Modified Level III
Preacquisition Environmental Contaminants Survey

For

Rocky Flats Environmental Technology Site
Jefferson and Boulder Counties, Colorado

Prepared for:

U.S. Fish and Wildlife Service
Region 6
Denver, Colorado

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COMMONLY USED ACRONYMS

AEU	Aquatic Exposure Unit
AL	Action Level
AOI	Analyte of Interest
BZ	Buffer Zone
CAD/ROD	Corrective Action Plan/Record of Decision
CCP	Comprehensive Conservation Plan
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHWA	Colorado Hazardous Waste Act
CRA	Comprehensive Risk Assessment
CWQCC	Colorado Water Quality Control Commission
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DQA	Data Quality Assessment
DQO	Data Quality Objective
ECOI	Ecological Contaminant of Interest
ECOC	Ecological Contaminant of Concern
ECOPC	Ecological Contaminant of Potential Concern
EcoSSL	Ecological Soil Screening Levels
EIS	Environmental Impact Study
EPA	U.S. Environmental Protection Agency

EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
ESL	Ecological Screening Level
ETPTS	East Trenches Plume Treatment System
EU	Exposure Unit
FS	Feasibility Study
HAER	Historic American Engineering Record
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IA	Industrial Area
IABZSAP	Industrial Area and Buffer Zone Sampling and Analysis Plan
IAEU	Industrial Area Exposure Unit
IAG	Interagency Agreement
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measures/Interim Response Action
IMP	Integrated Monitoring Plan
LHSU	Lower Hydrostratigraphic Unit
LOEC	Lowest observed effect concentration
LOAEL	Lowest observed adverse effect concentration
MDC	Maximum detected concentration
mg	milligram
mg/kg	milligram per kilogram

mrem	millirems
mrem/yr	millirems per year
MSPTS	Mound Site Plume Treatment System
NCP	National Contingency Plan
NFAA	No Further Accelerated Action
NOEC	No Observed Effect Concentration
NOAEL	No Observed Adverse Effect Level
OU	Operable Unit
PARCC	Precision, accuracy, representativeness, completeness, and comparability
PCB	Polychlorinated Biphenyls
pCi	Picocuries
PCOC	Potential Contaminant of Concern
PMJM	Preble's Meadow Jumping Mouse
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goal
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFLMA	Rocky Flats Legacy Management Agreement
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study

SAP	Sampling and Analysis Plan
SID	South Interceptor Ditch
SPPTS	Solar Ponds Plume Treatment System
SVOC	Semi-Volatile Organic Compound
TCDD	2,3,7,8-tetrachlorodibenzodioxin
TEQ	Toxic Equivalency
UCL	Upper Confidence Level
UHSU	Upper Hydrostratigraphic Unit
UTL	Upper Threshold Level
VOC	Volatile Organic Compound
WRV	Wildlife Refuge Visitor
WRW	Wildlife Refuge Worker

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1.0 Introduction

The U.S. Fish and Wildlife Service (Service) has established procedures for the preacquisition assessment process. The fundamental goal of Service preacquisition assessments was to identify potential hazardous substance-related threats to fish, wildlife, their habitats, and other environmental problems prior to real property acquisition. A Level III Survey was required when it was determined, on the basis of the Level I or II Survey, that there was a reasonable basis to assume that hazardous substances were present on the real property or that there were effects of such hazardous substances present at the site, and extensive work (e.g. "significant" sampling and original research) was required to determine the extent of any hazardous substance, obtain an estimate of the remediation or other cleanup costs, and determine whether reprogramming was required (USFWS, 1996). Although no formal Level I or II Surveys have been conducted at the RFETS, the history of the site, coupled with evidence of contamination revealed during extensive DOE and contractor sampling, before and during the Remedial Investigation/Feasibility Study (RI/FS) (DOE, 2006), provide reasonable basis to conduct a Modified Level III Survey. Data collected by DOE before and during the cleanup of Rocky Flats was reviewed and incorporated in the Modified level III Survey through references. In addition, Service employees have been involved in the development of the Comprehensive Risk Assessment. It was reviewed and became part of the Modified Level III survey through reference as well. The Service also collected surface soil and vegetation samples to confirm some of the assumptions that DOE has made in the RI/FS. In particular, the Service wanted to collect samples from future trail locations, confirming extrapolated data that DOE had provided. The Service also confirmed the level of contamination present on and in plants. Note: Primary jurisdiction for the inner 1,300 acres of Rocky Flats will be retained by DOE and will not be directly included in this survey. If, in the future, the Service contemplates taking some type of responsibility with the retained area, an additional Modified Level III Survey should be completed.

2.0 Site Background

Accelerated building demolition and soil cleanup actions were recently completed in the Industrial Area and inner Buffer Zone Areas. The majority of the contamination removed was radionuclides, volatile organic compounds (VOCs), and metals. In addition, it was known that low levels of plutonium and americium contamination extended from RFETS to offsite areas in an easterly direction, and was transported to those areas by wind dispersion and surface water. The DOE completed performing sampling and analyses of environmental media, including surface soil, following removal actions to finalize accelerated cleanup actions, as necessary. Work was performed in accordance with the Rocky Flats Cleanup Agreement (RFCA) which provides the framework for DOE obligations under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA) and the Colorado Hazardous Waste Act (CHWA).

Citing diverse, undisturbed habitats available for threatened and endangered species and the presence of rare xeric tallgrass prairie plant communities at RFETS, the Rocky Flats National Wildlife Refuge Act of 2001 (Public Law 107-107, Subtitle F, 16 USC 668dd) (Refuge Act) was enacted to “promote the preservation and enhancement of these resources for present and future

generations" through the ultimate transfer of some BZ lands for the establishment of the Rocky Flats National Wildlife Refuge (Refuge). This proposed transformation in human use of the Rocky Flats property has been described as turning "weapons into wildlife". It is the U.S. Department of the Interior (DOI) policy to minimize the potential liability of the Department and its bureaus by acquiring real property that was not contaminated, unless directed by Congress, court mandate, or determined by the Secretary. For this transition to go smoothly, it was mandated that the Service define the extent of residual sources of contamination, on lands being transferred, following accelerated clean-up actions, and calculate actual or potential cost for remediation to meet future site goals. It was not the intent of the Service to duplicate work that has been completed by DOE and its contractors.

