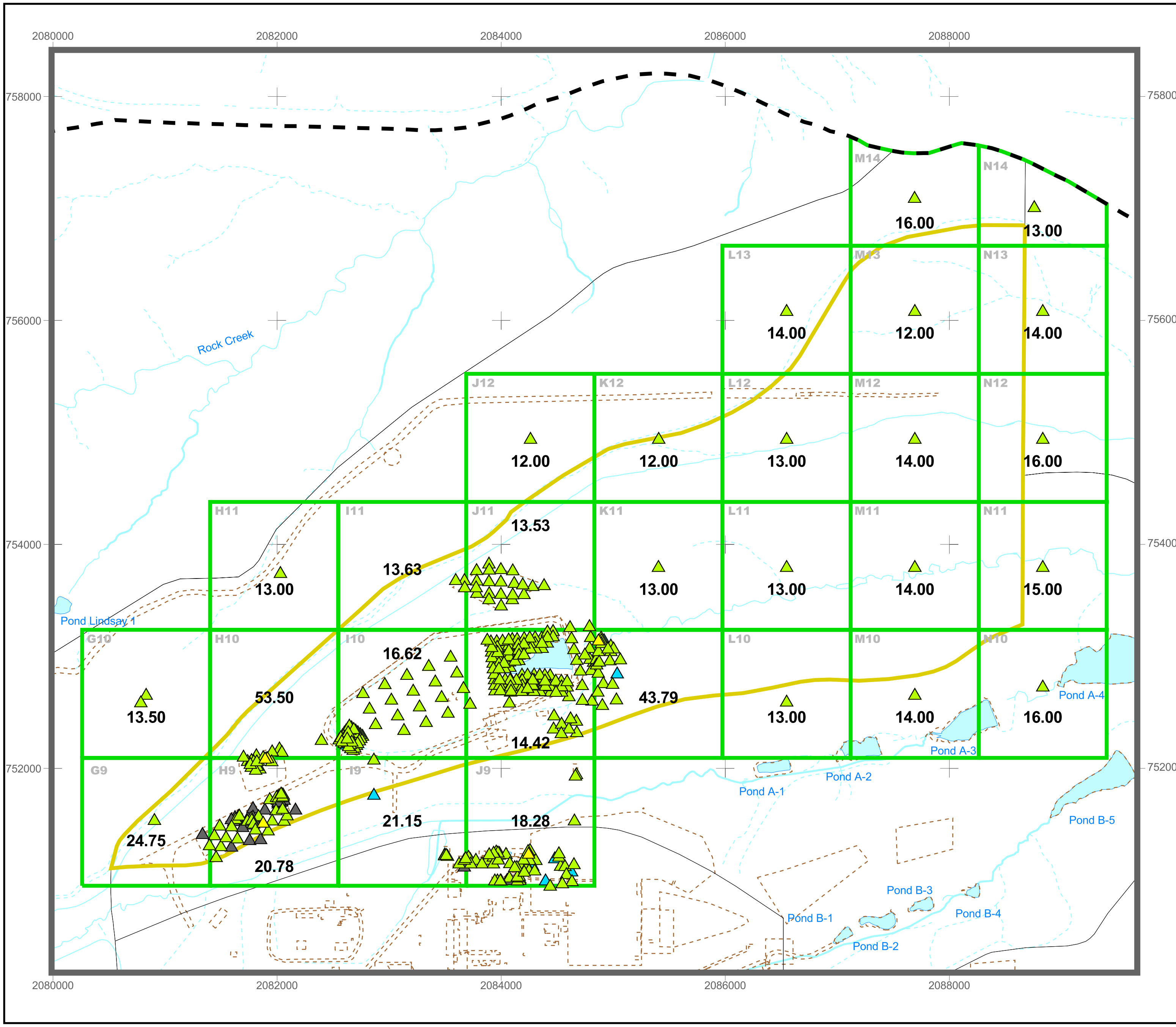
Technology Site

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

Figure 10.3
No Name Gulch 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
- No Name Gulch 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

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0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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

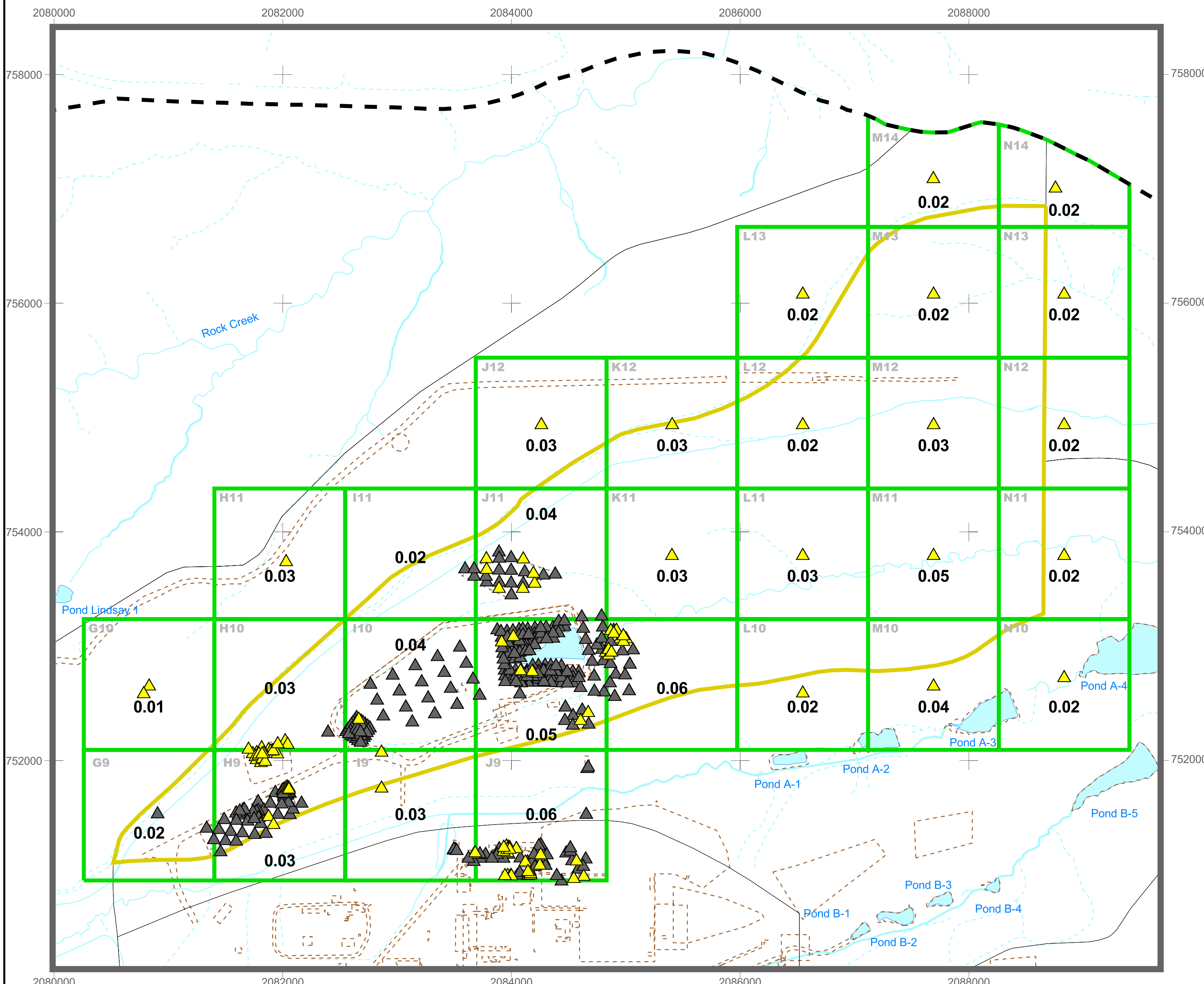

Figure 10.4
No Name Gulch Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Mercury

KEY

Surface soil sample location
- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- No Name Gulch Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 0.0001 mg/kg
Receptor: Mourning Dove (Insectivore)
95th UCL background: 0.083 mg/kg
Maximum background concentration: 0.12 mg/kg

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

N E S W

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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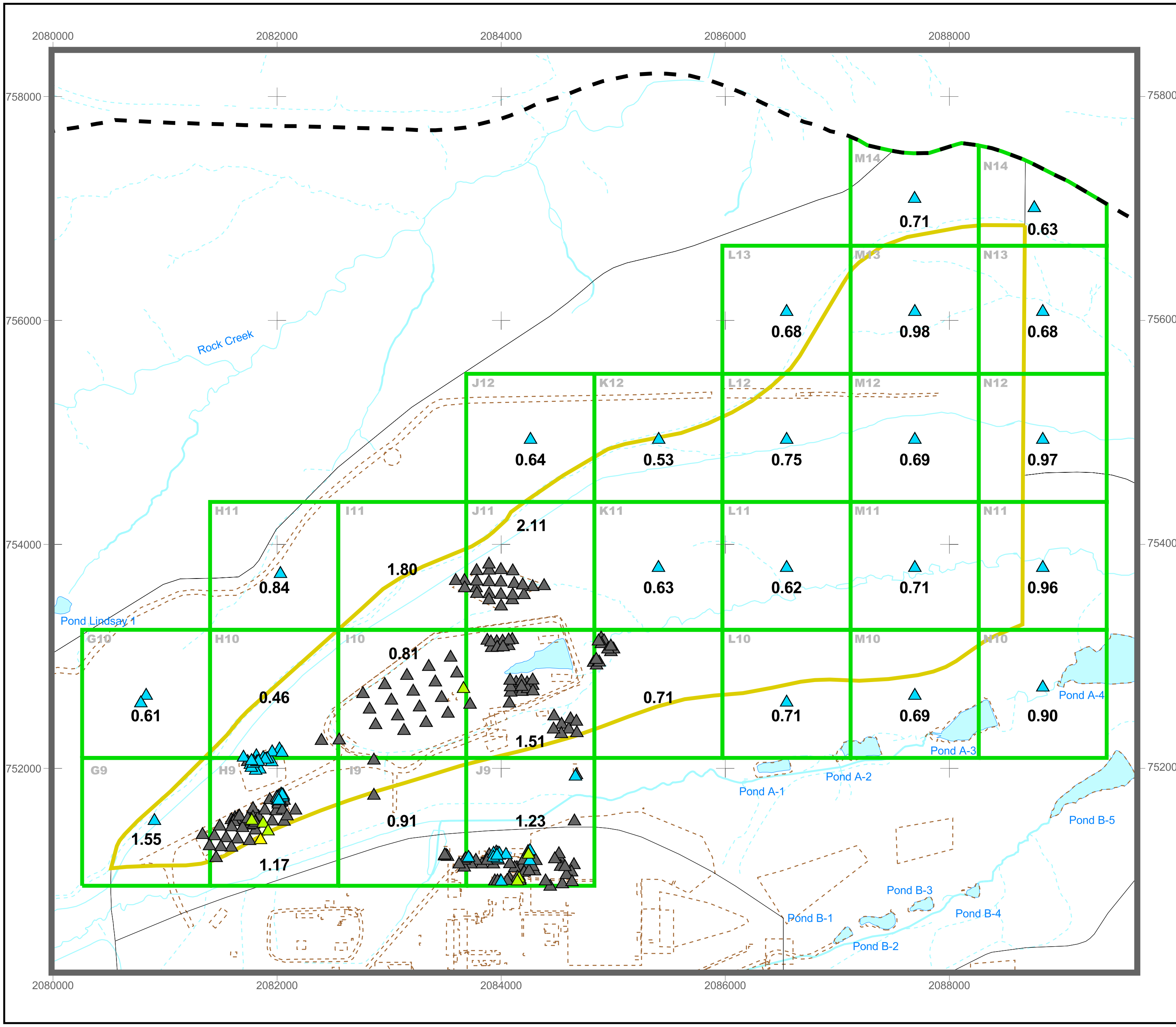

Figure 10.5
No Name Gulch Drainage
Exposure Unit Sample-by-Sample
Comparison to the Limiting ESL - Molybdenum

KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- No Name Gulch Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 1.89 mg/kg
Receptor: Deer Mouse (Insectivore)
95th UCL background: 0.644 mg/kg
Maximum background concentration: N/A

Standard Map Features

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

N S E W

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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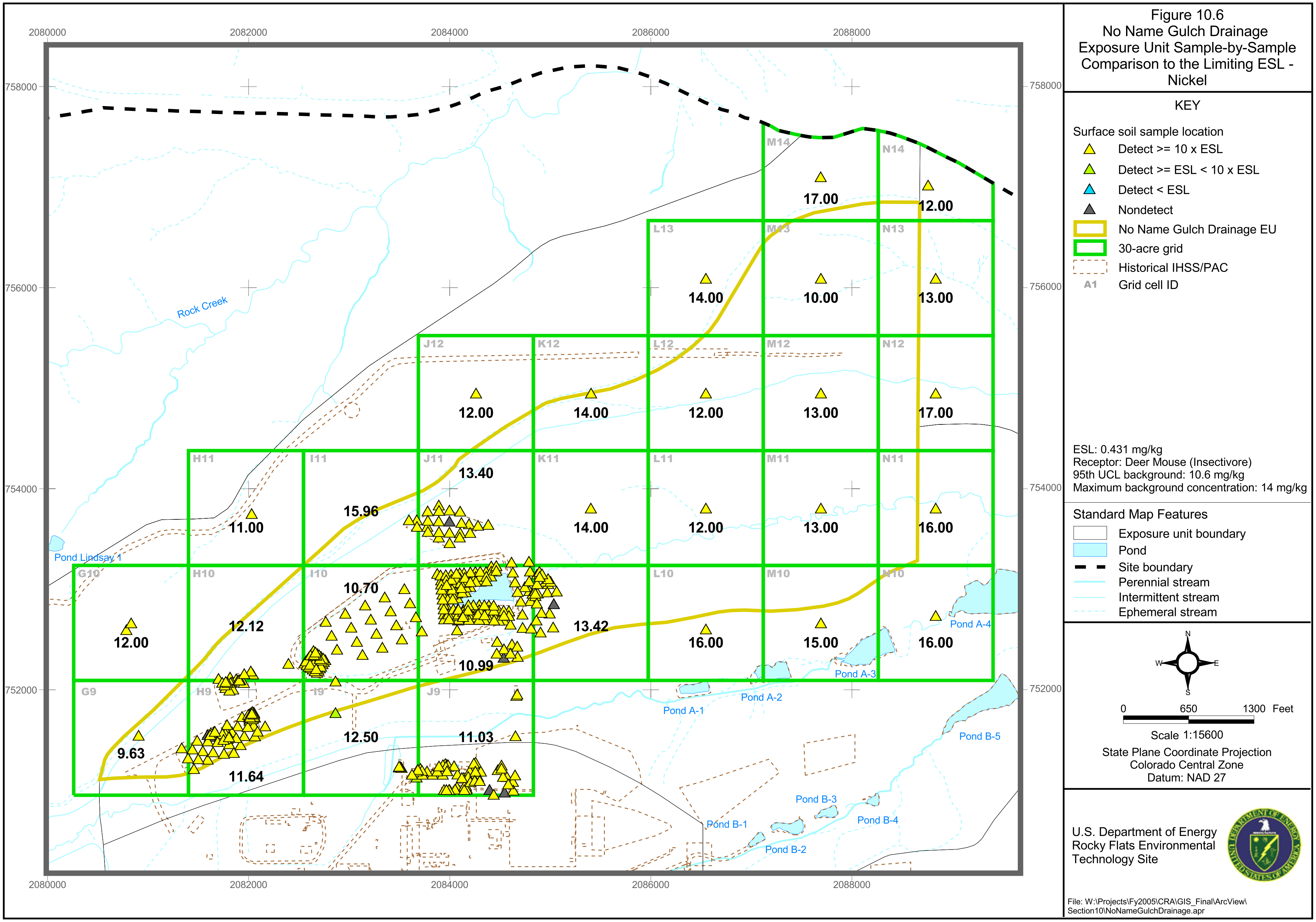
Figure 10.6
No Name Gulch Drainage
Exposure Unit Sample-by-Sample
Comparison to the Limiting ESL -
Nickel
KEY
Surface soil sample location
Detect >= 10 x ESL
Detect >= ESL < 10 x ESL
Detect < ESL
Nondetect
No Name Gulch Drainage EU
30-acre grid
Historical IHSS/PAC
A1 Grid cell ID
ESL: 0.431 mg/kg
Receptor: 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
Scale 1:15600
0 650 1300 Feet
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
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Rock Creek
Pond Lindsay 1
Pond A-1
Pond A-2
Pond A-3
Pond A-4
Pond B-1
Pond B-2
Pond B-3
Pond B-4
Pond B-5
17.00
12.00
14.00
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12.00
14.00
12.00
13.00
17.00
13.40
15.96
11.00
14.00
12.00
13.00
16.00
10.70
12.12
12.00
13.42
16.00
15.00
16.00
10.99
9.63
12.50
11.03
11.64
2080000
2082000
2084000
2086000
2088000
758000
756000
754000
752000
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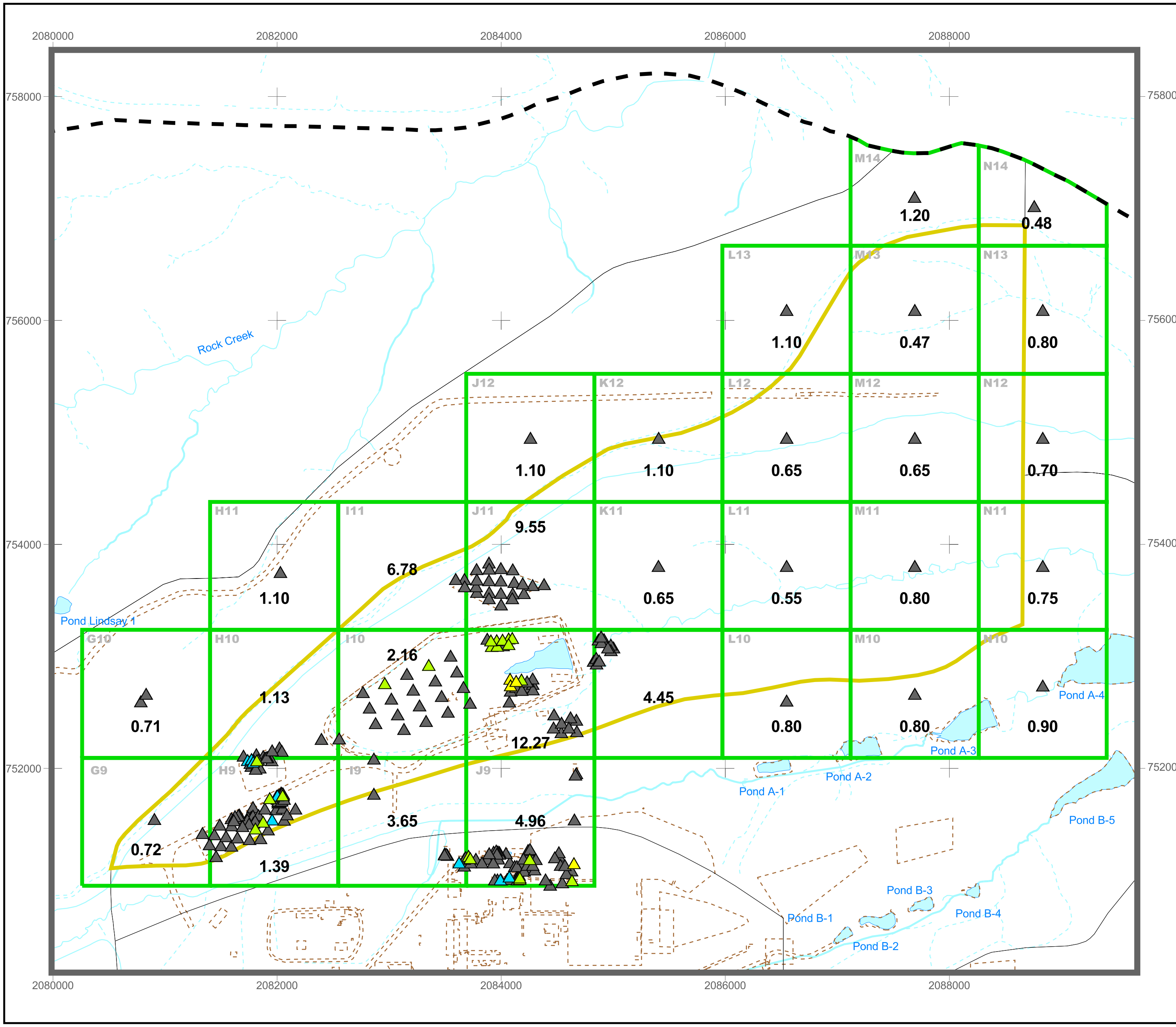
Figure 10.7
No Name Gulch Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Tin



KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- No Name Gulch 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

N S E W

0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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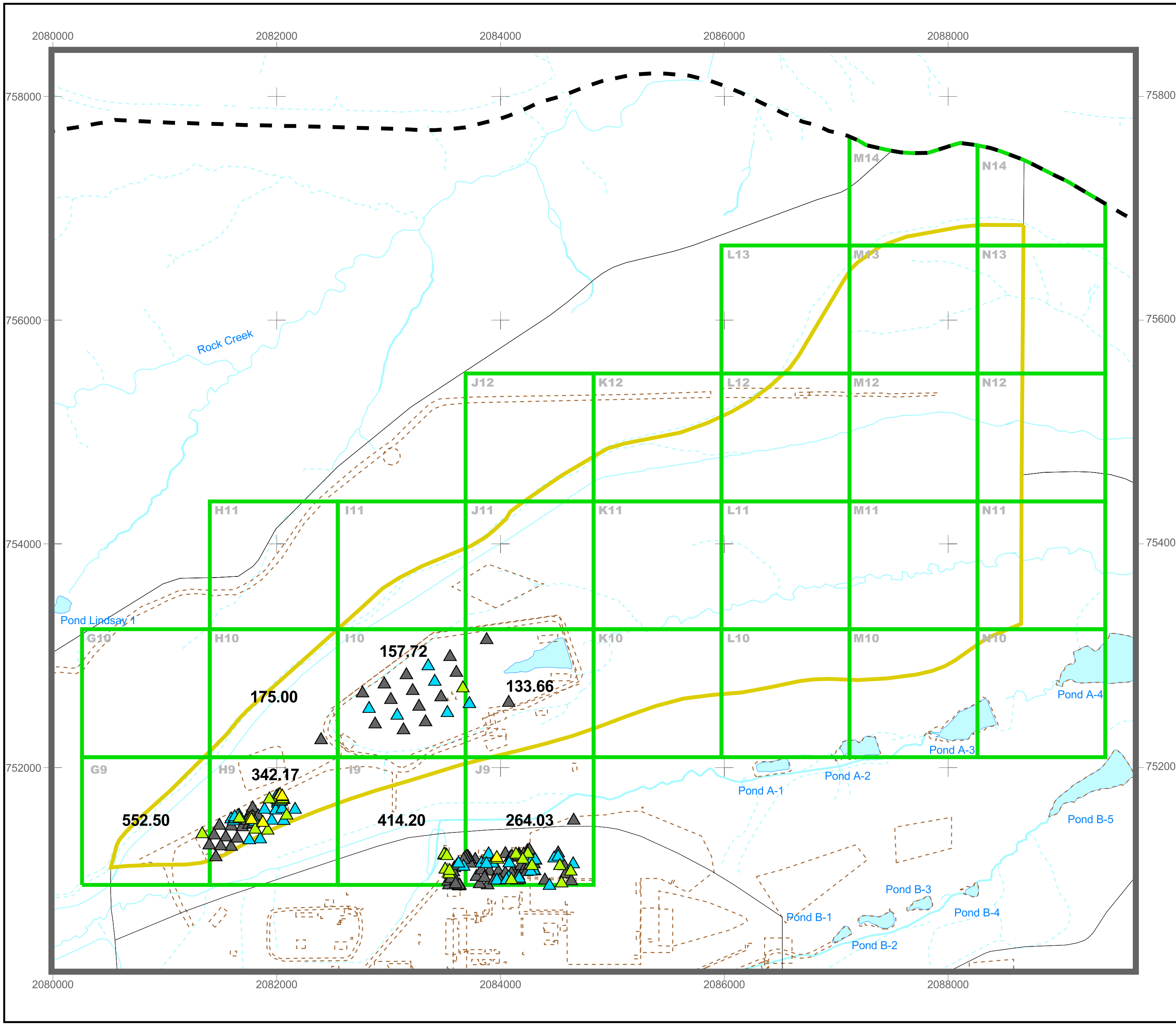
File: W:\Projects\Fy2005\CRA\GIS_Final\ArcView\Section10\NoNameGulchDrainage.apr

Figure 10.8
No Name Gulch 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
- No Name Gulch Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 137 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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0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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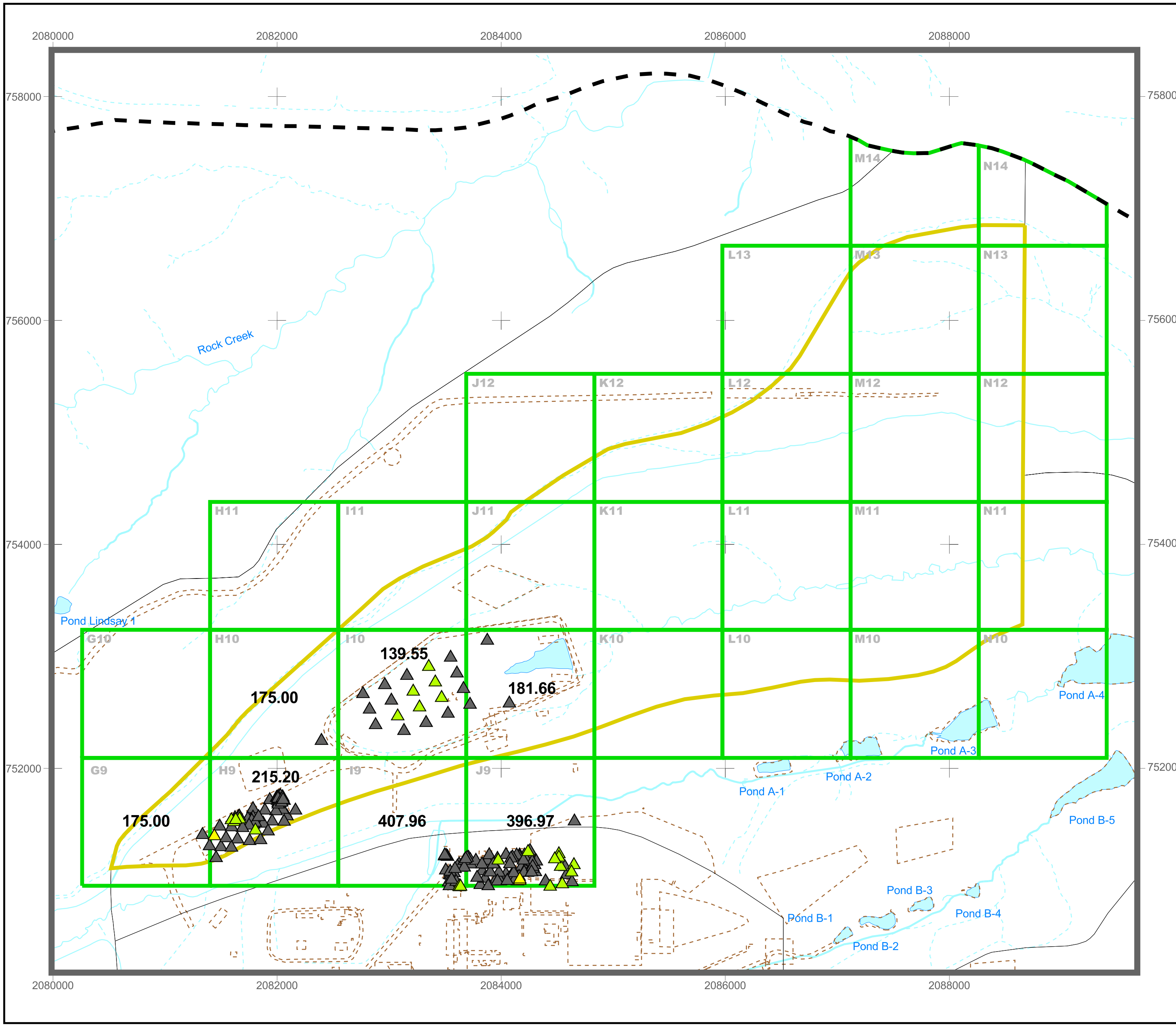

Figure 10.9
No Name Gulch Drainage Exposure Unit Sample-by-Sample Comparison to the Limiting ESL - Di-n-butylphthalate

KEY

Surface soil sample location

- Detect >= 10 x ESL
- Detect >= ESL < 10 x ESL
- Detect < ESL
- Nondetect
- No Name Gulch Drainage EU
- 30-acre grid
- Historical IHSS/PAC
- A1 Grid cell ID

ESL: 15.9 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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0 650 1300 Feet

Scale 1:15600

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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

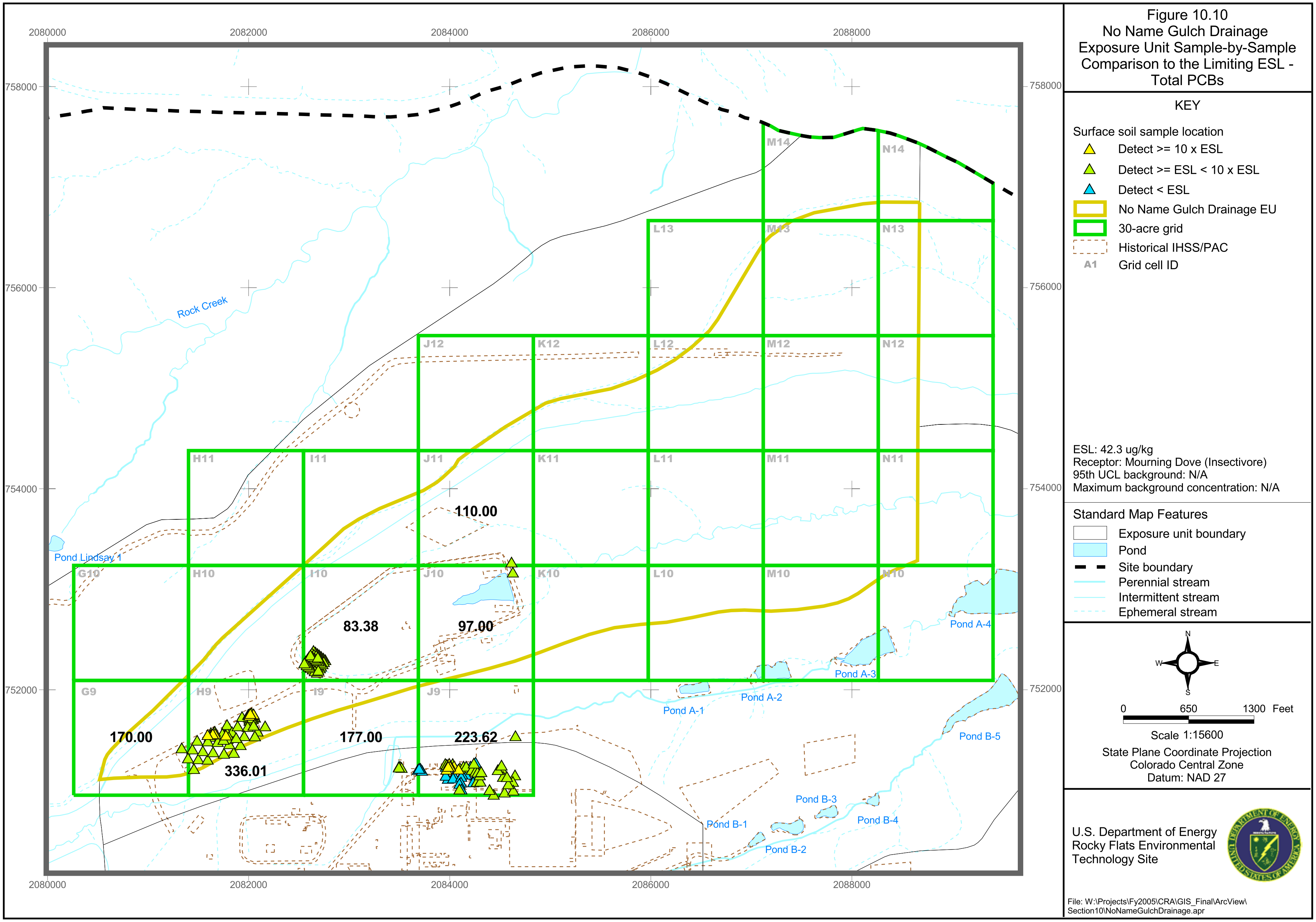

Figure 10.10
No Name Gulch Drainage
Exposure Unit Sample-by-Sample
Comparison to the Limiting ESL -
Total PCBs

COMPREHENSIVE RISK ASSESSMENT

NO NAME GULCH DRAINAGE EXPOSURE UNIT

VOLUME 6: ATTACHMENT 1

Detection Limit Screen

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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
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
NNEU	No Name Gulch Drainage Exposure Unit

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
WRW	wildlife refuge worker

1.0 EVALUATION OF ANALYTE DETECTION LIMITS FOR THE NO NAME GULCH DRAINAGE EXPOSURE UNIT

For the No Name Gulch Drainage Exposure Unit (EU) (NNEU), 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 4 analytes in surface soil/surface sediment where some percent of the reported results exceed the PRG: 3,3'-dichlorobenzidine (0.99 percent), dibenz(a,h)anthracene (26.5 percent), hexachlorobenzene (0.98 percent), and N-nitroso-di-n-propylamine (15.5 percent). In all cases, greater than 70 percent of the reported results are less than the PRGs. Therefore, because only a few analytes have reported results that exceed the PRGs, and for these analytes, most of the reported results are less than 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 are only 2 analytes in subsurface soil/subsurface sediment where some percent of the reported results exceed the PRG: 1,2-dibromoethane (83.3 percent), and N-nitrosodiethylamine (100 percent). In both cases, the maximum reported result is within a factor of 2 of the PRG. Therefore, because only two analytes have reported results that exceed the PRGs, and for these analytes, the reported results are the same order of magnitude as the PRGs, 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 24 analytes in surface soil where some percent of the reported results exceed the lowest ESL. For over one-half of these analytes, more than 70 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 11 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 11 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 NNEU 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 NNEU (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, all of the 11 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 NNEU surface soil even if detection limits (reported results) had been lower, which minimizes the uncertainty in the overall risk estimates because of their higher reported results. Although the category 3 analyte, 4,4' dichlorodiphenyltrichloroethane (DDT) has a maximum detected concentration (26 ug/kg) in the NNEU more than an order of magnitude above the minimum ESL (would qualify as a category 4 analyte), there are no known historical source areas for DDT in the NNEU, it had a low historical inventory at RFETS, and the NNEU and sitewide detection frequencies are low and similar.

Comparing the maximum reported results to the LOAEL-based soil concentrations indicates more than half of the above noted analytes would present a potential for adverse ecological effects if they were detected at the maximum reported results.

In conclusion, 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 NNEU surface soil even if detection limits (reported results) had been lower. Although some of the analytes would present a potential for adverse ecological effects if they were detected at their maximum reported results, because they are not expected to be ECOPCs in NNEU surface soil, uncertainty in the overall risk estimates is low.

1.2.2 Subsurface Soil

As shown in Table A1.6, only 2,3,7,8- tetrachlorodibenzo-*p*-dioxin (TCDD) in subsurface soil has reported results that exceed the ESL. However, there was only one sample collected for 2,3,7,8-TCDD analysis, and the reported result is within a factor of two of the ESL. Therefore, because only one analyte has reported results that exceed the ESL, and for this analyte, the reported result is the same order of magnitude as the ESL, 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 Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Surface Soil/Surface Sediment in the LWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Uranium	1.40	-	18	56	333	0	0	No
Organic (ug/kg)								
1,1,1-Trichloroethane	6	-	16	15	9.18E+06	0	0	No
1,1,2,2-Tetrachloroethane	6	-	16	15	10,483	0	0	No
1,1,2-Trichloroethane	6	-	16	15	28,022	0	0	No
1,1-Dichloroethane	6	-	16	15	2.72E+06	0	0	No
1,1-Dichloroethene	6	-	16	15	17,366	0	0	No
1,2,4-Trichlorobenzene	360	-	2,100	31	151,360	0	0	No
1,2-Dichlorobenzene	360	-	2,100	27	2.89E+06	0	0	No
1,2-Dichloroethane	6	-	16	15	13,270	0	0	No
1,2-Dichloroethene	6	-	16	15	999,783	0	0	No
1,2-Dichloropropane	6	-	16	15	38,427	0	0	No
1,3-Dichlorobenzene	360	-	2,100	31	3.33E+06	0	0	No
1,4-Dichlorobenzene	360	-	2,100	27	91,315	0	0	No
1234789-HpCDF	0.00271	-	0.00271	1		0	0	No
123478-HxCDD	0.00271	-	0.00271	1	0.483	0	0	No
123478-HxCDF	0.00271	-	0.00271	1		0	0	No
123678-HxCDD	0.00271	-	0.00271	1	0.483	0	0	No
123678-HxCDF	0.00271	-	0.00271	1		0	0	No
123789-HxCDD	0.00271	-	0.00271	1	0.483	0	0	No
123789-HxCDF	0.00271	-	0.00271	1		0	0	No
12378-PeCDF	0.00271	-	0.00271	1		0	0	No
2,4,5-Trichlorophenol	1,200	-	10,000	31	8.01E+06	0	0	No
2,4,6-Trichlorophenol	360	-	2,100	31	272,055	0	0	No
2,4-Dichlorophenol	360	-	2,100	31	240,431	0	0	No
2,4-Dimethylphenol	360	-	2,100	31	1.60E+06	0	0	No
2,4-Dinitrophenol	1,700	-	10,000	28	160,287	0	0	Yes
2,4-Dinitrotoluene	360	-	2,100	31	160,287	0	0	No
2,6-Dinitrotoluene	360	-	2,100	31	80,144	0	0	No
234678-HxCDF	0.00271	-	0.00271	1		0	0	No
23478-PeCDF	0.00271	-	0.00271	1		0	0	No
2378-TCDD	0.00108	-	0.00108	1	0.0248	0	0	No
2378-TCDF	0.00108	-	0.00108	1		0	0	No
2-Chloronaphthalene	360	-	2,100	31	6.41E+06	0	0	No
2-Chlorophenol	360	-	2,100	31	555,435	0	0	No
2-Hexanone	12	-	32	14		0	0	No
2-Methylnaphthalene	360	-	2,100	31	320,574	0	0	No
2-Methylphenol	360	-	2,100	31	4.01E+06	0	0	No
2-Nitroaniline	1,700	-	10,000	31	192,137	0	0	No
2-Nitrophenol	360	-	2,100	31		0	0	No
3,3'-Dichlorobenzidine	720	-	4,100	31	6,667	0	0	No
3-Nitroaniline	1,700	-	10,000	31		0	0	No
4,4'-DDD	17	-	200	28	15,528	0	0	No
4,4'-DDE	17	-	200	28	10,961	0	0	No
4,4'-DDT	17	-	200	28	10,927	0	0	No
4,6-Dinitro-2-methylphenol	1,700	-	10,000	30	8,014	1	3.33	Yes
4-Bromophenyl-phenylether	360	-	2,100	31		0	0	No
4-Chloro-3-methylphenol	360	-	3,100	31		0	0	No
4-Chloroaniline	360	-	3,100	31	320,574	0	0	No
4-Chlorophenyl-phenyl ether	360	-	2,100	31		0	0	No
4-Nitroaniline	1,700	-	10,000	30	207,917	0	0	No
4-Nitrophenol	1,700	-	10,000	31	641,148	0	0	No
Acenaphthylene	360	-	2,100	31		0	0	No

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

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Aldrin	8.60	-	99	27	176	0	0	Yes
alpha-BHC	8.60	-	99	28	570	0	0	No
alpha-Chlordane	86	-	990	27	10,261	0	0	Yes
Ametryne	50	-	50	1		0	0	No
Atraton	50	-	50	1		0	0	No
Atrazine	50	-	50	1	13,636	0	0	No
Benzene	6	-	16	15	23,563	0	0	No
Benzo(g,h,i)perylene	360	-	2,100	30		0	0	Yes
Benzyl Alcohol	360	-	3,100	31	2.40E+07	0	0	No
beta-BHC	8.60	-	99	27	1,995	0	0	Yes
beta-Chlordane	86	-	270	11	10,261	0	0	No
bis(2-Chloroethoxy) methane	360	-	2,100	31		0	0	No
bis(2-Chloroethyl) ether	360	-	2,100	31	3,767	0	0	No
bis(2-Chloroisopropyl) ether	360	-	2,100	31	59,301	0	0	No
Bromodichloromethane	6	-	16	15	67,070	0	0	No
Bromoform	6	-	16	15	419,858	0	0	No
Bromomethane	12	-	32	15	20,959	0	0	No
Butylbenzylphthalate	360	-	2,100	30	1.60E+07	0	0	Yes
Carbon Disulfide	6	-	16	15	1.64E+06	0	0	No
Carbon Tetrachloride	6	-	16	15	8,446	0	0	No
Chlorobenzene	6	-	16	15	666,523	0	0	No
Chloroethane	12	-	32	15	1.43E+06	0	0	No
Chloroform	6	-	16	15	7,850	0	0	No
Chloromethane	15	-	32	13	115,077	0	0	No
cis-1,3-Dichloropropene	6	-	16	15	19,432	0	0	No
delta-BHC	8.60	-	99	27	570	0	0	Yes
Dibenz(a,h)anthracene	360	-	2,100	30	379	29	96.7	Yes
Dibenzofuran	360	-	2,100	31	222,174	0	0	No
Dibromochloromethane	6	-	16	15	49,504	0	0	No
Dieldrin	17	-	200	28	187	1	3.57	No
Diethylphthalate	360	-	2,100	31	6.41E+07	0	0	No
Dimethylphthalate	360	-	2,100	31	8.01E+08	0	0	No
Di-n-octylphthalate	360	-	2,100	31	3.21E+06	0	0	No
Endosulfan I	8.60	-	99	27	480,861	0	0	Yes
Endosulfan II	17	-	200	28	480,861	0	0	No
Endosulfan sulfate	17	-	200	28	480,861	0	0	No
Endrin	17	-	200	28	24,043	0	0	No
Endrin ketone	17	-	200	28	33,326	0	0	No
Ethylbenzene	6	-	16	15	5.39E+06	0	0	No
Fluorene	360	-	2,100	31	3.21E+06	0	0	No
gamma-BHC (Lindane)	8.60	-	99	27	2,771	0	0	Yes
Heptachlor	8.60	-	99	27	665	0	0	Yes
Heptachlor epoxide	8.60	-	99	27	329	0	0	Yes
Hexachlorobenzene	360	-	2,100	31	1,870	1	3.23	No
Hexachlorobutadiene	360	-	2,100	31	22,217	0	0	No
Hexachlorocyclopentadiene	360	-	2,100	30	380,452	0	0	No
Hexachloroethane	360	-	2,100	31	111,087	0	0	No
Isophorone	360	-	2,100	31	3.16E+06	0	0	No
Methoxychlor	86	-	990	28	400,718	0	0	No
Naphthalene	360	-	2,100	31	1.40E+06	0	0	No
Nitrobenzene	360	-	2,100	31	43,246	0	0	No
N-Nitroso-di-n-propylamine	360	-	2,100	31	429	24	77.4	No
N-nitrosodiphenylamine	360	-	2,100	31	612,250	0	0	No