2.1 Site Description and History

The United States, through the then Atomic Energy Commission, acquired the land for the Rocky Flats Environmental Technology Site (RFETS) in several phases. RFETS is located approximately 16 miles northwest of Denver, Colorado, and approximately 10 miles south of Boulder, Colorado, and it occupies approximately 10 square miles of Sections 1 through 4 and 8 through 15 of Township 2 South, Range 70 West of the 6th Principal Meridian. The site is generally bound by State Highway 128 to the north; Jefferson County Highway 17, also known as Indiana Street, to the east; State Highway 93, which is approximately 0.25 miles from the site's western boundary; and privately owned property to the south. The private property to the south is agricultural and lies south of the site and north of State Highway 72. (See Figure 1).

Approximately 2,519 acres were acquired in 1951 and approximately 4,027 acres were added in 1974 and 1975. This additional acreage provided an additional security Buffer Zone (BZ) around the approximately 350-acre Industrial Area (IA) near the center of the site, resulting in the 6546-acre property. 280 acres were transferred to the National Renewable Energy Lab Wind Technology Site in 1994 and an additional 25 acres when the Refuge Act was signed. The remaining 6,241-acre site was what was known as RFETS. The IA was where the main fabrication and processing facilities were located. The BZ contained limited support facilities, but was mostly left vacant. When the United States acquired the RFETS land, it mostly acquired the surface rights from the landowners, but not necessarily the subsurface mineral rights. Approximately 800 acres in the western portion of the BZ are currently permitted for surface gravel mining. Mined property must be reclaimed in accordance with permit requirements. Other property rights, such as utility easements and water conveyances, also exist at RFETS.

RFETS was part of the United States' nationwide nuclear weapons complex and its mission was to fabricate plutonium pits and other key components making up the triggers for nuclear weapons. A description of the industrial processes and key manufacturing buildings of this facility, known originally as the Rocky Flats Plant, was contained in the Historic American Engineering Record (HAER) CO-83 (HAER 1998). The Atomic Energy Commission had jurisdiction over RFETS from 1951 to the end of 1974. The Atomic Energy Commission's successor agency, the Energy Research and Development Administration, had jurisdiction and control of RFETS from 1975 to 1977. Since 1977, RFETS has been under the jurisdiction and control of the U.S. Department of Energy (DOE). RFETS has always been a government owned/contractor operated facility. Only four companies have managed and operated RFETS

under contracts with DOE or its predecessors. Dow Chemical Company was the contractor prior to July 1975. Rockwell International Company was the contractor from July 1975 until December 1989. EG&G Rocky Flats, Inc. was the contractor from January 1990 until June 1995. Kaiser-Hill Company, LLC was the contractor from July 1995 until December 2005. In February 1991, DOE introduced a plan to realign the Nation's nuclear weapons production program. The Secretary of Energy announced in a February 1992 Report to Congress that as part of the realignment, RFETS would no longer have a nuclear production mission. DOE's mission at RFETS would become the safe deactivation of nuclear production facilities; decontamination, decommissioning, and demolition of buildings and infrastructure; cleanup; and closure. Kaiser-Hill Company, LLC completed the physical closure of the site in October 2005.

Because most of the RFETS land has remained relatively undisturbed since 1951, the preservation of the diversity of plants and animals is unique in this area of the Colorado Front Range. RFETS provides habitat for many wildlife species, including the Preble's meadow jumping mouse, which is a federally listed threatened species. RFETS also has several rare plant communities, including the xeric tallgrass prairie and the upland shrub communities. The Refuge Act provides that future ownership and management of RFETS shall be retained by the United States. Under the Refuge Act, upon completion of all remedial actions, the Secretary of Energy shall transfer administrative jurisdiction over certain parts of RFETS lands to the Secretary of the Interior for the purposes of establishing the Rocky Flats National Wildlife Refuge (Refuge).

2.2 Previous Investigations

This section summarizes the Remedial Investigation (RI) portion of the RI/FS for the Rocky Flats Environmental Technology Site (RFETS or site). The RI/FS was the cumulative report that takes into account previous investigations combined with new data and matches cleanup alternatives with the known data. The RI/FS was based on the nature and extent of contamination evaluations, results of the Comprehensive Risk Assessment (CRA), the contaminant fate and transport evaluation, and presents conclusions of the RI/FS. The nature and extent of contamination evaluations considered the following environmental media: soil, groundwater, surface water, sediment, and air. These evaluations were conducted to show the types of analytes remaining in the environmental media and their extent at RFETS following the Rocky Flats Cleanup Agreement (RFCA) accelerated actions. The CRA consists of two parts: a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA). A risk assessment was an evaluation of potential adverse impacts to human health and the environment that may exist from contaminated environmental media associated with site-related activities. The CRA was designed to provide information to decision makers to help determine the final remedy that was adequately protective of human health and the environment. Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the U.S. Environmental Protection Agency (EPA) considers environmental concentrations corresponding to a 1×10^{-6} to 1×10^{-4} cancer risk range and a total noncancer hazard index (HI) less than or equal to 1 to be adequately protective of human health (NCP 1990; EPA 1989, respectively). The Colorado Department of Public Health and the Environment (CDPHE) defines acceptable human health risk as a lifetime excess cancer risk less than 1×10^{-6} from exposure to carcinogenic compounds and/or a hazard quotient (HQ) less than 1.0 for noncarcinogenic compounds (CDPHE 1994). Because the CRA does not evaluate an unrestricted scenario, but

instead evaluated potential risk to the anticipated future user (wildlife refuge worker [WRW] and wildlife refuge visitor [WRV]), the assumptions used in the CRA human health calculations, including the assumptions used in calculating WRW preliminary remediation goals (PRGs), were embodied in institutional controls in the post-closure agreement. The exposure assumptions included ingestion and inhalation of soil particles as well as external exposure from the contaminants over four hours indoor and four hours outside in a day, for 230 days a year, and for 18.7 years in the job for a WRW. The exposure assumptions for a WRV included outdoor ingestion, inhalation, and external exposure for two and a half hours a day, for 100 days per year, for 24 years for an adult and 6 years for a child. These assumptions were developed by the Remediation Venture Organization at the Rocky Mountain Arsenal for use on the risk assessment at the Rocky Mountain Arsenal CERCLA site. They were calculated by averaging responses from three comparable refuges across the nation. The overall risk management goal identified for use in the ERA, as stated in the Final CRA Work Plan and Methodology (CRA Methodology) (DOE 2005a), was the following:

> *Site conditions due to residual contamination should not represent significant risk of adverse ecological effects to receptors from exposure to site-related residual contamination.*

The ERA was designed and implemented to determine whether site conditions meet the defined goal. The contaminant fate and transport evaluation used information about the site physical characteristics, contaminant source characteristics, and contaminant distribution across the site to develop a conceptual understanding of the dominant transport processes that affect the migration of different contaminants in various RFETS environmental media. The primary focus, consistent with the RFCA objectives, was evaluating the potential for contaminants from any medium to impact surface water quality. Evaluation of a contaminant's fate and transport was based upon two criteria: (1) does a complete migration pathway exist based on an evaluation of contaminant transport in each environmental medium, and (2) was there a potential impact to surface water quality based on an evaluation of data at representative groundwater and surface water locations in the creek drainages.

2.2.1 Components of the Remedial Investigation

The RI/FS consists of (1) the evaluation of the nature and extent of contamination after completion of RFCA accelerated actions, (2) the CRA for environmental media, and (3) the fate and transport evaluation at RFETS. The first step was to develop a list of Analytes of Interest (AOI). The purpose of identifying AOIs was to focus the nature and extent evaluation on constituents that have been detected at concentrations that may contribute to the risk to future receptors and to show overall spatial and temporal trends of those constituents on a sitewide basis. Soil and sediment AOIs were those analytes that were present with greater than a 1 percent frequency of detection above WRW Preliminary Remediation Goals (PRGs). WRW PRGs were calculated values equivalent to an HQ of 0.1 or risk of 1×10^{-6}. The more conservative of the two values was established as the PRG. These risk-based numbers were used for these media because no standards exist for soil or sediment, and the exposure assumptions used for the risk-based levels (specifically, WRW assumptions) were consistent with the future land use. Groundwater AOIs were those analytes with concentrations greater than surface water standards and that form contiguous, mappable plumes. Surface water standards were promulgated in the Colorado Water Quality Control Commission (CWQCC) regulations.

Comparison to surface water standards was consistent with RFCA objectives of protecting surface water quality. Surface water AOIs were those analytes that were present with greater than a 1 percent frequency of detection above surface water standards for samples collected since January 1, 2000. Air AOIs were those analytes that represent an ongoing source of potential emissions in the future. Details on the screening methodology, PRGs or standards used in the screen, and results were found in Sections 3.0 through 6.0 of the RI/FS report. The details of the CRA were found in Appendix A of the RI/FS Report. The CRA complies with the regulatory agency-approved CRA Methodology (DOE 2005a). A summary of the CRA Methodology is in Appendix A, Volume 2. For purposes of the CRA, RFETS was divided into 12 Exposure Units (EUs) for assessing potential risks to human and terrestrial ecological receptors, and 7 Aquatic EUs (AEUs) for assessing potential risks to aquatic ecological receptors. Contaminants of concern (COCs) and ecological contaminants of concern (ECOCs) were identified by the CRA on an EU or AEU basis using the processes outlined in the CRA Methodology. Quantitative risk characterization was performed for those EUs and AEUs where COCs and/or ECOCs were identified. COCs were quantitatively evaluated in the HHRA for the WRW and WRV consistent with the anticipated future land use of RFETS as a wildlife refuge. A variety of ecological receptors of concern for the ERA were identified in the CRA Methodology including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species present at RFETS. Section 8.0, of the RI/FS Report evaluates the environmental pathways and physical and chemical processes by which the AOIs, COCs, and ECOCs were transported and distributed in the RFETS environment, and evaluates whether those analytes may impact surface water quality. Air AOIs were evaluated based on the potential airborne radiological contaminant exposure received by a human receptor as measured against the EPA 10-millirem (mrem) annual benchmark level for the airborne pathway. Together, the nature and extent of contamination evaluations, results of the CRA, and contaminant fate and transport information were used to assess the extent to which residual contamination may pose a threat to human health and the environment.

2.2.2 Soil and Sediment

2.2.2.1 Surface Soil and Surface Sediment

Fourteen surface soil AOIs were identified in Section 3.0 of the RI/FS. The surface soil AOIs were aluminum, arsenic, chromium (total), vanadium, PCB-1254, PCB-1260, 2,3,7,8-tetrachlorodibenzodioxin (TCDD) toxicity equivalency (TEQ), benzo(a)pyrene, dibenzo(a,h)anthracene, americium-241, plutonium-239/240, uranium-233/234, uranium-235, and uranium-238. Even though sediment was evaluated in Section 5.0, the sediment results were included with soil because the HHRA portion of the CRA combined sediment with soil for the risk evaluations and the AOIs have similar transport mechanisms. Five sediment AOIs were identified in Section 5.0: benzo(a)pyrene, arsenic, chromium, americium-241, and plutonium-239/240. One COC was identified in Section 7.0, which required further evaluation. The surface soil COC for the Wind Blown Area EU (WBEU) was plutonium-239/240. The cancer risk estimates for the WBEU were estimated for exposure to plutonium (2×10^{-6}). The dose estimate for plutonium for the WRW was 0.3 millirem per year (mrem/yr) and for the WRV child was 0.2 mrem/yr, based on upper-bound average concentrations across the WBEU. No surface soil/surface sediment ECOCs were identified in the CRA. The overall conclusions from

the ERA indicate there was no significant risk of adverse ecological effects to receptors from exposure to site-related residual contamination. However, additional sediment and ecological monitoring were be evaluated in the FS. Contaminant fate and transport (Section 8.0) evaluated the environmental pathways and physical and chemical processes by which the AOIs, COCs, and ECOCs were transported and distributed in the RFETS environment and whether the AOIs, COCs, or ECOCs may impact surface water quality. Complete pathways from surface soil/surface sediment to surface water were identified in Section 8.0 for two surface soil analytes: americium-241 and plutonium-239/240 (see Sections 8.3.3.1 and 8.3.5.1 and Tables 8.4 and 8.5). These two analytes have been observed intermittently above the surface water standard, which was higher than background or the practical quantitation limit (PQL) at representative surface water locations upstream of the terminal ponds in North Walnut Creek, South Walnut Creek, and the South Interceptor Ditch (SID)/Woman Creek drainage. Removal of impervious areas has decreased runoff volumes and peak discharge rates resulting in reduced soil erosion and the associated particulate transport of americium-241 and plutonium-239/240 from surface soil/surface sediment with its potential impacts on surface water quality. Consequently, if residual soil contamination was disturbed, it could migrate to surface water via erosion which could result in some surface water sample results above surface water standards at some surface water monitoring locations. For surface soil/surface sediment analytes, the most current surface water data show concentrations below the highest of the surface water standard, background, or PQL at representative surface water locations downstream of the terminal ponds in North Walnut Creek, South Walnut Creek, and the SID/Woman Creek drainage. Of the 14 different AOIs or COCs identified in surface soil/surface sediment, only 2 have complete pathways to surface water: americium-241 and plutonium-239/240. In the past, these two analytes have intermittently been measured above their surface water standard upstream of the terminal ponds.