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

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
PCB-1016	58	-	990	32	1,349	0	0	No
PCB-1221	58	-	990	32	1,349	0	0	No
PCB-1232	58	-	990	32	1,349	0	0	No
PCB-1242	58	-	990	32	1,349	0	0	No
PCB-1248	58	-	990	32	1,349	0	0	No
PCB-1260	58	-	2,000	32	1,349	2	6.25	No
Pentachlorodibenzo-p-dioxin	0.00271	-	0.00271	1		0	0	No
Pentachlorophenol	1,700	-	10,000	30	17,633	0	0	Yes
Phenol	360	-	2,100	30	2.40E+07	0	0	Yes
Prometon	50	-	50	1		0	0	No
Prometryn	50	-	50	1		0	0	No
Propazine	50	-	50	1		0	0	No
Pyridine	1,200	-	1,600	4		0	0	No
Simazine	50	-	50	1	25,000	0	0	No
Simetryn	50	-	50	1		0	0	No
Styrene	6	-	16	15	1.38E+07	0	0	No
Terbutryn	50	-	50	1		0	0	No
Terbutylazine	50	-	50	1		0	0	No
Tetrachloroethene	6	-	16	15	6,705	0	0	No
Toxaphene	170	-	2,000	28	2,720	0	0	No
trans-1,3-Dichloropropene	6	-	16	15	20,820	0	0	No
Trichloroethene	6	-	16	15	1,770	0	0	No
Vinyl acetate	12	-	32	15	2.65E+06	0	0	No
Vinyl Chloride	12	-	32	15	2,169	0	0	No
Xylene	6	-	16	15	1.06E+06	0	0	No

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

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Silver	0.0730	-	1.40	51	6,388	0	0	Yes
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	0.952	-	6	3	1.05E+06	0	0	No
1,1,1-Trichloroethane	0.841	-	16	23	1.06E+08	0	0	No
1,1,2,2-Tetrachloroethane	0.928	-	16	23	120,551	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	0.840	-	6	3	2.74E+10	0	0	No
1,1,2-Trichloroethane	1.57	-	16	23	322,253	0	0	No
1,1-Dichloroethane	0.782	-	16	23	3.12E+07	0	0	No
1,1-Dichloroethene	0.873	-	16	23	199,706	0	0	No
1,1-Dichloropropene	0.606	-	6	3		0	0	No
1,2,3-Trichlorobenzene	2.05	-	6	3		0	0	No
1,2,3-Trichloropropane	1.08	-	6	3	23,910	0	0	No
1,2,4-Trichlorobenzene	1.76	-	1,800	13	1.74E+06	0	0	No
1,2,4-Trimethylbenzene	1.20	-	6	3	1.53E+06	0	0	No
1,2-Dibromo-3-chloropropane	2.21	-	6	3	34,137	0	0	No
1,2-Dibromoethane	1.34	-	6	3	403	0	0	No
1,2-Dichlorobenzene	1.08	-	1,800	11	3.32E+07	0	0	No
1,2-Dichloroethane	1.17	-	16	23	152,603	0	0	No
1,2-Dichloroethene	5	-	16	20	1.15E+07	0	0	No
1,2-Dichloropropane	0.747	-	16	23	441,907	0	0	No
1,3,5-Trimethylbenzene	0.942	-	6	3	1.31E+06	0	0	No
1,3-Dichlorobenzene	0.911	-	1,800	13	3.83E+07	0	0	No
1,3-Dichloropropane	0.850	-	6	3		0	0	No
1,4-Dichlorobenzene	1.32	-	1,800	11	1.05E+06	0	0	No
1234789-HpCDF	0.00147	-	0.00226	3		0	0	No
123478-HxCDD	0.00147	-	0.00226	3	5.55	0	0	No
123678-HxCDD	0.00147	-	0.00226	3	5.55	0	0	No
123789-HxCDD	0.00147	-	0.00226	3	5.55	0	0	No
123789-HxCDF	0.00147	-	0.00226	3		0	0	No
2,2-Dichloropropane	0.667	-	6	3		0	0	No
2,4,5-Trichlorophenol	410	-	8,900	11	9.22E+07	0	0	No
2,4,6-Trichlorophenol	340	-	1,800	11	3.13E+06	0	0	No
2,4-Dichlorophenol	340	-	1,800	11	2.76E+06	0	0	No
2,4-Dimethylphenol	340	-	1,800	11	1.84E+07	0	0	No
2,4-Dinitrophenol	1,600	-	8,900	11	1.84E+06	0	0	No
2,4-Dinitrotoluene	340	-	1,800	11	1.84E+06	0	0	No
2,6-Dinitrotoluene	340	-	1,800	11	921,651	0	0	No
2-Butanone	3.89	-	119	15	5.33E+08	0	0	No
2-Chloronaphthalene	340	-	1,800	11	7.37E+07	0	0	No
2-Chlorophenol	340	-	1,800	11	6.39E+06	0	0	No
2-Chlorotoluene	0.680	-	6	3	2.56E+07	0	0	No
2-Hexanone	2.20	-	59.5	23		0	0	No
2-Methylnaphthalene	340	-	1,800	11	3.69E+06	0	0	No
2-Methylphenol	340	-	1,800	11	4.61E+07	0	0	No
2-Nitroaniline	1,600	-	8,900	11	2.21E+06	0	0	No
2-Nitrophenol	340	-	1,800	11		0	0	No
3,3'-Dichlorobenzidine	670	-	3,700	11	76,667	0	0	No
3-Nitroaniline	1,600	-	8,900	10		0	0	No
4,4'-DDD	33	-	100	7	178,570	0	0	No
4,4'-DDE	33	-	100	7	126,049	0	0	No
4,4'-DDT	33	-	100	7	125,658	0	0	No
4,6-Dinitro-2-methylphenol	1,600	-	8,900	11	92,165	0	0	No
4-Bromophenyl-phenylether	340	-	1,800	11		0	0	No
4-Chloro-3-methylphenol	340	-	2,700	11		0	0	No
4-Chloroaniline	340	-	2,700	11	3.69E+06	0	0	No
4-Chlorophenyl-phenyl ether	340	-	1,800	11		0	0	No
4-Chlorotoluene	0.891	-	6	3		0	0	No
4-Isopropyltoluene	0.990	-	6	3		0	0	No

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

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
4-Methyl-2-pentanone	2.78	-	59.5	21	9.57E+08	0	0	No
4-Methylphenol	340	-	1,800	11	4.61E+06	0	0	No
4-Nitroaniline	1,600	-	8,900	11	2.39E+06	0	0	No
4-Nitrophenol	1,600	-	8,900	11	7.37E+06	0	0	No
Acenaphthylene	340	-	1,800	11		0	0	No
Aldrin	17	-	50	7	2,024	0	0	No
alpha-BHC	17	-	50	7	6,555	0	0	No
alpha-Chlordane	170	-	500	7	117,997	0	0	No
Ametryne	50	-	50	1		0	0	No
Atraton	50	-	50	1		0	0	No
Atrazine	50	-	410	2	156,820	0	0	No
Benzene	0.900	-	16	23	270,977	0	0	No
Benzo(b)fluoranthene	340	-	1,800	11	43,616	0	0	No
Benzo(g,h,i)perylene	340	-	1,800	11		0	0	No
Benzo(k)fluoranthene	340	-	1,800	11	436,159	0	0	No
Benzyl Alcohol	340	-	2,700	10	2.76E+08	0	0	No
beta-BHC	17	-	50	7	22,942	0	0	No
beta-Chlordane	330	-	330	1	117,997	0	0	No
bis(2-Chloroethoxy) methane	340	-	1,800	11		0	0	No
bis(2-Chloroethyl) ether	340	-	1,800	11	43,315	0	0	No
bis(2-Chloroisopropyl) ether	340	-	1,800	10	681,967	0	0	No
Bromobenzene	0.954	-	6	3		0	0	No
Bromochloromethane	1.03	-	6	3		0	0	No
Bromodichloromethane	1.08	-	16	23	771,304	0	0	No
Bromoform	1.18	-	16	23	4.83E+06	0	0	No
Bromomethane	4.43	-	32	21	241,033	0	0	No
Butylbenzylphthalate	340	-	1,800	11	1.84E+08	0	0	No
Carbon Disulfide	0.898	-	16	23	1.88E+07	0	0	No
Carbon Tetrachloride	0.823	-	16	23	97,124	0	0	No
Chlorobenzene	0.717	-	16	23	7.67E+06	0	0	No
Chloroethane	2.23	-	32	23	1.65E+07	0	0	No
Chloroform	0.777	-	16	23	90,270	0	0	No
Chloromethane	2.51	-	32	23	1.32E+06	0	0	No
cis-1,2-Dichloroethene	1.13	-	6	3	1.28E+07	0	0	No
cis-1,3-Dichloropropene	1.13	-	16	23	223,462	0	0	No
delta-BHC	17	-	50	7	6,555	0	0	No
Dibenz(a,h)anthracene	340	-	1,800	10	4,362	0	0	No
Dibenzofuran	340	-	1,800	11	2.56E+06	0	0	No
Dibromochloromethane	1.17	-	16	23	569,296	0	0	No
Dibromomethane	1.12	-	6	3		0	0	No
Dichlorodifluoromethane	2.76	-	6	3	2.64E+06	0	0	No
Dieldrin	33	-	100	7	2,151	0	0	No
Diethylphthalate	340	-	1,800	11	7.37E+08	0	0	No
Dimethylphthalate	340	-	1,800	11	9.22E+09	0	0	No
Di-n-octylphthalate	340	-	1,800	11	3.69E+07	0	0	No
Endosulfan I	17	-	50	7	5.53E+06	0	0	No
Endosulfan II	33	-	100	7	5.53E+06	0	0	No
Endosulfan sulfate	33	-	100	7	5.53E+06	0	0	No
Endrin	33	-	100	7	276,495	0	0	No
Endrin ketone	33	-	100	7	383,250	0	0	No
Ethylbenzene	0.657	-	16	23	6.19E+07	0	0	No
Fluorene	340	-	1,800	11	3.69E+07	0	0	No
gamma-BHC (Lindane)	17	-	50	7	31,864	0	0	No
gamma-Chlordane	170	-	500	6	117,997	0	0	No
Heptachlor	17	-	50	7	7,647	0	0	No
Heptachlor epoxide	17	-	50	7	3,782	0	0	No
Hexachlorobenzene	340	-	1,800	11	21,508	0	0	No
Hexachlorobutadiene	1.13	-	1,800	13	255,500	0	0	No

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

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	PRG	Number of Nondetected Results > PRG	Percent Nondetected Results > PRG	Analyte Detected?
Inorganic (mg/kg)								
Hexachlorocyclopentadiene	340	-	1,800	11	4.38E+06	0	0	No
Hexachloroethane	340	-	1,800	11	1.28E+06	0	0	No
Isophorone	340	-	1,800	11	3.63E+07	0	0	No
Isopropylbenzene	0.516	-	6	3	375,823	0	0	No
Methoxychlor	170	-	500	7	4.61E+06	0	0	No
n-Butylbenzene	1.34	-	6	3		0	0	No
Nitrobenzene	340	-	1,800	11	497,333	0	0	No
N-Nitroso-di-n-propylamine	340	-	1,800	11	4,929	0	0	No
N-nitrosodiphenylamine	340	-	1,800	11	7.04E+06	0	0	No
n-Propylbenzene	0.828	-	6	3		0	0	No
PCB-1016	41	-	500	9	15,514	0	0	No
PCB-1221	41	-	500	9	15,514	0	0	No
PCB-1232	41	-	500	9	15,514	0	0	No
PCB-1242	41	-	500	9	15,514	0	0	No
PCB-1248	41	-	500	9	15,514	0	0	No
PCB-1260	41	-	1,000	9	15,514	0	0	No
Pentachlorophenol	1,600	-	8,900	11	202,777	0	0	No
Phenol	340	-	1,800	11	2.76E+08	0	0	No
Prometon	50	-	50	1		0	0	No
Prometryn	50	-	50	1		0	0	No
Propazine	50	-	50	1		0	0	No
Pyrene	340	-	1,800	11	2.55E+07	0	0	No
Pyridine	820	-	1,400	2		0	0	No
sec-Butylbenzene	0.786	-	6	3		0	0	No
Simazine	50	-	50	1	287,502	0	0	No
Simetryn	50	-	50	1		0	0	No
Styrene	0.900	-	16	23	1.59E+08	0	0	No
Terbutryn	50	-	50	1		0	0	No
Terbutylazine	50	-	50	1		0	0	No
tert-Butylbenzene	1.06	-	6	3		0	0	No
Toxaphene	330	-	1,000	7	31,284	0	0	No
trans-1,2-Dichloroethene	1.09	-	6	3	3.30E+06	0	0	No
trans-1,3-Dichloropropene	1.09	-	16	21	239,434	0	0	No
Trichloroethene	0.715	-	16	23	20,354	0	0	No
Trichlorofluoromethane	0.935	-	6	3	1.74E+07	0	0	No
Vinyl acetate	10	-	32	18	3.04E+07	0	0	No
Vinyl Chloride	2.45	-	32	23	24,948	0	0	No
Xylene	3.50	-	16	22	1.22E+07	0	0	Yes

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

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
Uranium	1.40	-	1.80	46	5	0	0	No
Organic (ug/kg)								
1,2,4-Trichlorobenzene	360	-	1,100	9	777	2	22.2	No
1,2-Dichlorobenzene	360	-	1,100	9		0	0	No
1,3-Dichlorobenzene	360	-	1,100	9		0	0	No
1,4-Dichlorobenzene	360	-	1,100	9	20,000	0	0	No
2,4,5-Trichlorophenol	1,700	-	5,300	9	4,000	2	22.2	No
2,4,6-Trichlorophenol	360	-	1,100	9	161	9	100	No
2,4-Dichlorophenol	360	-	1,100	9	2,744	0	0	No
2,4-Dimethylphenol	360	-	1,100	9		0	0	No
2,4-Dinitrophenol	1,700	-	5,300	9	20,000	0	0	No
2,4-Dinitrotoluene	360	-	1,100	9	32.1	9	100	No
2,6-Dinitrotoluene	360	-	1,100	9	6,186	0	0	No
2-Chloronaphthalene	360	-	1,100	9		0	0	No
2-Chlorophenol	360	-	1,100	9	281	9	100	No
2-Methylnaphthalene	360	-	1,100	9	2,769	0	0	No
2-Methylphenol	360	-	1,100	9	123,842	0	0	No
2-Nitroaniline	1,700	-	5,300	9	5,659	0	0	No
2-Nitrophenol	360	-	1,100	9		0	0	No
3,3'-Dichlorobenzidine	720	-	2,100	9		0	0	No
3-Nitroaniline	1,700	-	5,300	9		0	0	No
4,4'-DDD	17	-	52	9	13,726	0	0	No
4,4'-DDE	17	-	52	9	7.95	9	100	No
4,4'-DDT	17	-	52	9	1.20	9	100	No
4,6-Dinitro-2-methylphenol	1,700	-	5,300	9	560	9	100	No
4-Bromophenyl-phenylether	360	-	1,100	9		0	0	No
4-Chloro-3-methylphenol	360	-	1,100	9		0	0	No
4-Chloroaniline	360	-	1,100	9	716	2	22.2	No
4-Chlorophenyl-phenyl ether	360	-	1,100	9		0	0	No
4-Methylphenol	360	-	1,100	9		0	0	No
4-Nitroaniline	1,700	-	5,300	9	41,050	0	0	No
4-Nitrophenol	1,700	-	5,300	9	7,000	0	0	No
Acenaphthene	360	-	1,100	9	20,000	0	0	No
Acenaphthylene	360	-	1,100	9		0	0	No
Aldrin	8.60	-	26	9	47.0	0	0	No
alpha-BHC	8.60	-	26	9	18,662	0	0	No
alpha-Chlordane	86	-	260	9	289	0	0	No
Anthracene	360	-	1,100	9		0	0	No
Benzo(a)anthracene	360	-	1,100	9		0	0	No
Benzo(a)pyrene	360	-	1,100	9	631	4	44.4	No
Benzo(b)fluoranthene	360	-	1,100	9		0	0	No
Benzo(g,h,i)perylene	360	-	1,100	9		0	0	No
Benzo(k)fluoranthene	360	-	1,100	9		0	0	No
Benzyl Alcohol	360	-	1,100	9	4,403	0	0	No
beta-BHC	8.60	-	26	9	207	0	0	No
beta-Chlordane	86	-	100	5	289	0	0	No
bis(2-Chloroethoxy) methane	360	-	1,100	9		0	0	No
bis(2-Chloroethyl) ether	360	-	1,100	9		0	0	No
bis(2-Chloroisopropyl) ether	360	-	1,100	9		0	0	No
Butylbenzylphthalate	360	-	1,100	9	24,155	0	0	No
delta-BHC	8.60	-	26	9	25.9	1	11.1	No
Dibenz(a,h)anthracene	360	-	1,100	9		0	0	No
Dibenzofuran	360	-	1,100	9	21,200	0	0	No

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

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
Dieldrin	17	-	52	9	7.40	9	100	No
Diethylphthalate	360	-	1,100	9	100,000	0	0	No
Dimethylphthalate	360	-	1,100	9	200,000	0	0	No
Di-n-butylphthalate	360	-	1,100	9	15.9	9	100	No
Di-n-octylphthalate	360	-	1,100	9	731,367	0	0	No
Endosulfan I	8.60	-	26	9	80.1	0	0	No
Endosulfan II	17	-	52	9	80.1	0	0	No
Endosulfan sulfate	17	-	52	9	80.1	0	0	No
Endrin	17	-	52	9	1.40	9	100	No
Endrin ketone	17	-	52	9	1.40	9	100	No
Fluorene	360	-	1,100	9	30,000	0	0	No
gamma-BHC (Lindane)	8.60	-	26	9	25.9	1	11.1	No
gamma-Chlordane	160	-	260	4	289	0	0	No
Heptachlor	8.60	-	26	9	63.3	0	0	No
Heptachlor epoxide	8.60	-	26	9	64.0	0	0	No
Hexachlorobenzene	360	-	1,100	9	7.73	9	100	No
Hexachlorobutadiene	360	-	1,100	9	431	4	44.4	No
Hexachlorocyclopentadiene	360	-	1,100	9	5,518	0	0	No
Hexachloroethane	360	-	1,100	9	366	8	88.9	No
Indeno(1,2,3-cd)pyrene	360	-	1,100	9		0	0	No
Isophorone	360	-	1,100	9		0	0	No
Methoxychlor	86	-	260	9	1,226	0	0	No
Naphthalene	360	-	1,100	9	27,048	0	0	No
Nitrobenzene	360	-	1,100	9	40,000	0	0	No
N-Nitroso-di-n-propylamine	360	-	1,100	9		0	0	No
N-nitrosodiphenylamine	360	-	1,100	9	20,000	0	0	No
PCB-1016	86	-	260	9	172	2	22.2	No
PCB-1221	86	-	260	9	172	2	22.2	No
PCB-1232	86	-	260	9	172	2	22.2	No
PCB-1242	86	-	260	9	172	2	22.2	No
PCB-1248	86	-	260	9	172	2	22.2	No
PCB-1254	170	-	520	9	172	8	88.9	No
PCB-1260	170	-	520	9	172	8	88.9	No
Pentachlorophenol	1,700	-	5,300	9	122	9	100	No
Phenol	360	-	1,100	9	23,090	0	0	No
Toxaphene	170	-	520	9	3,756	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

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
1,2-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
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

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
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
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

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
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
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 LOWEU 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 LOWEU Soil (ug/kg)	Detection Frequency in LOWEU 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 LOWEU (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	1100	0.07	No
2,4-Dinitrotoluene	No	0/0	N/A	0	NA	0	No	1	32.1	Deer Mouse Insectivore	10	321	1100	3	Yes
2-Chlorophenol	No	0.12/0.02	N/A	0	NA	0	No	1	281	Deer Mouse Insectivore	100	28100	1100	0.04	No
4,4'-DDE	No	0/0.001	7.2	1.5	NA	0	No	2	7.95	Mourning Dove Insectivore	10	79.5	52	0.7	No
4,4'-DDT	No	0/0.001	26	0.9	NA	0	No	2	1.20	Mourning Dove Insectivore	167	200.4	52	0.3	No
4,6-Dinitro-2-methylphenol	No	0/0	390	0.1	NA	0	No	2	560	Deer Mouse Insectivore	20	11200	5300	0.5	No
Dieldrin	No	0/0/003	92	2.4	NA	0	No	2	7.4	Deer Mouse Insectivore	2	14.8	52	4	Yes
Di-n-butylphthalate	Yes(1)	0/0.005	10000	8.0	NA	0	Yes	3	15.9	Mourning Dove Insectivore	10	159	1000	6	Yes
Endrin	No	0/0.004	17	1.3	NA	0	No	2	1.40	Mourning Dove Insectivore	10	14	52	4	Yes
Endrin ketone	No	0/0	36	0.2	NA	0	No	2	1.40	Mourning Dove Insectivore	10	14	52	4	Yes
Hexachlorobenzene	No	1.000/1.005	380	0.3	NA	0	No	2	7.73	Mourning Dove Insectivore	40	309	1100	4	Yes
Hexachloroethane	No	0.02/0.02	NA	0	NA	0	No	2	366	Deer Mouse Insectivore	20	7320	1100	0.2	No
PCB-1254	No	0/0.17	8900	17.9	NA	0	No	2	172	Mourning Dove Insectivore	14.1	2425	520	0.2	No
PCB-1260	No	0/0.17	7800	17.2	NA	0	No	2	172	Mourning Dove Insectivore	14.1	2425	520	0.2	No
Pentachlorophenol	No	0.02/0.02	39000	1.0	NA	0	No	3	122	Deer Mouse Insectivore	10	1220	5300	4	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) There are historical IHSSs upgradient of the LWOEU where wastes were burned or there was a release of oil. Phthalates may be a component of the oil.
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
WBEU – Wind Blown Exposure Unit
NA – Not applicable
NVA – No Value Available
I- Inconclusive

Table A1.6
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Subsurface Soil in the LWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
Silver	0.0730	-	1.40	44		0	0	Yes
Organic (ug/kg)								
1,1,1,2-Tetrachloroethane	5.50	-	6	2		0	0	No
1,1,1-Trichloroethane	5	-	6	20	4.85E+07	0	0	No
1,1,2,2-Tetrachloroethane	5	-	6	20	4.70E+06	0	0	No
1,1,2-Trichloro-1,2,2-trifluoroethane	5.50	-	6	2		0	0	No
1,1,2-Trichloroethane	5	-	6	20		0	0	No
1,1-Dichloroethane	5	-	6	20	215,360	0	0	No
1,1-Dichloroethene	5	-	6	20	1.28E+06	0	0	No
1,1-Dichloropropene	5.50	-	6	2		0	0	No
1,2,3-Trichlorobenzene	5.50	-	6	2		0	0	No
1,2,3-Trichloropropane	5.50	-	6	2	1.17E+06	0	0	No
1,2,4-Trichlorobenzene	5.50	-	890	8	94,484	0	0	No
1,2,4-Trimethylbenzene	5.50	-	6	2		0	0	No
1,2-Dibromo-3-chloropropane	5.50	-	6	2		0	0	No
1,2-Dibromoethane	5.50	-	6	2		0	0	No
1,2-Dichlorobenzene	5.50	-	890	8		0	0	No
1,2-Dichloroethane	5	-	6	20	2.00E+06	0	0	No
1,2-Dichloroethene	5	-	6	18	1.87E+06	0	0	No
1,2-Dichloropropane	5	-	6	20	3.92E+06	0	0	No
1,3,5-Trimethylbenzene	5.50	-	6	2	855,709	0	0	No
1,3-Dichlorobenzene	5.50	-	890	8		0	0	No
1,3-Dichloropropane	5.50	-	6	2		0	0	No
1,4-Dichlorobenzene	5.50	-	890	8	5.93E+06	0	0	No
1234789-HpCDF	0.00147	-	0.00154	2		0	0	No
123478-HxCDD	0.00147	-	0.00154	2		0	0	No
123478-HxCDF	0.00147	-	0.00154	2		0	0	No
123678-HxCDD	0.00147	-	0.00154	2		0	0	No
123678-HxCDF	0.00147	-	0.00154	2		0	0	No
123789-HxCDD	0.00147	-	0.00154	2		0	0	No
123789-HxCDF	0.00147	-	0.00154	2		0	0	No
2,2-Dichloropropane	5.50	-	6	2		0	0	No
2,4,5-Trichlorophenol	1,600	-	4,300	6		0	0	No
2,4,6-Trichlorophenol	340	-	890	6	17,263	0	0	No
2,4-Dichlorophenol	340	-	890	6	249,324	0	0	No
2,4-Dimethylphenol	340	-	890	6		0	0	No
2,4-Dinitrophenol	1,600	-	4,300	6	4.90E+06	0	0	No
2,4-Dinitrotoluene	340	-	890	6	2,473	0	0	No
2,6-Dinitrotoluene	340	-	890	6	477,309	0	0	No
2-Butanone	10	-	119	14	4.94E+07	0	0	No
2-Chloronaphthalene	340	-	890	6		0	0	No
2-Chlorophenol	340	-	890	6	21,598	0	0	No
2-Chlorotoluene	5.50	-	6	2		0	0	No
2-Hexanone	10	-	59.5	20		0	0	No
2-Methylnaphthalene	340	-	890	6	319,121	0	0	No
2-Methylphenol	340	-	890	6	9.26E+06	0	0	No
2-Nitroaniline	1,600	-	4,300	6	418,475	0	0	No
2-Nitrophenol	340	-	890	6		0	0	No
3,3'-Dichlorobenzidine	670	-	1,800	6		0	0	No
3-Nitroaniline	1,600	-	3,400	5		0	0	No
4,4'-DDD	33	-	43	4	6.19E+06	0	0	No
4,4'-DDE	33	-	43	4	54,420	0	0	No
4,4'-DDT	33	-	43	4	175,708	0	0	No
4,6-Dinitro-2-methylphenol	1,600	-	4,300	6	44,283	0	0	No
4-Bromophenyl-phenylether	340	-	890	6		0	0	No
4-Chloro-3-methylphenol	340	-	890	6		0	0	No

Table A1.6
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Subsurface Soil in the LWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
4-Chloroaniline	340	-	890	6	48,856	0	0	No
4-Chlorophenyl-phenyl ether	340	-	890	6		0	0	No
4-Chlorotoluene	5.50	-	6	2		0	0	No
4-Isopropyltoluene	5.50	-	6	2		0	0	No
4-Methyl-2-pentanone	10	-	59.5	18	859,131	0	0	No
4-Methylphenol	340	-	890	6		0	0	No
4-Nitroaniline	1,600	-	4,300	6	2.62E+06	0	0	No
4-Nitrophenol	1,600	-	4,300	6	1.02E+06	0	0	No
Acenaphthene	340	-	890	6		0	0	No
Acenaphthylene	340	-	890	6		0	0	No
Aldrin	17	-	22	4	11,282	0	0	No
alpha-BHC	17	-	22	4	2.47E+06	0	0	No
alpha-Chlordane	170	-	220	4	472,808	0	0	No
Anthracene	340	-	890	6		0	0	No
Benzene	5	-	6	20	1.10E+06	0	0	No
Benzo(a)anthracene	340	-	890	6		0	0	No
Benzo(a)pyrene	340	-	890	6	502,521	0	0	No
Benzo(b)fluoranthene	340	-	890	6		0	0	No
Benzo(g,h,i)perylene	340	-	890	6		0	0	No
Benzo(k)fluoranthene	340	-	890	6		0	0	No
Benzyl Alcohol	340	-	710	5	253,015	0	0	No
beta-BHC	17	-	22	4	27,399	0	0	No
bis(2-Chloroethoxy) methane	340	-	890	6		0	0	No
bis(2-Chloroethyl) ether	340	-	890	6		0	0	No
bis(2-Chloroisopropyl) ether	340	-	710	5		0	0	No
bis(2-ethylhexyl)phthalate	340	-	890	6	2.76E+06	0	0	No
Bromobenzene	5.50	-	6	2		0	0	No
Bromochloromethane	5.50	-	6	2		0	0	No
Bromodichloromethane	5	-	6	20	381,135	0	0	No
Bromoform	5	-	6	20	198,571	0	0	No
Bromomethane	5.50	-	13	18		0	0	No
Butylbenzylphthalate	340	-	890	6	3.37E+06	0	0	No
Carbon Disulfide	5	-	6	20	410,941	0	0	No
Carbon Tetrachloride	5	-	6	20	736,154	0	0	No
Chlorobenzene	5	-	6	20	413,812	0	0	No
Chloroethane	5.50	-	13	20		0	0	No
Chloroform	5	-	6	20	560,030	0	0	No
Chloromethane	5.50	-	13	20		0	0	No
Chrysene	340	-	890	6		0	0	No
cis-1,2-Dichloroethene	5.50	-	6	2	132,702	0	0	No
cis-1,3-Dichloropropene	5	-	6	20	222,413	0	0	No
delta-BHC	17	-	22	4	3,425	0	0	No
Dibenz(a,h)anthracene	340	-	890	6		0	0	No
Dibenzofuran	340	-	890	6	2.44E+06	0	0	No
Dibromochloromethane	5	-	6	20	389,064	0	0	No
Dibromomethane	5.50	-	6	2		0	0	No
Dichlorodifluoromethane	5.50	-	6	2	59,980	0	0	No
Dieldrin	33	-	43	4	301	0	0	No
Diethylphthalate	340	-	890	6	2.21E+08	0	0	No
Dimethylphthalate	340	-	890	6	1.35E+07	0	0	No
Di-n-octylphthalate	340	-	890	6	2.58E+08	0	0	No
Endosulfan I	17	-	22	4	8,726	0	0	No
Endosulfan II	33	-	43	4	8,726	0	0	No
Endosulfan sulfate	33	-	43	4	8,726	0	0	No
Endrin	33	-	43	4	8,060	0	0	No
Endrin ketone	33	-	43	4	8,060	0	0	No

Table A1.6
Evaluation of Reported Results for Nondetected Analytes and Analytes with a Detection Frequency less than 5 Percent in Subsurface Soil in the LWOEU

Analyte	Range of Nondetected Reported Results			Total Number of Nondetected Results	Lowest ESL	Number of Nondetected Results > ESL	Percent Nondetected Results > ESL	Analyte Detected?
Inorganic (mg/kg)								
Ethylbenzene	5	-	6	20		0	0	No
Fluoranthene	340	-	890	6		0	0	No
Fluorene	340	-	890	6		0	0	No
gamma-BHC (Lindane)	17	-	22	4	3,425	0	0	No
gamma-Chlordane	170	-	220	4	472,808	0	0	No
Heptachlor	17	-	22	4	12,359	0	0	No
Heptachlor epoxide	17	-	22	4	9,121	0	0	No
Hexachlorobenzene	340	-	890	6	190,142	0	0	No
Hexachlorobutadiene	5.50	-	890	8	150,894	0	0	No
Hexachlorocyclopentadiene	340	-	890	6	799,679	0	0	No
Hexachloroethane	340	-	890	6	45,656	0	0	No
Indeno(1,2,3-cd)pyrene	340	-	710	5		0	0	No
Isophorone	340	-	890	6		0	0	No
Isopropylbenzene	5.50	-	6	2		0	0	No
Methoxychlor	170	-	220	4	228,896	0	0	No
Naphthalene	5.50	-	890	8	1.60E+07	0	0	No
n-Butylbenzene	5.50	-	6	2		0	0	No
Nitrobenzene	340	-	890	6		0	0	No
N-Nitroso-di-n-propylamine	340	-	890	6		0	0	No
N-nitrosodiphenylamine	340	-	890	6	2.15E+06	0	0	No
n-Propylbenzene	5.50	-	6	2		0	0	No
PCB-1016	170	-	220	4	37,963	0	0	No
PCB-1221	170	-	220	4	37,963	0	0	No
PCB-1232	170	-	220	4	37,963	0	0	No
PCB-1242	170	-	220	4	37,963	0	0	No
PCB-1248	170	-	220	4	37,963	0	0	No
PCB-1254	330	-	430	4	37,963	0	0	No
PCB-1260	330	-	430	4	37,963	0	0	No
Pentachlorodibenzo-p-dioxin	0.00147	-	0.00154	2		0	0	No
Pentachlorophenol	1,600	-	4,300	6	18,373	0	0	No
Phenanthrene	340	-	890	6		0	0	No
Phenol	340	-	890	6	1.49E+06	0	0	No
Pyrene	340	-	890	6		0	0	No
sec-Butylbenzene	5.50	-	6	2		0	0	No
Styrene	5	-	6	20	1.53E+06	0	0	No
tert-Butylbenzene	5.50	-	6	2		0	0	No
Toxaphene	330	-	430	4	909,313	0	0	No
trans-1,2-Dichloroethene	5.50	-	6	2	1.87E+06	0	0	No
trans-1,3-Dichloropropene	5	-	6	18	222,413	0	0	No
Trichloroethene	5	-	6	20	32,424	0	0	No
Trichlorofluoromethane	5.50	-	6	2		0	0	No
Vinyl acetate	10	-	13	16	730,903	0	0	No
Vinyl Chloride	5.50	-	13	20	6,494	0	0	No

COMPREHENSIVE RISK ASSESSMENT

NO NAME GULCH DRAINAGE EXPOSURE UNIT

VOLUME 6: ATTACHMENT 2

Data Quality Assessment

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ACRONYMS AND ABBREVIATIONS

AA	atomic absorption
ASD	Analytical Services Division
CCV	continuing calibration verification
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
ESL	ecological screening level
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
NNEU	No Name Gulch Drainage Exposure Unit
PARCC	precision, accuracy, representativeness, completeness, and comparability
PPT	Pipette
PRG	preliminary remediation goal
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
TCLP	Toxicity Characteristic Leaching Procedure
TIC	tentatively identified compound
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 No Name Gulch Drainage Exposure Unit (NNEU). 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 244,523 environmental sampling records in the RFETS database associated with the NNEU, 153,775 were used in the NNEU risk assessment based on the data processing rules described in Section 2.0 of the Sitewide DQA. Of the 153,775 analytical records existing in the NNEU CRA data set, 93 percent (142,615 records) have undergone verification 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 calculations or selection of contaminants of concern [COCs] for human health or ecological contaminants of potential concern [ECOPCs]). In consultation with the data users and project team, the primary ways in which the PARCC parameters could impact the risk assessment 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 NNEU V&V data that were qualified as estimated and/or undetected by analyte group and matrix. Overall, approximately 14 percent of the NNEU 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 the 93 percent of the NNEU data set that underwent V&V, 82 percent were qualified as having no QC issues, and approximately 14 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 3 percent of the entire data set was rejected during the V&V process (Table A2.6). Rejected data were removed from the NNEU 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 17 percent of the NNEU 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 3 percent were noted for observations related to precision. Of that 3 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 were noted for accuracy-related observations. Of that 29 percent, 73 percent was noted for laboratory practice-related observations, while sample-specific accuracy observations make up the other 27 percent. It is important to note that not all accuracy-related observations resulted in data qualification. Only 14 percent of the NNEU 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 41 percent were noted for observations related to representativeness. Of that 41 percent, 68 percent was marked for blank observations, 19 percent for failure to observe allowed holding times, 6 percent for documentation issues, 4 percent for sample preparation observations, 1 percent for instrument set-up, and 1 percent for instrument sensitivity issues. Matrix, LCS, 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 3 percent of all V&V data associated with the NNEU were rejected.

Comparability of the NNEU 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 risk assessment decisions as described 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 FD/target sample precision information can be found in Table A2.5. Where there are analyte group and matrix combinations failures that have the potential to impact risk assessment decisions, the data quality is discussed in further detail in the bulleted list below.

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, and 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 decisions include the following:

- All dioxin and furan/soil results associated with the NNEU were not detected, but qualified as estimated and noted with V&V observations related to continuing calibration verification (CCV) criteria that were not met. As CCVs are performed to help ensure the accuracy of associated analyses, the COC and ECOPC selection processes were reviewed to determine the potential impact that any data inaccuracy may have had on risk assessment decisions. No dioxin and/or furan results exceeded human health preliminary remediation goals (PRGs) in the NNEU, and although one subsurface soil dioxin result did exceed the lowest associated ecological screening level (ESL), it is important to note that the exceedance and the screening level are within an order of magnitude of one another. Additionally, dioxins and furans were never detected in any media in the NNEU, so any inaccuracy in the data is determined to have little impact on risk assessment conclusions.

- 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, however, that this analyte group contains general chemistry parameters such as ions/anions and alkalinity 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 NNEU 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 potential impact on risk assessment results.

Those elements of data quality that could affect risk assessment decisions in the NNEU 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 NNEU.

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 V&V Records	Total No. of CRA Records	Percent V&V (%)
Dioxins and Furans	Soil	7	7	100.00
Dioxins and Furans	Water	266	399	66.67
Herbicide	Soil	127	149	85.23
Herbicide	Water	320	391	81.84
Metal	Soil	18,029	18,037	99.96
Metal	Water	28,836	30,737	93.82
PCB	Soil	1,180	1,188	99.33
PCB	Water	437	588	74.32
Pesticide	Soil	1,712	1,735	98.67
Pesticide	Water	1,539	2,013	76.45
Radionuclide	Soil	4,544	4,671	97.28
Radionuclide	Water	5,725	6,559	87.28
SVOC	Soil	7,396	8,426	87.78
SVOC	Water	14,188	15,223	93.20
VOC	Soil	7,978	8,154	97.84
VOC	Water	45,660	50,449	90.51
Wet Chem	Soil	403	454	88.77
Wet Chem	Water	4,268	4,595	92.88
	Total	**142,615**	**153,775**	**92.74%**