2.2.2.2 Subsurface Soil

Fourteen subsurface soil AOIs were identified in Section 3.0: chromium (total), lead, PCB-1260, benzo(a)pyrene, 1,1,2,2-tetrachloroethane, carbon tetrachloride, chloroform, methylene chloride, tetrachloroethene, trichloroethene, americium-241, plutonium-239/240, uranium-235, and uranium-238. No subsurface soil COCs or ECOCs were identified in the CRA. As stated earlier, contaminant fate and transport (Section 8.0) evaluated the environmental pathways and physical and chemical processes by which the AOIs were transported and distributed in the RFETS environment and whether the AOIs may impact surface water quality. Complete pathways from subsurface soil to surface water (via groundwater) were identified in Section 8.0 for five subsurface soil analytes, all of which were volatile organic compounds (VOCs). These analytes include carbon tetrachloride; chloroform, methylene chloride, tetrachloroethene, and trichloroethene. Subsurface soil analytes with complete pathways from subsurface soil to surface water (via groundwater) were associated with one or more groundwater areas, as addressed in the groundwater section below. Consequently, the subsurface soil analytes with complete pathways from subsurface soil to surface water (via groundwater) may be above the surface water standards (which were higher than background or the PQLs) at one or more Sentinel wells. For the subsurface AOIs, the most current data for those analytes measured in groundwater show concentrations below the highest of the surface water standard, background, or PQL at all Area of Concern (AOC) wells. The indoor air pathway was evaluated on a sitewide basis in the CRA (see Appendix A, Volume 2). Volatile chemicals have been detected in the subsurface in some

site subsurface soil sampling locations. If a building was erected over these subsurface soil sampling locations in the future, the volatile chemicals may migrate through the building foundation indoors and be subsequently inhaled by people. In the CRA, the evaluation for the indoor air inhalation pathway was performed by comparing the maximum detected concentration (MDC) of VOCs in subsurface soil and subsurface sediment to PRGs for indoor air. Where there were no exceedances of the volatilization PRGs, the indoor air inhalation pathway was assumed to be insignificant (all of the buffer zone). Where there were exceedances of the volatilization PRGs, the potential for an exposure resulting in unacceptable risk to the WRW was assumed to exist and these locations require further evaluation in the Feasibility Study (FS) (in the retained area). Contaminated subsurface features remain in the subsurface in the former Industrial Area (IA). These features were not evaluated in the CRA because they were not an environmental medium and because of the assumption in the CRA that there was no exposure pathway for a WRW given that he or she will not be digging below 3 feet (ft). Consequently, the FS will need to embody this CRA assumption in an institutional control. In conclusion, the five VOCs identified as having complete pathways from subsurface soil to surface water via groundwater have been measured below the highest of surface water standard, background, or PQL in the AOC wells and above the value in one or more sentinel wells. In addition, there were areas where exceedances of volatilization PRGs in subsurface soil indicate a potential indoor air risk.

2.2.3 Groundwater

Nineteen upper hydrostratigraphic unit (UHSU) groundwater AOIs were identified in Section 4.0, as analytes detected in wells that represent contiguous, mappable plumes above surface water standards. The UHSU groundwater AOIs were uranium (sum of isotopes), chloromethane, benzene, 1,2-dichloroethane, vinyl chloride, cis-1,2-dichloroethene, methylene chloride, 1,1-dichloroethene, chloroform, carbon tetrachloride, tetrachloroethene, trichloroethene, dissolved and total nickel, dissolved arsenic, total chromium, nitrate/nitrite (as N), fluoride, and sulfate. Shallow (UHSU) groundwater, impacted by site activities, discharges to surface water upgradient of the site boundary. This impacted groundwater emanates from the former Industrial Area and discharges to surface water in the drainages upgradient of the terminal ponds. Per the Fiscal Year (FY) 2005 Integrated Monitoring Plan (IMP) (K-H 2005a), potential impacts from shallow (UHSU) groundwater to surface water quality were measured at Sentinel and AOC wells. Sentinel wells were wells that were typically located near downgradient contaminant plume edges, in drainages, and downgradient of existing groundwater treatment systems. These wells were monitored to determine changes in groundwater quality. AOC wells were wells that were within a drainage and downgradient of a contaminant plume or group of contaminant plumes. These wells were monitored to determine whether the plume(s) may be discharging to surface water. Contaminant fate and transport (Section 8.0 of the RI/FS) evaluated the environmental pathways and physical and chemical processes by which the AOIs were transported and distributed in the RFETS environment and whether the AOIs may impact surface water quality. Complete pathways from shallow groundwater to surface water were identified for 10 groundwater AOIs: uranium (sum of isotopes uranium-233/234, uranium-235, and uranium-238), cis-1,2-dichloroethene, carbon tetrachloride, tetrachloroethene, trichloroethene, chloroform, methylene chloride, nitrate/nitrite (as N), fluoride, and sulfate. Groundwater AOIs with complete subsurface pathways from groundwater to surface water were primarily associated with five groundwater areas. The five groundwater areas with the potential to impact surface

water quality (complete pathway from groundwater to surface water) were identified because some groundwater analytes were above surface water standards at one or more Sentinel wells. These areas were:

- North of former Building 771 (north of the Carbon Tetrachloride Plume) – Trichloroethene may exceed the surface water standards.
- Historical East Trenches Area (downgradient portion between South Walnut Creek and the existing East Trenches Plume Treatment System [ETPTS]) – Tetrachloroethene, trichloroethene, carbon tetrachloride, methylene chloride, chloroform, and cis-1,2-dichloroethene may exceed the surface water standards.
- Historical Mound Site/Oil Burn Pit No. 2 Area (downgradient portion between South Walnut Creek and the Mound Site Plume Treatment System [MSPTS]) – Chloroform, trichloroethene, tetrachloroethene, 1,2-dichloroethene, cis-1,2- dichloroethene, 1,1-dichloroethene, and methylene chloride may exceed the surface water standards between South Walnut Creek and the MSPTS. Carbon tetrachloride, chloroform, methylene chloride, tetrachloroethene, and sulfate may exceed the surface water standards between Historical Oil Burn Pit No. 2 and the MSPTS. (Contaminated groundwater from Historical Oil Burn Pit No. 2 was treated at the MSPTS.)
- Historical 903 Pad/Ryan's Pit Area – Tetrachloroethene, trichloroethene, carbon tetrachloride, chloroform, and cis-1,2-dichloroethene may exceed the surface water standards downgradient of the Historical 903 Pad, while carbon tetrachloride, chloroform, and trichloroethene may exceed the surface water standards downgradient of Historical Ryan's Pit.
- Historical Solar Evaporation Ponds (SEP) Area and 700 Area Northeast Area (downgradient portion of plumes between Solar Ponds Plume Treatment System [SPPTS] and North Walnut Creek) – Nitrate and uranium at the Historical SEP and nitrate from the 700 Area Northeast plume may exceed the surface water standards. (Contaminated groundwater from the 700 Area Northeast plume was treated at the SPPTS.)

Based on data and numerical transport modeling results, it was likely that residual VOC sources and associated downgradient groundwater concentrations will persist in the environment for decades to hundreds of years even with the source removals that were implemented as accelerated actions (EPA 2003). As part of the Groundwater Interim Measure/Interim Remedial Action (IM/IRA) (DOE 2005b), an alternatives analysis was conducted to evaluate other accelerated action strategies that were feasible and practicable based on the type of residual contamination in these five areas and environmental conditions (for example, distance between the existing groundwater treatment systems and adjacent stream channels). The selected alternatives were conducted as one-time enhancements to previously implemented remedial actions. The selected enhancements were detailed in the Groundwater IM/IRA and were completed in 2005. The enhancements were intended to reduce the migration of contaminated groundwater that could impact surface water quality. They were not expected to eliminate groundwater contamination in the short term, but to have a positive long-term impact on groundwater and surface water quality. At this time, no other additional actions can reasonably be taken. The following actions have been implemented in accordance with approved RFCA decision documents to treat contaminated groundwater that could potentially impact surface water quality. The actions were:

- Post-closure care and monitoring of the Present Landfill and continued operation and maintenance (O&M) of the Present Landfill seep treatment system; and
- O&M of three groundwater treatment systems and performance monitoring (ETPTS, MSPTS, and SPPTS).

Continued operation of these four systems serves to protect surface water quality over short- and intermediate-term periods by removing contaminant loading to surface water. This protection also serves to meet long-term goals for returning groundwater to its beneficial use of surface water protection. For the groundwater AOIs, the most current data for those analytes measured in shallow groundwater show concentrations below the highest of the surface water standard, background, or PQL at all AOC wells with the exception of well 10594 (located downgradient of Pond A-1 in North Walnut Creek with sulfate results above background, which was higher than the surface water standard or PQL, in samples collected in 1995 and 1996). Groundwater contamination above maximum contaminant levels (MCLs) exists in some sampling locations at RFETS. The indoor air pathway for groundwater was evaluated on a sitewide basis in the CRA (see Appendix A, Volume 2 of the RI/FS). Volatile chemicals have been detected in the subsurface in some groundwater sampling locations of the site. If a building was erected over these groundwater sampling locations in the future, the volatile chemicals may migrate through the building foundation indoors and be subsequently inhaled by people. In the CRA, the evaluation for the indoor air inhalation pathway was performed by comparing the MDC of VOCs in groundwater to PRGs for indoor air. Where there were no exceedances of the volatilization PRGs, the indoor air inhalation pathway was assumed to be insignificant. Where there were exceedances of the volatilization PRGs, the potential for an exposure resulting in unacceptable risk to the WRW was assumed to exist and these locations require further evaluation in the FS. While groundwater was not specifically evaluated in the ERA, the only exposure pathway for ecological receptors to groundwater was where groundwater impacts surface water. The surface water evaluation in the ERA indicated no significant impact to surface water for ecological receptors. Consequently, there were no significant impacts for ecological receptors from groundwater. In conclusion, there were 10 groundwater AOIs associated with five areas of groundwater contamination that have potentially complete pathways to surface water. Where reasonable, groundwater treatment systems have been installed within these areas of groundwater contamination. After completion of all accelerated actions and based on the complete pathways identified in Section 8.0 of the RI/FS, no other additional actions can reasonably be taken at this time. In addition, there were areas where exceedances of volatilization PRGs in groundwater indicate a potential indoor air risk.

2.2.4 Surface Water

Eighteen surface water AOIs were identified in Section 5.0. The AOIs were carbon tetrachloride, chloroform, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, trichloroethene, vinyl chloride, dissolved aluminum, total beryllium, total chromium, total lead, total nickel, americium-241, gross alpha, gross beta, plutonium-239/240, uranium (sum of isotopes), and nitrate/nitrite (as N). No surface water COCs or ECOCs were identified in the CRA. The AEU assessments indicate that there were no continuing, significant risks to aquatic life from residual ECOPCs due to RFETS-related operations. However, additional surface water monitoring wasto be evaluated in the FS. In Section 8.0 of the RI/FS, surface water AOI data were compared to

surface water standards at representative surface water monitoring locations, including surface water Points of Compliance (POCs). Four surface water AOIs have been observed intermittently above the highest of the surface water standard, background, or PQL at representative (nonbackground) surface water locations. These AOIs were plutonium-239/240, americium-241, uranium (sum of isotopes), and nitrate/nitrite (as N). Americium-241 was observed intermittently above the surface water standard at surface water monitoring locations upstream of the terminal ponds in North Walnut Creek (station number SW093), South Walnut Creek (GS10), and the SID/Woman Creek drainage (GS51 and SW027). Plutonium-239/240 has been observed intermittently above the surface water standard at the same locations upstream from the terminal ponds as americium-241, as well as at station SW018 in the North Walnut Creek watershed. Uranium (sum of isotopes) was detected above the surface water standard in North Walnut Creek (GS13) and South Walnut Creek (GS10), although it was predominantly from natural uranium sources, based on analyses of uranium isotope fractions. Nitrate/nitrite (as N) was observed in North Walnut Creek (GS13) above the surface water standard. All other surface water AOIs were observed infrequently or not at all at concentrations above the highest of the surface water standard, background, or PQL at representative surface water locations. For the most current data, no surface water AOIs exceed the surface water standards at any surface water POC or at the surface water monitoring location immediately upstream of the surface water POC for those surface water AOIs where data were not available at the surface water POC. However, surface water sample results do not always meet Colorado surface water quality standards for some analytes at some on-site monitoring locations upstream of the terminal ponds (see Table 8.3 in the RI/FS Report). Surface water leaving RFETS was acceptable for all uses.

2.2.5 Air

With the completion of accelerated actions under RFCA, sources of ongoing emissions to air include the following:

- Volatilization/release of VOCs from residual subsurface contamination and the closed landfills; and
- Re-suspension of residual radioactive contaminants attached to surface soil particles.