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	Calibration	Continuing calibration verification criteria were not met	No	7	7	100.00	Accuracy
Dioxins and Furans	Soil	Documentation Issues	Transcription error	No	7	7	100.00	N/A
Dioxins and Furans	Water	Calibration	Continuing calibration verification criteria were not met	No	14	266	5.26	Accuracy
Dioxins and Furans	Water	Documentation Issues	Transcription error	No	35	266	13.16	N/A
Dioxins and Furans	Water	Internal Standards	Internal standards did not meet criteria	No	18	266	6.77	Accuracy
Herbicide	Soil	Holding Times	Holding times were exceeded	No	1	127	0.79	Representativeness
Herbicide	Soil	Matrices	MS/MSD precision criteria were not met	No	10	127	7.87	Precision
Herbicide	Soil	Other	Sample results were not validated due to re-analysis	No	16	127	12.60	N/A
Herbicide	Water	Calibration	Continuing calibration verification criteria were not met	No	3	320	0.94	Accuracy
Herbicide	Water	Calibration	Continuing calibration verification criteria were not met	Yes	1	320	0.31	Accuracy
Herbicide	Water	Documentation Issues	Transcription error	No	17	320	5.31	N/A
Herbicide	Water	Documentation Issues	Transcription error	Yes	1	320	0.31	N/A
Herbicide	Water	Holding Times	Holding times were exceeded	No	5	320	1.56	Representativeness
Herbicide	Water	Matrices	MS/MSD precision criteria were not met	No	2	320	0.63	Precision
Herbicide	Water	Other	Sample results were not validated due to re-analysis	No	2	320	0.63	N/A
Herbicide	Water	Sample Preparation	Samples were not properly preserved in the field	No	1	320	0.31	Representativeness
Herbicide	Water	Surrogates	Surrogate recovery criteria were not met	No	5	320	1.56	Accuracy
Metal	Soil	Blanks	Calibration verification blank contamination	No	78	18,029	0.43	Representativeness
Metal	Soil	Blanks	Method, preparation, or reagent blank contamination	No	744	18,029	4.13	Representativeness
Metal	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	766	18,029	4.25	Representativeness
Metal	Soil	Blanks	Negative bias indicated in the blanks	No	192	18,029	1.06	Representativeness
Metal	Soil	Blanks	Negative bias indicated in the blanks	Yes	149	18,029	0.83	Representativeness
Metal	Soil	Calculation Errors	Calculation error	Yes	5	18,029	0.03	N/A
Metal	Soil	Calibration	Calibration correlation coefficient did not meet requirements	No	1	18,029	0.01	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	Calibration	Calibration correlation coefficient did not meet requirements	Yes	4	18,029	0.02	Accuracy
Metal	Soil	Calibration	Continuing calibration verification criteria were not met	No	4	18,029	0.02	Accuracy
Metal	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	4	18,029	0.02	Accuracy
Metal	Soil	Documentation Issues	Transcription error	No	60	18,029	0.33	N/A
Metal	Soil	Documentation Issues	Transcription error	Yes	274	18,029	1.52	N/A
Metal	Soil	Instrument Set-up	AA duplicate injection precision criteria were not met	Yes	1	18,029	0.01	Precision
Metal	Soil	Instrument Set-up	Interference was indicated in the interference check sample	No	23	18,029	0.13	Accuracy
Metal	Soil	Instrument Set-up	Interference was indicated in the interference check sample	Yes	86	18,029	0.48	Accuracy
Metal	Soil	LCS	CRDL check sample recovery criteria were not met	No	215	18,029	1.19	Accuracy
Metal	Soil	LCS	CRDL check sample recovery criteria were not met	Yes	209	18,029	1.16	Accuracy
Metal	Soil	LCS	LCS recovery criteria were not met	No	562	18,029	3.12	Accuracy
Metal	Soil	LCS	LCS recovery criteria were not met	Yes	445	18,029	2.47	Accuracy
Metal	Soil	LCS	Low level check sample recovery criteria were not met	No	74	18,029	0.41	Accuracy
Metal	Soil	LCS	Low level check sample recovery criteria were not met	Yes	49	18,029	0.27	Accuracy
Metal	Soil	Matrices	Duplicate sample precision criteria were not met	No	2	18,029	0.01	Precision
Metal	Soil	Matrices	Duplicate sample precision criteria were not met	Yes	463	18,029	2.57	Precision
Metal	Soil	Matrices	LCS/LCSD precision criteria were not met	Yes	12	18,029	0.07	Precision
Metal	Soil	Matrices	MSA calibration correlation coefficient < 0.995	Yes	16	18,029	0.09	Accuracy
Metal	Soil	Matrices	MSA was required, but not performed	Yes	1	18,029	0.01	Representativeness
Metal	Soil	Matrices	Post-digestion MS did not meet control criteria	No	105	18,029	0.58	Accuracy
Metal	Soil	Matrices	Post-digestion MS did not meet control criteria	Yes	144	18,029	0.80	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	No	695	18,029	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
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	Yes	1,019	18,029	5.65	Accuracy
Metal	Soil	Matrices	Predigestion MS recovery was < 30 percent	Yes	23	18,029	0.13	Accuracy
Metal	Soil	Matrices	Serial dilution criteria were not met	Yes	293	18,029	1.63	Accuracy
Metal	Soil	Other	IDL is older than 3 months from date of analysis	No	332	18,029	1.84	Accuracy
Metal	Soil	Other	IDL is older than 3 months from date of analysis	Yes	1,159	18,029	6.43	Accuracy
Metal	Soil	Other	Result obtained through dilution	No	5	18,029	0.03	N/A
Metal	Soil	Other	Result obtained through dilution	Yes	123	18,029	0.68	N/A
Metal	Soil	Other	See hard copy for further explanation	No	4	18,029	0.02	N/A
Metal	Soil	Other	See hard copy for further explanation	Yes	8	18,029	0.04	N/A
Metal	Water	Blanks	Calibration verification blank contamination	No	1,073	28,836	3.72	Representativeness
Metal	Water	Blanks	Calibration verification blank contamination	Yes	122	28,836	0.42	Representativeness
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	No	1,686	28,836	5.85	Representativeness
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	435	28,836	1.51	Representativeness
Metal	Water	Blanks	Negative bias indicated in the blanks	No	332	28,836	1.15	Representativeness
Metal	Water	Blanks	Negative bias indicated in the blanks	Yes	197	28,836	0.68	Representativeness
Metal	Water	Calculation Errors	Control limits not assigned correctly	No	37	28,836	0.13	N/A
Metal	Water	Calculation Errors	Control limits not assigned correctly	Yes	55	28,836	0.19	N/A
Metal	Water	Calibration	Calibration correlation coefficient did not meet requirements	No	128	28,836	0.44	Accuracy
Metal	Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	16	28,836	0.06	Accuracy
Metal	Water	Calibration	Continuing calibration verification criteria were not met	No	24	28,836	0.08	Accuracy
Metal	Water	Calibration	Continuing calibration verification criteria were not met	Yes	7	28,836	0.02	Accuracy
Metal	Water	Calibration	Frequency or sequencing verification criteria not met	No	35	28,836	0.12	Accuracy
Metal	Water	Calibration	Frequency or sequencing verification criteria not met	Yes	79	28,836	0.27	Accuracy
Metal	Water	Calibration	Result exceeded linear range of measurement system	Yes	2	28,836	0.01	Accuracy
Metal	Water	Documentation Issues	Information missing from case narrative	No	25	28,836	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
Metal	Water	Documentation Issues	Information missing from case narrative	Yes	21	28,836	0.07	N/A
Metal	Water	Documentation Issues	Key data fields incorrect	No	8	28,836	0.03	N/A
Metal	Water	Documentation Issues	Key data fields incorrect	Yes	48	28,836	0.17	N/A
Metal	Water	Documentation Issues	Missing deliverables (not required for validation)	No	172	28,836	0.60	N/A
Metal	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	112	28,836	0.39	N/A
Metal	Water	Documentation Issues	Missing deliverables (required for validation)	No	119	28,836	0.41	Representativeness
Metal	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	108	28,836	0.37	Representativeness
Metal	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	663	28,836	2.30	N/A
Metal	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	878	28,836	3.04	N/A
Metal	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	10	28,836	0.03	Representativeness
Metal	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	6	28,836	0.02	Representativeness
Metal	Water	Documentation Issues	Record added by the validator	No	26	28,836	0.09	N/A
Metal	Water	Documentation Issues	Record added by the validator	Yes	32	28,836	0.11	N/A
Metal	Water	Documentation Issues	Transcription error	No	834	28,836	2.89	N/A
Metal	Water	Documentation Issues	Transcription error	Yes	443	28,836	1.54	N/A
Metal	Water	Holding Times	Holding times were exceeded	No	22	28,836	0.08	Representativeness
Metal	Water	Holding Times	Holding times were exceeded	Yes	21	28,836	0.07	Representativeness
Metal	Water	Holding Times	Holding times were grossly exceeded	Yes	1	28,836	0.00	Representativeness
Metal	Water	Instrument Set-up	Interference was indicated in the interference check sample	No	41	28,836	0.14	Accuracy
Metal	Water	Instrument Set-up	Interference was indicated in the interference check sample	Yes	94	28,836	0.33	Accuracy
Metal	Water	LCS	CRDL check sample recovery criteria were not met	No	169	28,836	0.59	Accuracy
Metal	Water	LCS	CRDL check sample recovery criteria were not met	Yes	137	28,836	0.48	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	LCS	LCS recovery criteria were not met	No	18	28,836	0.06	Accuracy
Metal	Water	LCS	LCS recovery criteria were not met	Yes	14	28,836	0.05	Accuracy
Metal	Water	LCS	Low level check sample recovery criteria were not met	No	334	28,836	1.16	Accuracy
Metal	Water	LCS	Low level check sample recovery criteria were not met	Yes	246	28,836	0.85	Accuracy
Metal	Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	41	28,836	0.14	Representativeness
Metal	Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	24	28,836	0.08	Representativeness
Metal	Water	Matrices	Duplicate sample precision criteria were not met	No	38	28,836	0.13	Precision
Metal	Water	Matrices	Duplicate sample precision criteria were not met	Yes	165	28,836	0.57	Precision
Metal	Water	Matrices	LCS/LCSD precision criteria were not met	No	67	28,836	0.23	Precision
Metal	Water	Matrices	LCS/LCSD precision criteria were not met	Yes	115	28,836	0.40	Precision
Metal	Water	Matrices	MSA calibration correlation coefficient < 0.995	Yes	4	28,836	0.01	Accuracy
Metal	Water	Matrices	Post-digestion MS did not meet control criteria	No	289	28,836	1.00	Accuracy
Metal	Water	Matrices	Post-digestion MS did not meet control criteria	Yes	43	28,836	0.15	Accuracy
Metal	Water	Matrices	Predigestion MS recovery criteria were not met	No	401	28,836	1.39	Accuracy
Metal	Water	Matrices	Predigestion MS recovery criteria were not met	Yes	466	28,836	1.62	Accuracy
Metal	Water	Matrices	Predigestion MS recovery was < 30 percent	No	2	28,836	0.01	Accuracy
Metal	Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	10	28,836	0.03	Accuracy
Metal	Water	Matrices	Serial dilution criteria were not met	No	26	28,836	0.09	Accuracy
Metal	Water	Matrices	Serial dilution criteria were not met	Yes	429	28,836	1.49	Accuracy
Metal	Water	Other	Analysis was not requested according to the statement of work	No	2	28,836	0.01	N/A
Metal	Water	Other	IDL is older than 3 months from date of analysis	No	429	28,836	1.49	Accuracy
Metal	Water	Other	IDL is older than 3 months from date of analysis	Yes	539	28,836	1.87	Accuracy
Metal	Water	Other	Incorrect analysis sequence	No	2	28,836	0.01	Representativeness
Metal	Water	Other	Incorrect analysis sequence	Yes	1	28,836	0.00	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
Metal	Water	Other	QC sample frequency does not meet method requirements	Yes	2	28,836	0.01	Representativeness
Metal	Water	Other	See hard copy for further explanation	No	20	28,836	0.07	N/A
Metal	Water	Other	See hard copy for further explanation	Yes	5	28,836	0.02	N/A
Metal	Water	Sample Preparation	Samples were not properly preserved in the field	No	249	28,836	0.86	Representativeness
Metal	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	405	28,836	1.40	Representativeness
Metal	Water	Sensitivity	IDL changed due to a significant figure discrepancy	No	106	28,836	0.37	Representativeness
PCB	Soil	Blanks	Method, preparation, or reagent blank contamination	No	1	1,180	0.08	Representativeness
PCB	Soil	Calculation Errors	Calculation error	Yes	1	1,180	0.08	N/A
PCB	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	3	1,180	0.25	Accuracy
PCB	Soil	Documentation Issues	Transcription error	No	163	1,180	13.81	N/A
PCB	Soil	Documentation Issues	Transcription error	Yes	6	1,180	0.51	N/A
PCB	Soil	Holding Times	Holding times were exceeded	No	6	1,180	0.51	Representativeness
PCB	Soil	Other	Sample results were not validated due to re-analysis	No	7	1,180	0.59	N/A
PCB	Soil	Other	Sample results were not validated due to re-analysis	Yes	1	1,180	0.08	N/A
PCB	Soil	Other	See hard copy for further explanation	No	8	1,180	0.68	N/A
PCB	Soil	Other	See hard copy for further explanation	Yes	2	1,180	0.17	N/A
PCB	Soil	Surrogates	Surrogate recovery criteria were not met	No	21	1,180	1.78	Accuracy
PCB	Water	Calibration	Continuing calibration verification criteria were not met	No	14	437	3.20	Accuracy
PCB	Water	Calibration	Continuing calibration verification criteria were not met	Yes	4	437	0.92	Accuracy
PCB	Water	Documentation Issues	Transcription error	No	71	437	16.25	N/A
PCB	Water	Documentation Issues	Transcription error	Yes	5	437	1.14	N/A
PCB	Water	Holding Times	Holding times were exceeded	No	21	437	4.81	Representativeness
PCB	Water	Other	Sample results were not validated due to re-analysis	Yes	4	437	0.92	N/A
PCB	Water	Surrogates	Surrogate recovery criteria were not met	No	70	437	16.02	Accuracy
Pesticide	Soil	Documentation Issues	Transcription error	No	23	1,712	1.34	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
Pesticide	Soil	Holding Times	Holding times were exceeded	No	1	1,712	0.06	Representativeness
Pesticide	Soil	Matrices	MS/MSD precision criteria were not met	No	10	1,712	0.58	Precision
Pesticide	Soil	Other	Sample results were not validated due to re-analysis	No	17	1,712	0.99	N/A
Pesticide	Soil	Other	See hard copy for further explanation	No	3	1,712	0.18	N/A
Pesticide	Soil	Surrogates	Surrogate recovery criteria were not met	No	60	1,712	3.50	Accuracy
Pesticide	Water	Calibration	Continuing calibration verification criteria were not met	No	63	1,539	4.09	Accuracy
Pesticide	Water	Documentation Issues	Transcription error	No	145	1,539	9.42	N/A
Pesticide	Water	Documentation Issues	Transcription error	Yes	7	1,539	0.45	N/A
Pesticide	Water	Holding Times	Holding times were exceeded	No	42	1,539	2.73	Representativeness
Pesticide	Water	Matrices	MS/MSD precision criteria were not met	No	2	1,539	0.13	Precision
Pesticide	Water	Other	Sample results were not validated due to re-analysis	No	4	1,539	0.26	N/A
Pesticide	Water	Other	Sample results were not validated due to re-analysis	Yes	6	1,539	0.39	N/A
Pesticide	Water	Sample Preparation	Samples were not properly preserved in the field	No	1	1,539	0.06	Representativeness
Pesticide	Water	Surrogates	Surrogate recovery criteria were not met	No	210	1,539	13.65	Accuracy
Radionuclide	Soil	Blanks	Blank recovery criteria were not met	Yes	62	4,544	1.36	Representativeness
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	No	23	4,544	0.51	Representativeness
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	665	4,544	14.63	Representativeness
Radionuclide	Soil	Calculation Errors	Calculation error	Yes	12	4,544	0.26	N/A
Radionuclide	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	303	4,544	6.67	Accuracy
Radionuclide	Soil	Documentation Issues	Record added by the validator	Yes	10	4,544	0.22	N/A
Radionuclide	Soil	Documentation Issues	Results were not included on Data Summary Table	No	6	4,544	0.13	N/A
Radionuclide	Soil	Documentation Issues	Sufficient documentation not provided by the laboratory	No	1	4,544	0.02	Representativeness
Radionuclide	Soil	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	2,263	4,544	49.80	Representativeness
Radionuclide	Soil	Documentation Issues	Transcription error	No	5	4,544	0.11	N/A
Radionuclide	Soil	Documentation Issues	Transcription error	Yes	1,189	4,544	26.17	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	Holding Times	Holding times were grossly exceeded	Yes	6	4,544	0.13	Representativeness
Radionuclide	Soil	Instrument Set-up	Detector efficiency did not meet requirements	Yes	12	4,544	0.26	Accuracy
Radionuclide	Soil	Instrument Set-up	Resolution criteria were not met	Yes	222	4,544	4.89	Representativeness
Radionuclide	Soil	LCS	LCS data not submitted by the laboratory	Yes	5	4,544	0.11	Representativeness
Radionuclide	Soil	LCS	LCS recovery > +/- 3 sigma	No	18	4,544	0.40	Accuracy
Radionuclide	Soil	LCS	LCS recovery > +/- 3 sigma	Yes	380	4,544	8.36	Accuracy
Radionuclide	Soil	LCS	LCS recovery criteria were not met	No	2	4,544	0.04	Accuracy
Radionuclide	Soil	LCS	LCS recovery criteria were not met	Yes	53	4,544	1.17	Accuracy
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	No	3	4,544	0.07	Accuracy
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	Yes	555	4,544	12.21	Accuracy
Radionuclide	Soil	Matrices	Recovery criteria were not met	No	5	4,544	0.11	Accuracy
Radionuclide	Soil	Matrices	Recovery criteria were not met	Yes	66	4,544	1.45	Accuracy
Radionuclide	Soil	Matrices	Replicate analysis was not performed	Yes	1	4,544	0.02	Precision
Radionuclide	Soil	Matrices	Replicate precision criteria were not met	No	15	4,544	0.33	Precision
Radionuclide	Soil	Matrices	Replicate precision criteria were not met	Yes	446	4,544	9.82	Precision
Radionuclide	Soil	Matrices	Replicate recovery criteria were not met	No	4	4,544	0.09	Accuracy
Radionuclide	Soil	Matrices	Replicate recovery criteria were not met	Yes	31	4,544	0.68	Accuracy
Radionuclide	Soil	Other	Lab results not verified due to unsubmitted data	Yes	10	4,544	0.22	Representativeness
Radionuclide	Soil	Other	Sample exceeded efficiency curve weight limit	Yes	10	4,544	0.22	Accuracy
Radionuclide	Soil	Other	Sample results were not validated due to re-analysis	Yes	1	4,544	0.02	N/A
Radionuclide	Soil	Other	See hard copy for further explanation	Yes	505	4,544	11.11	N/A
Radionuclide	Soil	Other	Tracer requirements were not met	Yes	7	4,544	0.15	Accuracy
Radionuclide	Soil	Sensitivity	Incorrect reported activity or MDA	No	46	4,544	1.01	N/A
Radionuclide	Soil	Sensitivity	MDA exceeded the RDL	No	1	4,544	0.02	Representativeness
Radionuclide	Soil	Sensitivity	MDA exceeded the RDL	Yes	8	4,544	0.18	Representativeness
Radionuclide	Soil	Sensitivity	MDA was calculated by reviewer	No	24	4,544	0.53	N/A
Radionuclide	Soil	Sensitivity	MDA was calculated by reviewer	Yes	2,776	4,544	61.09	N/A
Radionuclide	Soil	Sensitivity	Results considered qualitative not quantitative	Yes	2	4,544	0.04	Accuracy
Radionuclide	Water	Blanks	Blank recovery criteria were not met	No	8	5,725	0.14	Representativeness
Radionuclide	Water	Blanks	Blank recovery criteria were not met	Yes	40	5,725	0.70	Representativeness
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	No	73	5,725	1.28	Representativeness
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	494	5,725	8.63	Representativeness
Radionuclide	Water	Calculation Errors	Calculation error	No	5	5,725	0.09	N/A
Radionuclide	Water	Calculation Errors	Calculation error	Yes	5	5,725	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
Radionuclide	Water	Calibration	Calibration counting statistics did not meet criteria	No	19	5,725	0.33	Accuracy
Radionuclide	Water	Calibration	Calibration counting statistics did not meet criteria	Yes	1	5,725	0.02	Accuracy
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	No	39	5,725	0.68	Accuracy
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	Yes	454	5,725	7.93	Accuracy
Radionuclide	Water	Documentation Issues	Information missing from case narrative	No	3	5,725	0.05	N/A
Radionuclide	Water	Documentation Issues	Information missing from case narrative	Yes	2	5,725	0.03	N/A
Radionuclide	Water	Documentation Issues	Key data fields incorrect	Yes	1	5,725	0.02	N/A
Radionuclide	Water	Documentation Issues	Missing deliverables (required for validation)	No	4	5,725	0.07	Representativeness
Radionuclide	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	6	5,725	0.10	Representativeness
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	29	5,725	0.51	N/A
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	17	5,725	0.30	N/A
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	4	5,725	0.07	Representativeness
Radionuclide	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	5	5,725	0.09	Representativeness
Radionuclide	Water	Documentation Issues	Record added by the validator	No	4	5,725	0.07	N/A
Radionuclide	Water	Documentation Issues	Record added by the validator	Yes	9	5,725	0.16	N/A
Radionuclide	Water	Documentation Issues	Sample analysis was not requested	Yes	1	5,725	0.02	N/A
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	No	34	5,725	0.59	Representativeness
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	616	5,725	10.76	Representativeness
Radionuclide	Water	Documentation Issues	Transcription error	No	299	5,725	5.22	N/A
Radionuclide	Water	Documentation Issues	Transcription error	Yes	294	5,725	5.14	N/A
Radionuclide	Water	Holding Times	Holding times were exceeded	No	12	5,725	0.21	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	Water	Holding Times	Holding times were exceeded	Yes	27	5,725	0.47	Representativeness
Radionuclide	Water	Holding Times	Holding times were grossly exceeded	No	2	5,725	0.03	Representativeness
Radionuclide	Water	Holding Times	Holding times were grossly exceeded	Yes	3	5,725	0.05	Representativeness
Radionuclide	Water	Instrument Set-up	Resolution criteria were not met	Yes	37	5,725	0.65	Representativeness
Radionuclide	Water	Instrument Set-up	Transformed spectral index external site criteria were not met	No	10	5,725	0.17	Representativeness
Radionuclide	Water	Instrument Set-up	Transformed spectral index external site criteria were not met	Yes	2	5,725	0.03	Representativeness
Radionuclide	Water	LCS	Expected LCS value not submitted/verifiable	No	7	5,725	0.12	Representativeness
Radionuclide	Water	LCS	Expected LCS value not submitted/verifiable	Yes	28	5,725	0.49	Representativeness
Radionuclide	Water	LCS	LCS data not submitted by the laboratory	Yes	2	5,725	0.03	Representativeness
Radionuclide	Water	LCS	LCS recovery > +/- 3 sigma	No	79	5,725	1.38	Accuracy
Radionuclide	Water	LCS	LCS recovery > +/- 3 sigma	Yes	133	5,725	2.32	Accuracy
Radionuclide	Water	LCS	LCS recovery criteria were not met	No	9	5,725	0.16	Accuracy
Radionuclide	Water	LCS	LCS recovery criteria were not met	Yes	29	5,725	0.51	Accuracy
Radionuclide	Water	LCS	LCS relative percent error criteria not met	No	17	5,725	0.30	Accuracy
Radionuclide	Water	LCS	LCS relative percent error criteria not met	Yes	141	5,725	2.46	Accuracy
Radionuclide	Water	Matrices	Duplicate sample precision criteria were not met	Yes	6	5,725	0.10	Precision
Radionuclide	Water	Matrices	Recovery criteria were not met	No	4	5,725	0.07	Accuracy
Radionuclide	Water	Matrices	Recovery criteria were not met	Yes	48	5,725	0.84	Accuracy
Radionuclide	Water	Matrices	Replicate analysis was not performed	No	11	5,725	0.19	Precision
Radionuclide	Water	Matrices	Replicate analysis was not performed	Yes	85	5,725	1.48	Precision
Radionuclide	Water	Matrices	Replicate precision criteria were not met	No	38	5,725	0.66	Precision
Radionuclide	Water	Matrices	Replicate precision criteria were not met	Yes	306	5,725	5.34	Precision
Radionuclide	Water	Matrices	Replicate recovery criteria were not met	No	10	5,725	0.17	Accuracy
Radionuclide	Water	Matrices	Replicate recovery criteria were not met	Yes	14	5,725	0.24	Accuracy
Radionuclide	Water	Other	Lab results not verified due to unsubmitted data	Yes	33	5,725	0.58	Representativeness
Radionuclide	Water	Other	QC sample does not meet method requirements	No	38	5,725	0.66	Representativeness
Radionuclide	Water	Other	QC sample does not meet method requirements	Yes	10	5,725	0.17	Representativeness
Radionuclide	Water	Other	Sample exceeded efficiency curve weight limit	Yes	3	5,725	0.05	Accuracy
Radionuclide	Water	Other	Sample results were not validated due to re-analysis	No	6	5,725	0.10	N/A
Radionuclide	Water	Other	Sample results were not validated due to re-analysis	Yes	1	5,725	0.02	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	Other	See hard copy for further explanation	No	25	5,725	0.44	N/A
Radionuclide	Water	Other	See hard copy for further explanation	Yes	242	5,725	4.23	N/A
Radionuclide	Water	Other	Tracer requirements were not met	No	39	5,725	0.68	Accuracy
Radionuclide	Water	Other	Tracer requirements were not met	Yes	35	5,725	0.61	Accuracy
Radionuclide	Water	Sample Preparation	Improper aliquot size	Yes	2	5,725	0.03	Accuracy
Radionuclide	Water	Sample Preparation	Samples were not properly preserved in the field	No	7	5,725	0.12	Representativeness
Radionuclide	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	5	5,725	0.09	Representativeness
Radionuclide	Water	Sensitivity	Incorrect reported activity or MDA	No	1	5,725	0.02	N/A
Radionuclide	Water	Sensitivity	Incorrect reported activity or MDA	Yes	15	5,725	0.26	N/A
Radionuclide	Water	Sensitivity	MDA exceeded the RDL	No	19	5,725	0.33	Representativeness
Radionuclide	Water	Sensitivity	MDA exceeded the RDL	Yes	173	5,725	3.02	Representativeness
Radionuclide	Water	Sensitivity	MDA was calculated by reviewer	No	7	5,725	0.12	N/A
Radionuclide	Water	Sensitivity	MDA was calculated by reviewer	Yes	1,094	5,725	19.11	N/A
SVOC	Soil	Blanks	Method, preparation, or reagent blank contamination	No	58	7,396	0.78	Representativeness
SVOC	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	3	7,396	0.04	Representativeness
SVOC	Soil	Calculation Errors	Calculation error	Yes	45	7,396	0.61	N/A
SVOC	Soil	Calibration	Continuing calibration verification criteria were not met	No	12	7,396	0.16	Accuracy
SVOC	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	18	7,396	0.24	Accuracy
SVOC	Soil	Calibration	Independent calibration verification criteria not met	No	16	7,396	0.22	Accuracy
SVOC	Soil	Calibration	Independent calibration verification criteria not met	Yes	1	7,396	0.01	Accuracy
SVOC	Soil	Documentation Issues	Missing deliverables (not required for validation)	No	3	7,396	0.04	N/A
SVOC	Soil	Documentation Issues	Missing deliverables (required for validation)	No	9	7,396	0.12	Representativeness
SVOC	Soil	Documentation Issues	Omissions or errors in data package (not required for validation)	No	17	7,396	0.23	N/A
SVOC	Soil	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	1	7,396	0.01	N/A
SVOC	Soil	Documentation Issues	Transcription error	No	1	7,396	0.01	N/A
SVOC	Soil	Documentation Issues	Transcription error	Yes	4	7,396	0.05	N/A
SVOC	Soil	Holding Times	Holding times were exceeded	No	58	7,396	0.78	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
SVOC	Soil	Holding Times	Holding times were exceeded	Yes	1	7,396	0.01	Representativeness
SVOC	Soil	Internal Standards	Internal standards did not meet criteria	No	76	7,396	1.03	Accuracy
SVOC	Soil	Internal Standards	Internal standards did not meet criteria	Yes	27	7,396	0.37	Accuracy
SVOC	Soil	Matrices	MS/MSD precision criteria were not met	No	531	7,396	7.18	Precision
SVOC	Soil	Matrices	MS/MSD precision criteria were not met	Yes	29	7,396	0.39	Precision
SVOC	Soil	Other	QC sample frequency does not meet method requirements	No	6	7,396	0.08	Representativeness
SVOC	Soil	Other	Sample results were not validated due to re-analysis	No	878	7,396	11.87	N/A
SVOC	Soil	Other	Sample results were not validated due to re-analysis	Yes	74	7,396	1.00	N/A
SVOC	Soil	Other	See hard copy for further explanation	No	8	7,396	0.11	N/A
SVOC	Soil	Sample Preparation	Samples were not properly preserved in the field	No	6	7,396	0.08	Representativeness
SVOC	Soil	Surrogates	Surrogate recovery criteria were not met	Yes	5	7,396	0.07	Accuracy
SVOC	Water	Blanks	Method, preparation, or reagent blank contamination	No	53	14,188	0.37	Representativeness
SVOC	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	1	14,188	0.01	Representativeness
SVOC	Water	Calibration	Continuing calibration verification criteria were not met	No	141	14,188	0.99	Accuracy
SVOC	Water	Calibration	Continuing calibration verification criteria were not met	Yes	5	14,188	0.04	Accuracy
SVOC	Water	Calibration	Independent calibration verification criteria not met	No	24	14,188	0.17	Accuracy
SVOC	Water	Calibration	Independent calibration verification criteria not met	Yes	1	14,188	0.01	Accuracy
SVOC	Water	Documentation Issues	Missing deliverables (not required for validation)	No	33	14,188	0.23	N/A
SVOC	Water	Documentation Issues	Missing deliverables (required for validation)	No	6	14,188	0.04	Representativeness
SVOC	Water	Documentation Issues	No mass spectra were provided	No	1	14,188	0.01	Representativeness
SVOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	247	14,188	1.74	N/A
SVOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	2	14,188	0.01	N/A
SVOC	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	6	14,188	0.04	Representativeness
SVOC	Water	Documentation Issues	Record added by the validator	No	26	14,188	0.18	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	No	182	14,188	1.28	N/A
SVOC	Water	Documentation Issues	Transcription error	Yes	11	14,188	0.08	N/A
SVOC	Water	Holding Times	Holding times were exceeded	No	478	14,188	3.37	Representativeness
SVOC	Water	Holding Times	Holding times were exceeded	Yes	6	14,188	0.04	Representativeness
SVOC	Water	Instrument Set-up	Instrument tune criteria were not met	No	123	14,188	0.87	Accuracy
SVOC	Water	Internal Standards	Internal standards did not meet criteria	No	42	14,188	0.30	Accuracy
SVOC	Water	Internal Standards	Internal standards did not meet criteria	Yes	2	14,188	0.01	Accuracy
SVOC	Water	LCS	LCS recovery criteria were not met	No	54	14,188	0.38	Accuracy
SVOC	Water	LCS	LCS recovery criteria were not met	Yes	2	14,188	0.01	Accuracy
SVOC	Water	Matrices	MS/MSD precision criteria were not met	No	112	14,188	0.79	Precision
SVOC	Water	Matrices	MS/MSD precision criteria were not met	Yes	1	14,188	0.01	Precision
SVOC	Water	Other	Sample results were not validated due to re-analysis	No	166	14,188	1.17	N/A
SVOC	Water	Other	Sample results were not validated due to re-analysis	Yes	7	14,188	0.05	N/A
SVOC	Water	Sample Preparation	Preservation requirements were not met by the laboratory	No	3	14,188	0.02	Representativeness
SVOC	Water	Sample Preparation	Samples were not properly preserved in the field	No	117	14,188	0.82	Representativeness
SVOC	Water	Surrogates	Surrogate recovery criteria were not met	No	113	14,188	0.80	Accuracy
SVOC	Water	Surrogates	Surrogate recovery criteria were not met	Yes	23	14,188	0.16	Accuracy
VOC	Soil	Blanks	Method, preparation, or reagent blank contamination	No	256	7,978	3.21	Representativeness
VOC	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	20	7,978	0.25	Representativeness
VOC	Soil	Calculation Errors	Calculation error	Yes	1	7,978	0.01	N/A
VOC	Soil	Calibration	Continuing calibration verification criteria were not met	No	42	7,978	0.53	Accuracy
VOC	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	4	7,978	0.05	Accuracy
VOC	Soil	Calibration	Independent calibration verification criteria not met	No	77	7,978	0.97	Accuracy
VOC	Soil	Calibration	Independent calibration verification criteria not met	Yes	8	7,978	0.10	Accuracy
VOC	Soil	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	7	7,978	0.09	Accuracy
VOC	Soil	Calibration	Result exceeded linear range of measurement system	Yes	1	7,978	0.01	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
VOC	Soil	Documentation Issues	Missing deliverables (not required for validation)	No	96	7,978	1.20	N/A
VOC	Soil	Documentation Issues	Missing deliverables (not required for validation)	Yes	1	7,978	0.01	N/A
VOC	Soil	Documentation Issues	Missing deliverables (required for validation)	No	179	7,978	2.24	Representativeness
VOC	Soil	Documentation Issues	Missing deliverables (required for validation)	Yes	4	7,978	0.05	Representativeness
VOC	Soil	Documentation Issues	Omissions or errors in data package (not required for validation)	No	399	7,978	5.00	N/A
VOC	Soil	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	3	7,978	0.04	N/A
VOC	Soil	Documentation Issues	Transcription error	No	452	7,978	5.67	N/A
VOC	Soil	Documentation Issues	Transcription error	Yes	21	7,978	0.26	N/A
VOC	Soil	Holding Times	Holding times were exceeded	No	70	7,978	0.88	Representativeness
VOC	Soil	Holding Times	Holding times were exceeded	Yes	3	7,978	0.04	Representativeness
VOC	Soil	Internal Standards	Internal standards did not meet criteria	No	176	7,978	2.21	Accuracy
VOC	Soil	Internal Standards	Internal standards did not meet criteria	Yes	10	7,978	0.13	Accuracy
VOC	Soil	Matrices	MS/MSD precision criteria were not met	No	22	7,978	0.28	Precision
VOC	Soil	Other	QC sample frequency does not meet method requirements	No	120	7,978	1.50	Representativeness
VOC	Soil	Other	QC sample frequency does not meet method requirements	Yes	2	7,978	0.03	Representativeness
VOC	Soil	Other	Sample results were not validated due to re-analysis	No	64	7,978	0.80	N/A
VOC	Soil	Other	Sample results were not validated due to re-analysis	Yes	3	7,978	0.04	N/A
VOC	Soil	Other	See hard copy for further explanation	No	120	7,978	1.50	N/A
VOC	Soil	Other	See hard copy for further explanation	Yes	2	7,978	0.03	N/A
VOC	Soil	Sample Preparation	Samples were not properly preserved in the field	No	122	7,978	1.53	Representativeness
VOC	Soil	Surrogates	Surrogate recovery criteria were not met	No	224	7,978	2.81	Accuracy
VOC	Soil	Surrogates	Surrogate recovery criteria were not met	Yes	8	7,978	0.10	Accuracy
VOC	Water	Blanks	Method, preparation, or reagent blank contamination	No	105	45,660	0.23	Representativeness
VOC	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	41	45,660	0.09	Representativeness
VOC	Water	Calculation Errors	Calculation error	Yes	1	45,660	0.00	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	Calibration	Continuing calibration verification criteria were not met	No	698	45,660	1.53	Accuracy
VOC	Water	Calibration	Continuing calibration verification criteria were not met	Yes	59	45,660	0.13	Accuracy
VOC	Water	Calibration	Independent calibration verification criteria not met	No	53	45,660	0.12	Accuracy
VOC	Water	Calibration	Independent calibration verification criteria not met	Yes	18	45,660	0.04	Accuracy
VOC	Water	Calibration	Original result exceeded linear range, serial dilution value reported	Yes	8	45,660	0.02	Accuracy
VOC	Water	Calibration	Result exceeded linear range of measurement system	Yes	3	45,660	0.01	Accuracy
VOC	Water	Confirmation	Results were not confirmed	No	12	45,660	0.03	Precision
VOC	Water	Documentation Issues	Information missing from case narrative	No	1	45,660	0.00	N/A
VOC	Water	Documentation Issues	Information missing from case narrative	Yes	3	45,660	0.01	N/A
VOC	Water	Documentation Issues	Missing deliverables (not required for validation)	No	587	45,660	1.29	N/A
VOC	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	15	45,660	0.03	N/A
VOC	Water	Documentation Issues	Missing deliverables (required for validation)	No	96	45,660	0.21	Representativeness
VOC	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	2	45,660	0.00	Representativeness
VOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	4,320	45,660	9.46	N/A
VOC	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	205	45,660	0.45	N/A
VOC	Water	Documentation Issues	Omissions or errors in data package (required for validation)	No	102	45,660	0.22	Representativeness
VOC	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	8	45,660	0.02	Representativeness
VOC	Water	Documentation Issues	Original documentation not provided	Yes	1	45,660	0.00	N/A
VOC	Water	Documentation Issues	Record added by the validator	No	107	45,660	0.23	N/A
VOC	Water	Documentation Issues	Reported data does not agree with raw data	No	1	45,660	0.00	N/A
VOC	Water	Documentation Issues	Transcription error	No	613	45,660	1.34	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	Transcription error	Yes	151	45,660	0.33	N/A
VOC	Water	Holding Times	Holding times were exceeded	No	2,618	45,660	5.73	Representativeness
VOC	Water	Holding Times	Holding times were exceeded	Yes	29	45,660	0.06	Representativeness
VOC	Water	Holding Times	Holding times were grossly exceeded	No	1	45,660	0.00	Representativeness
VOC	Water	Holding Times	Holding times were grossly exceeded	Yes	7	45,660	0.02	Representativeness
VOC	Water	Instrument Set-up	Instrument tune criteria were not met	No	2,131	45,660	4.67	Accuracy
VOC	Water	Instrument Set-up	Instrument tune criteria were not met	Yes	113	45,660	0.25	Accuracy
VOC	Water	Internal Standards	Internal standards did not meet criteria	No	54	45,660	0.12	Accuracy
VOC	Water	Internal Standards	Internal standards did not meet criteria	Yes	2	45,660	0.00	Accuracy
VOC	Water	LCS	LCS recovery criteria were not met	No	442	45,660	0.97	Accuracy
VOC	Water	LCS	LCS recovery criteria were not met	Yes	39	45,660	0.09	Accuracy
VOC	Water	Matrices	MS/MSD precision criteria were not met	No	101	45,660	0.22	Precision
VOC	Water	Matrices	MS/MSD precision criteria were not met	Yes	6	45,660	0.01	Precision
VOC	Water	Other	Sample results were not validated due to re-analysis	No	70	45,660	0.15	N/A
VOC	Water	Other	Sample results were not validated due to re-analysis	Yes	52	45,660	0.11	N/A
VOC	Water	Other	See hard copy for further explanation	No	1	45,660	0.00	N/A
VOC	Water	Other	See hard copy for further explanation	Yes	42	45,660	0.09	N/A
VOC	Water	Sample Preparation	Preservation requirements were not met by the laboratory	No	49	45,660	0.11	Representativeness
VOC	Water	Sample Preparation	Samples were not properly preserved in the field	No	1,032	45,660	2.26	Representativeness
VOC	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	64	45,660	0.14	Representativeness
VOC	Water	Sensitivity	Instrument detection limit > the associated RDL	No	4	45,660	0.01	Representativeness
VOC	Water	Surrogates	Surrogate recovery criteria were not met	No	508	45,660	1.11	Accuracy
VOC	Water	Surrogates	Surrogate recovery criteria were not met	Yes	47	45,660	0.10	Accuracy
Wet Chem	Soil	Blanks	Calibration verification blank contamination	Yes	4	403	0.99	Representativeness
Wet Chem	Soil	Documentation Issues	Transcription error	No	2	403	0.50	N/A
Wet Chem	Soil	Documentation Issues	Transcription error	Yes	1	403	0.25	N/A
Wet Chem	Soil	Holding Times	Holding times were exceeded	No	55	403	13.65	Representativeness
Wet Chem	Soil	Holding Times	Holding times were exceeded	Yes	62	403	15.38	Representativeness
Wet Chem	Soil	Holding Times	Holding times were grossly exceeded	No	1	403	0.25	Representativeness
Wet Chem	Soil	LCS	LCS recovery criteria were not met	No	6	403	1.49	Accuracy
Wet Chem	Soil	LCS	LCS recovery criteria were not met	Yes	4	403	0.99	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
Wet Chem	Soil	Matrices	Predigestion MS recovery criteria were not met	No	2	403	0.50	Accuracy
Wet Chem	Soil	Matrices	Predigestion MS recovery criteria were not met	Yes	15	403	3.72	Accuracy
Wet Chem	Soil	Matrices	Predigestion MS recovery was < 30 percent	Yes	41	403	10.17	Accuracy
Wet Chem	Soil	Other	IDL is older than 3 months from date of analysis	Yes	51	403	12.66	Accuracy
Wet Chem	Water	Blanks	Calibration verification blank contamination	No	1	4,268	0.02	Representativeness
Wet Chem	Water	Blanks	Calibration verification blank contamination	Yes	2	4,268	0.05	Representativeness
Wet Chem	Water	Blanks	Method, preparation, or reagent blank contamination	No	59	4,268	1.38	Representativeness
Wet Chem	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	3	4,268	0.07	Representativeness
Wet Chem	Water	Blanks	Negative bias indicated in the blanks	No	20	4,268	0.47	Representativeness
Wet Chem	Water	Blanks	Negative bias indicated in the blanks	Yes	7	4,268	0.16	Representativeness
Wet Chem	Water	Calculation Errors	Control limits not assigned correctly	Yes	2	4,268	0.05	N/A
Wet Chem	Water	Calibration	Calibration correlation coefficient did not meet requirements	Yes	7	4,268	0.16	Accuracy
Wet Chem	Water	Calibration	Continuing calibration verification criteria were not met	No	2	4,268	0.05	Accuracy
Wet Chem	Water	Calibration	Continuing calibration verification criteria were not met	Yes	33	4,268	0.77	Accuracy
Wet Chem	Water	Calibration	Result exceeded linear range of measurement system	Yes	3	4,268	0.07	Accuracy
Wet Chem	Water	Documentation Issues	Missing deliverables (not required for validation)	Yes	12	4,268	0.28	N/A
Wet Chem	Water	Documentation Issues	Missing deliverables (required for validation)	Yes	9	4,268	0.21	Representativeness
Wet Chem	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	No	2	4,268	0.05	N/A
Wet Chem	Water	Documentation Issues	Omissions or errors in data package (not required for validation)	Yes	64	4,268	1.50	N/A
Wet Chem	Water	Documentation Issues	Omissions or errors in data package (required for validation)	Yes	3	4,268	0.07	Representativeness
Wet Chem	Water	Documentation Issues	Record added by the validator	No	1	4,268	0.02	N/A
Wet Chem	Water	Documentation Issues	Transcription error	No	101	4,268	2.37	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	Transcription error	Yes	191	4,268	4.48	N/A
Wet Chem	Water	Holding Times	Holding times were exceeded	No	36	4,268	0.84	Representativeness
Wet Chem	Water	Holding Times	Holding times were exceeded	Yes	50	4,268	1.17	Representativeness
Wet Chem	Water	Holding Times	Holding times were grossly exceeded	No	27	4,268	0.63	Representativeness
Wet Chem	Water	Holding Times	Holding times were grossly exceeded	Yes	16	4,268	0.37	Representativeness
Wet Chem	Water	LCS	LCS recovery criteria were not met	No	6	4,268	0.14	Accuracy
Wet Chem	Water	LCS	LCS recovery criteria were not met	Yes	4	4,268	0.09	Accuracy
Wet Chem	Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	No	2	4,268	0.05	Representativeness
Wet Chem	Water	LCS	QC sample/analyte (e.g. spike, duplicate, LCS) was not analyzed	Yes	4	4,268	0.09	Representativeness
Wet Chem	Water	Matrices	Duplicate sample precision criteria were not met	No	4	4,268	0.09	Precision
Wet Chem	Water	Matrices	Duplicate sample precision criteria were not met	Yes	14	4,268	0.33	Precision
Wet Chem	Water	Matrices	LCS/LCSD precision criteria were not met	No	4	4,268	0.09	Precision
Wet Chem	Water	Matrices	LCS/LCSD precision criteria were not met	Yes	3	4,268	0.07	Precision
Wet Chem	Water	Matrices	Predigestion MS recovery criteria were not met	No	44	4,268	1.03	Accuracy
Wet Chem	Water	Matrices	Predigestion MS recovery criteria were not met	Yes	122	4,268	2.86	Accuracy
Wet Chem	Water	Matrices	Predigestion MS recovery was < 30 percent	Yes	2	4,268	0.05	Accuracy
Wet Chem	Water	Other	IDL is older than 3 months from date of analysis	Yes	2	4,268	0.05	Accuracy
Wet Chem	Water	Other	Lab results not verified due to unsubmitted data	No	2	4,268	0.05	Representativeness
Wet Chem	Water	Other	Lab results not verified due to unsubmitted data	Yes	33	4,268	0.77	Representativeness
Wet Chem	Water	Other	Result obtained through dilution	Yes	4	4,268	0.09	N/A
Wet Chem	Water	Other	See hard copy for further explanation	No	2	4,268	0.05	N/A
Wet Chem	Water	Other	See hard copy for further explanation	Yes	2	4,268	0.05	N/A
Wet Chem	Water	Sample Preparation	Preservation requirements were not met by the laboratory	Yes	7	4,268	0.16	Representativeness
Wet Chem	Water	Sample Preparation	Sample pretreatment or preparation method was incorrect	Yes	3	4,268	0.07	Representativeness
Wet Chem	Water	Sample Preparation	Samples were not properly preserved in the field	Yes	23	4,268	0.54	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	7	7	No	100.00
Dioxins and Furans	Water	32	266	No	12.03
Herbicide	Soil	1	127	No	0.79
Herbicide	Water	12	320	No	3.75
Metal	Soil	2,486	18,029	No	13.79
Metal	Soil	3,262	18,029	Yes	18.09
Metal	Water	4,257	28,836	No	14.76
Metal	Water	2,272	28,836	Yes	7.88
PCB	Soil	35	1,180	No	2.97
PCB	Soil	2	1,180	Yes	0.17
PCB	Water	105	437	No	24.03
PCB	Water	4	437	Yes	0.92
Pesticide	Soil	61	1,712	No	3.56
Pesticide	Water	302	1,539	No	19.62
Radionuclide	Soil	18	4,544	No	0.40
Radionuclide	Soil	44	4,544	Yes	0.97
Radionuclide	Water	53	5,725	No	0.93
Radionuclide	Water	93	5,725	Yes	1.62
SVOC	Soil	220	7,396	No	2.97
SVOC	Soil	26	7,396	Yes	0.35
SVOC	Water	817	14,188	No	5.76
SVOC	Water	11	14,188	Yes	0.08
VOC	Soil	720	7,978	No	9.02
VOC	Soil	34	7,978	Yes	0.43
VOC	Water	4,119	45,660	No	9.02
VOC	Water	179	45,660	Yes	0.39
Wet Chem	Soil	56	403	No	13.90
Wet Chem	Soil	122	403	Yes	30.27
Wet Chem	Water	197	4,268	No	4.62
Wet Chem	Water	297	4,268	Yes	6.96
	Total	**19,844**	**142,615**		**13.91%**

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	81	12,927	0.6265955
Metal	Water	674	13,649	4.938091
VOC	Soil	5	251	1.992032
VOC	Water	13	2,153	0.6038086
Wet Chem	Water	1	3,231	0.03095017
	Total	**774**	**32,211**	**2.40%**

[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	Water	0	14	0.00	3.51
Herbicide	Soil	0	9	0.00	6.04
Herbicide	Water	0	17	0.00	4.35
Metal	Soil	115	1,840	6.25	10.20
Metal	Water	122	3,647	3.35	11.87
PCB	Soil	0	77	0.00	6.48
PCB	Water	0	21	0.00	3.57
Pesticide	Soil	0	68	0.00	3.92
Pesticide	Water	0	74	0.00	3.68
Radionuclide	Soil	5	443	1.13	9.48
Radionuclide	Water	4	736	0.54	11.22
SVOC	Soil	0	527	0.00	6.25
SVOC	Water	0	859	0.00	5.64
VOC	Soil	1	159	0.63	1.95
VOC	Water	3	5,190	0.06	10.29
Wet Chem	Soil	1	48	2.08	10.57
Wet Chem	Water	14	515	2.72	11.21

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	14	0.00
Dioxins and Furans	Water	0	266	0.00
Herbicide	Soil	3	250	1.20
Herbicide	Water	9	417	2.16
Metal	Soil	184	23,913	0.77
Metal	Water	618	37,221	1.66
PCB	Soil	24	1,778	1.35
PCB	Water	42	518	8.11
Pesticide	Soil	40	2,278	1.76
Pesticide	Water	53	1,801	2.94
Radionuclide	Soil	818	6,452	12.68
Radionuclide	Water	667	8,478	7.87
SVOC	Soil	89	13,948	0.64
SVOC	Water	690	18,671	3.70
VOC	Soil	233	15,388	1.51
VOC	Water	1,523	62,563	2.43
Wet Chem	Soil	76	732	10.38
Wet Chem	Water	149	5,827	2.56
	Total	**5,218**	**200,515**	**2.60%**

*Value includes "CRA-Ready" and non-CRA data as rejected data is removed from the data set.