However, as described previously, sources of VOC and radionuclide contamination were removed during accelerated actions conducted pursuant to RFCA. VOC emissions were rapidly decreasing and present no health or environmental concerns at present and anticipated future levels in ambient air. Historic concentrations of airborne radionuclides were low relative to the applicable air emission standard (40 Code of Federal Regulations [CFR], Part 61, Subpart H). The total off-site annual effective dose equivalent (EDE) of combined radionuclides (americium-241, plutonium-239/240, uranium-233/234, uranium-235, and uranium-238) has been less than 3 percent of the allowable 10-mrem standard, based on samples collected since 1999. Subpart H monitoring was no longer required. No further evaluation for air was required in the FS.

2.2.6 Reconfiguration and Renaming of the Operable Unit

In 2004, the RFCA Parties modified the 1996 Operable Unit (OU) Consolidation Plan in RFCA Attachment 1 to reduce the number of OUs that may need individual Corrective Action Decisions/Record of Decisions (CAD/RODs). Thus, there were two OUs: the IA OU and the

Buffer Zone (BZ OU) that were evaluated in the RI/FS. Results of the RI/FS analysis have identified the Area of RFETS impacted by U.S. Department of Energy (DOE) activities. For purposes of the RI/FS Report, the OU boundaries were reconfigured to consolidate all areas of the site that may require final remedial actions into a final reconfigured OU. The boundary of this new "Central OU" also considers conveniences and practicalities of future land management. The remaining portions of the site have been consolidated into the reconfigured "Peripheral OU". The Peripheral OU has been determined to be unimpacted by site activities from a hazardous waste perspective; that was, no hazardous wastes or constituents have been placed in or migrated to the Peripheral OU in quantities requiring remediation. This determination was based on process knowledge including past waste management practices, research into evidence of disturbed areas (Appendix B), and results of extensive sampling in the BZ OU. A small portion of the Peripheral OU was impacted by site activities from a radiological perspective. For example, plutonium-239/240 exists above background in surface soil in the WBEU. As illustrated on Figure 9.10 of the RI/FS report, there were a few sampling locations within the Peripheral OU that exceed a level of 9.8 picocuries per gram (pCi/g), which corresponds to a 1×10^{-6} risk level for a WRW. Of these few sampling locations, the highest result was approximately 20 pCi/g. If the highest concentration of 20 pCi/g was considered the average concentration over an appropriate EU, it would correspond to an increased risk of cancer over a lifetime of approximately 1×10^{-5} for a rural resident, which would be in the middle of the CERCLA risk range (10^{-6} to 10^{-4}). These levels of radioactivity were also far below the 231-pCi/g activity level for an adult rural resident that equates to the 25-mrem/y-dose criterion specified in the Colorado Standards for Protection Against Radiation (CDPHE 2005). Therefore, no action was required in the Peripheral OU and the Peripheral OU was determined to be acceptable for all uses from a radiological perspective. Further evaluation of the Peripheral OU was not required. No ECOCs were identified in the CRA for the Peripheral OU. The Central OU boundary was included for discussion purposes and may be refined throughout the CAD/ROD process. This reconfiguration and nomenclature were used throughout the remainder of the RI/FS Report.

2.2.7 Conclusions of the RI

Air emissions present no health or environmental concerns at present and anticipated future levels. Based on results of the RI, an FS was not required for the Peripheral OU. The RFCA Parties proposed a No Action CAD/ROD for the Peripheral OU. The Peripheral OU is the land base that will be transferred to the Department of the Interior for the Rocky Flats National Wildlife Refuge. Based on results of the RI, an FS was required for the Central OU. The underlying assumptions used in the CRA human health calculations are embodied in an institutional control. The specific media evaluated in the FS were:

Groundwater

- Five UHSU groundwater areas where contaminated groundwater may impact surface water;
- UHSU groundwater sampling locations where groundwater contamination exceeds MCLs; and
- Groundwater sampling locations where exceedances of volatilization PRGs in groundwater indicate a potential indoor air risk.

Surface Water

- Surface water upstream of the terminal ponds where some surface water sample results do not always meet CWQCC surface water quality standards for some analytes; and
- Additional surface water monitoring to address uncertainties identified in the ERA.

Soil

- Subsurface soil where complete pathways from subsurface soil to surface water (via groundwater) may impact surface water;
- Surface soil that may contribute to intermittent exceedances of the surface water standard for americium-241 and plutonium-239/240 upstream of the terminal ponds;
- Surface soil in the WBEU where results of the CRA indicate potential risk to a WRW was 2×10^{-6} for plutonium-239/240;
- Subsurface soil sampling locations where exceedances of volatilization PRGs in subsurface soil indicate a potential indoor air risk; and
- Additional ecological and sediment monitoring to address uncertainties identified in the ERA.

2.3 Previous Remediation

Three successive environmental compliance agreements/orders have provided a regulatory framework for the cleanup of RFETS since the 1980s. The first was in 1986, prior to the NPL listing in 1989; the second was in 1991; and the third was in 1996. These agreements/orders resulted in reordering and restructuring the investigation and cleanup priorities.

Compliance Agreement (1986)

The 1986 Compliance Agreement (1986 Compliance Agreement, CERCLA VIII-86-08 and RCRA VIII 86-06) defined the roles and established milestones for major environmental operations and response action investigations for the site. The 1986 Compliance Agreement established requirements for compliance with CERCLA, RCRA and CHWA and established a specific strategy, which allowed for management of high-priority past disposal areas and low-priority areas at the site. A precursor to the 1986 Compliance Agreement was the 1985 Draft Comprehensive Environmental Assessment and Response Program (CEARP) Phase I: Installation Assessment (DOE 1986). The CEARP consisted of record searches, an open literature search, inspections, and interviews with RFETS employees.

Inter-Agency Agreement (1991)

The 1986 Compliance Agreement did not reflect the requirements of the 1986 Superfund Amendments and Reauthorization Act, particularly the requirements governing federal facility NPL sites pursuant to Section 120 of CERCLA. EPA and CDPHE priorities were also refined due to additional knowledge gained from on-going investigations. This placed greater emphasis on OUs that, based on available information, were known to pose the greatest risk to humans and the environment through potential exposure to wastes. January 1991, DOE, EPA, and CDPHE signed Federal Facility Agreement and Consent Order CERCLA VIII-91-03, RCRA (3008[h])

VIII-91-07, and State of Colorado Docket #91-01-22-01, referred to as the Rocky Flats Interagency Agreement (IAG). The IAG regulated and provided for enforcement of DOE's investigation, planning, and conduct of response and corrective actions at the site. It also established a comprehensive plan for integrating CERCLA and RCRA/CHWA requirements for these remedial actions. The IAG also consolidated the waste sites into larger OUs.