Table A2.7
Summary of Data Quality Issues

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	Calibration	Continuing calibration verification criteria were not met	No	100.00	0.00	100.00	Accuracy	No
Dioxins and Furans	Water	Internal Standards	Internal standards did not meet criteria	No	6.77	0.00	6.77	Accuracy	No
Herbicide	Soil	Matrices	MS/MSD precision criteria were not met	No	7.87	0.00	0.00	Precision	No
Metal	Soil	Matrices	Predigestion MS recovery criteria were not met	Yes	5.65	0.00	5.65	Accuracy	No
Metal	Soil	Other	IDL is older than 3 months from date of analysis	Yes	6.43	0.00	1.18	Accuracy	No
Metal	Water	Blanks	Method, preparation, or reagent blank contamination	No	5.85	0.02	5.83	Representativeness	No
PCB	Water	Surrogates	Surrogate recovery criteria were not met	No	16.02	0.00	16.02	Accuracy	No
Pesticide	Water	Surrogates	Surrogate recovery criteria were not met	No	13.65	0.00	13.65	Accuracy	No
Radionuclide	Soil	Blanks	Method, preparation, or reagent blank contamination	Yes	14.63	0.00	0.92	Representativeness	No
Radionuclide	Soil	Calibration	Continuing calibration verification criteria were not met	Yes	6.67	0.00	0.02	Accuracy	No
Radionuclide	Soil	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	49.80	0.00	0.00	Representativeness	No
Radionuclide	Soil	LCS	LCS recovery > +/- 3 sigma	Yes	8.36	0.00	0.00	Accuracy	No
Radionuclide	Soil	LCS	LCS relative percent error criteria not met	Yes	12.21	0.00	0.00	Accuracy	No
Radionuclide	Soil	Matrices	Replicate precision criteria were not met	Yes	9.82	0.00	0.00	Precision	No
Radionuclide	Water	Blanks	Method, preparation, or reagent blank contamination	Yes	8.63	0.00	0.89	Representativeness	No
Radionuclide	Water	Calibration	Continuing calibration verification criteria were not met	Yes	7.93	0.00	0.26	Accuracy	No
Radionuclide	Water	Documentation Issues	Sufficient documentation not provided by the laboratory	Yes	10.76	0.00	0.26	Representativeness	No
SVOC	Soil	Matrices	MS/MSD precision criteria were not met	No	7.18	0.14	0.00	Precision	No
VOC	Water	Holding Times	Holding times were exceeded	No	5.73	4.91	0.79	Representativeness	No
Wet Chem	Soil	Holding Times	Holding times were exceeded	No	13.65	0.00	13.65	Representativeness	No
Wet Chem	Soil	Holding Times	Holding times were exceeded	Yes	15.38	0.00	15.38	Representativeness	No
Wet Chem	Soil	Matrices	Predigestion MS recovery was < 30 percent	Yes	10.17	0.00	10.17	Accuracy	No
Wet Chem	Soil	Other	IDL is older than 3 months from date of analysis	Yes	12.66	0.00	10.17	Accuracy	No

[a]Defined as validation qualifier codes containing "U"

[b]Defined as validation qualifier codes containing "J", except "UJ"

COMPREHENSIVE RISK ASSESSMENT

NO NAME GULCH DRAINAGE EXPOSURE UNIT

VOLUME 6: ATTACHMENT 3

Statistical Analyses and Professional Judgment

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ACRONYMS AND ABBREVIATIONS

AL	action level
CDH	Colorado Department of Health
CDPHE	Colorado Department of Public Health and Environment
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
ECOI	ecological contaminant of interest
EcoSSL	Ecological Soil Screening Level
ECOPC	ecological contaminant of potential concern
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
IA	Industrial Area
IHSS	Individual Hazardous Substance Site
MDC	maximum detected concentration
mg/kg	milligrams per kilogram

NCP	National Contingency Plan
NFA	No Further Action
NNEU	No Name Gulch Drainage Exposure Unit
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
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 No Name Gulch Drainage Exposure Unit (NNEU) 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 of the RI/FS report.

2.0 RESULTS OF STATISTICAL COMPARISONS TO BACKGROUND FOR THE NO NAME GULCH 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 NNEU 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 A3.2.33.[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 NNEU 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 NNEU that are statistically greater than background (or those where background comparisons were not performed) are carried through to the upper-bound exposure point concentration (EPC) – threshold ecological screening level (tESL) comparison step of the ECOPC selection processes.

[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 NNEU 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.

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 NNEU surface soil/surface sediment data set, the maximum detected concentrations (MDCs) and upper confidence limits on the mean (UCLs) for arsenic, vanadium, cesium-134, cesium-137, and radium-228 exceed the wildlife refuge worker (WRW) preliminary remediation goals (PRGs) for the NNEU dataset, and these PCOCs were carried forward into the statistical background comparison step. The NNEU MDC for aluminum, antimony, chromium, iron, manganese, benzo(a)pyrene, and PCB-1254 exceed the PRG, but the UCL for the NNEU dataset does not exceed the PRG, and these analytes was not evaluated further. The results of the statistical comparison of the NNEU 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 NNEU surface soil/surface sediment data are shown in Table A3.2.2. The NNEU MDCs for all other PCOCs do not exceed the PRGs and were not evaluated further.

The results of the statistical comparisons of the NNEU surface soil/surface sediment data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Vanadium

Not Statistically Greater than Background at the 0.1 Significance Level

- Cesium-134
- Cesium-137
- Radium-228

Background Comparison Not Performed[1]

- None

2.2 Subsurface Soil/Subsurface Sediment Data Used in the HHRA

For the NNEU subsurface soil/subsurface sediment data set, the maximum detected concentrations (MDCs) and upper confidence limits on the mean (UCLs) for radium-228 exceeds the wildlife refuge worker (WRW) preliminary remediation goals (PRGs) for the NNEU dataset, and this PCOC was carried forward into the statistical background comparison step. The results of the statistical comparison of the NNEU subsurface soil/subsurface sediment data to background data for these PCOCs are presented in

Table A3.2.3 and the summary statistics for background and NNEU subsurface soil/ subsurface sediment data are shown in Table A3.2.4. The NNEU MDCs for all other PCOCs do not exceed the PRGs and were not evaluated further.

The results of the statistical comparisons of the NNEU subsurface soil/subsurface sediment data to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Radium-228

Not Statistically Greater than Background at the 0.1 Significance Level

- None

Background Comparison Not Performed[1]

- None

2.3 Surface Soil Data Used in the ERA (Non-PMJM)

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, thallium, tin, vanadium, and zinc exceed a non-PMJM ESL, and these ECOIs were carried forward into the statistical background comparison step. The MDCs for 4,4'-DDT, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and Total PCBs also exceed a non-PMJM ESL. The results of the statistical comparison of the NNEU surface soil data to background data are presented in Table A3.2.5 and the summary statistics for background and NNEU surface soil data are shown in Table A3.2.6.

The results of the statistical comparisons of the NNEU surface soil to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Barium
- Copper
- Nickel

Not Statistically Greater than Background at the 0.1 Significance Level

- Aluminum
- Arsenic

- Cadmium
- Chromium
- Cobalt
- Lead
- Lithium
- Manganese
- Selenium
- Vanadium
- Zinc

Background Comparison not Performed[1]

- Antimony
- Boron
- Mercury
- Molybdenum
- Silver
- Thallium
- Tin
- 4,4’-DDT
- Benzo(a)pyrene
- Bis(2 ethylhexyl)phthalate
- Di-n-butylphthalate
- Total PCBs

2.4 Surface Soil Data Used in the ERA (PMJM)

For the ECOIs in surface soil in PMJM habitat, the MDCs for arsenic, mercury, nickel, vanadium, and zinc exceed the PMJM ESLs, and were carried forward into the background comparison step. The results of the statistical comparison of the NNEU surface soil data to background data are presented in Table A3.2.7 and the summary statistics for background and NNEU surface soil data are shown in Table A3.2.8.

The results of the statistical comparisons of the NNEU surface soil in PMJM habitat to background data indicate the following:

Statistically Greater than Background at the 0.1 Significance Level

- Nickel
- Vanadium
- Zinc

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Mercury

Background Comparison not Performed[1]

- None

2.5 Subsurface Soil Data Used in the ERA

For the ECOIs in subsurface soil, the MDC for antimony, arsenic, copper, molybdenum, nickel, nitrate, selenium, vanadium, and zinc exceed the prairie dog ESL and was 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 NNEU subsurface soil data to background data are presented in Table A3.2.9 and the summary statistics for background and NNEU subsurface soil data are shown in Table A3.2.10.

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

- None

Not Statistically Greater than Background at the 0.1 Significance Level

- Arsenic
- Copper
- Nickel

- Nitrate
- Vanadium
- Zinc

Background Comparison not Performed[1]

- Antimony
- Molybdenum
- Selenium

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 NNEU 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

Silver, thallium, and benzo(a)pyrene in surface soil (non-PMJM) were eliminated from further consideration because the EPCs are not greater than the limiting tESLs. 4,4'-DDT was eliminated from further consideration because the detection frequency was less than 5 percent. Antimony, barium, boron, copper, mercury, molybdenum, nickel, and tin along with three organics (bis(2-ethylhexyl)phthalate, di-n-butylphthalate, 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, molybdenum, and selenium in subsurface soil were eliminated from further consideration because the EPCs are not greater than the tESLs. No analytes have an EPC greater than the limiting tESL and 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 datasets (see Table A3.4.1 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 is 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 NNEU:

- Surface soil/surface sediment (HHRA)
  - Arsenic
  - Vanadium
- Subsurface soil/subsurface sediment (HHRA)

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[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

- Radium-228

- Surface soil for non-PMJM receptors (ERA)
  - Antimony
  - Barium
  - Boron
  - Copper
  - Mercury
  - Molybdenum
  - Nickel
  - Tin
  - Bis(2-Ethylhexyl)phthalate
  - Di-n-butylphthalate
  - Total PCBs
- Surface soil for PMJM receptors (ERA)
  - Nickel
  - Vanadium
  - Zinc
- 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/subsurface sediment 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 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 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. However, antimony was used as a constituent of bullets and there was a firing range (North Firing Range [NW-1505]) in NNEU.

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, antimony concentrations exceed 3x the background MDC in the NNEU, and largely occur in historical IHSSs.

4.1.3 Conclusion

Antimony in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than 3 times the ESL) occur in historical IHSSs. Antimony was used in limited 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 ECOPCs 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 may be present in NNEU soil as a result of historical site-related activities, i.e., arsenic was a component of the bullets used at the North Firing Range (IHSS NW-1505).

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 indicates that arsenic concentrations in NNEU surface soil/surface sediment reflect variations in naturally occurring arsenic.

4.2.3 Pattern Recognition

Surface Soil/Surface Sediment

The probability plot for arsenic (Figure A3.4.1) suggests a single population.

4.2.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil/Surface Sediment

Arsenic concentrations in NNEU surface soil/surface sediment range from 1.40 to 13.2 mg/kg with a mean concentration of 5.01 mg/kg and a standard deviation of 1.93 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 NNEU and background samples overlap considerably with only ten of 375 detections greater than the background MDC.

Arsenic concentrations in NNEU 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 13.2 mg/kg and the UCL is 5.17 mg/kg. The UCL is less than three times greater than the PRG (2.41 mg/kg), with 352 of the 375 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 was detected in 67 of 73 background samples, and detected concentrations in 39 of the 67 samples exceeded 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 NNEU is similar to background risk.

4.2.6 Conclusion

The weight of evidence presented above shows that arsenic concentrations in NNEU surface soil/surface sediment are not likely to be a result of historical site-related activities based on a spatial distribution that suggests arsenic is naturally occurring, probability plots that suggest the presence of single arsenic data population which is also indicative of background conditions, NNEU concentrations that are well within regional background levels, and NNEU 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 NNEU and, therefore, is not further evaluated quantitatively.

4.3 Barium

Barium 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 barium should be retained for risk characterization are summarized below.

4.3.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS report, process knowledge indicates barium is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.3.2 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 barium concentrations in NNEU surface soil exceed three times the minimum ESL at locations near historical IHSSs. Therefore, barium cannot be eliminated as an ECOPC.

4.3.3 Conclusion

Barium in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than 3 times the ESL) are located near an historic IHSS. Barium was used in limited quantities during historical RFETS operations, which would indicate it is unlikely to be a site-related contaminant. Nevertheless, as a conservative measure, barium is carried forward into the risk characterization recognizing that its classification as an ECOPC 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 NNEU, and no documented operations or activities that occurred in NNEU involving the use of bis(2-ethylhexyl)phthalate (CDH 1991a; CDH 1991b; CDH 1992; DOE 2005). Therefore, the potential for bis(2-ethylhexyl)phthalate to be present in NNEU 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 (Figure A3.4.2) has eight exceedances three times the minimum ESL of 137 micrograms per kilogram (μg/kg) (out of 87 detections), including one sample that is greater than forty times the ESL. These exceedances are located near historical IHSSs.

4.4.3 Conclusion

Although bis(2-ethylhexyl)phthalate is not necessarily associated with site activities in the NNEU, a decision could not be made whether concentrations in samples collected from the NNEU are significantly elevated compared to background because the background comparison is not performed for organics. Bis(2-ethylhexyl)phthalate in surface soil concentrations is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than 40 times the ESL) are within or near historical IHSSs.

4.5 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 indicates that boron concentrations in NNEU surface soil reflect variations in naturally occurring boron.

4.5.3 Pattern Recognition

Surface Soil (Non-PMJM)

The probability plot for boron is consistent with the hypothesis that there is only one population of data, but that data are too limited to draw a reliable conclusion (Figure A3.4.3).

4.5.4 Comparison to RFETS Background and Other Background Data Sets

Surface Soil (Non-PMJM)

For boron in surface soil, a statistical comparison between NNEU and RFETS background data could not be performed because RFETS background surface soil samples were not analyzed for boron. 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 NNEU is 1.20 to 7.90 mg/kg with a mean concentration of 3.72 mg/kg and a standard deviation of 1.44 mg/kg (Table A3.2.6). The range of concentrations of boron in surface soil is well within 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 NNEU (6.21 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 since risks are not typically expected at background concentrations, boron concentrations are not likely to be indicative of site-related risk to the terrestrial plant community in the NNEU. 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. 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 NNEU.

4.5.6 Conclusion

The weight of evidence presented above shows that boron concentrations in NNEU 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, NNEU concentrations that are well within regional background levels, and NNEU concentrations that are unlikely to result in risk concerns for wildlife populations. Boron is not considered an ECOPC in surface soil for the NNEU and, therefore, is not further evaluated quantitatively.

4.6 Copper

Copper 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 copper 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 copper was used in very small quantities. However, copper was a constituent of waste generated in two buildings (both of which utilized HEPA filtration). Copper may be present in RFETS soil as a result of historical site-related activities.

4.6.2 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 NNEU surface soil exceed three times the minimum ESL at locations near historical IHSSs.

4.6.3 Conclusion

Copper in surface soil is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than 3 times the ESL) occur near historical IHSSs. Copper was used in limited quantities during historical RFETS operations, and was a constituent of waste generated in two buildings (both of which utilized HEPA filtration). Nevertheless, as a conservative measure, copper is carried forward into the risk characterization recognizing that the classification as an ECOPCs is uncertain.

4.7 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 risk characterization are summarized below.

4.7.1 Summary of Process Knowledge

There are no documented operations or activities that occurred in NNEU involving the use of di-n-butylphthalate (CDH 1991a; CDH 1991b; CDH 1992; DOE 2005). Therefore, the potential for di-n-butylphthalate to be present in NNEU surface soil as a result of historical site-related activities is unlikely.

4.7.2 Evaluation of Spatial Trends

Surface Soil (non-PMJM)

Di-n-butylphthalate (Figure A3.4.4) has nine exceedances three times the ESL of 15.9 micrograms per kilogram (µg/kg) (out of 87 detections), including one sample that is greater than ten times the ESL. These exceedances are located near historical IHSSs.

4.7.3 Conclusion

Although di-n-butylphthalate is not necessarily associated with site activities in the NNEU, di-n-butylphthalate in surface soil concentrations is being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than 10 times the ESL) are within or near historical IHSSs.

4.8 Mercury

Mercury 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 mercury should be retained for risk characterization are summarized below.

4.8.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS report, process knowledge indicates mercury was used in very small quantities. However, mercury was used as a constituent of waste generated in thirteen buildings. Mercury may be present in RFETS soil as a result of historical site-related activities.

4.8.2 Evaluation of Spatial Trends

Surface Soil (non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS report, mercury concentrations exceed the background MDC in the NNEU and are generally within historical IHSSs.

4.8.3 Conclusion

Mercury in surface soil is being carried forward into the ecological non-PMJM risk characterization because of elevated concentrations within historical IHSSs. Mercury was used in limited quantities during historical RFETS operations, and was a constituent of waste generated in thirteen buildings. Nevertheless, as a conservative measure, mercury is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

4.9 Molybdenum

Molybdenum 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 molybdenum should be retained for risk characterization are summarized below.

4.9.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS report, process knowledge indicates molybdenum is unlikely to be present in RFETS soil as a result of historical site-related activities.

4.9.2 Evaluation of Spatial Trends

Surface Soil (non-PMJM)

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS report, molybdenum concentrations exceed the regional background MDC in the NNEU at locations generally within historical IHSSs.

4.9.3 Conclusion

Molybdenum in surface soil is being carried forward into the ecological non-PMJM risk characterization because of elevated concentrations within historical IHSSs. Molybdenum was used in limited quantities during historical RFETS operations, and was a constituent of waste generated in one building. Nevertheless, as a conservative measure, molybdenum is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

4.10 Nickel

Nickel 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. In addition, nickel in surface soil (for PMJM receptors) had concentrations statistically greater than background, 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.

4.10.1 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. Nickel may be present in NNEU soil as a result of historical site-related activities.

4.10.2 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 NNEU surface soil exceed the minimum ESL at locations near historical IHSSs.

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 NNEU surface soil exceed the minimum ESL at locations near historical IHSSs.

4.10.3 Conclusion

Nickel in surface soil is being carried forward into the ecological non-PMJM and PMJM risk characterization because of elevated concentrations near historical IHSSs. Nickel was used in limited quantities during historical RFETS operations, and was a constituent of waste generated in twelve buildings. Nevertheless, as a conservative measure, nickel is carried forward into the risk characterization recognizing that its classification as an ECOPC is uncertain.

4.11 Radium-228

Radium-228 has activities statistically greater than background in subsurface soil/subsurface sediment and, therefore, was carried forward to the professional judgment step. The lines of evidence used to determine if radium-228 should be retained for risk characterization are summarized below.

4.11.1 Summary of Process Knowledge

Based on a review of site historical information, the potential for radium-228 to be a COC in the NNEU is very low since it was not used at RFETS. The ChemRisk Task 1 Report did no identify radium-228 as a radionuclide used at RFETS (CDH 1991a) and no radium-228 waste was reported to have been generated.

4.11.2 Evaluation of Spatial Trends

Subsurface Soil/Subsurface Sediment

The overall spatial trend of Ra-228 activities within the NNEU in subsurface soil/subsurface sediment is seen within the other EUs (Figure A3.4.5). Radium-228 seems to be elevated in a number of locations throughout the site. Many of these locations are outside of IHSS, including the IHSSs in the NNEU. Therefore, radium-228 activities appear to be indicative of variations in the naturally occurring radium-228.

4.11.3 Pattern Recognition

Subsurface Soil/Subsurface Sediment

The probability plot for radium-228 activities (Figure A3.4.6) indicates a single population with two potentially anomalous sample results. The two data points are insufficient evidence to determine whether they represent a second population.

4.11.4 Comparison to RFETS Background and Other Background Data Sets

Subsurface Soil/Subsurface Sediment

Radium-228 activities in NNEU subsurface soil/subsurface sediment range from .0690 to 3.03 mg/kg with a mean concentration of 1.57 mg/kg and a standard deviation of 0.337 mg/kg. Radium-228 activities in the background data set range from 1.00 to 2.10 mg/kg with a mean activity of 1.45 mg/kg and a standard deviation of 0.320 mg/kg (Table A3.2.4). The range of activity of radium-228 in the NNEU and background samples overlap considerably.

4.11.5 Risk Potential for HHRA

Subsurface Soil/Subsurface Sediment

The radium-228 MDC for subsurface soil/subsurface sediment is 3.03 pCi/g and the UCL is 1.62 pCi/g. The UCL is less than two times greater than the PRG (1.28 pCi/g). The PRG is based on an excess carcinogenic risk of 10^{-6}, therefore, the risk to human health is well within the National Contingency Plan (NCP) risk range of 10^{-6} to 10^{-4}. Radium-228 was detected in 31 of 31 background samples, and the NNEU MDC was less than the background MDC. Therefore, the excess cancer risks to the WRW from exposure to radium-228 in surface soil/surface sediment in the NNEU are similar to background risk.

4.11.6 Conclusion

The weight of evidence presented above shows that radium-228 activities in NNEU subsurface soil/subsurface sediment are not likely to be a result of historical site-related activities based on process knowledge, spatial distributions that suggest radium-228 is naturally occurring, probability plots that suggest the presence of single radium-228 data populations which are also indicative of background conditions, NNEU concentrations that are well within regional background levels, and NNEU concentrations that are unlikely to result in risks to humans significantly above background risks. Radium-228 is not considered a COC in subsurface soil/subsurface sediment for the NNEU and, therefore, is not further evaluated quantitatively.

4.12 Tin

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. The lines of evidence used to determine if tin 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 tin to have been released into RFETS soil because of the moderate tin metal inventory during former operations. Therefore tin may be present in NNEU 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, tin concentrations exceed the regional background MDC in the NNEU at locations within historical IHSSs.

4.12.3 Conclusion

Tin in surface soil is being carried forward into the ecological non-PMJM risk characterization because of elevated concentrations within historical IHSSs, recognizing that its classification as an ECOPC is uncertain.

4.13 Total PCBs

Total PCBs 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 total PCBs should be retained risk characterization are summarized below.

4.13.1 Summary of Process Knowledge

There are no documented historical operations at RFETS involving the use of PCBs (CDH 1991a; CDH 1991b; CDH 1992). However, PCBs were a constituent in oil used in transformers at RFETS, and PCB-contaminated soil, debris, and PCB-contaminated oil were stored at IHSS NW- 203, the Inactive Hazardous Waste Storage Area. Therefore, there is a potential for PCBs to be present in surface soil in a portion of the NNEU as a result of historical site-related activities.

4.13.2 Evaluation of Spatial Trends

Surface Soil (non-PMJM)

Total PCBs (Figure A3.4.7) has twelve exceedances three times the minimum ESL of 172 micrograms per kilogram (μg/kg) (out of 42 detections), including one sample that is greater than eighty times the ESL. These exceedances are located near historical IHSSs.

4.13.3 Conclusion

PCBs are associated with site activities in IHSS NW-203. PCBs are being carried forward into the ecological non-PMJM risk characterization because elevated concentrations (greater than 80 times the ESL) are within or near historical IHSSs, including IHSS NW-203.

4.14 Vanadium

Vanadium has concentrations statistically greater than background in surface soil/surface sediment and in surface soil within PMJM habitat, therefore, 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.

4.14.1 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. However, vanadium was at concentrations exceeding the RFCA action level in the PU&D Yard (IHSS 174), and the soil was removed through an accelerated action on August 22, 2005.

4.14.2 Evaluation of Spatial Trends

Surface Soil/Surface Sediment and 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 NNEU surface soil/surface sediment and surface soil (PMJM) exceed the ESLs at locations in or near historical IHSSs. Therefore, vanadium cannot be eliminated as an ECOPC.

4.14.3 Conclusion

Vanadium in surface soil is being carried forward into the ecological PMJM risk characterization because of elevated concentrations are located near historical IHSSs, recognizing that its classification as an ECOPC is uncertain.

4.15 Zinc

Zinc has an MDC in surface soil (for 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 zinc should be retained for risk characterization are summarized below.

4.15.1 Summary of Process Knowledge

As discussed in Appendix A, Volume 2, Attachment 8 of the RI/FS report, process knowledge indicates a potential for zinc to have been released into RFETS soil because of the moderate zinc metal inventory.

4.15.2 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 NNEU surface soil exceed the minimum ESL at locations near historical IHSSs. Therefore, zinc cannot be eliminated as an ECOPC.

4.15.3 Conclusion

Zinc in surface soil is being carried forward into the ecological PMJM risk characterization because of elevated concentrations are located near historical IHSSs, recognizing that its classification as an ECOPC is uncertain.

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TABLES

Table A3.2.1
Statistical Distributions and Comparison to Background for NNEU Surface Soil/ Surface Sediment

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test Results		
		Background Dataset			NNEU Dataset (excluding background samples)			Test	1 - p	Statistically Greater Than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Arsenic	**mg/kg**	**73**	**GAMMA**	**92**	**375**	**GAMMA**	**100**	**WRS**	**6.64E-09**	**Yes**
Vanadium	**mg/kg**	**72**	**NORMAL**	**96**	**375**	**NON-PARAMETRIC**	**100**	**WRS**	**5.98E-09**	**Yes**
Cesium-134	pCi/g	77	NON-PARAMETRIC	100	35	NON-PARAMETRIC	100	WRS	1.000	No
Cesium-137	pCi/g	105	NON-PARAMETRIC	100	215	NON-PARAMETRIC	100	WRS	1.000	No
Radium-228	pCi/g	40	GAMMA	100	56	NORMAL	100	WRS	0.300	No

WRS = Wilcoxon Rank Sum

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

Table A3.2.2
Summary Statistics for Background and NNEU Surface Soil/ Surface Sediment[a]

Analyte	Units	Background					NNEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation
Arsenic	mg/kg	73	0.270	9.60	3.42	2.55	375	1.40	13.2	5.01	1.93
Vanadium	mg/kg	72	3.40	73.0	22.6	14.1	375	7.40	5,300	80.5	375
Cesium-134	pCi/g	77	1.00E-03	0.300	0.141	0.066	35	-0.267	0.167	0.024	0.092
Cesium-137	pCi/g	105	-0.027	1.80	0.692	0.492	215	-0.072	2.27	0.414	0.538
Radium-228	pCi/g	40	0.200	4.10	1.60	0.799	56	1.00E-03	2.20	1.51	0.371

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

Table A3.2.3
Statistical Distributions and Comparison to Background for NNEU Subsurface Soil/ Subsurface Sediment

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test Results		
		Background Dataset			NNEU Dataset (excluding background samples)			Test	1 - p	Statistically Greater Than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Radium-228	**pCi/g**	**31**	**GAMMA**	**100**	**122**	**NORMAL**	**100**	**WRS**	**0.023**	**Yes**

WRS = Wilcoxon Rank Sum

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

Table A3.2.4

Summary Statistics for Background and NNEU Subsurface Soil/ Subsurface Sediment[a]

Analyte	Units	Background					NNEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation
Radium-228	pCi/g	31	1.00	2.10	1.45	0.320	122	0.690	3.03	1.57	0.337

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

Table A3.2.5
Statistical Distributions and Comparison to Background for NNEU Surface Soil (non-PMJM)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test Results		
		Background Dataset			NNEU Dataset (excluding background samples)			Test	1 - p	Statistically Greater Than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Aluminum	mg/kg	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.334	No
Antimony	**mg/kg**	**20**	**NON-PARAMETRIC**	**0**	**341**	**NON-PARAMETRIC**	**19**	**N/A**	**N/A**	**N/A**
Arsenic	mg/kg	20	NORMAL	100	356	GAMMA	100	WRS	0.993	No
Barium	**mg/kg**	**20**	**NORMAL**	**100**	**356**	**LOGNORMAL**	**100**	**WRS**	**0.018**	**Yes**
Boron	**mg/kg**	**N/A**	**N/A**	**N/A**	**36**	**NORMAL**	**100**	**N/A**	**N/A**	**N/A**
Cadmium	mg/kg	20	NON-PARAMETRIC	65	356	NON-PARAMETRIC	26	WRS	0.984	No
Chromium	mg/kg	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.168	No
Cobalt	mg/kg	20	NORMAL	100	356	NON-PARAMETRIC	97	WRS	0.930	No
Copper	**mg/kg**	**20**	**NON-PARAMETRIC**	**100**	**356**	**NON-PARAMETRIC**	**91**	**WRS**	**0.031**	**Yes**
Lead	mg/kg	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.996	No
Lithium	mg/kg	20	NORMAL	100	190	GAMMA	80	WRS	0.836	No
Manganese	mg/kg	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.792	No
Mercury	**mg/kg**	**20**	**NON-PARAMETRIC**	**40**	**355**	**NON-PARAMETRIC**	**17**	**N/A**	**N/A**	**N/A**
Molybdenum	**mg/kg**	**20**	**NORMAL**	**0**	**190**	**NON-PARAMETRIC**	**21**	**N/A**	**N/A**	**N/A**
Nickel	**mg/kg**	**20**	**NORMAL**	**100**	**356**	**NON-PARAMETRIC**	**97**	**WRS**	**0.048**	**Yes**
Selenium	mg/kg	20	NON-PARAMETRIC	60	344	NON-PARAMETRIC	25	WRS	1.000	No
Silver	**mg/kg**	**20**	**NORMAL**	**0**	**356**	**NON-PARAMETRIC**	**36**	**N/A**	**N/A**	**N/A**
Thallium	**mg/kg**	**14**	**NORMAL**	**0**	**352**	**NON-PARAMETRIC**	**6**	**N/A**	**N/A**	**N/A**
Tin	**mg/kg**	**20**	**NORMAL**	**0**	**190**	**NON-PARAMETRIC**	**13**	**N/A**	**N/A**	**N/A**
Vanadium	mg/kg	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.123	No
Zinc	mg/kg	20	NORMAL	100	356	NON-PARAMETRIC	100	WRS	0.404	No

WRS = Wilcoxon Rank Sum
Bold = Analyte retained for further consideration in the next ECOPC selection step.

Table A3.2.6
Summary Statistics for Background and NNEU Surface Soil (non-PMJM)[a]

Analyte	Units	Background					NNEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation
Aluminum	mg/kg	20	4,050	17,100	10,203	3,256	356	1,580	29,300	10,484	3,715
Antimony	mg/kg	20	ND	ND	0.279	0.078	341	0.380	348	5.16	19.1
Arsenic	mg/kg	20	2.30	9.60	6.09	2.00	356	1.60	13.2	5.00	1.96
Barium	mg/kg	20	45.7	134	102	19.4	356	25.0	1,120	141	90.3
Boron	mg/kg	N/A	N/A	N/A	N/A	N/A	36	1.20	7.90	3.72	1.44
Cadmium	mg/kg	20	0.670	2.30	0.708	0.455	356	0.090	12.3	0.566	0.748
Chromium	mg/kg	20	5.50	16.9	11.2	2.78	356	4.20	128	12.8	7.71
Cobalt	mg/kg	20	3.40	11.2	7.27	1.79	356	1.10	27.1	6.79	2.77
Copper	mg/kg	20	5.20	16.0	13.0	2.58	356	5.70	640	19.3	37.4
Lead	mg/kg	20	8.60	53.3	33.5	10.5	356	0.870	814	39.9	75.2
Lithium	mg/kg	20	4.80	11.6	7.66	1.89	190	2.30	16.4	7.44	3.12
Manganese	mg/kg	20	129	357	237	63.9	356	21.1	1,370	240	154
Mercury	mg/kg	20	0.090	0.120	0.072	0.031	355	0.011	0.340	0.048	0.026
Molybdenum	mg/kg	20	ND	ND	0.573	0.184	190	0.200	9.10	1.14	1.06
Nickel	mg/kg	20	3.80	14.0	9.60	2.59	356	2.90	93.4	11.5	7.37
Selenium	mg/kg	20	0.680	1.40	0.628	0.305	344	0.290	2.20	0.380	0.295
Silver	mg/kg	20	ND	ND	0.207	0.007	356	0.110	64.9	0.882	3.44
Thallium	mg/kg	14	ND	ND	0.414	0.015	352	0.240	5.80	0.277	0.335
Tin	mg/kg	20	ND	ND	2.06	0.410	190	1.70	72.3	4.54	8.61
Vanadium	mg/kg	20	10.8	45.8	27.7	7.68	356	8.40	5,300	82.9	385
Zinc	mg/kg	20	21.1	75.9	49.8	12.2	356	14.0	293	54.1	28.4
4,4'-DDT	ug/kg	N/A	N/A	N/A	N/A	N/A	65	26.0	26.0	9.98	9.09
Benzo(a)pyrene	ug/kg	N/A	N/A	N/A	N/A	N/A	87	42.0	1,000	217	227
bis(2-ethylhexyl)phthalate	ug/kg	N/A	N/A	N/A	N/A	N/A	87	36.0	5,500	303	676
Di-n-butylphthalate	ug/kg	N/A	N/A	N/A	N/A	N/A	87	40.0	260	197	184
Total PCBs	ug/kg	N/A	N/A	N/A	N/A	N/A	116	54.0	3,490	224	425

[a] For inorganics and organics, one-half the detection limit used as proxy value for nondetects in computation of the mean and standard deviation.
N/A = Not available.
ND = Anlyate not detected.

Table A3.2.7
Statistical Distributions and Comparison to Background for NNEU Surface Soil (PMJM)

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test Results		
		Background Dataset			NNEU Dataset (excluding background samples)			Test	1 - p	Statistically Greater Than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Arsenic	mg/kg	20	NORMAL	100.0	5	NORMAL	100.00	t-Test_N	0.236	No
Mercury	mg/kg	20	NON-PARAMETRIC	40.0	5	NON-PARAMETRIC	100.00	WRS	0.555	No
Nickel	**mg/kg**	**20**	**NORMAL**	**100.0**	**5**	**NORMAL**	**100.00**	**t-Test_N**	**9.78E-04**	**Yes**
Vanadium	**mg/kg**	**20**	**NORMAL**	**100.0**	**5**	**NORMAL**	**100.00**	**t-Test_N**	**0.007**	**Yes**
Zinc	**mg/kg**	**20**	**NORMAL**	**100.0**	**5**	**NORMAL**	**100.00**	**t-Test_N**	**1.43E-04**	**Yes**

WRS = Wilcoxon Rank Sum
Bold = Analyte retained for further consideration in the next ECOPC selection step.
t-Test_N = Student's t-test using normal data

Table A3.2.8
Summary Statistics for Background and NNEU Surface Soil (PMJM)[a]

Analyte	Units	Background					NNEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation
Arsenic	mg/kg	20	2.30	9.60	6.09	2.00	5	5.70	8.00	6.76	0.820
Mercury	mg/kg	20	0.090	0.120	0.072	0.031	5	0.030	0.080	0.064	0.019
Nickel	mg/kg	20	3.80	14.0	9.60	2.59	5	12.0	14.8	13.8	1.12
Vanadium	mg/kg	20	10.8	45.8	27.7	7.68	5	30.0	42.1	37.5	5.59
Zinc	mg/kg	20	21.1	75.9	49.8	12.2	5	54.0	87.4	76.5	13.9

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

Table A3.2.9
Statistical Distributions and Comparison to Background for NNEU Subsurface Soil

Analyte	Units	Statistical Distribution Testing Results						Background Comparison Test Results		
		Background Dataset			NNEU Dataset (excluding background samples)			Test	1 - p	Statistically Greater Than Background?
		Total Samples	Distribution Recommended by ProUCL	Detects (%)	Total Samples	Distribution Recommended by ProUCL	Detects (%)			
Antimony	**mg/kg**	**28**	**NON-PARAMETRIC**	**7**	**248**	**NON-PARAMETRIC**	**11**	**N/A**	**N/A**	**N/A**
Arsenic	mg/kg	45	NON-PARAMETRIC	93	289	NON-PARAMETRIC	99	WRS	0.863	No
Copper	mg/kg	45	NORMAL	96	289	NON-PARAMETRIC	96	WRS	0.300	No
Molybdenum	**mg/kg**	**45**	**NON-PARAMETRIC**	**67**	**288**	**NON-PARAMETRIC**	**16**	**N/A**	**N/A**	**N/A**
Nickel	mg/kg	44	GAMMA	100	289	NON-PARAMETRIC	81	WRS	1.000	No
Nitrate	mg/kg	44	NON-PARAMETRIC	61	110	NON-PARAMETRIC	50	WRS	0.984	No
Selenium	**mg/kg**	**38**	**LOGNORMAL**	**0**	**284**	**NON-PARAMETRIC**	**30**	**N/A**	**N/A**	**N/A**
Vanadium	mg/kg	45	NORMAL	98	289	NON-PARAMETRIC	99	WRS	1.000	No
Zinc	mg/kg	44	NORMAL	100	289	NON-PARAMETRIC	100	WRS	0.504	No

WRS = Wilcoxon Rank Sum
Bold = Analyte retained for further consideration in the next ECOPC selection step.
N/A = not applicable; site and/or background detection frequency less than 20%.

Table A3.2.10
Summary Statistics for Background and NNEU Subsurface Soil[a]

Analyte	Units	Background					NNEU (excluding background samples)				
		Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation	Total Samples	Minimum Detected Concentration	Maximum Detected Concentration	Mean Concentraiton	Standard Deviation
Antimony	mg/kg	28	2.90	8.20	4.21	2.78	248	0.670	22.3	4.75	3.17
Arsenic	mg/kg	45	1.70	41.8	5.48	6.02	289	0.460	23.8	4.46	2.78
Copper	mg/kg	45	2.20	31.6	11.6	6.09	289	2.60	1,000	18.9	64.5
Molybdenum	mg/kg	45	3.50	41.0	13.5	7.80	288	0.200	27.9	1.83	1.94
Nickel	mg/kg	44	4.30	54.2	20.9	11.1	289	4.70	41.5	11.6	5.83
Nitrate	mg/kg	44	1.10	7.08	1.57	1.38	110	0.550	20,000	184	1,907
Selenium	mg/kg	38	ND	ND	0.592	0.543	284	0.240	4.20	0.369	0.402
Vanadium	mg/kg	45	11.4	70.0	33.8	14.8	289	2.10	119	25.7	13.0
Zinc	mg/kg	44	0.520	79.8	36.2	21.0	289	5.50	1,400	46.3	99.5

[a] For inorganics and organics, one-half the detection limit used as proxy value for nondetects in computation of the mean and standard deviation.
ND = Analyte was not detected.

Table A3.4.1
Summary of Element Concentrations in Colorado and Bordering States Surface Soil[a]

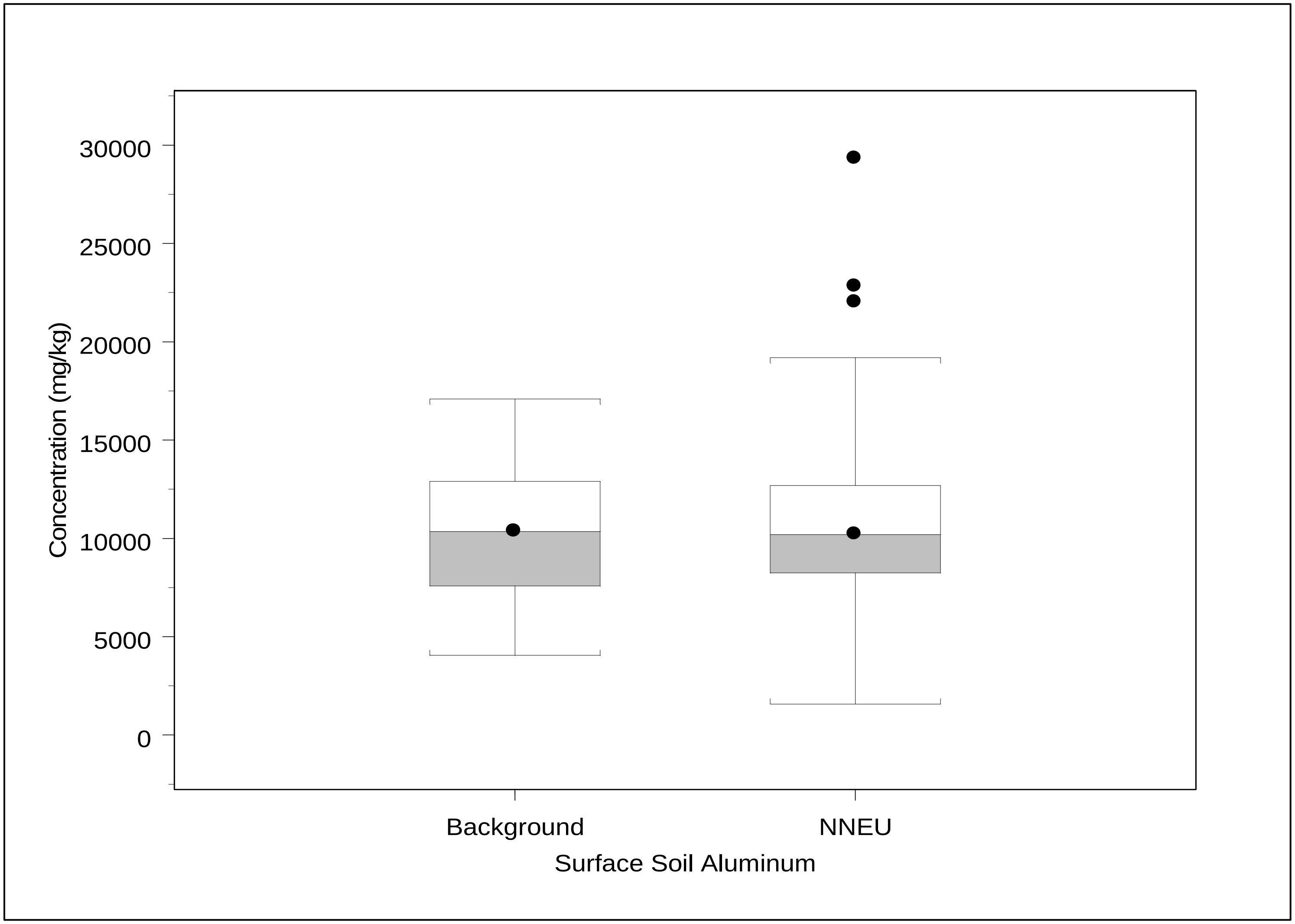
Analyte	Total Number of Results	Detection Frequency (%)	Range of Detected Values (mg/kg)	Average (mg/kg)[b]	Standard Deviation (mg/kg)[b]
Aluminum	303	100	5,000 - 100,000	50,800	23,500
Antimony	84	15.0	1.038 - 2.531	0.647	0.378
Arsenic	307	99.0	1.224 - 97	6.9	7.64
Barium	342	100	100 - 3,000	642	330
Beryllium	342	36.0	1 - 7	0.991	0.876
Boron	342	67.0	20 - 150	27.9	19.7
Bromine	85	51.0	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	16.0	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	0.5777 - 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	3.50	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.

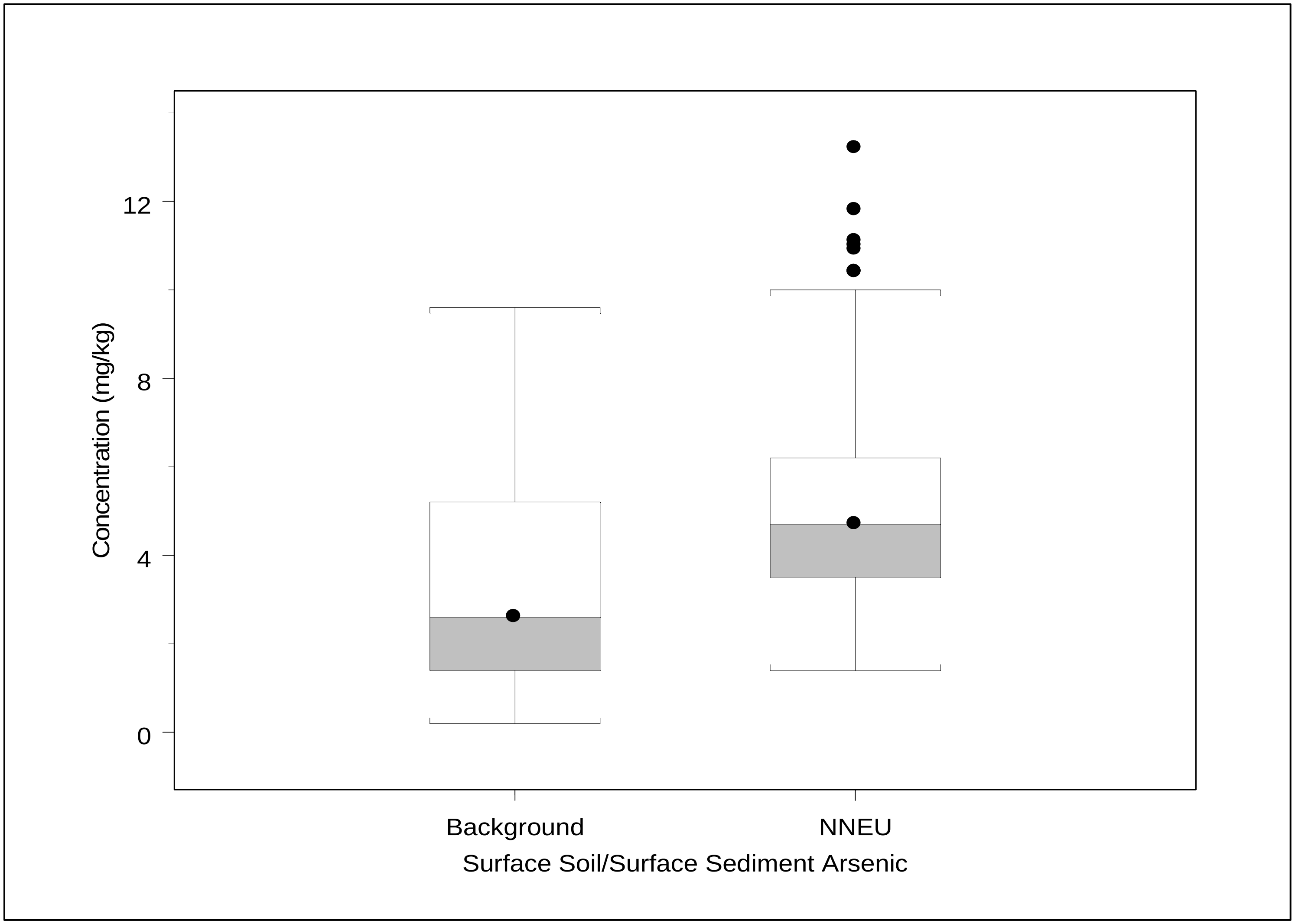
FIGURES

Figure A3.2.1
NNEU Surface Soil (Non-PMJM) Box Plots for Aluminum



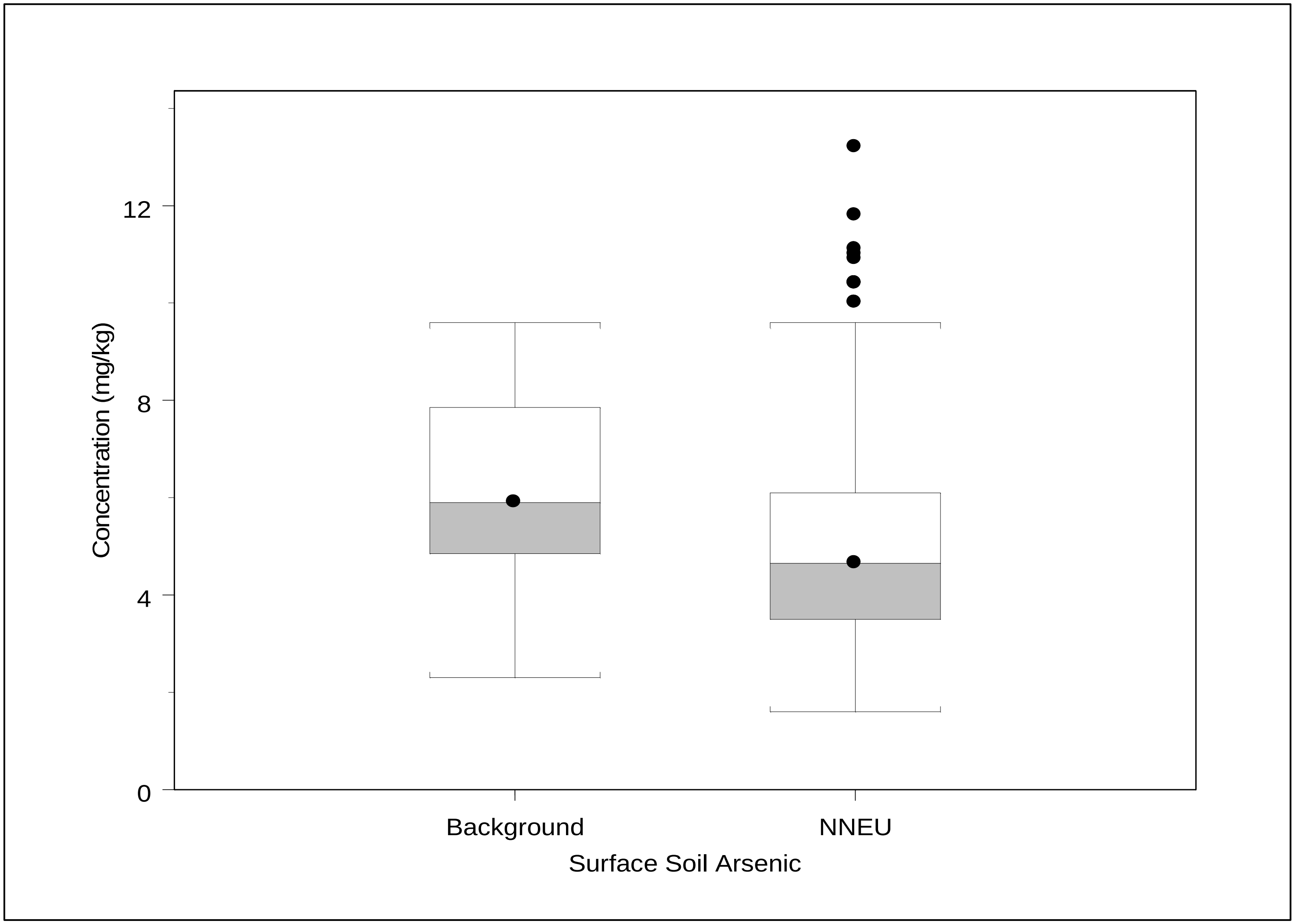
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.2
NNEU Surface Soil/Surface Sediment Box Plots for Aluminum



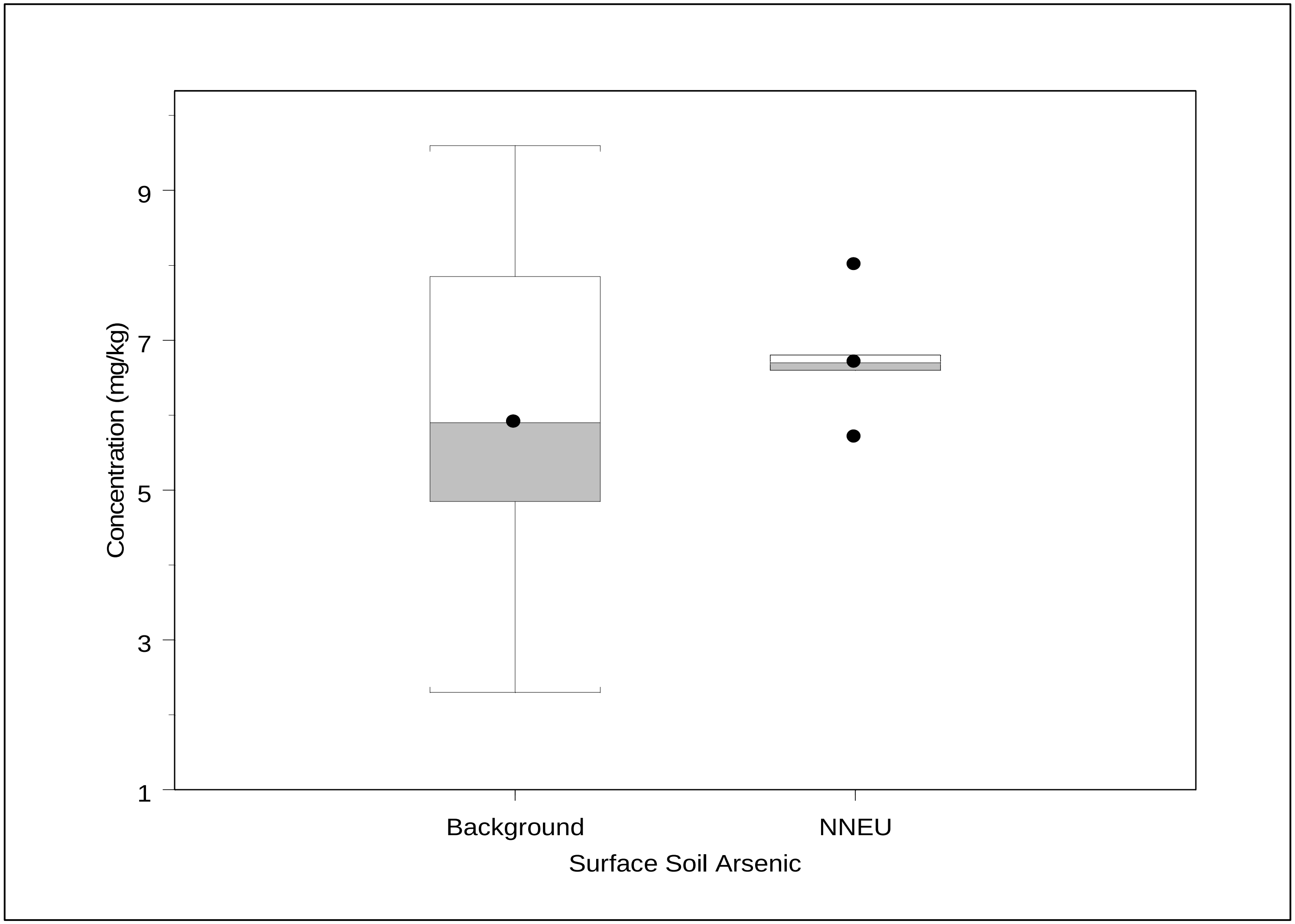
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.3
NNEU Surface Soil (Non-PMJM) Box Plots for Arsenic



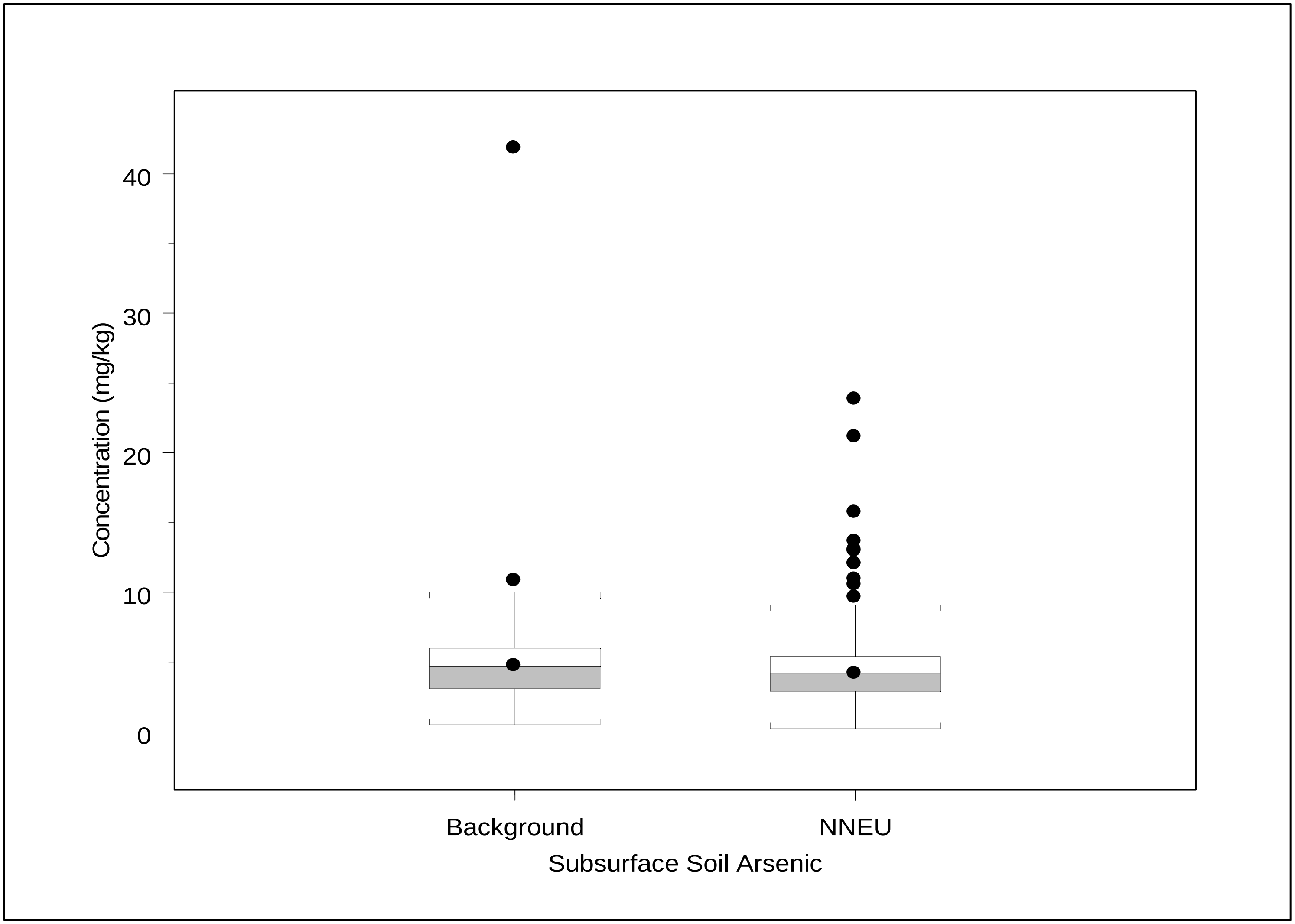
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.4
NNEU Surface Soil (PMJM) Box Plots for Arsenic



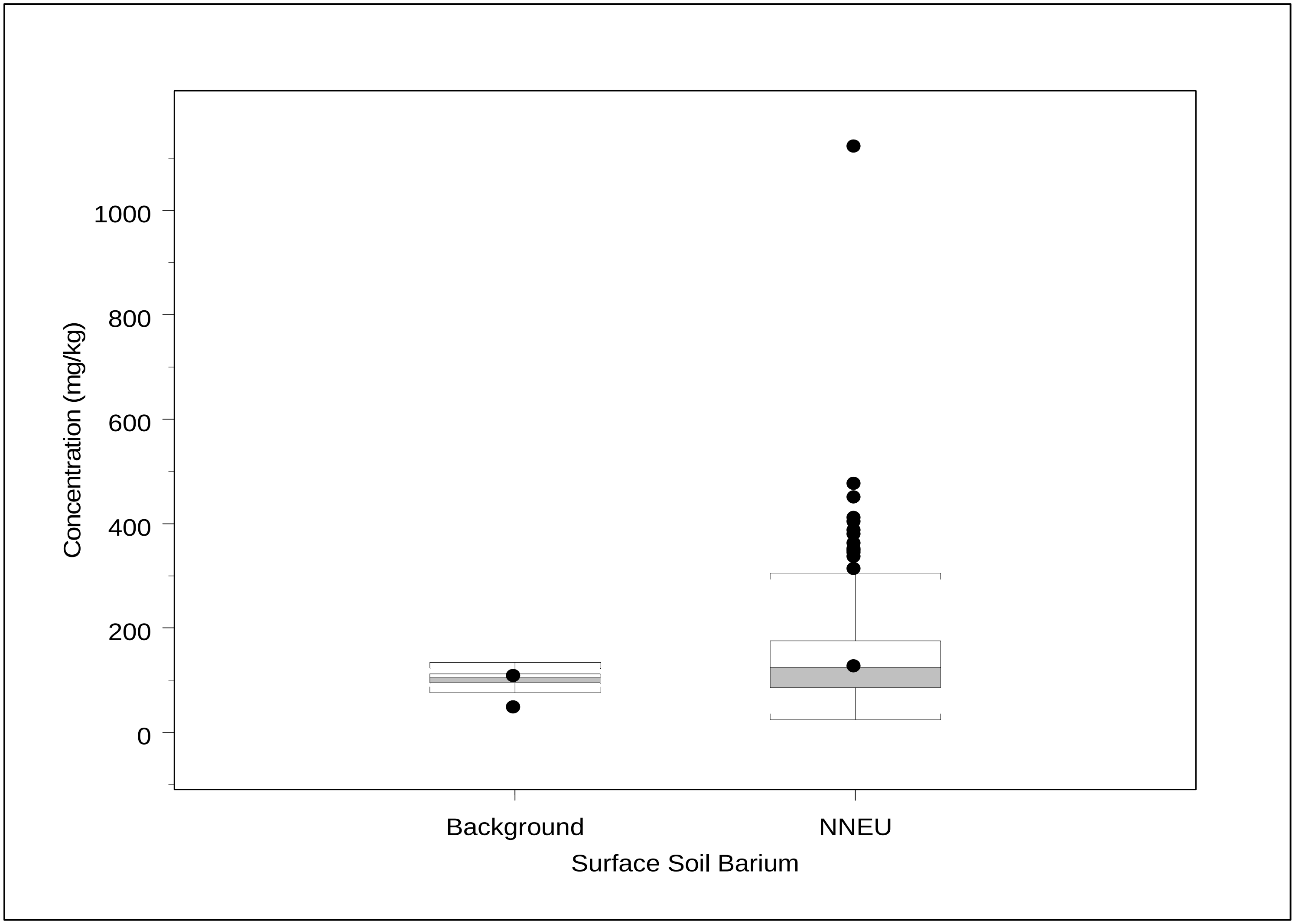
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.5
NNEU Subsurface Soil Box Plots for Arsenic



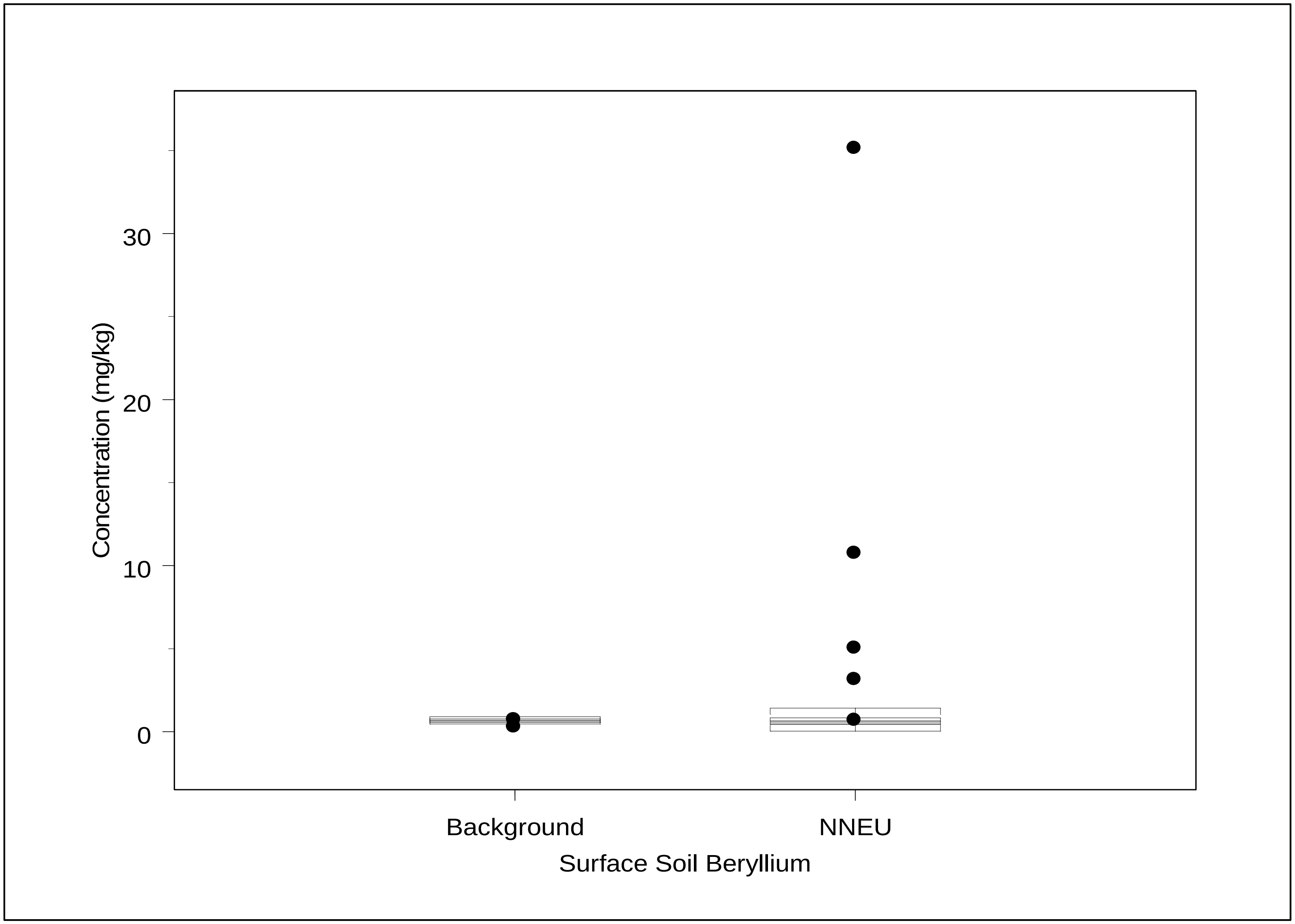
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.6
NNEU Surface Soil (Non-PMJM) Box Plots for Barium



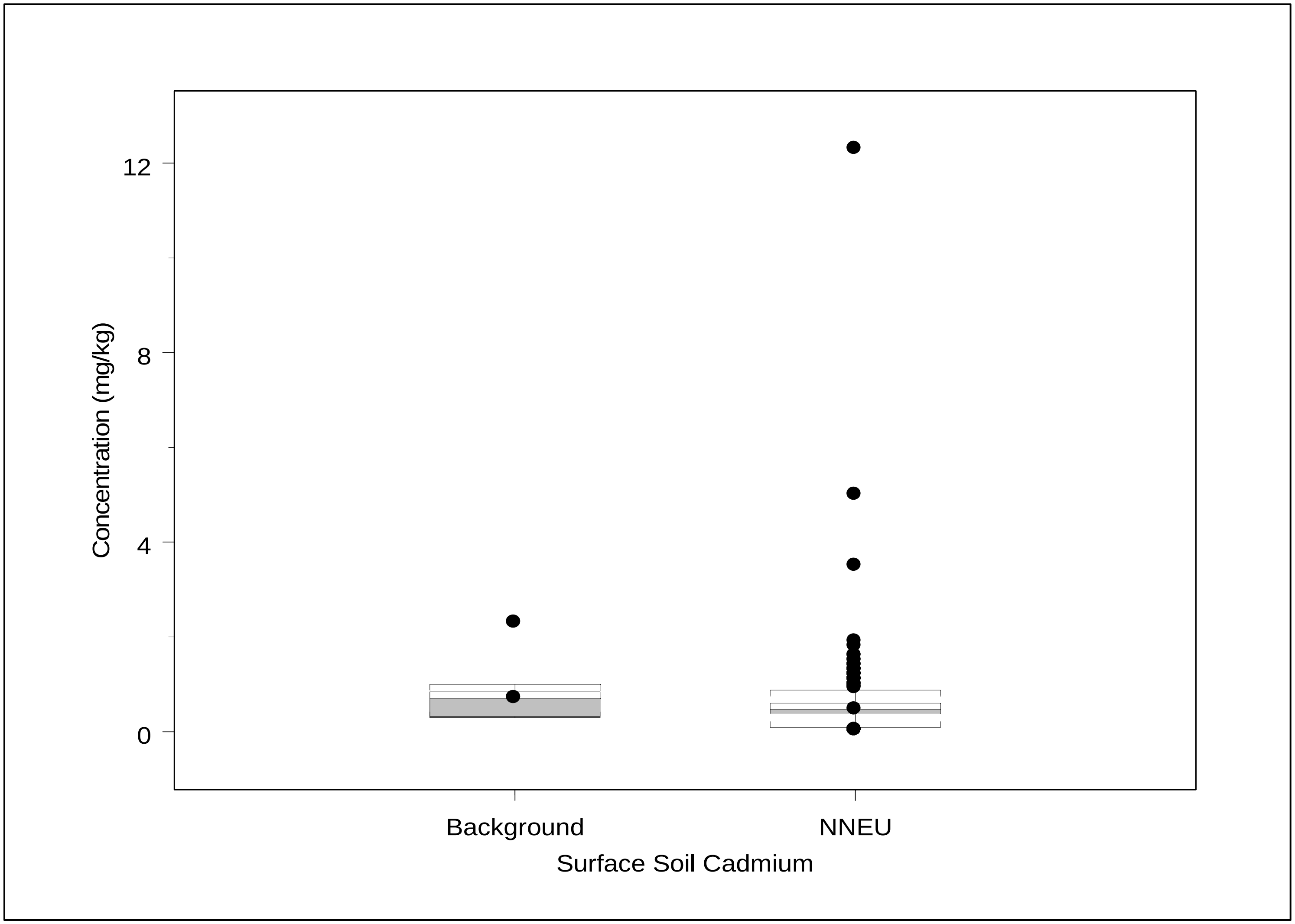
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.7
NNEU Surface Soil (Non-PMJM) Box Plots for Beryllium



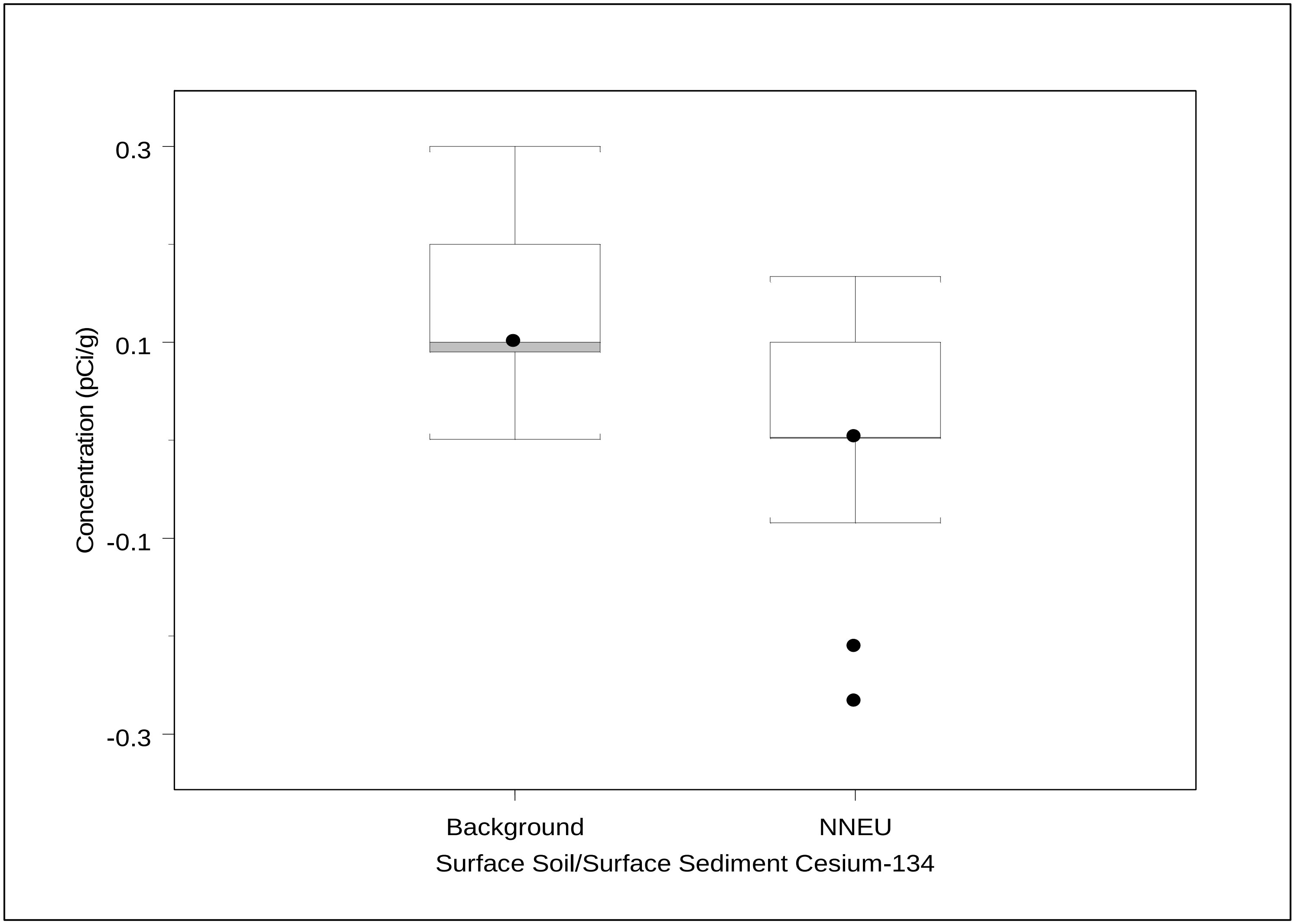
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.8
NNEU Surface Soil (Non-PMJM) Box Plots for Cadmium



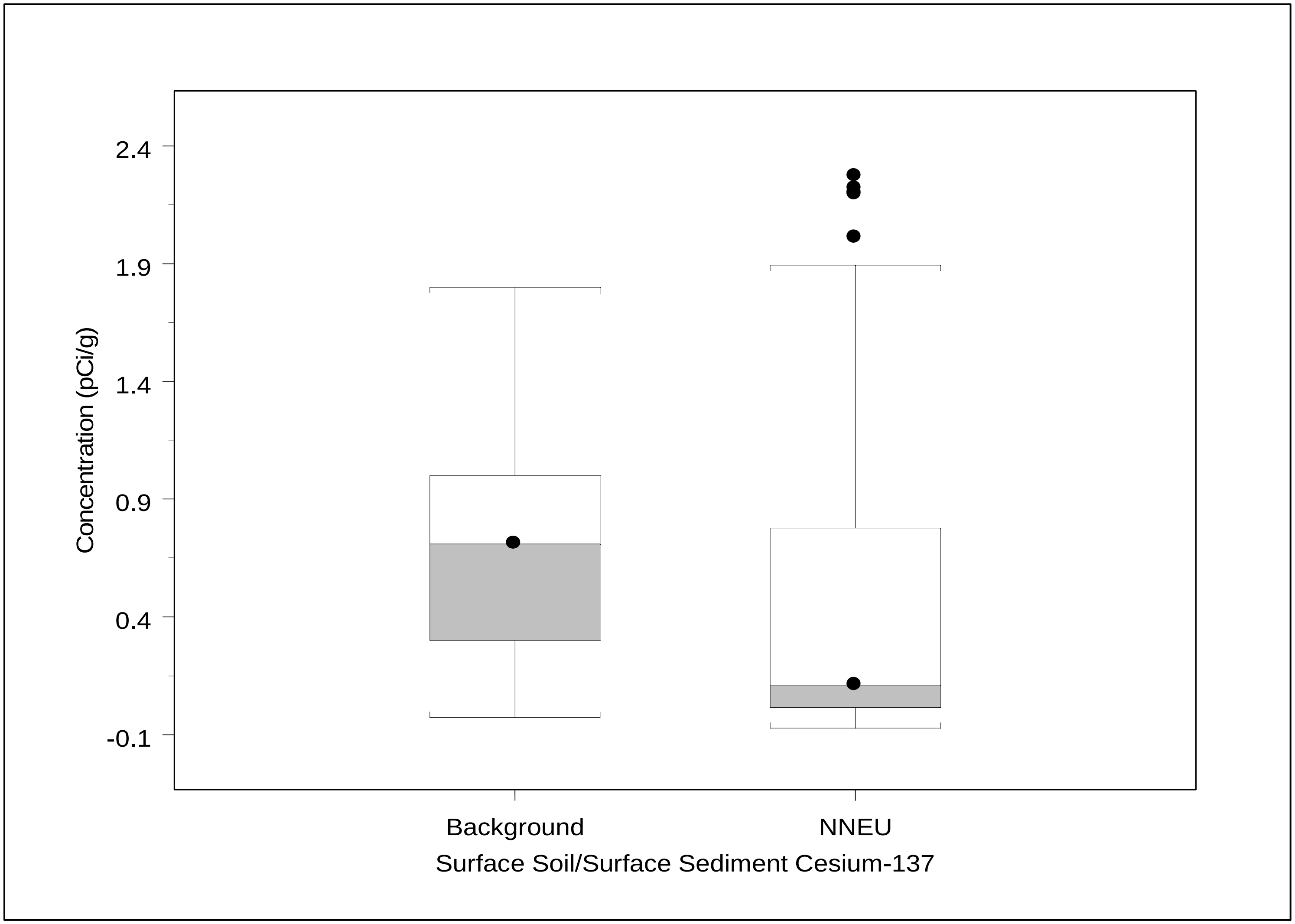
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.9
NNEU Surface Soil/Surface Sediment Box Plots for Cesium-134



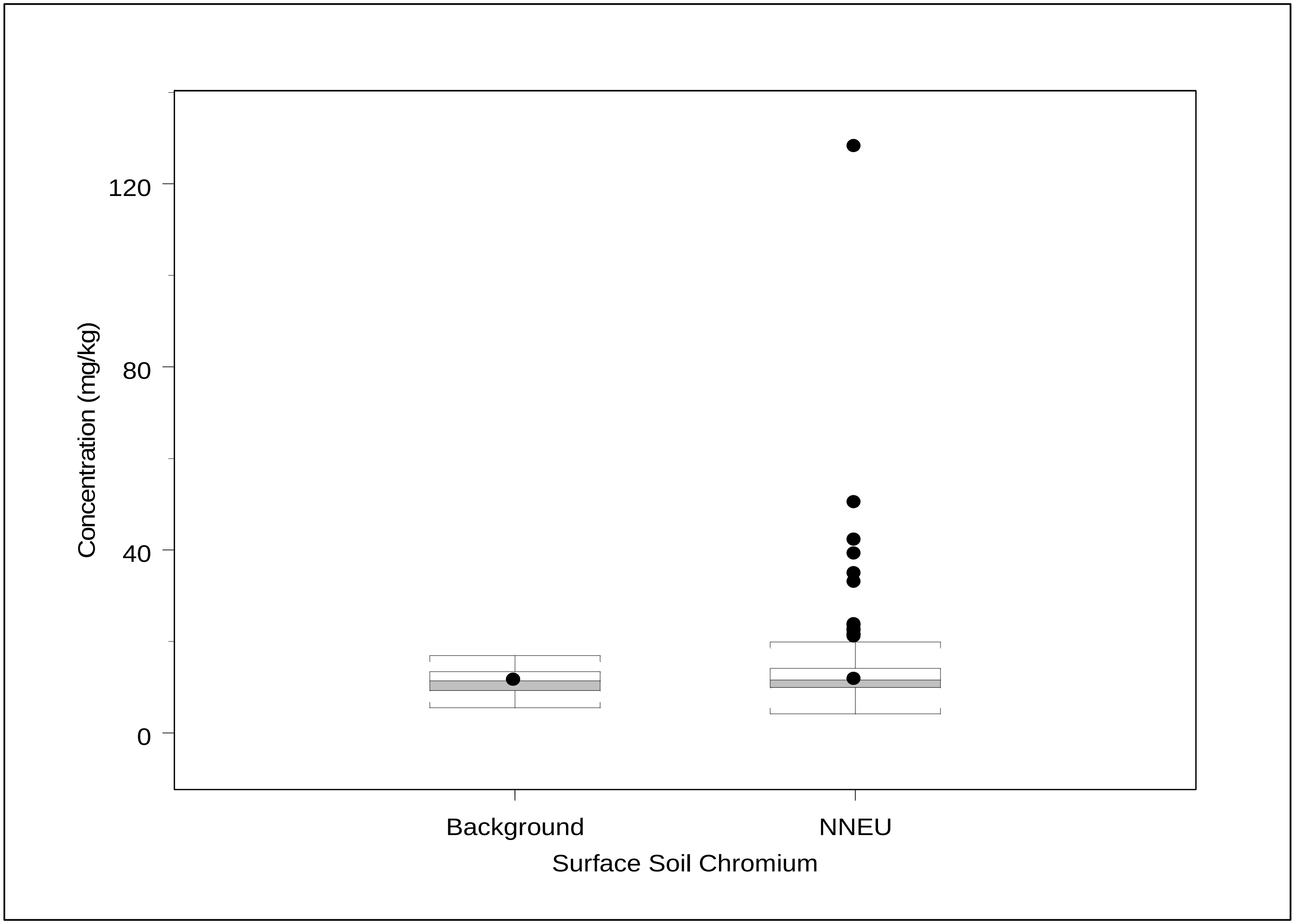
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.10
NNEU Surface Soil/Surface Sediment Box Plots for Cesium-137



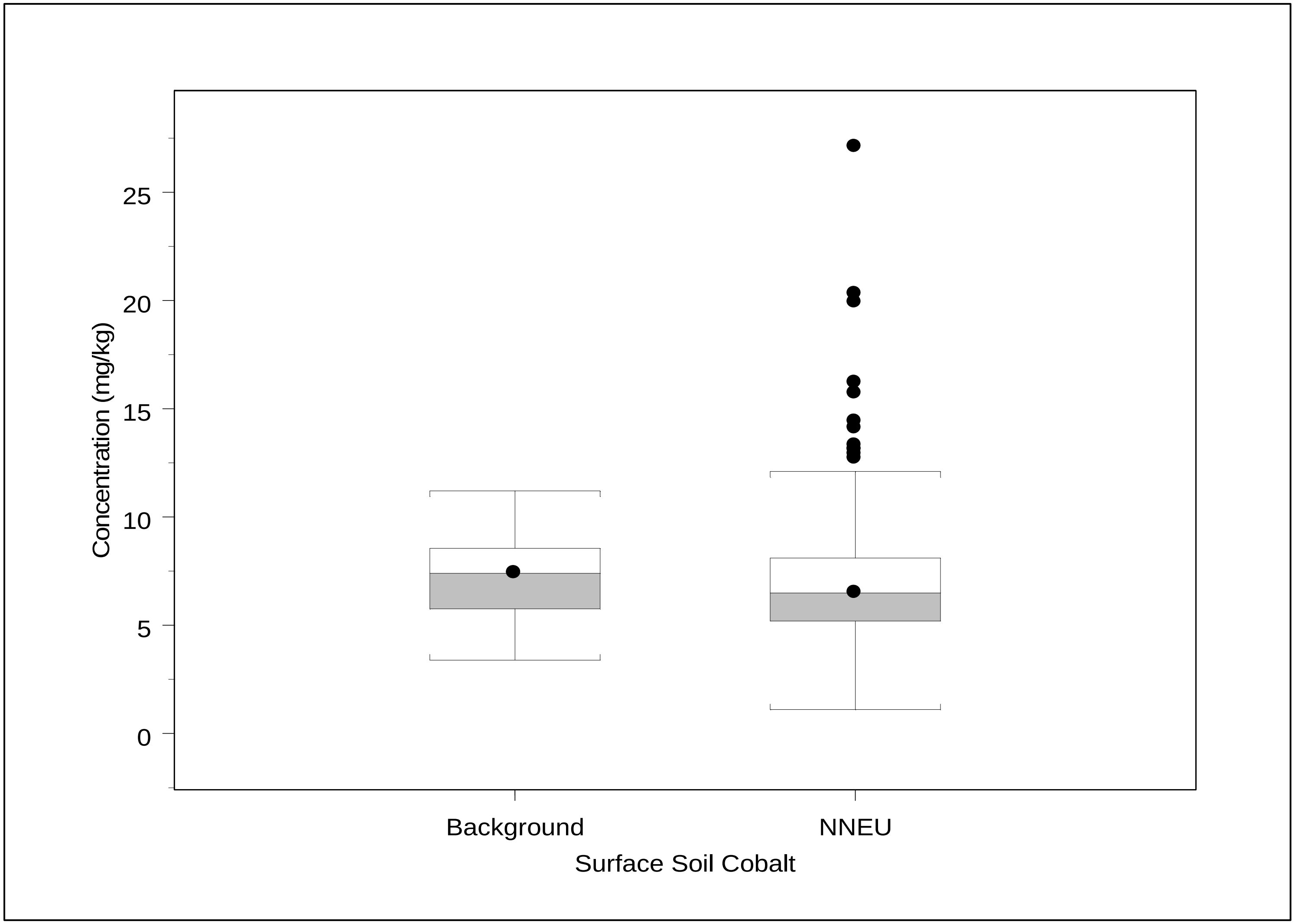
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.11
NNEU Surface Soil (Non-PMJM) Box Plots for Chromium



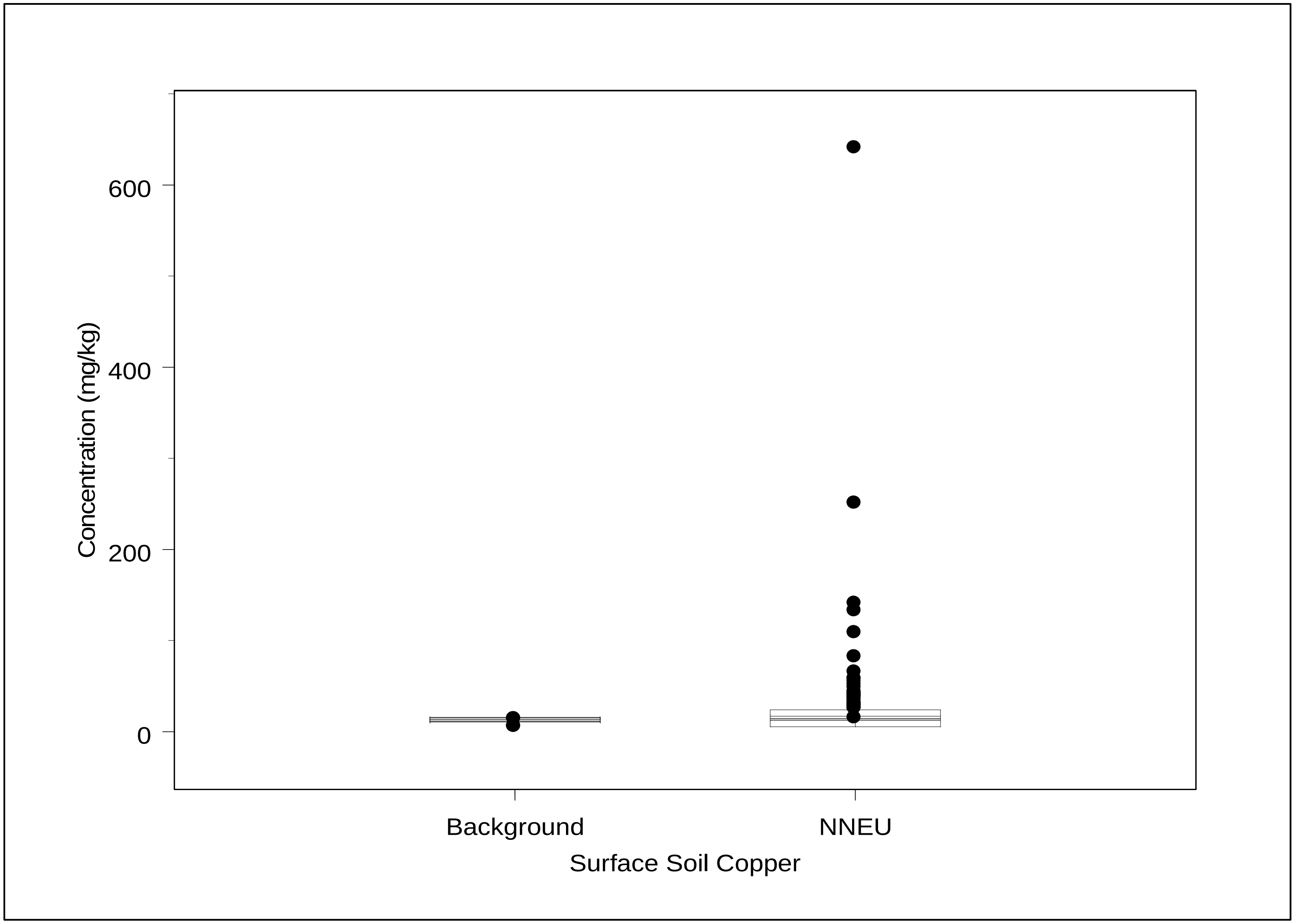
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.12
NNEU Surface Soil (Non-PMJM) Box Plots for Cobalt



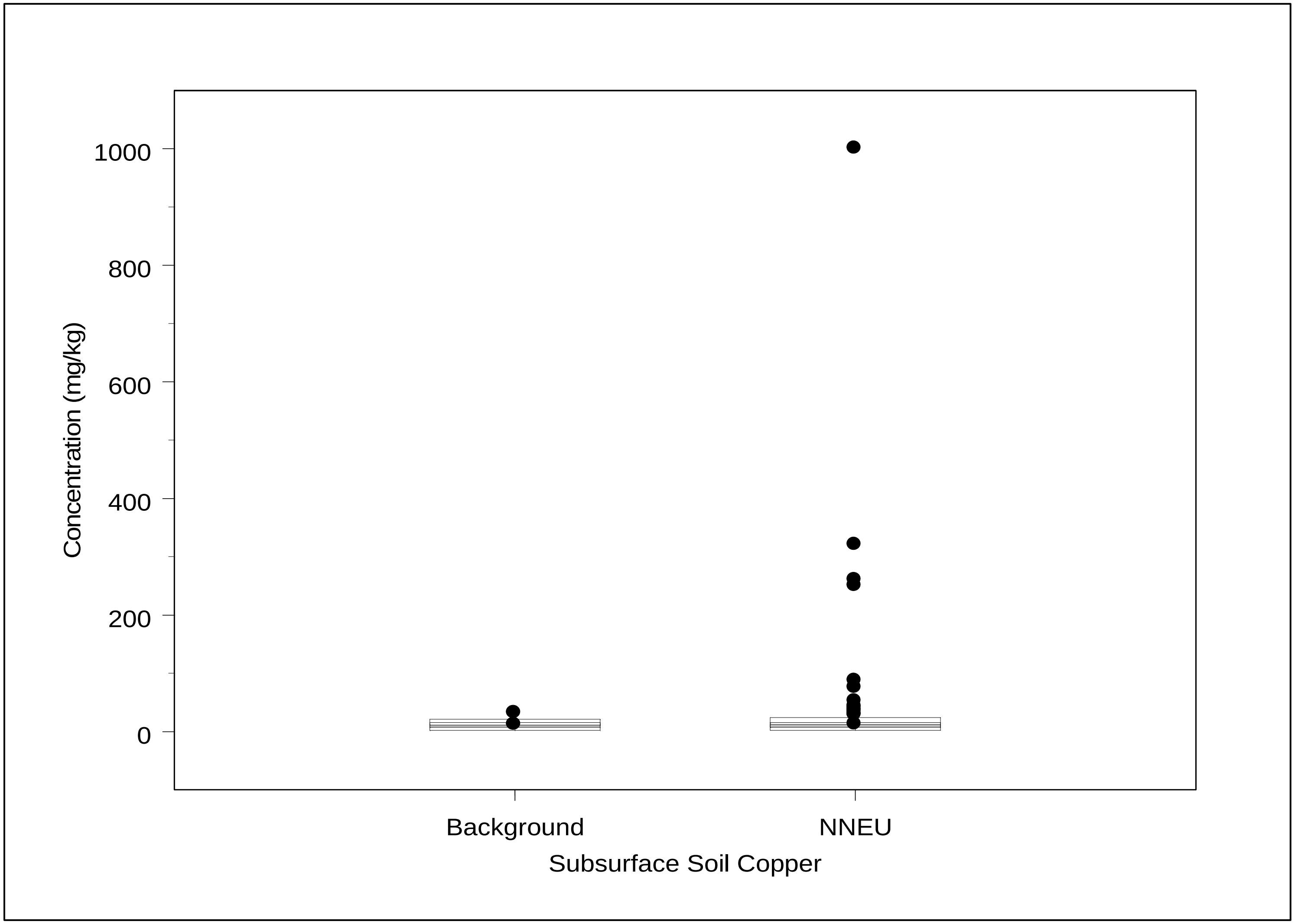
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.13
NNEU Surface Soil (Non-PMJM) Box Plots for Copper



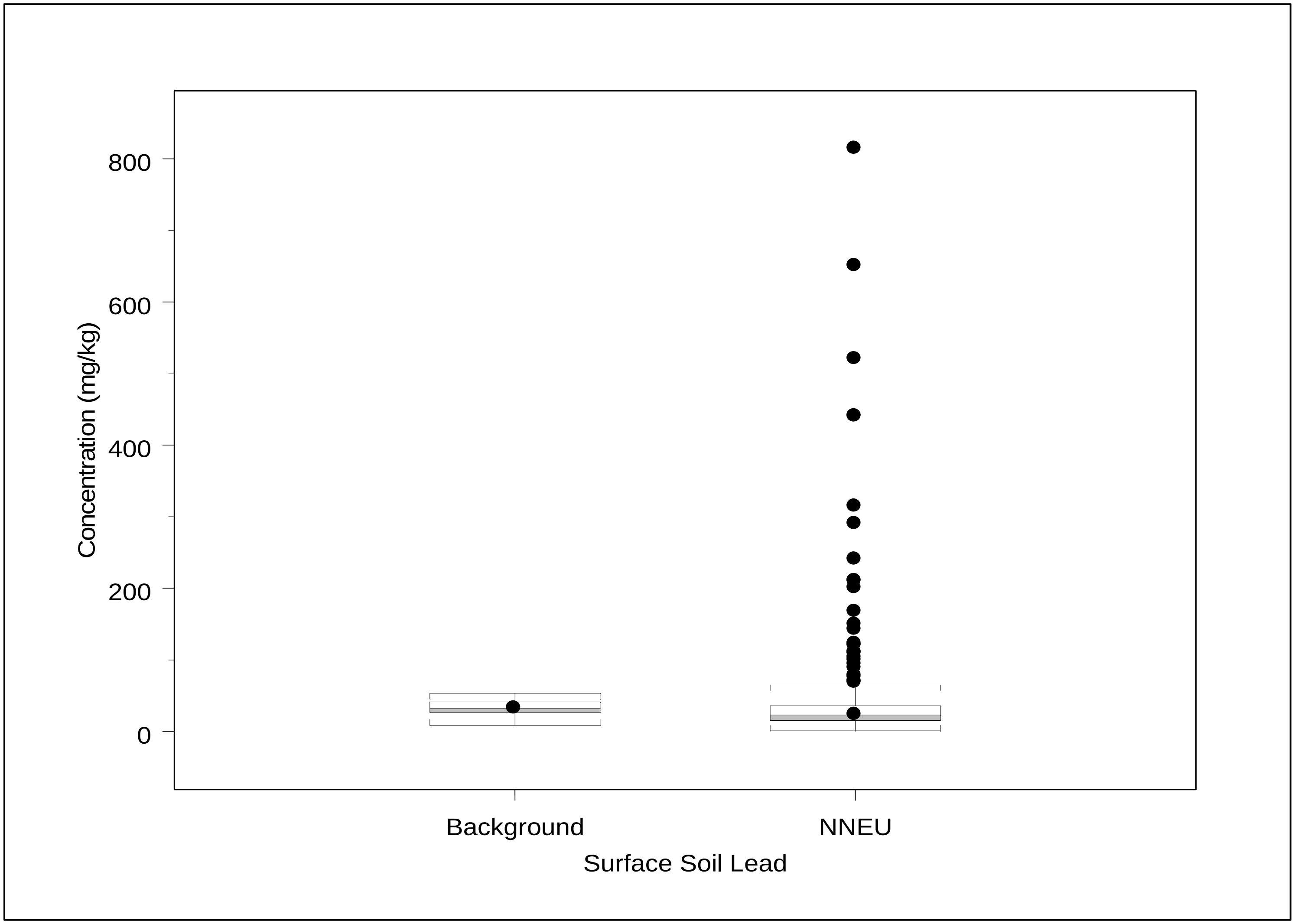
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.14
NNEU Subsurface Soil Box Plots for Copper



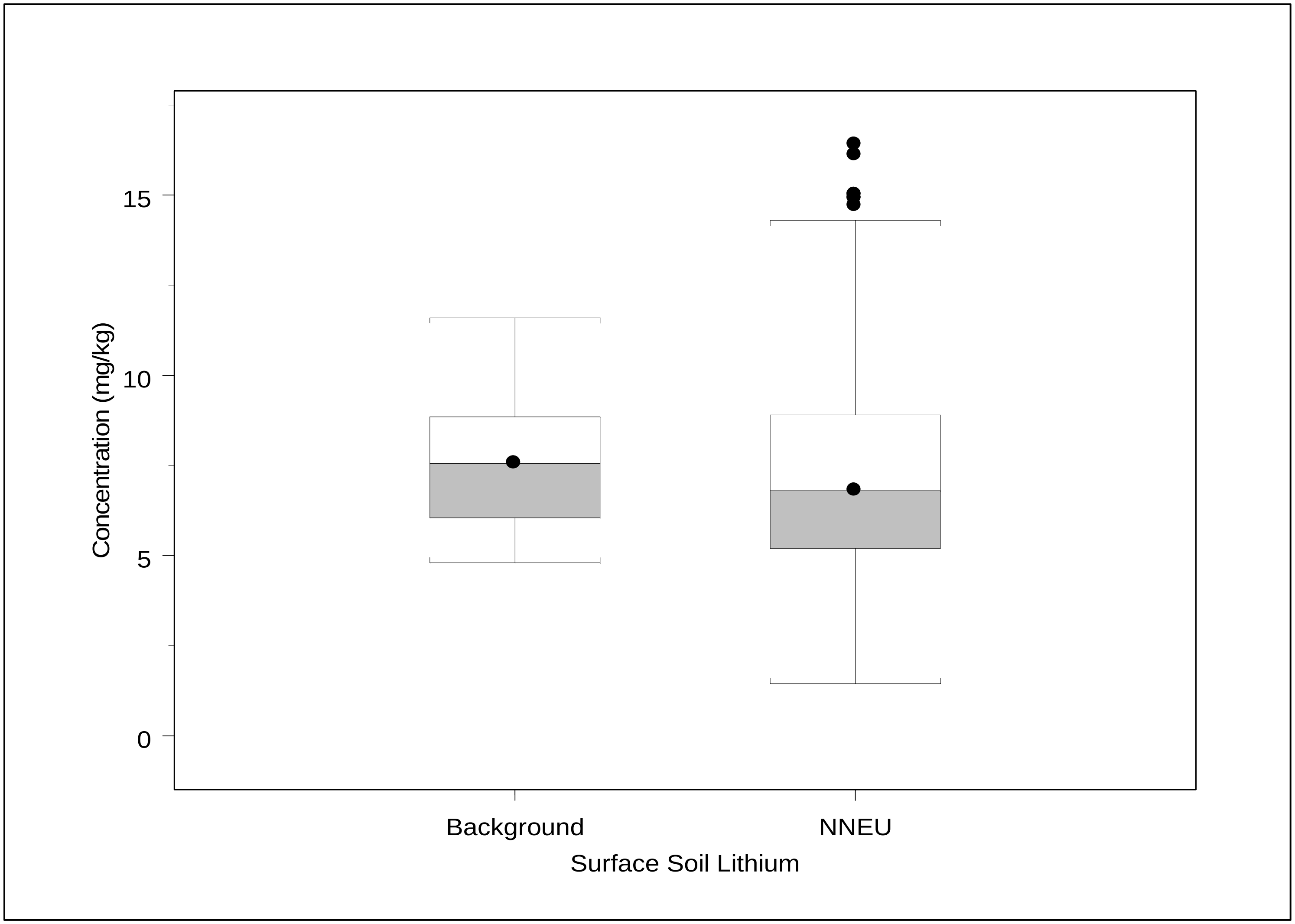
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.15
NNEU Surface Soil (Non-PMJM) Box Plots for Lead



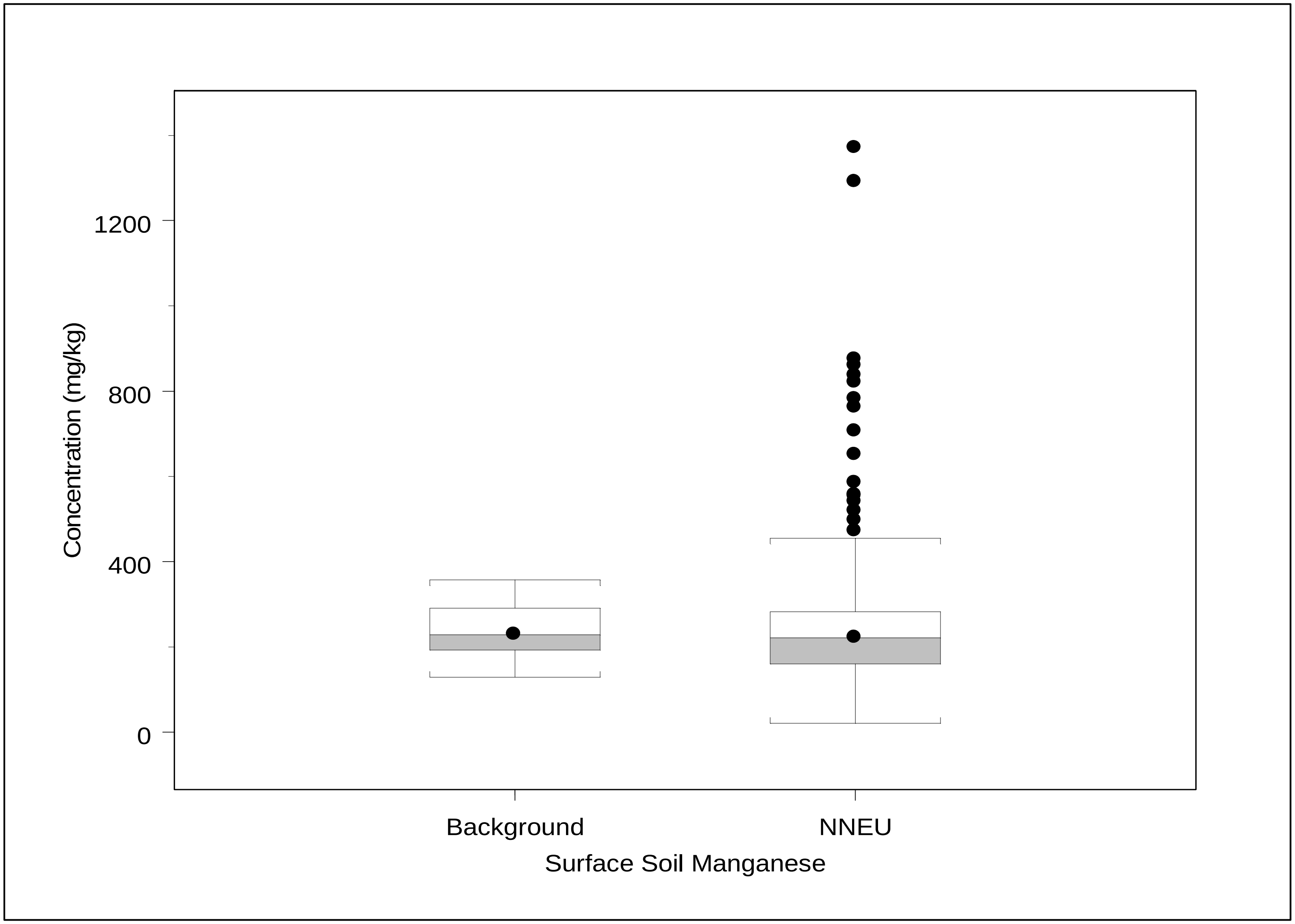
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.16
NNEU Surface Soil (Non-PMJM) Box Plots for Lithium



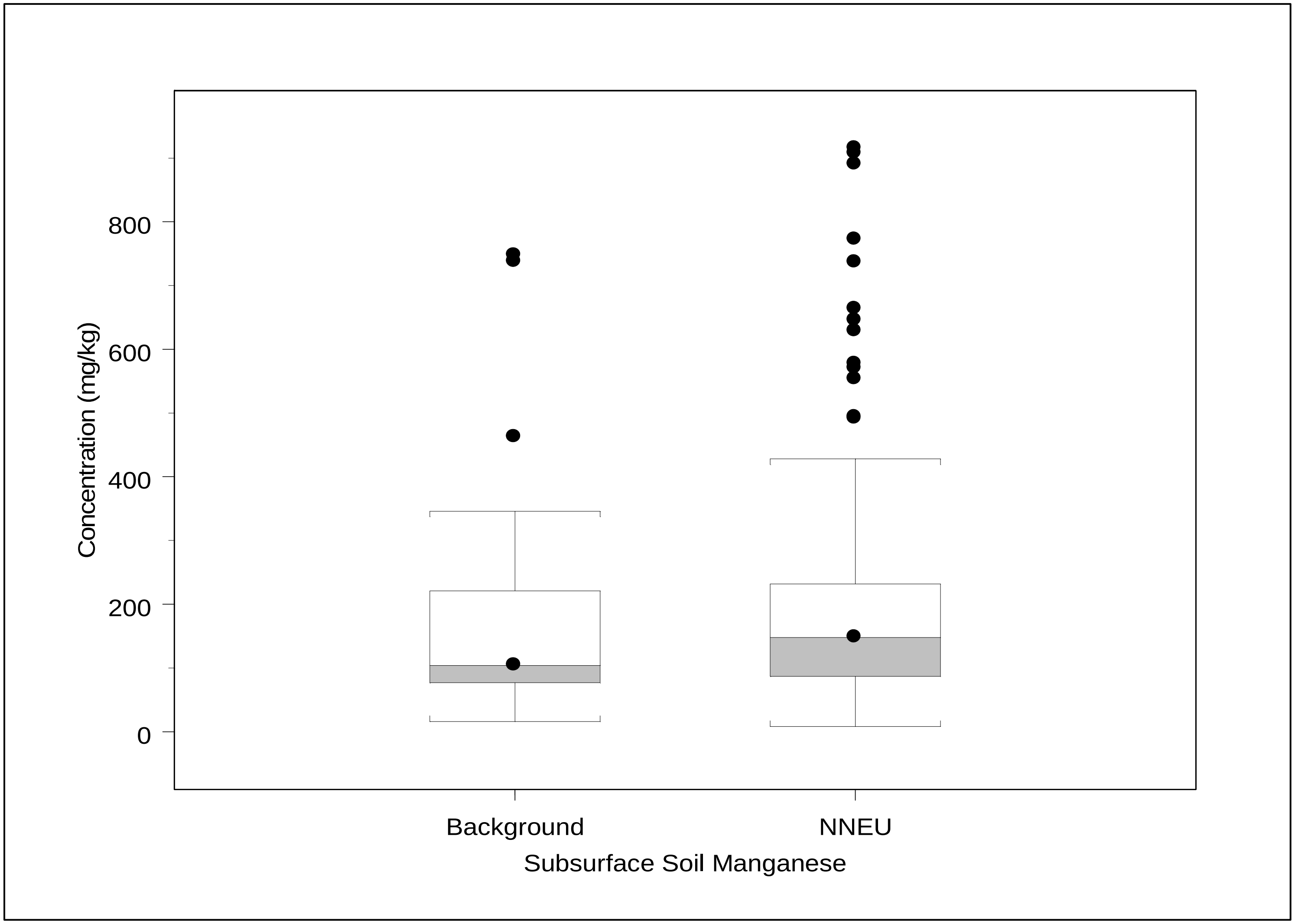
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.17
NNEU Surface Soil (Non-PMJM) Box Plots for Manganese



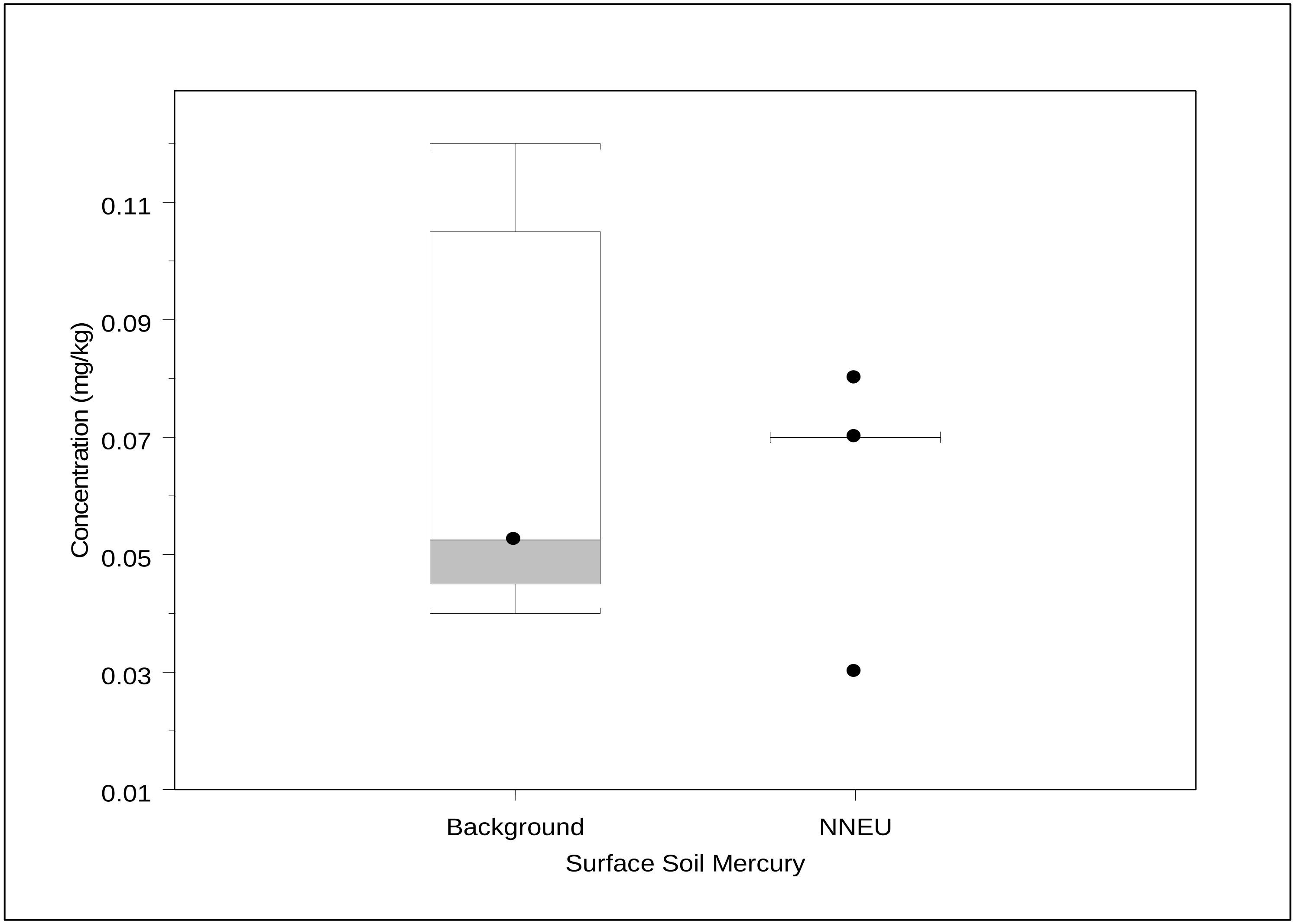
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.18
NNEU Subsurface Soil Box Plots for Manganese



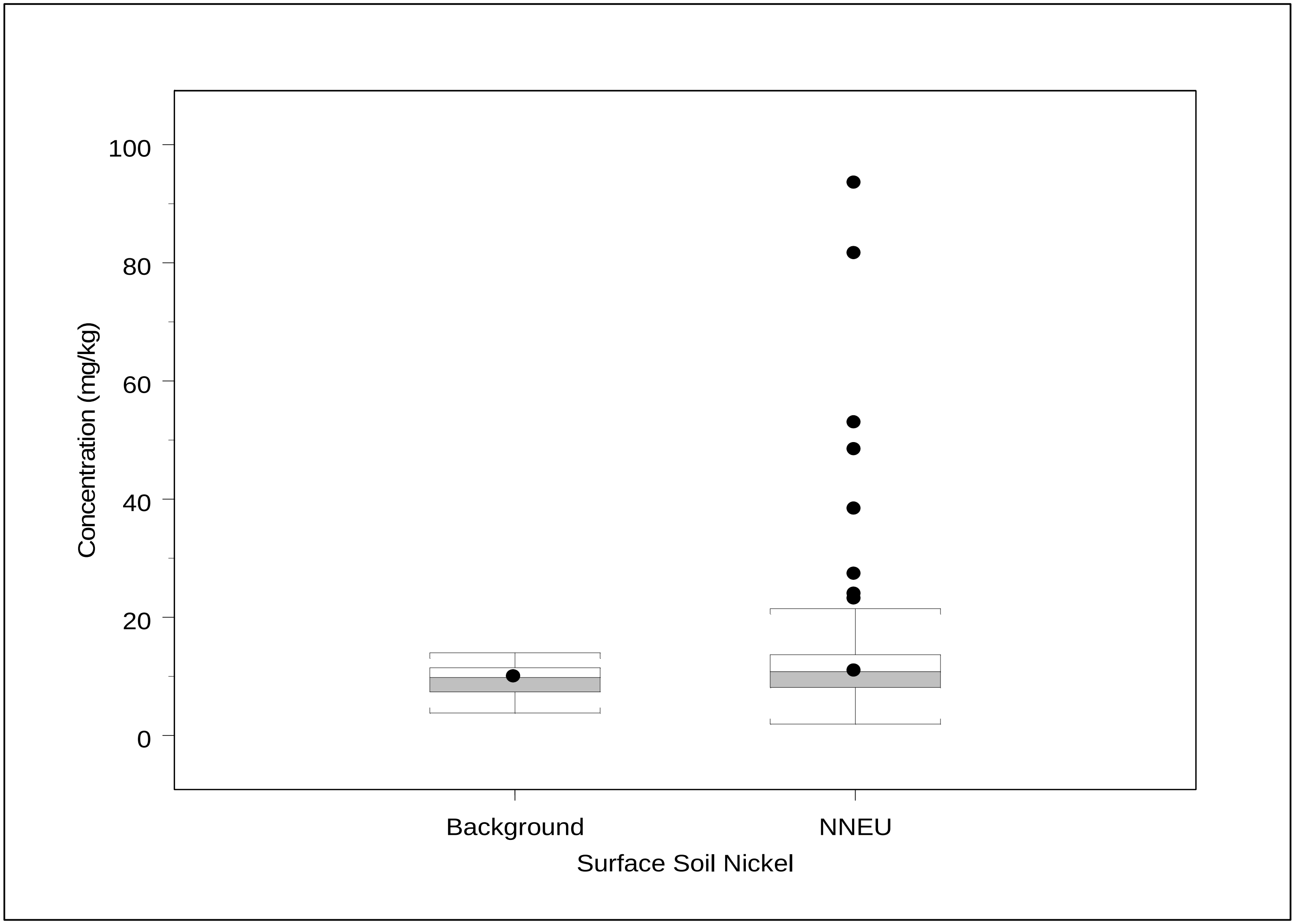
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.19
NNEU Surface Soil (PMJM) Box Plots for Mercury



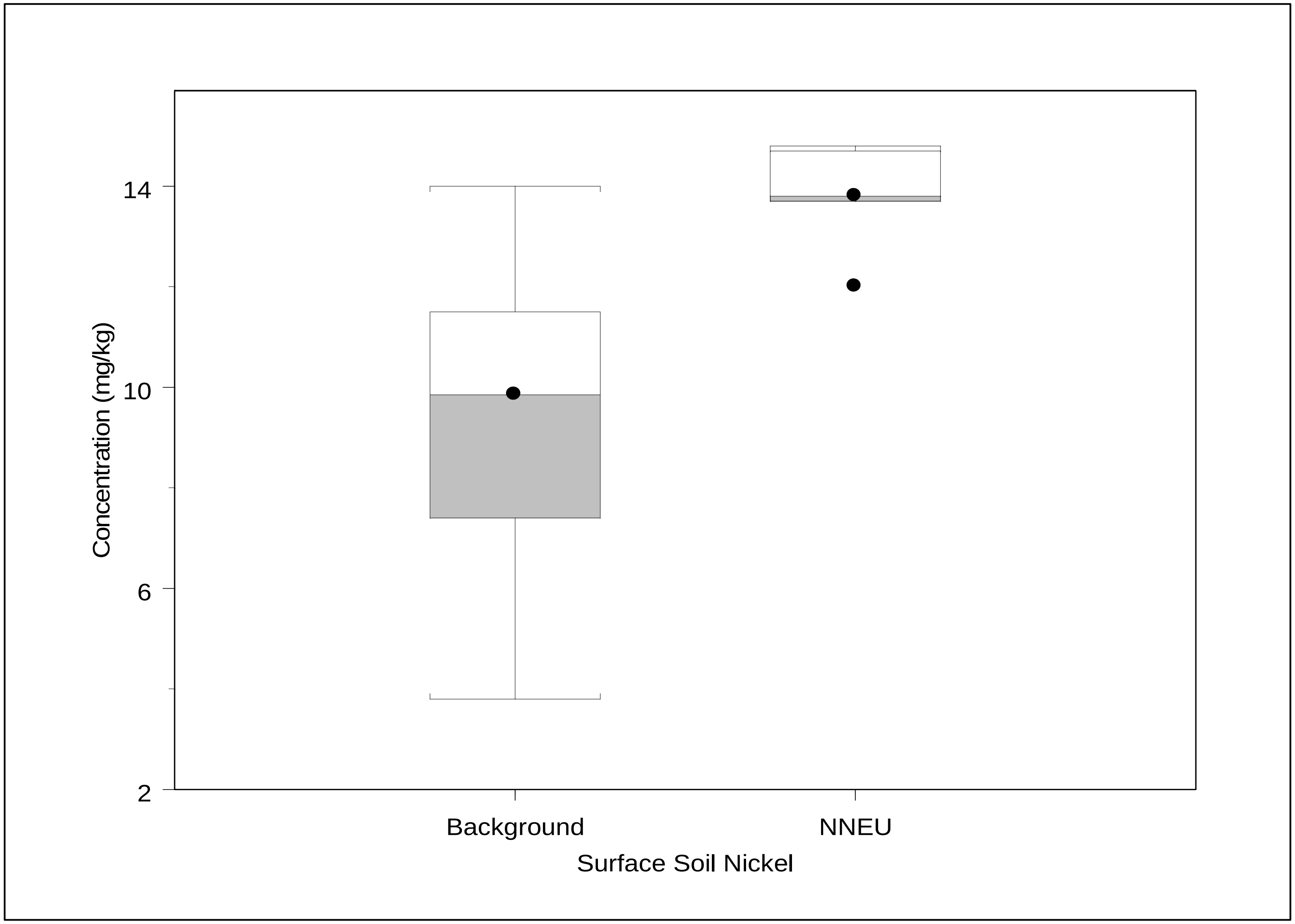
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.20
NNEU Surface Soil (Non-PMJM) Box Plots for Nickel



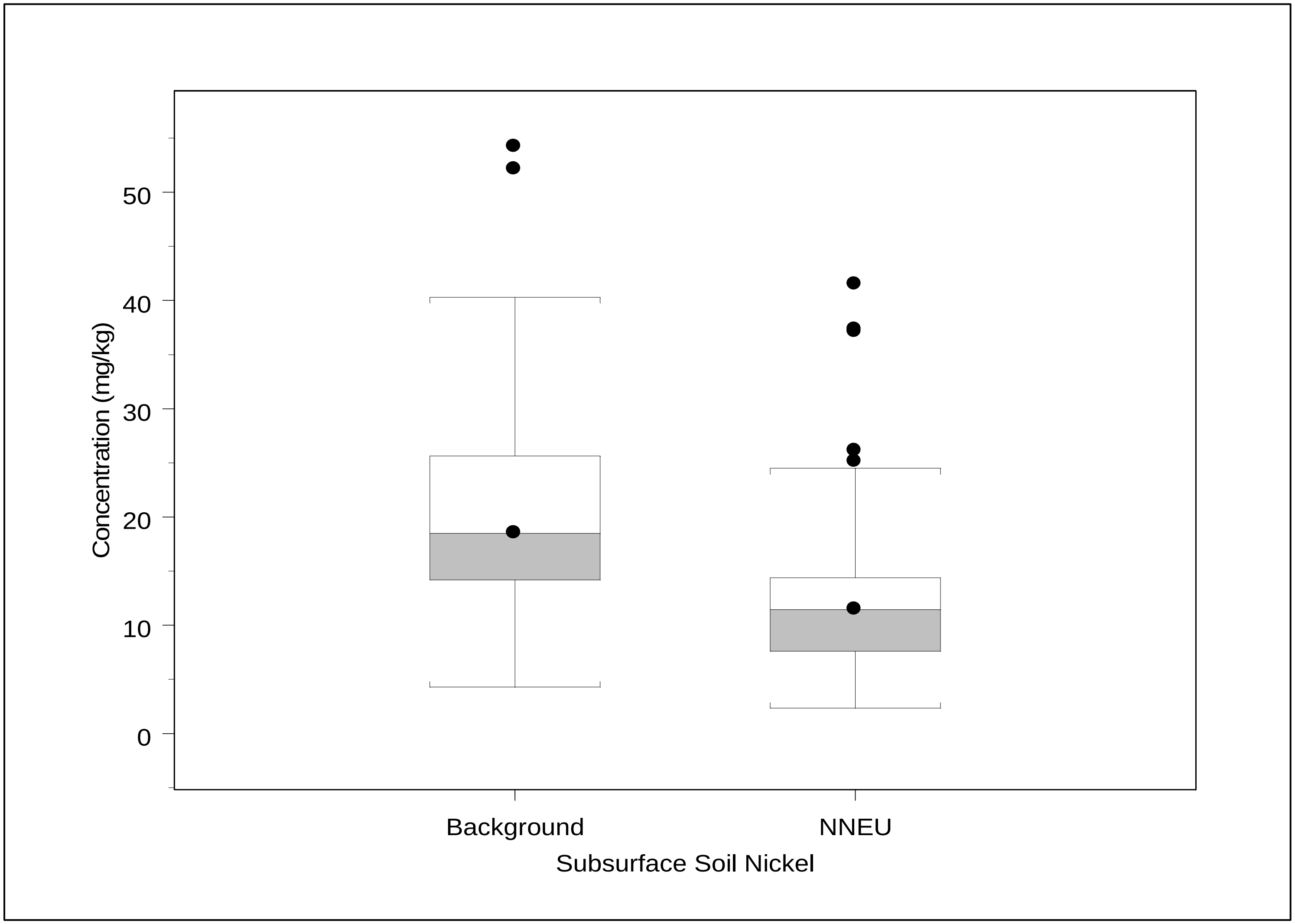
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.21
NNEU Surface Soil (PMJM) Box Plots for Nickel



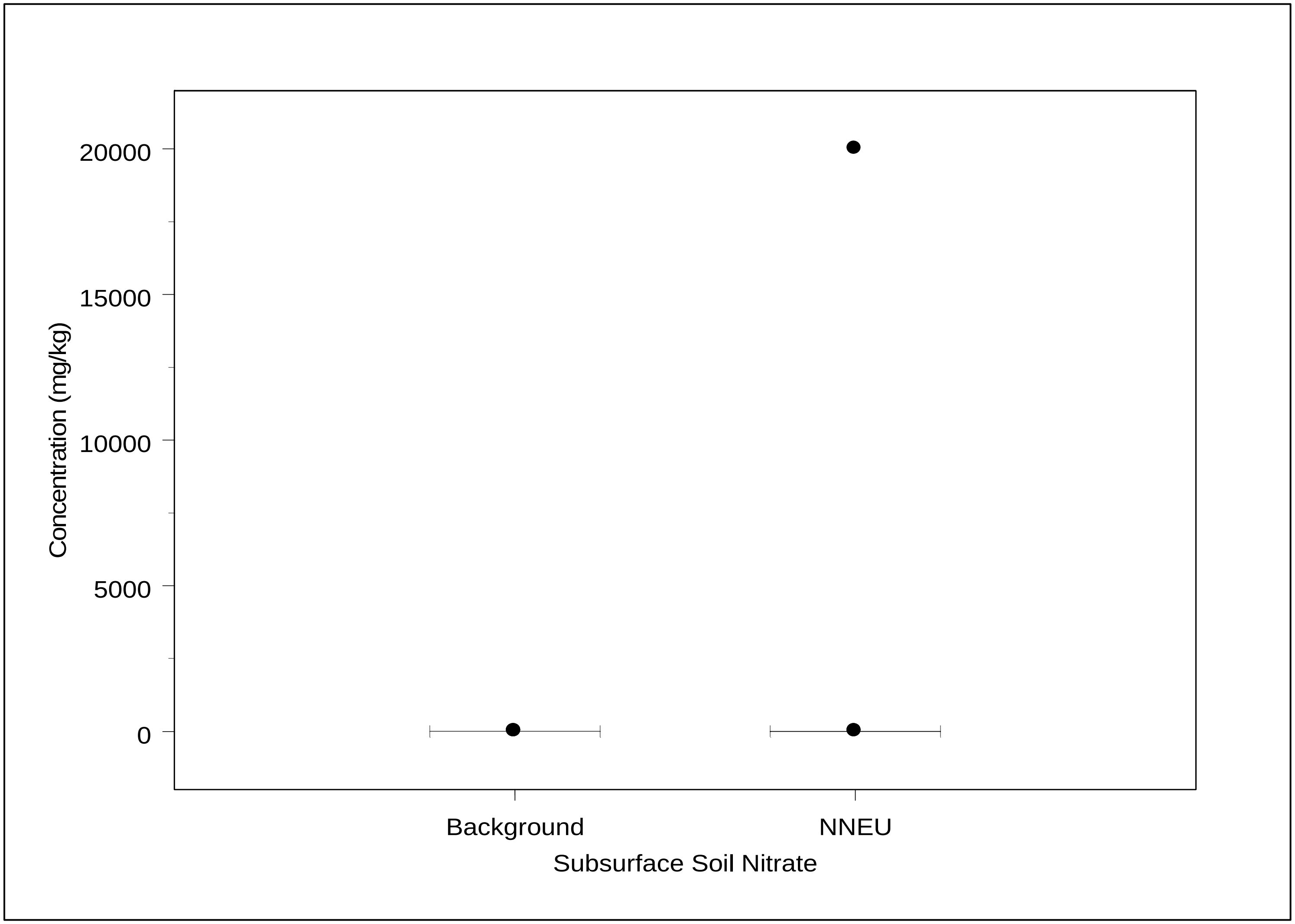
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.22
NNEU Subsurface Soil Box Plots for Nickel



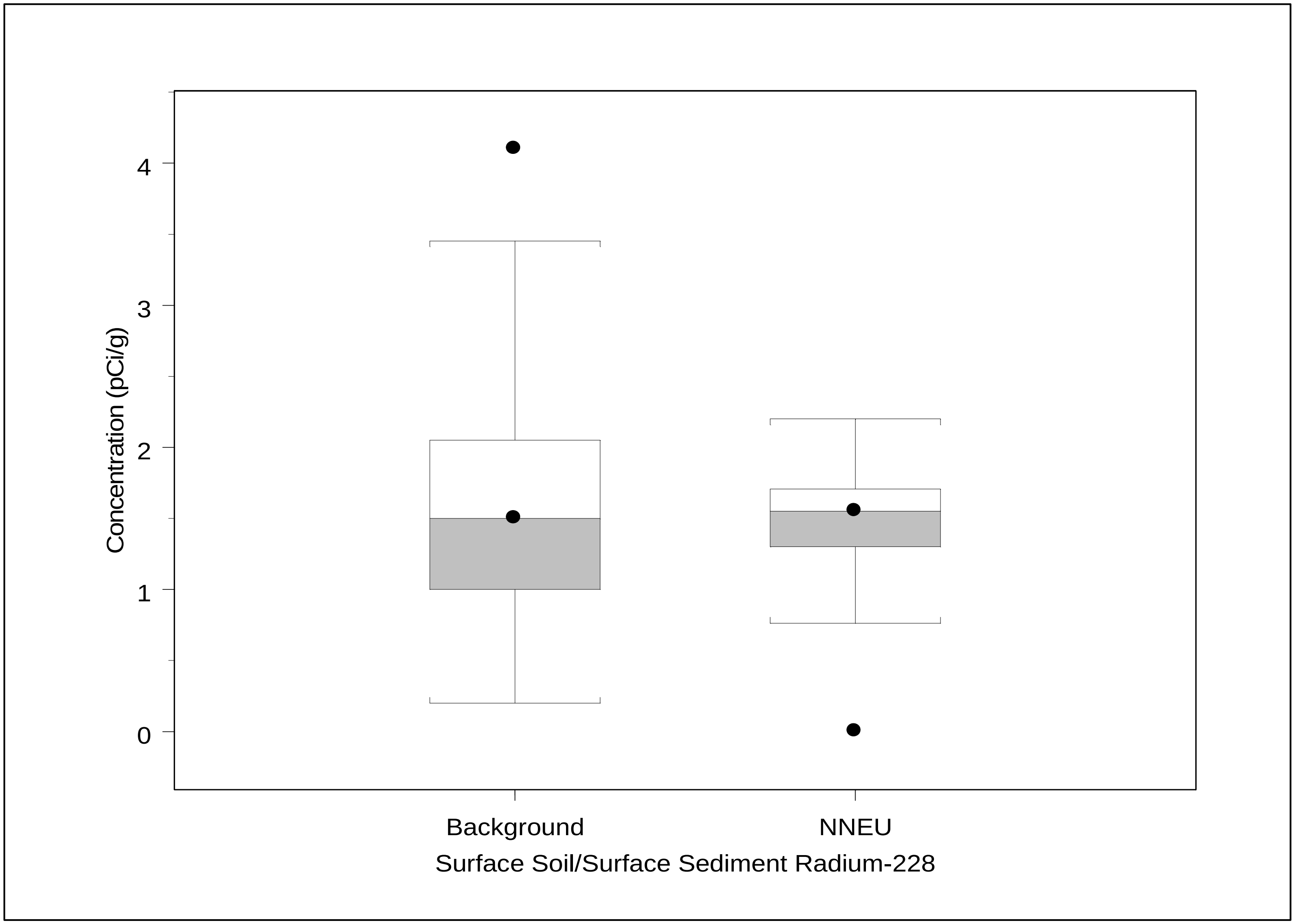
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.23
NNEU Subsurface Soil Box Plots for Nitrate



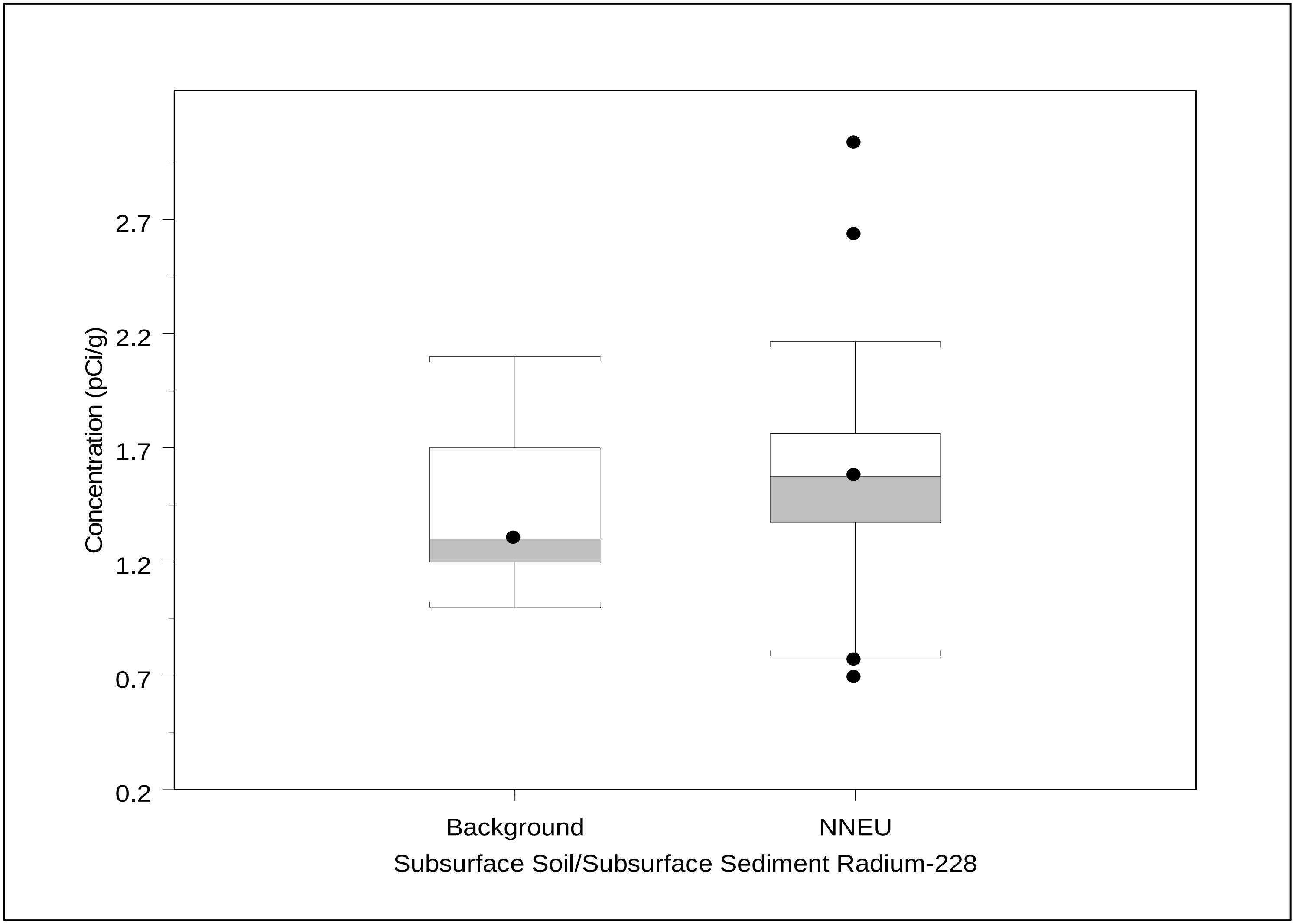
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.24
NNEU Surface Soil/Surface Sediment Box Plots for Radium-228



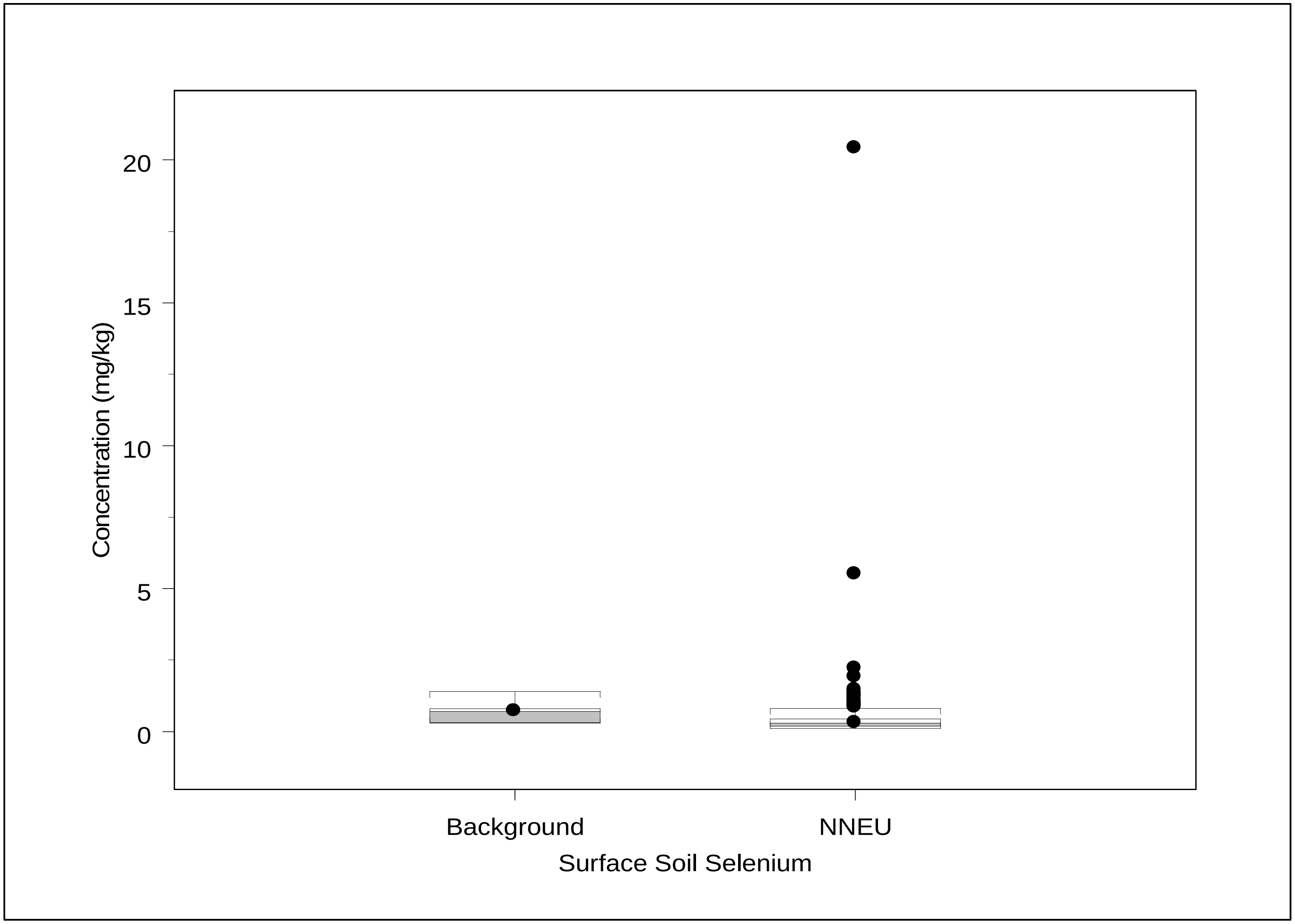
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.25
NNEU Subsurface Soil/Subsurface Sediment Box Plots for Radium-288



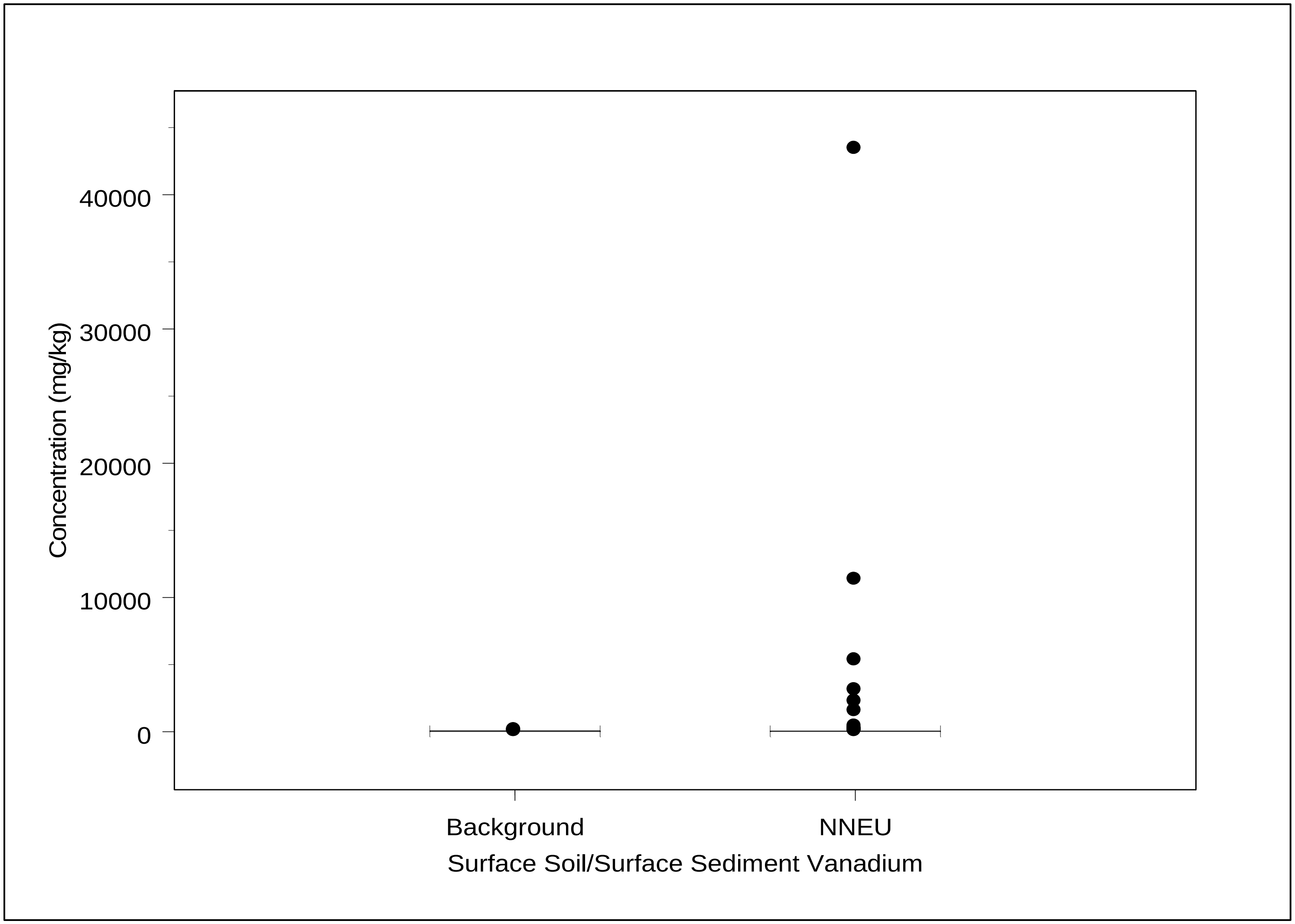
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.26
NNEU Surface Soil (Non-PMJM) Box Plots for Selenium



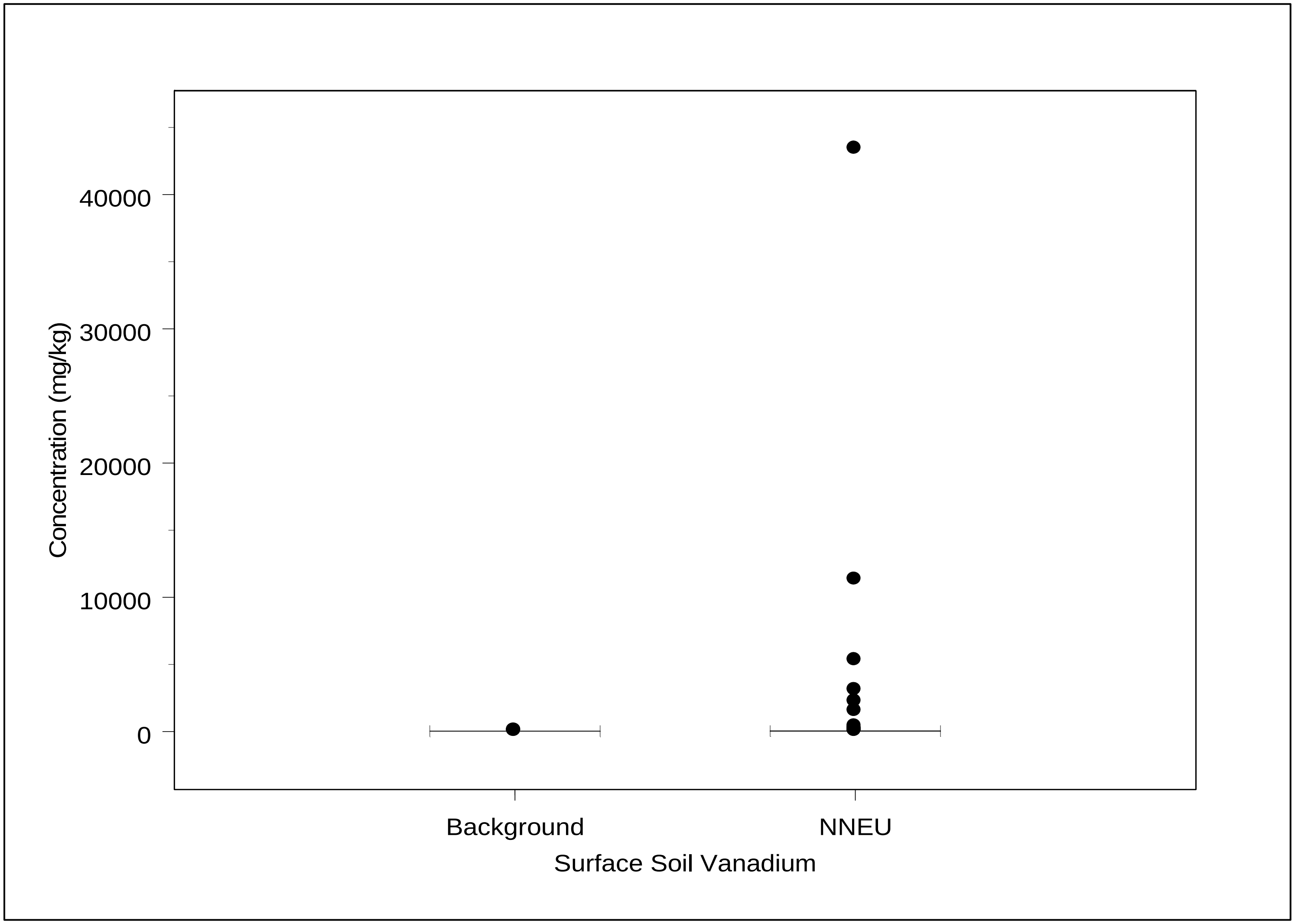
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.27
NNEU Surface Soil/Surface Sediment Box Plots for Vanadium



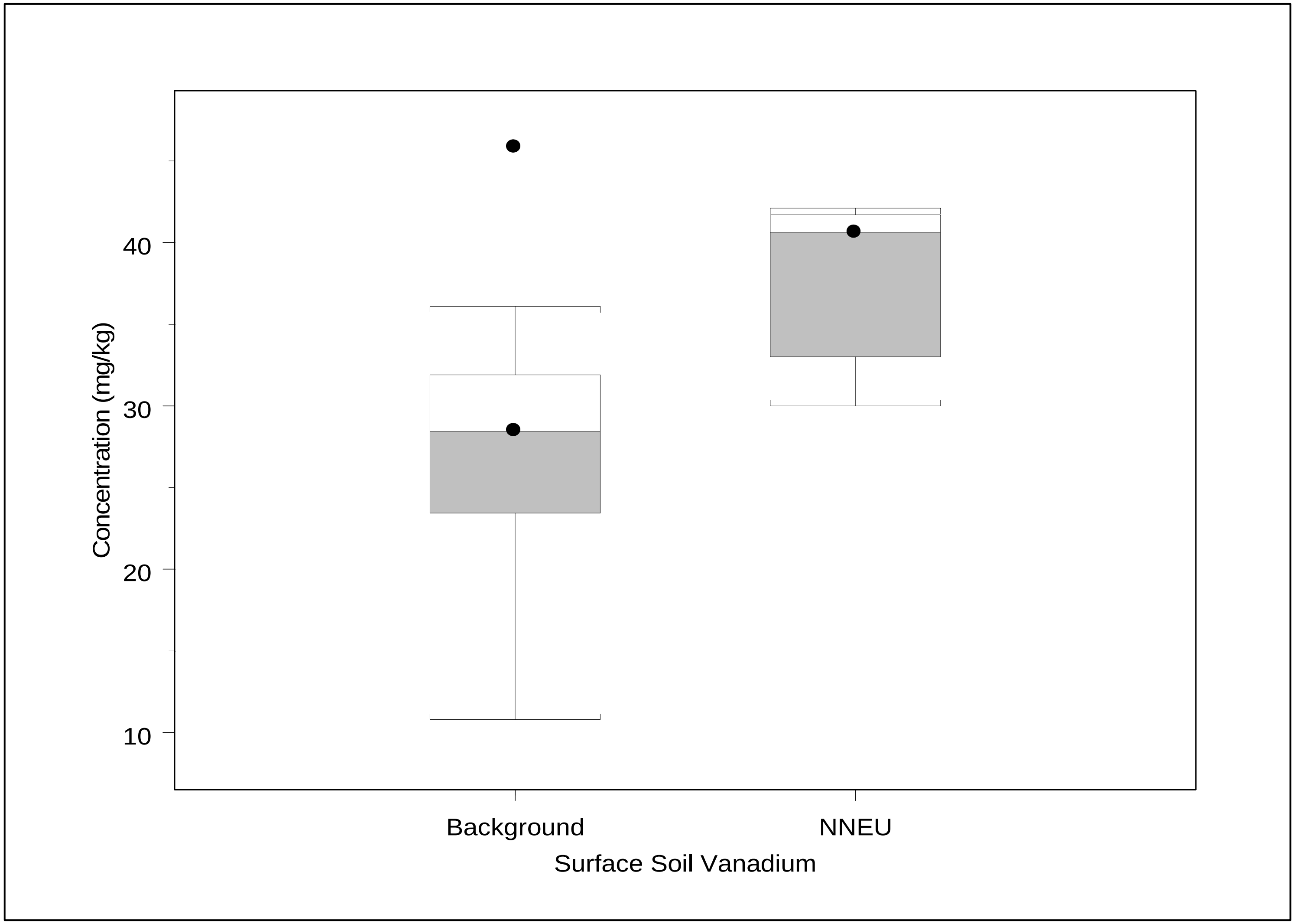
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.28
NNEU Surface Soil (Non-PMJM) Box Plots for Vanadium



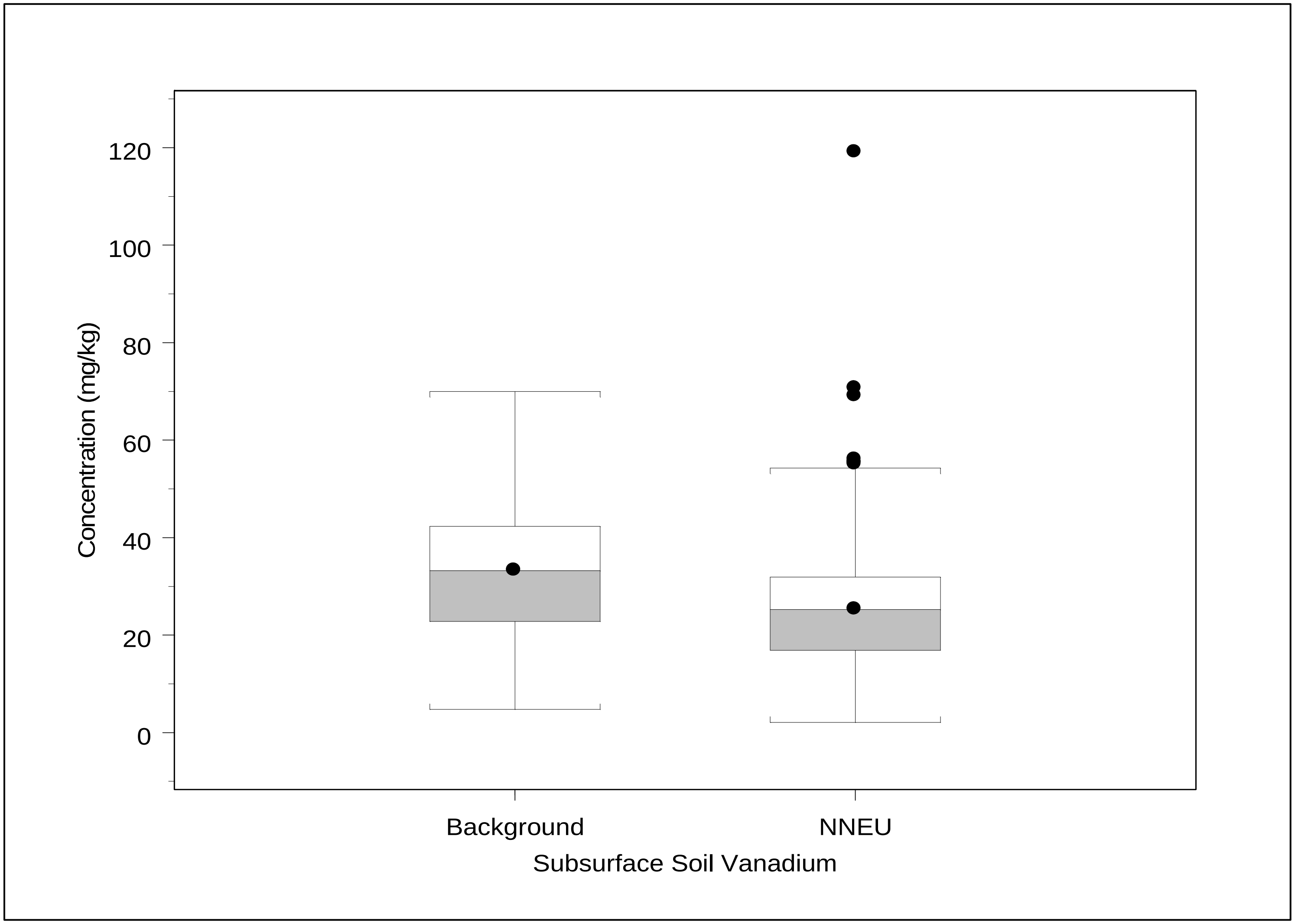
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.29
NNEU Surface Soil (PMJM) Box Plots for Vanadium



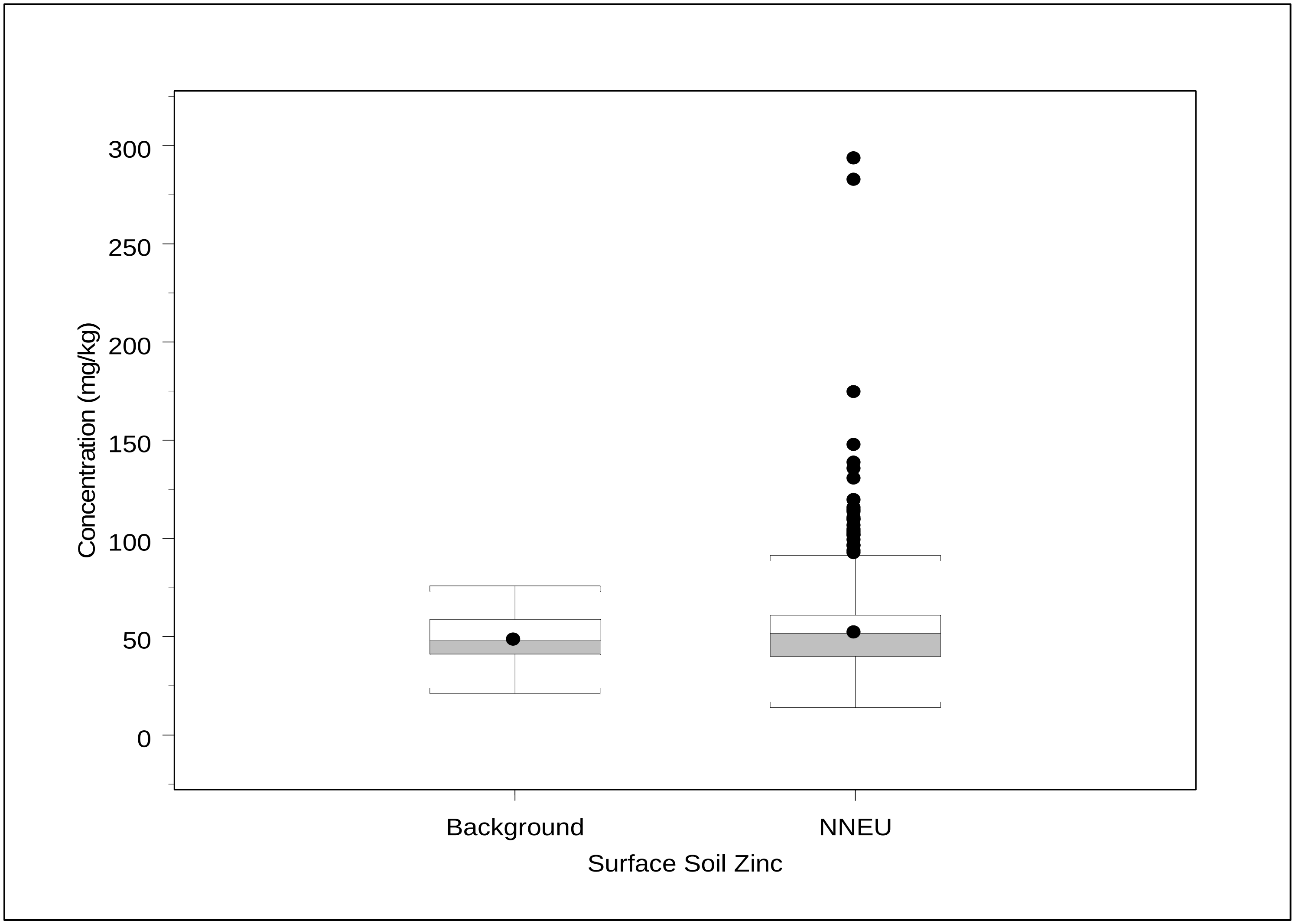
Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.30
NNEU Subsurface 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 A3.2.31
NNEU Surface Soil (Non-PMJM) Box Plots for Zinc

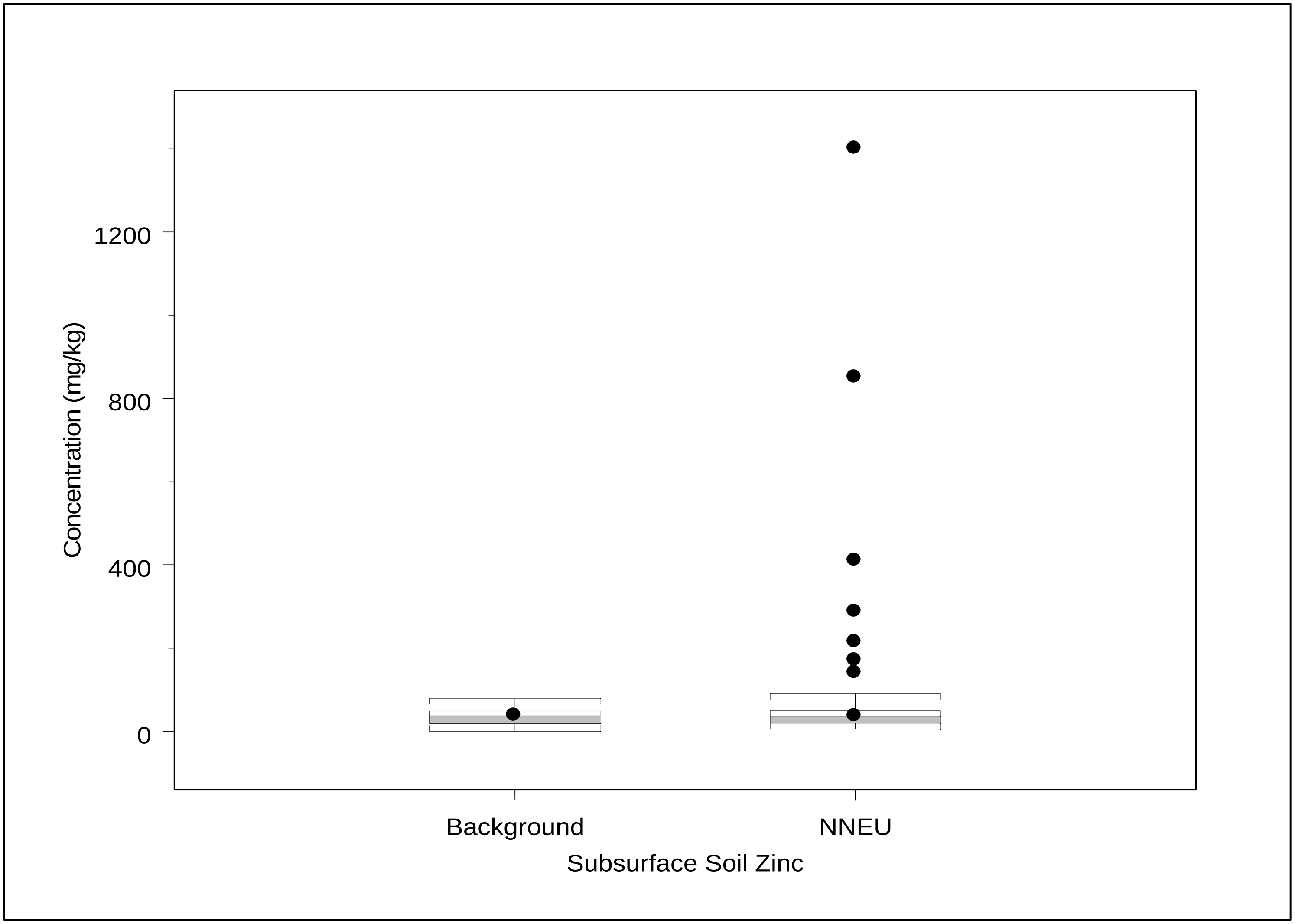


Box Plot Reference Points - 1) Line inside of box is median, 2) Lower edge of box is 25th percentile, 3) Upper edge of box is 75th percentile, 4) Lower and upper whiskers are drawn to the nearest values not beyond 1.5 times the inter-quartile range.

Figure A3.2.32
NNEU 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 A3.2.33
NNEU 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.

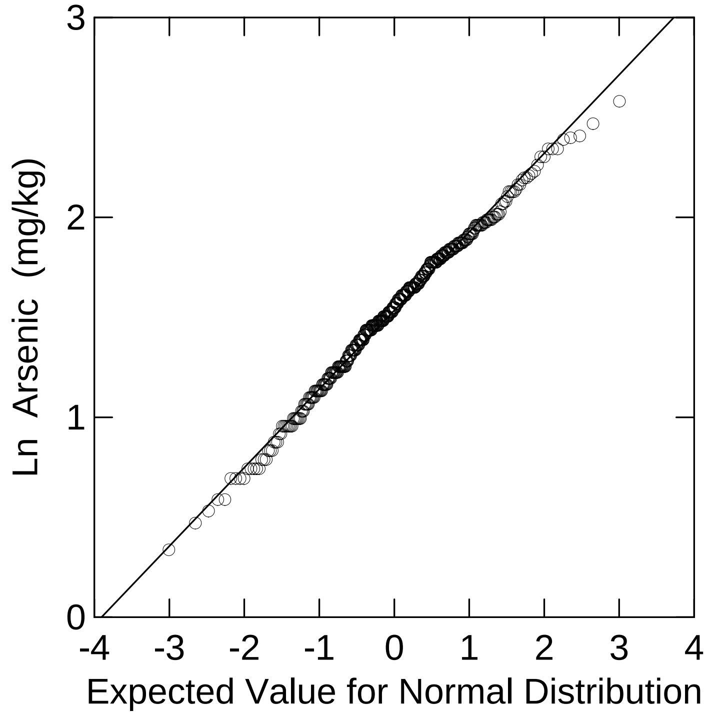
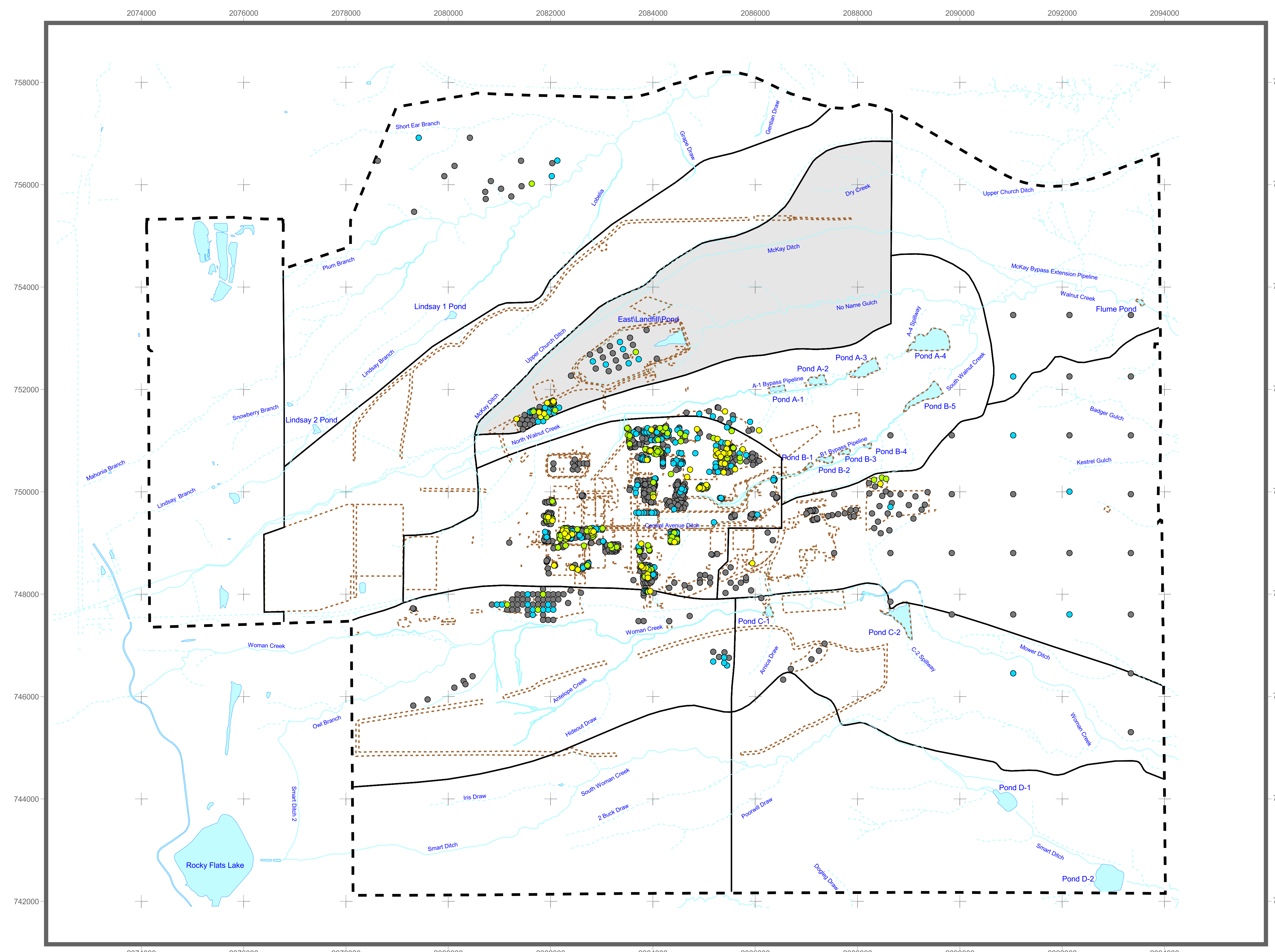


Figure A3.4.1 Probability plot for the natural logarithm of arsenic concentrations in surface soil/ surface sediment from the No Name Gulch Drainage EU.

Figure A3.4.2

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

- No Name Gulch 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

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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

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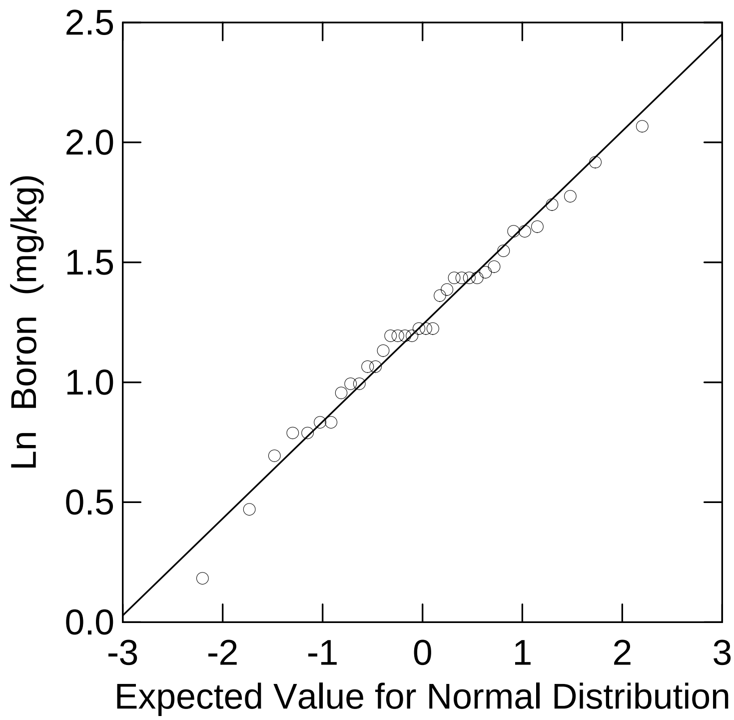

Figure A3.4.3 Probability plot for the natural logarithm of boron concentrations in surface soils from the No Name Gulch Drainage EU.

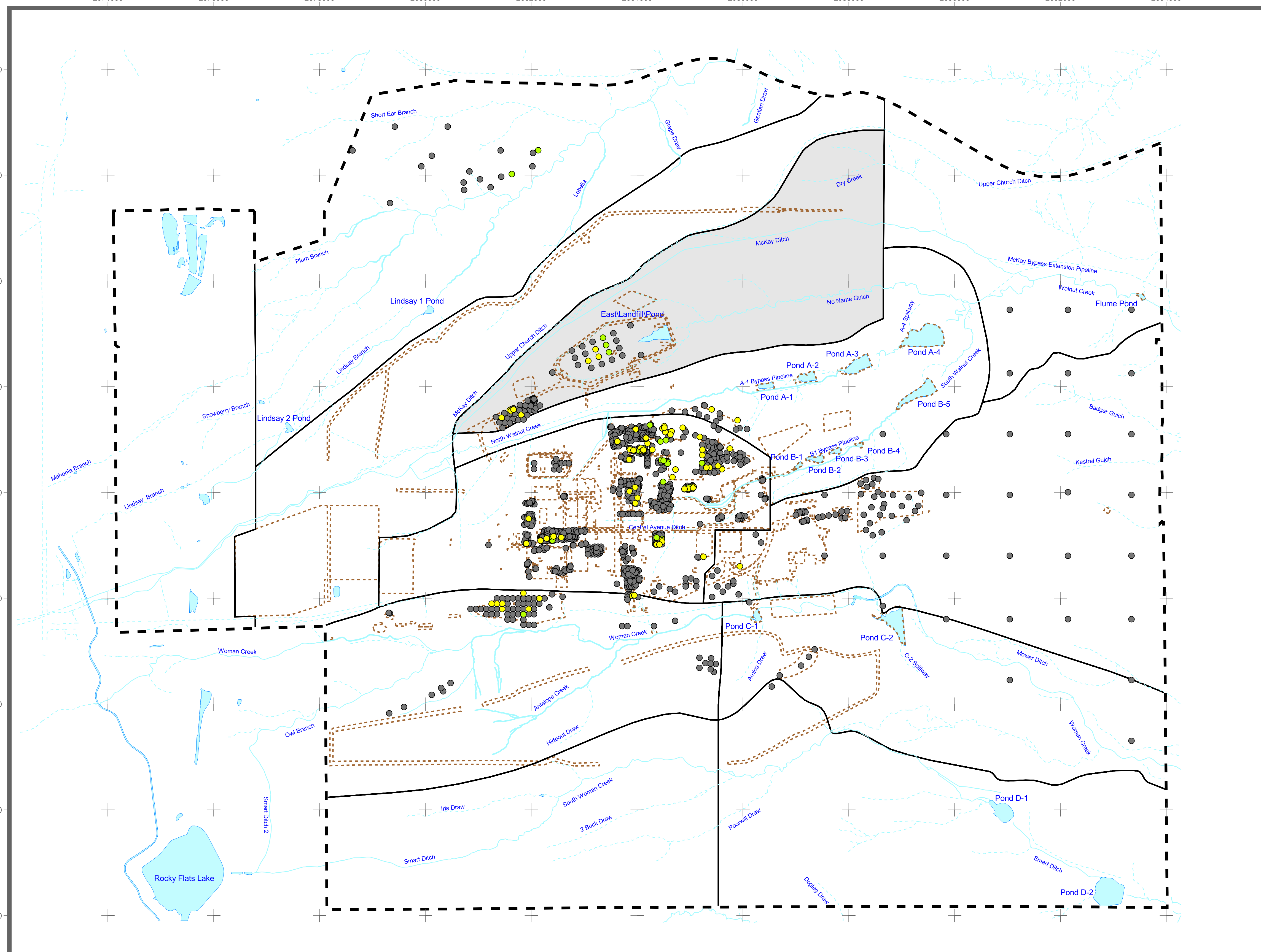

Figure A3.4.4

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

- No Name Gulch 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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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Technology Site

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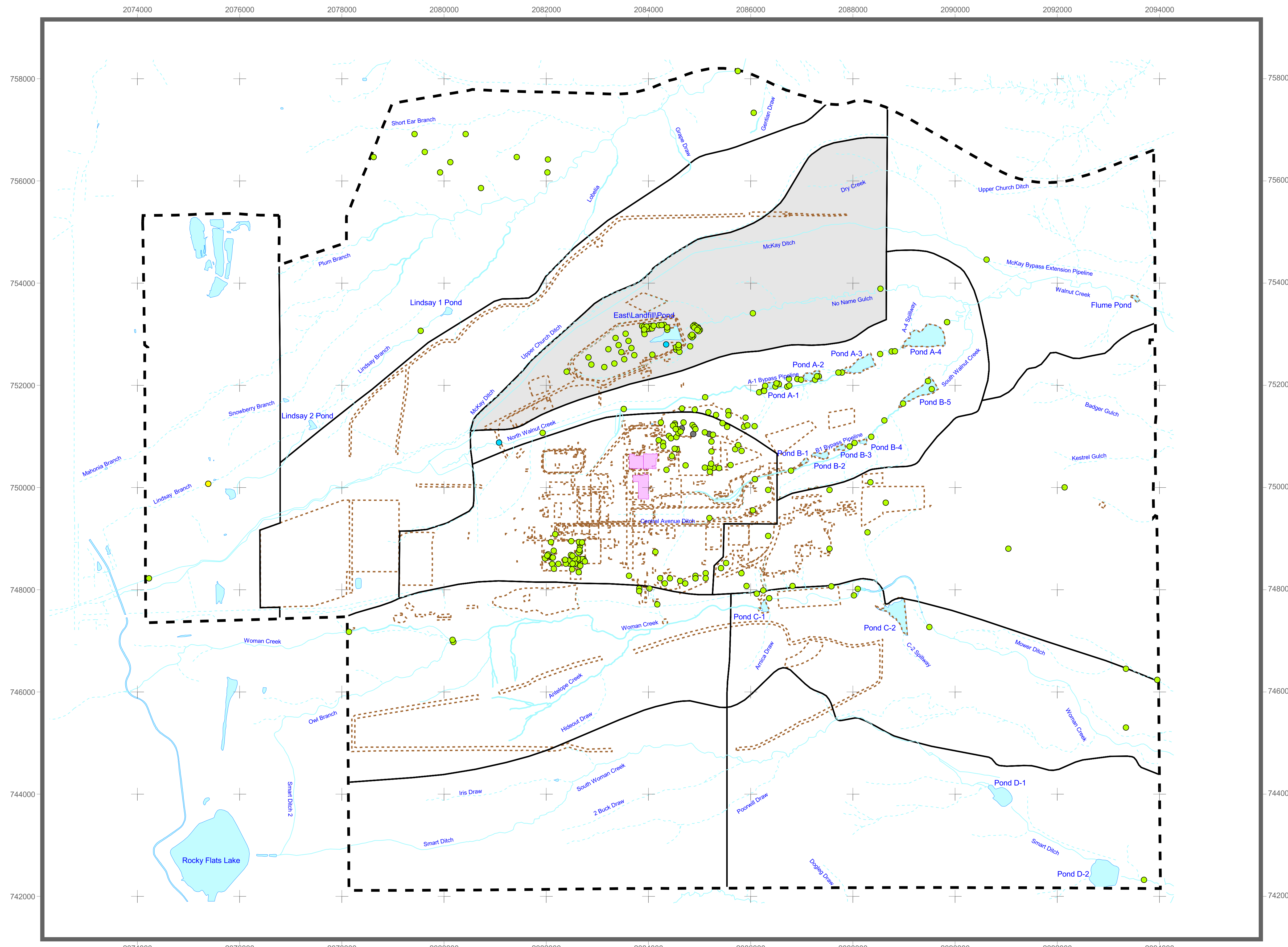

Figure A3.4.5

Radium-228 Activity in Sitewide Surface Soil/Surface Sediment

KEY

- Concentration > 3x Background MDC
- Concentration > Background MDC and <= 3x Background MDC
- Concentration > WRW PRG and <= Background MDC
- Concentration <= WRW PRG
- Nondetect (ND)

WRW PRG = 0.111 pCi/g
Background MDC = 4.10 pCi/g
3 x Background MDC = 12.3 pCi/g

Standard Map Features

- No Name Gulch 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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Colorado Central Zone
Datum: NAD 27

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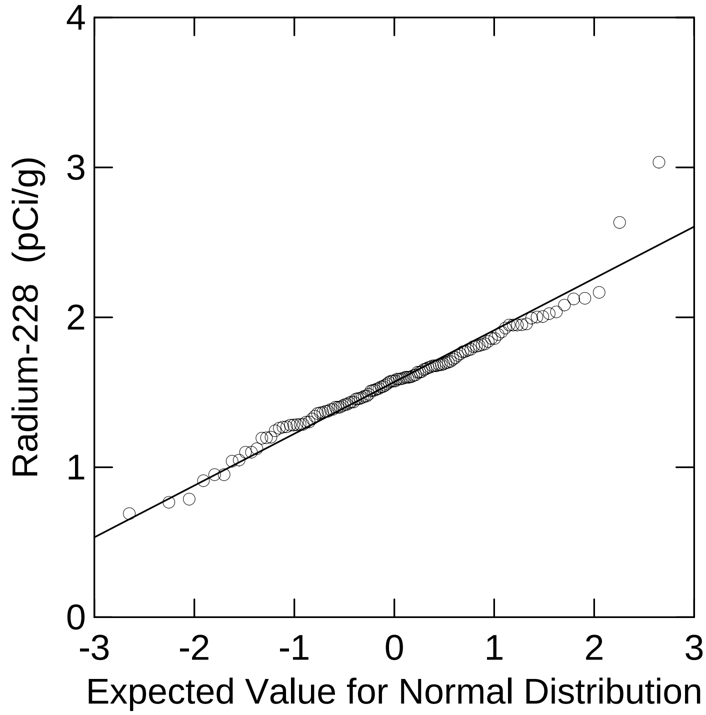

Figure A3.4.6 Probability plot for radium-228 concentrations in subsurface soil/subsurface sediment in the No Name Gulch Drainage EU.

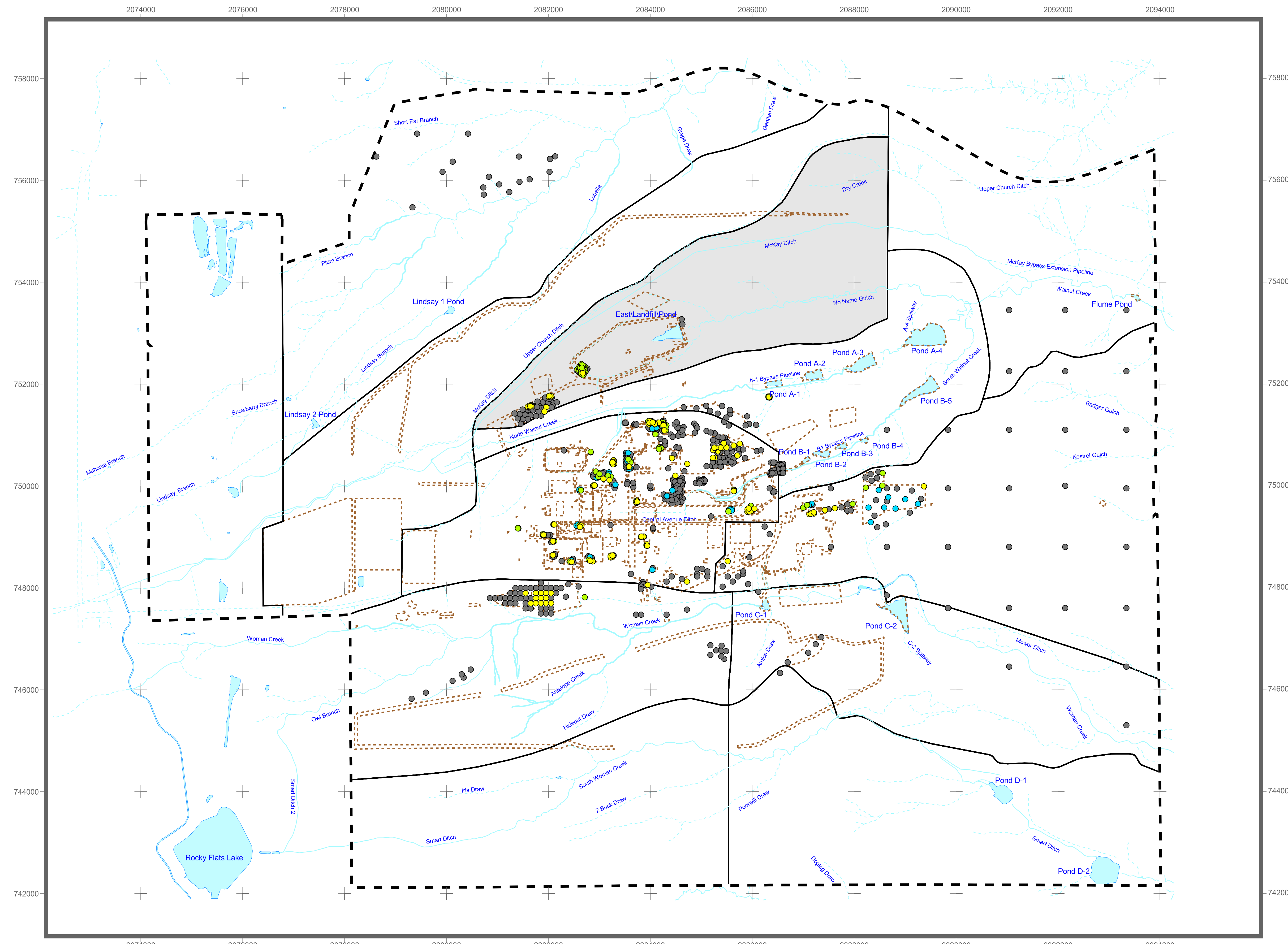

Figure A3.4.7

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

- No Name Gulch 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 S E W

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Scale 1:24,000

State Plane Coordinate Projection
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Datum: NAD 27

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COMPREHENSIVE RISK ASSESSMENT

NO NAME DRAINAGE EXPOSURE UNIT

VOLUME 6: ATTACHMENT 4

Risk Assessment Calculations

TABLE OF CONTENTS

NO NAME DRAINAGE EXPOSURE UNIT

1.0 Human Health 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			Non-Cancer Hazard Calculations		
			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	Vanadium	165	3.97E-05	N/A	NC	1.48E-04	0.001	0.148
				Ingestion Total:	**0**		**Ingestion Total:**	**0.1**
Inhalation (indoor + outdoor)	Vanadium	165	2.35E-07	N/A	NC	8.79E-07	N/A	NC
				Inhalation Total:	**0**		**Inhalation Total:**	**NC**
Dermal	Vanadium	165	NC	N/A	NC	NC	N/A	NC
				Dermal Total:	**0**		**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**0**		**Surface Soil/Surface Sediment Total:**	**0.1**
				WRW Total:	**0**		**WRW Total:**	**0.1**

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			Non-Cancer Hazard Calculations		
			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	Vanadium	56.2	1.35E-05	N/A	NC	5.06E-05	0.001	0.051
				Ingestion Total:	**0**	4.03E-05	**Ingestion Total:**	**0.05**
Inhalation (indoor + outdoor)	Vanadium	56.2	8.00E-08	N/A	NC	3.00E-07	N/A	NC
				Inhalation Total:	**0**		**Inhalation Total:**	**NC**
Dermal	Vanadium	56.2	NC	N/A	NC	NC	N/A	NC
				Dermal Total:	**0**		**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**0**		**Surface Soil/Surface Sediment Total:**	**0.05**
				WRW Total:	**0**		**WRW Total:**	**0.05**

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			Non-Cancer Hazard Calculations		
			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	Vanadium	165	3.69E-05	N/A	NC	8.61E-05	0.00100	0.086
				Ingestion Total:	**0**		**Ingestion Total:**	**0.1**
Inhalation (outdoor)	Vanadium	165	1.58E-07	N/A	NC	3.69E-07	N/A	NC
				Inhalation Total:	**0**		**Inhalation Total:**	**NC**
Dermal	Vanadium	165	NC	N/A	NC	NC	N/A	NC
				Dermal Total:	**0**		**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**0**		**Surface Soil/Surface Sediment Total:**	**0.1**
				WRV Total:	**0**		**WRV Total:**	**0.1**

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

Exposure Route	Contaminant of Concern	Tier 2 EPC (mg/kg)	Cancer Risk Calculations			Non-Cancer Hazard Calculations		
			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	Vanadium	56.2	1.26E-05	N/A	NC	2.93E-05	0.001	0.0293
				Ingestion Total:	**0**		**Ingestion Total:**	**0.03**
Inhalation (outdoor)	Vanadium	56.2	5.39E-08	N/A	NC	1.26E-07	N/A	NC
				Inhalation Total:	**0**		**Inhalation Total:**	**NC**
Dermal	Vanadium	56.2	NC	N/A	NC	NC	N/A	NC
				Dermal Total:	**0**		**Dermal Total:**	**NC**
				Surface Soil/Surface Sediment Total:	**0**		**Surface Soil/Surface Sediment Total:**	**0.03**
				WRV Total:	**0**		**WRV Total:**	**0.03**

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.

NO NAME DRAINAGE EXPOSURE UNIT

2.0 Ecological Risk Assessment Tables

Table A4.2.1
Non-PMJM Intake and 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)**	
10.1	Tier 1 UTL	0.35	10.1	0.78	0.0211	
9.67	Tier 1 UCL	0.33	9.7	0.75	0.0127	
9.83	Tier 2 UTL	0.34	9.8	0.76	0.0211	
7.7	Tier 2 UCL	0.27	7.7	0.60	0.0127	
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 - 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	0.0383	N/A	N/A	0.0224	0.00401	0.0647
Tier 1 UCL	0.0368	N/A	N/A	0.0215	0.00241	0.0607
Tier 2 UTL	0.0373	N/A	N/A	0.0218	0.00401	0.0632
Tier 2 UCL	0.0297	N/A	N/A	0.0171	0.00241	0.0492
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.657	N/A	0.0131	0.00401	0.674
Tier 1 UCL	N/A	0.629	N/A	0.0126	0.00241	0.644
Tier 2 UTL	N/A	0.639	N/A	0.0128	0.00401	0.656
Tier 2 UCL	N/A	0.501	N/A	0.0100	0.00241	0.513
Coyote - Insectivore						
Tier 1 UTL	N/A	0.152	N/A	0.00424	0.00169	0.157
Tier 1 UCL	N/A	0.145	N/A	0.00406	0.00102	0.150
Tier 2 UTL	N/A	0.147	N/A	0.00413	0.00169	0.153
Tier 2 UCL	N/A	0.116	N/A	0.00323	0.00102	0.120

N/A = Not applicable or not available

Table A4.2.2
Terrestrial Plant Hazard Quotients for Antimony
Default Exposure Scenario

EPC Statistic	**Concentration (mg/kg)**	**TRV (mg/kg BW day)**	**Hazard Quotients**
		Screening ESL	**Screening ESL**
Terrestrial Plant			
Tier 1 UTL	10.1	5	**2**
Tier 1 UCL	9.78	5	**2**
Tier 2 UTL	9.83	5	**2**
Tier 2 UCL	7.7	5	**2**

No alternative TRVs were available for antimony.
Bold = Hazard quotients > 1.

Table A4.2.3
Non-PMJM Hazard Quotients for Antimony

EPC Statistic/Receptor	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Antimony (Default Exposure)					
Deer Mouse - Herbivore					
Tier 1 UTL	0.0647	0.06	0.59	1	0.1
Tier 1 UCL	0.0607	0.06	0.59	1	0.1
Tier 2 UTL	0.0632	0.06	0.59	1	0.1
Tier 2 UCL	0.0492	0.06	0.59	0.8	0.08
Deer Mouse - Insectivore					
Tier 1 UTL	0.674	0.06	0.59	**11**	1
Tier 1 UCL	0.644	0.06	0.59	**11**	1
Tier 2 UTL	0.656	0.06	0.59	**11**	1
Tier 2 UCL	0.513	0.06	0.59	**9**	0.9
Coyote - Insectivore					
Tier 1 UTL	0.157	0.06	0.59	**3**	0.3
Tier 1 UCL	0.150	0.06	0.59	**3**	0.3
Tier 2 UTL	0.153	0.06	0.59	**3**	0.3
Tier 2 UCL	0.120	0.06	0.59	**2**	0.2

N/A = Not applicable
Bold = Hazard quotients > 1.

Table A4.2.4
Non-PMJM Intake and Estimates for Barium
Default Exposure Scenario

Bioaccumulation Factors						
Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
0.447	0.16	0.1121				
Media Concentrations (mg/kg)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
258	Tier 1 UTL	115	41.3	28.9	0.643	
148	Tier 1 UCL	66.2	23.7	16.6	0.360	
176	Tier 2 UTL	78.7	28.2	19.7	0.643	
136	Tier 2 UCL	60.8	21.8	15.2	0.360	
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
Intake Estimates (mg/kg BW day)						
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove - Herbivore						
Tier 1 UTL	26.5	N/A	N/A	5.52	0.0772	32.1
Tier 1 UCL	15.2	N/A	N/A	3.17	0.0432	18.4
Tier 2 UTL	18.1	N/A	N/A	3.76	0.0772	21.9
Tier 2 UCL	14.0	N/A	N/A	2.91	0.0432	16.9

N/A = Not applicable or not available.

Table A4.2.5
Non-PMJM Hazard Quotients for Barium

EPC Statistic/Receptor	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Barium (Default Exposure)					
Mourning Dove - Herbivore					
Tier 1 UTL	32.1	20.8	41.7	**2**	0.8
Tier 1 UCL	18.4	20.8	41.7	0.9	0.4
Tier 2 UTL	21.9	20.8	41.7	1	0.5
Tier 2 UCL	16.9	20.8	41.7	0.8	0.4

N/A = Not applicable
Bold = Hazard quotients > 1.

Table A4.2.6
Non-PMJM Intake and 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)**	
28.1	Tier 1 UTL	7.27	12.9	12.5	0.0115	
22.6	Tier 1 UCL	6.67	12.2	12.1	0.00526	
43.8	Tier 2 UTL	8.66	14.5	13.3	0.0115	
20.2	Tier 2 UCL	6.38	11.8	11.9	0.00526	
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	1.67	N/A	N/A	0.601	0.00138	2.27
Tier 1 UCL	1.53	N/A	N/A	0.483	6.31E-04	2.02
Tier 2 UTL	1.99	N/A	N/A	0.937	0.00138	2.93
Tier 2 UCL	1.47	N/A	N/A	0.432	6.31E-04	1.90
Mourning Dove - Insectivore						
Tier 1 UTL	N/A	2.96	N/A	0.601	0.00138	3.56
Tier 1 UCL	N/A	2.80	N/A	0.483	6.31E-04	3.28
Tier 2 UTL	N/A	3.33	N/A	0.937	0.00138	4.27
Tier 2 UCL	N/A	2.72	N/A	0.432	6.31E-04	3.15

N/A = Not applicable or not available.

Table A4.2.7
Non-PMJM Hazard Quotients for Copper

EPC Statistic/Receptor	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	2.27	2.30	52.3	0.99	0.04
Tier 1 UCL	2.02	2.30	52.3	0.9	0.04
Tier 2 UTL	2.93	2.30	52.3	1	0.06
Tier 2 UCL	1.90	2.30	52.3	0.8	0.04
Mourning Dove - Insectivore					
Tier 1 UTL	3.56	2.30	52.3	**2**	0.1
Tier 1 UCL	3.28	2.30	52.3	1	0.1
Tier 2 UTL	4.27	2.30	52.3	**2**	0.1
Tier 2 UCL	3.15	2.30	52.3	1	0.1

Bold = Hazard quotients > 1.

Table A4.2.8

Non-PMJM Intake and Estimates for Mercury Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
lnCp = -0.996+0.544(lnCs)	lnCe = -0.684+0.118(lnCs)	0.192				
			Media Concentrations (mg/kg)			
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
0.07	Tier 1 UTL	0.0869	0.369	0.0134	2.70E-04	
0.05	Tier 1 UCL	0.0724	0.354	0.00960	1.40E-04	
0.0636	Tier 2 UTL	0.08	0.36	0.0122	0.00027	
0.0392	Tier 2 UCL	0.06	0.34	0.0075	0.000140278	
			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
			Intake Estimates (mg/kg BW day)			
	Plant Tissue	**Invertebrate Tissue**	**Mammal Tissue**	**Soil**	**Surface Water**	**Total**
Mourning Dove (insectivore)						
Tier 1 UTL	N/A	0.00309	N/A	0.00150	3.24E-05	0.00462
Tier 1 UCL	N/A	0.00221	N/A	0.00107	1.68E-05	0.00329
Tier 2 UTL	N/A	0.00281	N/A	0.00136	3.24E-05	0.00420
Tier 2 UCL	N/A	0.00173	N/A	8.38E-04	1.68E-05	0.00259

N/A = Not applicable or not available.

Table A4.2.9
Non-PMJM Hazard Quotients for Mercury

EPC Statistic/Receptor	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Mercury (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 UTL	0.00462	0.027	0.3	0.2	0.02
Tier 1 UCL	0.00329	0.027	0.3	0.1	0.01
Tier 2 UTL	0.00420	0.027	0.3	0.2	0.02
Tier 2 UCL	0.00259	0.027	0.3	0.1	0.01

Bold = Hazard quotients > 1.

Table A4.2.10

Non-PMJM Intake and Estimates for Molybdenum Default Exposure Scenario

Bioaccumulation Factors						
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)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
2.25	Tier 1 UTL	0.563	4.70	4.61	0.00820	
1.47	Tier 1 UCL	0.368	3.07	3.01	0.00382	
1.8	Tier 2 UTL	0.45	3.8	3.69	0.00500	
1.03	Tier 2 UCL	0.26	2.2	2.11	0.00300	
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	0.306	NA	0.00293	0.00156	0.310
Tier 1 UCL	N/A	0.200	NA	0.00191	7.25E-04	0.202
Tier 2 UTL	N/A	0.245	NA	0.00234	9.50E-04	0.248
Tier 2 UCL	N/A	0.140	NA	0.00134	5.70E-04	0.142

N/A = Not applicable or not available.

Table A4.2.11
Terrestrial Plants Hazard Quotients for Molybdenum

EPC Statistic	Concentration (mg/kg)	TRV (mg/kg BW day)	Hazard Quotients
		Screening ESL	Screening ESL
Terrestrial Plant			
Tier 1 UTL	2.25	2	1
Tier 1 UCL	1.47	2	0.7
Tier 2 UTL	1.8	2	0.9
Tier 2 UCL	1.03	2	0.5

No alternative TRVs were available for molybdenum.
Bold = Hazard quotients > 1.

Table A4.2.12

Non-PMJM Hazard Quotients for Molybdenum

EPC Statistic/Receptor	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Molybdenum (Default Exposure)					
Deer Mouse - Insectivore					
Tier 1 UTL	0.310	0.3	3	1	0.1
Tier 1 UCL	0.202	0.3	3	0.8	0.1
Tier 2 UTL	0.248	0.3	3	0.95	0.1
Tier 2 UCL	0.142	0.3	3	0.5	0.1

Bold = Hazard quotients > 1.

Table A4.2.13
Non-PMJM Intake and Estimates for Nickel Default Exposure Scenario

Bioaccumulation Factors						
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)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
16.6	Tier 1 UTL	0.885	78.5	2.89	0.0258	
12.2	Tier 1 UCL	0.703	57.7	2.51	0.0114	
16.8	Tier 2 UTL	0.89	79.5	2.91	0.0258	
13.8	Tier 2 UCL	0.77	65.3	2.65	0.0114	
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 - 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	18.1	N/A	0.355	0.00310	18.4
Tier 1 UCL	N/A	13.3	N/A	0.261	0.00136	13.5
Tier 2 UTL	N/A	18.3	N/A	0.359	0.00310	18.6
Tier 2 UCL	N/A	15.0	N/A	0.295	0.00136	15.3
American Kestrel						
Tier 1 UTL	N/A	1.44	0.213	0.0764	0.00310	1.74
Tier 1 UCL	N/A	1.06	0.184	0.0561	0.00136	1.30
Tier 2 UTL	N/A	1.46	0.214	0.0773	0.00310	1.76
Tier 2 UCL	N/A	1.20	0.195	0.0635	0.00136	1.46
Deer Mouse - Herbivore						
Tier 1 UTL	0.0982	N/A	N/A	0.0369	0.00490	0.140
Tier 1 UCL	0.0780	N/A	N/A	0.0271	0.00216	0.107
Tier 2 UTL	0.0991	NA	N/A	0.0373	0.00490	0.141
Tier 2 UCL	0.0855	NA	N/A	0.0306	0.00216	0.118
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	5.10	N/A	0.0216	0.00490	5.13
Tier 1 UCL	N/A	3.75	N/A	0.0159	0.00216	3.77
Tier 2 UTL	N/A	5.17	N/A	0.0218	0.00490	5.19
Tier 2 UCL	N/A	4.24	N/A	0.0179	0.00216	4.26
Coyote - Generalist						
Tier 1 UTL	N/A	0.294	0.0326	0.0125	0.00206	0.342
Tier 1 UCL	N/A	0.216	0.0282	0.00915	9.09E-04	0.255
Tier 2 UTL	N/A	0.298	0.0327	0.0126	0.00206	0.345
Tier 2 UCL	N/A	0.245	0.0299	0.0104	9.09E-04	0.286
Coyote - Insectivore						
Tier 1 UTL	N/A	1.18	N/A	0.00697	0.00206	1.19
Tier 1 UCL	N/A	0.866	N/A	0.00512	9.09E-04	0.872
Tier 2 UTL	N/A	1.19	N/A	0.00706	0.00206	1.20
Tier 2 UCL	N/A	0.979	N/A	0.00580	9.09E-04	0.986

N/A = Not applicable or not available.

Table A4.2.14

Non-PMJM Intake and Estimates for Nickel Alternative Exposure Scenario

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)						
Soil Concentration	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**	
16.6	Tier 1 UTL	0.885	17.6	2.89	0.0258	
12.2	Tier 1 UCL	0.703	12.9	2.51	0.0114	
16.8	Tier 2 UTL	0.893	17.8	2.91	0.0258	
13.8	Tier 2 UCL	0.770	14.6	2.65	0.0114	
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	1.14	N/A	0.0216	0.00490	1.17
Tier 1 UCL	N/A	0.840	N/A	0.0159	0.00216	0.858
Tier 2 UTL	N/A	1.16	N/A	0.0218	0.00490	1.18
Tier 2 UCL	N/A	0.950	N/A	0.0179	0.00216	0.970

N/A = Not applicable or not available.

Table A4.2.15

PMJM Intake Estimates for Nickel

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)						
PMJM Habitat	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
Patch 11 area	14.8	MDC	0.812	70.0	2.74	0.0363
Patch 11 area	14.8	95th UTL	0.812	70.0	2.74	0.0258
Patch 11 area	14.8	95th UCL	0.812	70.0	2.74	0.0114
Patch 11 area	13.8	Mean	0.770	65.3	2.65	0.00733
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**
PMJM Habitat						
MDC	0.0966	3.57	N/A	0.0604	0.00545	3.73
UTL	0.0966	3.57	N/A	0.0604	0.00387	3.73
UCL	0.0966	3.57	N/A	0.0604	0.00170	3.73
Mean	0.0917	3.33	N/A	0.0563	0.00110	3.48

N/A = Not applicable or not available.

Table A4.2.16

PMJM Intake Estimates for Nickel - Alternative 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)						
PMJM Habitat	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
Patch 11 area	14.8	MDC	0.812	15.7	2.74	0.0363
Patch 11 area	14.8	95th UTL	0.812	15.7	2.74	0.0258
Patch 11 area	14.8	95th UCL	0.812	15.7	2.74	0.0114
Patch 11 area	13.8	Mean	0.770	14.6	2.65	0.00733
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**
PMJM Habitat						
MDC	0.0966	0.799	N/A	0.0604	0.00545	0.962
UTL	0.0966	0.799	N/A	0.0604	0.00387	0.960
UCL	0.0966	0.799	N/A	0.0604	0.00170	0.958
Mean	0.0917	0.745	N/A	0.0563	0.00110	0.894

N/A = Not applicable or not available.

Table A4.2.17

Non-PMJM Hazard Quotients for Nickel

EPC Statistic/Receptor	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)				Hazard Quotients			
		NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Nickel (Default Exposure)									
Mourning Dove - Insectivore									
Tier 1 UTL	18.4	1.38	55.26	77.4	107	**13**	0.3	0.2	0.01
Tier 1 UCL	13.5	1.38	55.26	77.4	107	**10**	0.2	0.2	0.01
Tier 2 UTL	18.6	1.38	55.26	77.4	107	**14**	0.3	0.2	0.01
Tier 2 UCL	15.3	1.38	55.26	77.4	107	**11**	0.3	0.2	0.01
American Kestrel									
Tier 1 UTL	1.74	1.38	55.26	77.4	107	1	0.03	0.02	0.01
Tier 1 UCL	1.30	1.38	55.26	77.4	107	0.9	0.02	0.02	0.01
Tier 2 UTL	1.76	1.38	55.26	77.4	107	1	0.03	0.02	0.01
Tier 2 UCL	1.46	1.38	55.26	77.4	107	1.1	0.03	0.02	0.01
Deer Mouse - Herbivore									
Tier 1 UTL	0.140	0.133	1.33	40	80	1	0.1	0.003	0.002
Tier 1 UCL	0.107	0.133	1.33	40	80	0.8	0.1	0.003	0.001
Tier 2 UTL	0.141	0.133	1.33	40	80	1	0.1	0.004	0.002
Tier 2 UCL	0.118	0.133	1.33	40	80	0.9	0.1	0.003	0.001
Deer Mouse - Insectivore									
Tier 1 UTL	5.13	0.133	1.33	40	80	**39**	**4**	0.1	0.06
Tier 1 UCL	3.77	0.133	1.33	40	80	**28**	**3**	0.1	0.05
Tier 2 UTL	5.19	0.133	1.33	40	80	**39**	**4**	0.1	0.06
Tier 2 UCL	4.26	0.133	1.33	40	80	**32**	**3**	0.1	0.05
Coyote - Generalist									
Tier 1 UTL	0.342	0.133	1.33	40	80	**3**	0.3	0.01	0.004
Tier 1 UCL	0.255	0.133	1.33	40	80	**2**	0.2	0.01	0.003
Tier 2 UTL	0.345	0.133	1.33	40	80	**3**	0.3	0.01	0.004
Tier 2 UCL	0.286	0.133	1.33	40	80	**2**	0.2	0.01	0.004
Coyote - Insectivore									
Tier 1 UTL	1.19	0.133	1.33	40	80	**9**	0.9	0.03	0.01
Tier 1 UCL	0.872	0.133	1.33	40	80	**7**	0.7	0.02	0.01
Tier 2 UTL	1.20	0.133	1.33	40	80	**9**	0.9	0.03	0.02
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	1.17	0.133	1.33	40	80	**9**	0.9	0.03	0.01
Tier 1 UCL	0.858	0.133	1.33	40	80	**6**	0.6	0.02	0.01
Tier 2 UTL	0.276	0.133	1.33	40	80	**2**	0.2	0.007	0.003
Tier 2 UCL	0.226	0.133	1.33	40	80	**2**	0.2	0.006	0.003

Bold = Hazard quotients > 1.

Table A4.2.18

PMJM Hazard Quotients for Nickel

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)				Hazard Quotients			
		NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Nickel (Default Exposure)									
Patch 11									
MDC	3.73	0.133	1.33	40	80	**28**	**3**	0.1	0.05
UTL	3.73	0.133	1.33	40	80	**28**	**3**	0.1	0.05
UCL	3.73	0.133	1.33	40	80	**28**	**3**	0.1	0.05
Mean	3.48	0.133	1.33	40	80	**26**	**3**	0.1	0.04
Nickel (Alternative Exposure Scenario; Median BAFs)									
Patch 11									
MDC	0.962	0.133	1.33	40	80	**7**	0.7	0.02	0.01
UTL	0.960	0.133	1.33	40	80	**7**	0.7	0.02	0.01
UCL	0.958	0.133	1.33	40	80	**7**	0.7	0.02	0.01
Mean	0.894	0.133	1.33	40	80	**7**	0.7	0.02	0.01

Bold = Hazard quotients > 1.

Table A4.2.19

Non-PMJM Intake and 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)**	
10.9	Tier 1 UTL	0.327	10.9	2.29	0.036	
8.44	Tier 1 UCL	0.253	8.44	1.77	0.018	
9.55	Tier 2 UTL	0.29	9.55	2.01	0.036	
4.49	Tier 2 UCL	0.13	4.49	0.94	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 - 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	2.51	N/A	0.233	0.00432	2.74
Tier 1 UCL	N/A	1.94	N/A	0.181	0.00216	2.12
Tier 2 UTL	N/A	2.20	N/A	0.204	0.00432	2.41
Tier 2 UCL	N/A	1.03	N/A	0.0960	0.00216	1.13
Deer Mouse - Insectivore						
Tier 1 UTL	N/A	0.709	N/A	0.0142	0.00684	0.730
Tier 1 UCL	N/A	0.549	N/A	0.0110	0.00341	0.563
Tier 2 UTL	N/A	0.621	N/A	0.0124	0.00684	0.640
Tier 2 UCL	N/A	0.292	N/A	0.00584	0.00341	0.301

N/A = Not applicable or not available.

Table A4.2.20
Non-PMJM Hazard Quotients for Tin

Receptor/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients			
		NOAEL	LOAEL	NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Tin (Default Exposure)							
Mourning Dove - Insectivore							
Tier 1 UTL	2.74	0.73	18.34	**4**	0.1	N/A	N/A
Tier 1 UCL	2.12	0.73	18.34	**3**	0.1	N/A	N/A
Tier 2 UTL	2.41	0.73	18.34	**3**	0.1	N/A	N/A
Tier 2 UCL	1.13	0.73	18.34	**2**	0.1	N/A	N/A
Deer Mouse - Insectivore							
Tier 1 UTL	0.730	0.25	15	**3**	0.05	0.03	0.02
Tier 1 UCL	0.563	0.25	15	**2**	0.04	0.02	0.02
Tier 2 UTL	0.640	0.25	15	**3**	0.04	0.04	0.02
Tier 2 UCL	0.301	0.25	15	**1**	0.02	0.03	0.02

N/A = Not applicable
Bold = Hazard quotients > 1.

Table A4.2.21

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)			
PMJM Habitat	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
Patch 11 area	42.1	MDC	0.408	3.70	0.552	0.0951
Patch 11 area	42.1	UTL	0.408	3.70	0.552	0.0434
Patch 11 area	42.1	UCL	0.408	3.70	0.552	0.0203
Patch 11 area	37.5	Mean	0.364	3.30	0.491	0.00766
			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**
PMJM Habitat						
MDC	0.0486	0.189	N/A	0.172	0.0143	0.424
UTL	0.0486	0.189	N/A	0.172	0.00651	0.416
UCL	0.0486	0.189	N/A	0.172	0.00304	0.412
Mean	0.0433	0.168	N/A	0.153	0.00115	0.366

N/A = Not applicable or not available.

Table A4.2.22
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 11					
MDC	0.424	0.21	2.1	**2**	0.2
UTL	0.416	0.21	2.1	**2**	0.2
UCL	0.413	0.21	2.1	**2**	0.2
Mean	0.366	0.21	2.1	**2**	0.2

N/A = Not applicable
Bold = Hazard quotients > 1.

Table A4.2.23
PMJM Exposure Estimates for Zinc - Default Exposure Scenario

Soil to Plant	Soil to Invertebrate	Soil to Small Mammal				
= 1.575 + 0.554 (ln	lnCi = 4.449 + 0.328 (ln Cs)	lnCsm = 4.4987 + 0.0745 (ln Cs)				
Media Concentrations (mg/kg)						
PMJM Habitat	**Soil Concentration**	**Statistic**	**Plant**	**Earthworm**	**Small Mammal**	**Surface Water (mg/L)**
Patch 11 area	87.4	MDC	57.5	371	125	2.22
Patch 11 area	87.4	UTL	57.5	371	125	2.20
Patch 11 area	87.4	UCL	57.5	371	125	1.06
Patch 11 area	76.5	Mean	53.4	355	124	0.262
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**
PMJM Habitat						
MDC	6.84	18.9	N/A	0.357	0.333	26.4
UTL	6.84	18.9	N/A	0.357	0.330	26.4
UCL	6.84	18.9	N/A	0.357	0.160	26.3
Mean	6.35	18.1	N/A	0.312	0.0393	24.8

N/A = Not applicable or not available.

Table A4.2.24
PMJM Hazard Quotients for Zinc

Patch/ EPC Statistic	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)				Hazard Quotients			
		NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL	NOAEL	LOAEL	Sample et al. (1996) NOAEL	Sample et al. (1996) LOAEL
Zinc (Default Exposure)									
Patch 11									
MDC	26.4	9.61	411.4	160	320	**3**	0.1	0.2	0.1
UTL	26.4	9.61	411.4	160	320	**3**	0.1	0.2	0.1
UCL	26.3	9.61	411.4	160	320	**3**	0.1	0.2	0.1
Mean	24.8	9.61	411.4	160	320	**3**	0.1	0.2	0.1

Bold = Hazard quotients>1.

Table A4.2.25

Non-PMJM Intake and 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)**	
0.98	Tier 1 UTL	0.147	34.2	28.2	0.0340	
0.619	Tier 1 UCL	0.0929	21.6	17.8	0.0121	
0.553	Tier 2 UTL[a]	0.0830	19.3	15.9	0.0340	
0.405	Tier 2 UCL	0.0608	14.1	11.7	0.0121	
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	7.87	N/A	0.0210	0.00408	7.89
Tier 1 UCL	N/A	4.97	N/A	0.0132	0.00145	4.98
Tier 2 UTL[a]	N/A	4.44	N/A	0.0118	0.00408	4.45
Tier 2 UCL	N/A	3.25	N/A	0.00866	0.00145	3.26
American Kestrel						
Tier 1 UTL	N/A	0.629	2.08	0.00451	0.00408	2.72
Tier 1 UCL	N/A	0.397	1.31	0.00285	0.00145	1.71
Tier 2 UTL[a]	N/A	0.355	1.17	0.00254	0.00408	1.53
Tier 2 UCL	N/A	0.260	0.859	0.00186	0.00145	1.12

[a]Tier 2 soil UTL was greater than the maximum grid mean,so the maximum grid mean was used as to calculate intake.
N/A = Not applicable or not available.

Table A4.2.26
Non-PMJM Hazard Quotients for Bis(2-ethylhexyl)phthalate

EPC Statistic/Receptor	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	7.89	1.1	214	**7**	0.04
Tier 1 UCL	4.98	1.1	214	**5**	0.02
Tier 2 UTL[a]	4.45	1.1	214	**4**	0.02
Tier 2 UCL	3.26	1.1	214	**3**	0.02
American Kestrel					
Tier 1 UTL	2.72	1.1	214	**2**	0.01
Tier 1 UCL	1.71	1.1	214	**2**	0.01
Tier 2 UTL[a]	1.53	1.1	214	1	0.007
Tier 2 UCL	1.12	1.1	214	1	0.005

[a]Tier 2 soil UTL was greater than the maximum grid mean,so the maximum grid mean was used as to calculate intake.

Bold = Hazard quotients>1.

Table A4.2.27

Non-PMJM Intake and 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)**	
0.26	Tier 1 UTL	0.101	7.83	7.39	0.048	
0.283	Tier 1 UCL	0.110	8.52	8.05	0.0149	
0.408	Tier 2 UTL[a]	0.16	12.3	11.60	0.048	
0.346	Tier 2 UCL	0.13	10.4	9.84	0.0149	
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	1.80	N/A	0.00556	0.00576	1.81
Tier 1 UCL	N/A	1.96	N/A	0.00605	0.00179	1.97
Tier 2 UTL[a]	N/A	2.82	N/A	0.00873	0.00576	2.84
Tier 2 UCL	N/A	2.40	N/A	0.00740	0.00179	2.40
American Kestrel						
Tier 1 UTL	N/A	0.144	0.544	0.00120	0.00576	0.695
Tier 1 UCL	N/A	0.157	0.592	0.00130	0.00179	0.752
Tier 2 UTL[a]	N/A	0.226	0.854	0.00188	0.00576	1.09
Tier 2 UCL	N/A	0.192	0.724	0.00159	0.00179	0.919

[a]Tier 2 soil UTL was greater than the maximum grid mean,so the maximum grid mean was used as to calculate intake.

N/A = Not applicable or not available.

Table A4.2.28
Non-PMJM Hazard Quotients for Di-n-butylphthalate

EPC Statistic/Receptor	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	1.81	0.11	1.1	**16**	**2**
Tier 1 UCL	1.97	0.11	1.1	**18**	**2**
Tier 2 UTL[a]	2.84	0.11	1.1	**26**	**3**
Tier 2 UCL	2.40	0.11	1.1	**22**	**2**
American Kestrel					
Tier 1 UTL	0.695	0.11	1.1	**6**	0.6
Tier 1 UCL	0.752	0.11	1.1	**7**	0.7
Tier 2 UTL[a]	1.09	0.11	1.1	**10**	0.99
Tier 2 UCL	0.919	0.11	1.1	**8**	0.8

[a]Tier 2 soil UTL was greater than the maximum grid mean,so the maximum grid mean was used as to calculate intake.
Bold = Hazard quotients>1.

Table A4.2.29

Non-PMJM Intake and 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)	(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)**	
0.580	Tier 1 UTL	0.145	1.95	1.56	0	
0.396	Tier 1 UCL	0.0990	1.16	1.48	0	
0.428	Tier 2 UTL[a]	0.107	1.29	1.49	0	
0.318	Tier 2 UCL	0.0795	0.861	1.44	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	N/A	0.449	N/A	0.0124	0	0.461
Tier 1 UCL	N/A	0.267	N/A	0.00847	0	0.275
Tier 2 UTL[a]	N/A	0.297	N/A	0.00915	0	0.306
Tier 2 UCL	N/A	0.198	N/A	0.00680	0	0.205
American Kestrel						
Tier 1 UTL	N/A	0.0359	0.115	0.00267	0	0.153
Tier 1 UCL	N/A	0.0214	0.109	0.00182	0	0.132
Tier 2 UTL[a]	N/A	0.0237	0.110	0.00197	0	0.136
Tier 2 UCL	N/A	0.0158	0.106	0.00146	0	0.123

[a]Tier 2 soil UTL was greater than the maximum grid mean,so the maximum grid mean was used as to calculate intake.
N/A = Not applicable or not available.

Table A4.2.30
Non-PMJM Hazard Quotients for Total PCBs

EPC Statistic/Receptor	Total Intake (mg/kg BW day)	TRV (mg/kg BW day)		Hazard Quotients	
		NOAEL	LOAEL	NOAEL	LOAEL
Total PCBs (Default Exposure)					
Mourning Dove - Insectivore					
Tier 1 UTL	0.461	0.09	1.27	**5**	0.4
Tier 1 UCL	0.275	0.09	1.27	**3**	0.2
Tier 2 UTL[a]	0.306	0.09	1.27	**3**	0.2
Tier 2 UCL	0.205	0.09	1.27	**2**	0.2
American Kestrel					
Tier 1 UTL	0.153	0.09	1.27	**2**	0.1
Tier 1 UCL	0.132	0.09	1.27	1	0.1
Tier 2 UTL[a]	0.136	0.09	1.27	**2**	0.1
Tier 2 UCL	0.123	0.09	1.27	1	0.1

[a]Tier 2 soil UTL was greater than the maximum grid mean,so the maximum grid mean was used as to calculate intake.

Bold = Hazard quotients>1.

COMPREHENSIVE RISK ASSESSMENT

NO NAME DRAINAGE EXPOSURE UNIT

VOLUME 6: ATTACHMENT 5

Chemical-Specific Uncertainty Analysis

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS

BAF	Bioaccumulation Factors
BW	body weight
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
HQ	hazard quotient
LOAEL	lowest observed adverse effect level
LOEC	lowest observed effect concentration
mg/kg	milligrams per kilogram
mg/kg BW/day	milligram 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
RFETS	Rocky Flats Environmental Technology Site
TRV	toxicity reference value
UCL	upper confidence limit
UTL	upper tolerance limit
NNEU	No Name Gulch Drainage Exposure Unit

1.0 INTRODUCTION

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 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., 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. 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 (EcoSSL) guidance (EPA 2005).
- **Toxicity Reference Values (TRVs).** The Comprehensive Risk Assessment (CRA) Methodology (U.S. Department of Energy [DOE] 2005) used an established hierarchy to identify the most appropriate default TRVs for use in the 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 NNEU 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 a 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 RI/FS Report.

1.2 Barium

Bioaccumulation Factors

The soil-to-plant BAF used to estimate plant tissue concentrations for the mourning dove (herbivore) 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 plant tissues. This conservative estimate may serve to overestimate barium concentrations in plant 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

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 there was a 5 percent increase in chick mortality. Based on the same study, the NOAEL TRV represents an intake rate at which no mortality was noted in the chicks. 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

Barium 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) were calculated using both the UCL and UTL of background soils. No HQs greater than 1 were calculated for the mourning dove (herbivore) using the NOAEL or LOAEL TRVs. NOAEL HQs equal to 1 were calculated for the mourning dove (herbivore) with both the MDC and UCL EPCs.

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 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.

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. No HQs greater than 1 were calculated for either receptor using the NOAEL, threshold or LOAEL TRVs. NOAEL HQs equal to 1 were calculated for the mourning dove (insectivore) with both the UCL and UTL EPCs. NOAEL HQs for the mourning dove (herbivore) were less than 1 for the UCL and UTL EPCs.

1.4 Mercury

Bioaccumulation Factors

For the soil-to-invertebrate BAF, regression equations were used to estimate invertebrate 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 mercury 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 mercury. The LOAEL TRV represents a dose of mercury at which there was an increase in mortality in mallards. The NOAEL TRV was estimated from the LOAEL TRV. 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

Mercury 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 (insectivore) were calculated using both the UCL and UTL of background soils. NOAEL HQs greater than 1 (HQs = 2) were calculated for the mourning dove (insectivore) with both the UCL and UTL EPCs. LOAEL HQs were less than one for the mourning dove (insectivore) with both the UCL and UTL EPCs.

1.5 Molybdenum

Plant Toxicity

Toxicity information on the effects of molybdenum on plants is extremely limited. The summary of molybdenum 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 LOEC 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, but overestimation is the more likely scenario.

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 Eco-SSL guidance (EPA 2003a) 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 potentially 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. 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 background concentration in 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 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.

1.8 Vanadium

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 conservative 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 PMJM receptor were calculated using both the UCL and UTL of background soils and default NOAEL and LOAEL TRVs. NOAEL HQs ranged from 1 using the UCL to 2 using the UTL EPCs for the PMJM receptor. LOAEL HQs were less than 1 for the PMJM receptor.

1.9 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.

1.10 Bis(2-ethylhexyl)phthalate

Bioaccumulation Factors

Invertebrate tissue concentrations for bis(2-ethylhexyl)phthalate were estimated using uptake models based on the log K_{ow} 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 EcoSSL [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(2-ethylhexyl)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.

1.11 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 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 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.

1.12 Polychlorinated Biphenyls (Total)

Bioaccumulation Factors

For the soil-to-invertebrate BAF, a regression equation was 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 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 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 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 NNEU, the uncertainty associated with the TRVs is considered low. The TRVs may overestimate or underestimate risk to an unknown degree.

Background Risk Calculations

PCBs was 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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COMPREHENSIVE RISK ASSESSMENT

NO NAME GULCH DRAINAGE EXPOSURE UNIT

VOLUME 6: ATTACHMENT 6

CRA Analytical Data Set