During 1992 and into 1993, it became apparent that unrealistic schedule and cost assumptions would make it impossible for DOE to fully comply with the IAG schedules. DOE began missing milestones and projected that a series of future milestones were likely to be missed. Because of these events and issues surrounding the scope of work for response actions at the site given that the RFETS component production mission had ended, DOE, EPA, and CDPHE began negotiations to modify or replace the IAG.

Rocky Flats Cleanup Agreement (1996)

July 1996, DOE, EPA, and CDPHE signed the Federal Facility Agreement and Consent Order CERCLA VIII-96-21, RCRA (3008[h]) VIII-96-01, and State of Colorado Docket #96-07-19-01, referred to as the Rocky Flats Cleanup Agreement (RFCA). RFCA terminated and replaced the IAG and has since served as the regulatory agreement to accomplish the required cleanup of radioactive and other hazardous substance contamination at and from RFETS. RFCA expanded the cleanup scope to include disposition of all buildings, which were not covered in the IAG and changed the regulatory approach in several significant respects. It incorporated an unenforceable Preamble recitation of the objectives for eight topics that influenced cleanup decision making that were developed in consultation with the community and local governments, resulting in a Vision for the Site. The Vision was intended to provide a holistic view of key RFETS activities in relation to the required cleanup of the Site.

The following were the objectives taken from the RFCA Preamble. The status of each topic in relation to its current site condition was described.

1. Disposition of Weapons Useable Fissile Materials and Transuranic Wastes

Status: All weapons useable fissile material was removed by 2003 and transuranic waste removal for disposal at Waste Isolation Project Plant was completed in 2005.

2. On-Site and Off-Site Waste Management

Status: No monitored retrievable storage was needed. All waste materials generated during the Project were shipped off site for disposition. Cleanup or closure of former storage sites was completed in October 2005. Whether any follow-up cleanup of environmental media is required will be evaluated in the CERCLA periodic reviews.

3. Water Quality meets Standards

Status: All surface water and groundwater leaving RFETS boundaries currently meet the water quality criteria based on the results of routine, continuous, flow-paced surface water monitoring

for radionuclides and historical, non-routine monitoring of surface water and groundwater for a limited number of other analytes of interest (AOIs). Surface water downstream of the Woman Creek and Walnut Creek terminal ponds currently meets this objective and Colorado water quality standards based on the results of routine, continuous, flow-paced surface water monitoring for radionuclides and pre-discharge monitoring of the terminal ponds for radionuclides and a limited number of other AOIs. Completed accelerated actions have removed significant surface soil sources of surface water contamination and significant subsurface soil and non-aqueous phase liquid sources of groundwater contamination that contribute to surface water contamination. However, surface water sample results do not always meet Colorado surface water quality standards for some analytes at some on-site monitoring locations upstream of the terminal ponds. The Solar Ponds Passive Treatment System, East Trenches Passive Treatment System, Mound Site Passive Treatment System, and the Present Landfill seep collection and passive aeration treatment system were installed and continue to operate to reduce surface water contaminant loading from residual subsurface soil and groundwater contamination.

4. Cleanup Guidelines

Status: Building cleanup and waste disposition was complete. Several areas containing wastes buried more than 30 years ago; two Historical landfills with engineered covers meeting landfill closure criteria, and some infrastructure and building slabs/basement walls below 3 feet (ft) from the surface remain in the Central Operable Unit (OU). Building structures that have residual contamination are 6 ft or more below the ground surface. Appropriate monitoring, operation, and maintenance of the site has been identified and implemented. The “streamlined regulatory approach” is discussed further below.

5. Land Use was Determined

Status: The future land use for RFETS was a National Wildlife Refuge, as defined in the Refuge Act.

6. Environmental Monitoring

Status: Environmental monitoring was conducted pursuant to the Integrated Monitoring Plan (IMP) established in accordance with RFCA. The IMP was first approved in 1997 and was reviewed annually and updated as needed (through FY 2003 reviews and any needed updates were performed quarterly). The Rocky Flats Legacy Management Agreement (RFLMA) will replace the IMP for post-closure monitoring and maintenance. Reviews and updates will be conducted in consultation with CDPHE, EPA, local cities’ staff, and other stakeholders. Consultative meetings were routinely held, and quarterly monitoring information exchanges were conducted. These consultations considered monitoring results, the evolving nature of site condition, and changes to monitoring needs as cleanup goals were met. City and other stakeholder participants included, but were not limited to, representatives of the City and County of Broomfield; the Cities of Arvada, Westminster, Northglenn, and Thornton; the Rocky Flats Coalition of Local Governments (RFCoLG); the Rocky Flats Citizens Advisory Board (RFCAB); and the Service.

7. Building Disposition

Status: All RFETS buildings were decommissioned, decontaminated as necessary and demolished except for the east and west vehicle inspection sheds that DOE and the Service respectively retain for future use. See the status description for On-Site and Off-Site Waste Management presented earlier.

8. Mortgage Reduction

Status: See the status descriptions for On-Site and Off-Site Waste Management, Land Use and Building Disposition presented earlier.

The majority of accelerated action remedial work was completed after RFCA replaced the IAG in 1996. Since that time, all historical IHSSs, buildings, and identified contaminated groundwater plumes were dispositioned. All planned accelerated actions were implemented and signed off as completed by EPA and CDPHE by May 2006. RFCA Accelerated Actions were described below.

IHSSs

To prioritize work at the site, IHSSs were listed in RFCA Attachment 3 and ranked in RFCA Attachment 4, Environmental Restoration Ranking, in order of descending risk using a methodology developed by the RFCA Parties. Accelerated actions were planned and conducted to address the highest risk-ranked IHSSs as early in the cleanup process as practicable, while the detailed consolidated plans for all RFCA cleanup activities (the Site baseline and schedule) were being developed. This allowed streamlined decision making and focused available resources on meaningful risk reduction. The RFCA Parties updated the ranking on an annual basis through fall 2001. They subsequently agreed that there was no need for future updates, because the Site baseline and schedule were sufficiently developed to address proper sequencing of building decontamination and decommissioning and historical IHSS cleanup through planned project completion in 2006. Also, many of the high risk-ranked historical IHSSs had been or were in the process of being cleaned up by that time. All historical IHSSs listed in RFCA Attachment 3 were dispositioned in accordance with RFCA requirements. Under RCRA/CHWA, releases from SWMUs must be addressed to protect human health and the environment. The facility owner/operator was required to collect and present all information necessary for the individual release sites, or sources of contamination, to allow it and CDPHE to characterize the release and evaluate the risks to human health and the environment. IHSSs were originally identified as SWMUs at RFETS. All known and suspected sources of contamination, which were designated as IHSSs, were thoroughly investigated as part of the RFCA IHSS disposition process as individual release sites. As stated in RFCA paragraph 11, the Parties intend that compliance with the requirements of the RFCA will be deemed to achieve compliance with:

> *11(b) the corrective action requirements of sections 3004(u) and (v) of RCRA, 42 U.S.C. section 6924(u) and (v), for a RCRA permit, and section 3008(h), 42 U.S.C. section 6928(h), for interim status facilities; and 11(c) the corrective action requirements of CHWA, including 6 CCR 1007-3 sections 264.101 and 265.5.*

The IHSS general disposition process was described below. HRR information, process knowledge, and results of previous sampling and analysis efforts were used in planning for disposition of each historical IHSS. To facilitate the RFCA decision-making process, the majority of IHSSs were further consolidated into 58 IHSS Groups in the IA OU and 8 IHSS Groups in the BZ OU as part of the 1999 IA Characterization and Remediation Strategy (IA Strategy) (DOE 1999a). Even though IHSSs were placed in groups, each IHSS within each group was evaluated on an individual basis.

RFCA Accelerated Actions and Action Levels

The requirement for a RFCA accelerated action was based on an Action Level (AL) evaluation. RFCA ALs were numeric levels that, when exceeded, triggered an action determination evaluation in accordance with RFCA Attachment 5 and an appropriate accelerated response action (RFCA Attachment 5, Section 1.1). In general, RFCA ALs were based on the following:

- Soil ALs were calculated to be protective of a wildlife refuge worker (WRW) based on (1) a lifetime excess cancer risk of 1×10^{-5} and (2) a hazard index (HI) of 1. The more conservative of the two values was used as the soil AL (RFCA Attachment 5, Sections 4.0 and 5.0).
- Groundwater ALs were based on surface water protection (RFCA Attachment 5, Section 3.1) by applying maximum contaminant levels (MCLs). Where an MCL for a particular contaminant was missing, the residential groundwater ingestion based preliminary remediation goal (PRG) value applied (RFCA Attachment 5, Section 3.2).
- Surface water ALs (RFCA Attachment 5, Section 2.2) were based on Colorado surface water use classifications for RFETS: water supply, aquatic life – warm 2, recreation 2, and agricultural. Numeric values were derived from the following:
  - For metals, the site-specific standards or the basic standards applied. If the basic and site-specific standards differed for a particular metal, the site specific standard applied.
  - For inorganics, the site-specific standards or the basic standards applied. If the basic or site-specific standards differed for a particular inorganic, the site specific standard applied.
  - For organic chemicals, the more stringent of the basic standards or the site specific standards applied.
  - For radionuclides, the basic standards applied.

  The surface water standards that ALF was designed to protect are found in Colorado Water Quality Control Commission (CWQCC) Regulation No. 31: Basic Standards and Methodologies for Surface Water (5 Code of Colorado Regulations [CCR] 1002-31) (basic standards) and the site-specific water quality standards in CWQCC Regulation No. 38 (5 CCR 1002-38) (site-specific standards). If a numeric value existed for multiple use classifications, then the lowest numeric value was selected as the AL.

For additional details on the basis of ALs and how they were specifically applied at RFETS, see RFCA Attachment 5.

Characterization results were compared to RFCA soil ALs specified in Action Level Framework (ALF) to evaluate whether the levels and extent of contamination triggered an accelerated action. Because of concerns by some in the community over the exposure parameters used to establish

the radionuclide soil action levels (RSALs) in 1996, these levels were considered interim. The RFCA Parties conducted a review to determine whether the interim RSALs should be modified. During the period of review the future land use as a National Wildlife Refuge became law. Thus, the RSAL review expanded to reconsider soil ALs for all analytes, using the WRW exposure scenario. As a result of the review, soil ALs and the evaluation and implementing criteria for RFCA accelerated actions required under ALF were modified in 2003 based upon levels that were calculated to result in a lifetime excess cancer risk of $1x10^{-5}$ to the WRW. However, while this risk level equated with a surface soil concentration of 116 picocuries per gram (pCi/g) for plutonium-239/240, the RSAL for plutonium was established at a lower level of 50 pCi/g, which equates to approximately $3x10^{-6}$ risk. This lower RSAL was designed to help ensure the total risk from all radionuclides would be below $1x10^{-5}$ and reduce plutonium concentrations that could migrate through the soil erosion pathway. The lower plutonium RSAL also met acceptable risk and annual radiation dose applicable or relevant and appropriate requirements (ARARs) for an unrestricted user scenario. In addition, the modified ALF implementing criteria required soils within 3 ft of the surface contaminated above the plutonium RSAL to be removed to below the RSAL. This also addressed the soil erosion pathway concerns. Thus, in the disposition of all IHSSs where plutonium-239/240 was the soil contaminant, 50 pCi/g in surface soil was the accelerated action trigger for soil removal. This RSAL was not a trigger for actions being evaluated in the FS for final remedy purposes, and was not used in the evaluation of nature and extent of soil contamination or the CRA for risk calculations. Rather, risk for plutonium, like all other contaminants, was calculated based on existing contamination levels after completion of accelerated actions.

Prior to 2000, characterization was completed in accordance with CDPHE and EPA approved Sampling and Analysis Plans (SAPs) for a specific IHSS or group of IHSSs within relatively close geographic proximity. To streamline the regulatory review process, existing IA and BZ characterization data were summarized), and two SAPs were developed and approved by EPA and CDPHE to direct the soil characterization activities: the IA SAP (IASAP) (DOE 2000a) and the BZ SAP (BZSAP) (DOE 2002). These SAPs emphasized performing real-time analyses using an on-site laboratory and field-portable instruments to streamline the sampling and data analysis processes and shorten the time to render remedial decisions. The specific sampling and analytical requirements for each IHSS Group were contained in SAP Addenda, which were prepared and submitted to the lead regulatory agency (LRA) for the particular IHSS group for review and agreement. The Addenda provided "starting points" from which the soil cleanup activities proceeded. The strategies and decision rules defined in the SAPs guided in-process and final "endpoint" confirmation sampling and analysis. In 2004, the IASAP and BZSAP were combined into one sitewide SAP titled the IABZSAP (DOE 2004a), which was approved by EPA and CDPHE. Ecological threats were considered and evaluated in accordance with ALF and the IABZSAP. (An ERA was also part of the CRA.) If no accelerated action was required, the data were summarized in a Data Summary Report and the IHSS or IHSS Group was recommended for No Further Accelerated Action (NFAA). The Data Summary Report summarized, in tabular and graphical format, the data that justify the NFAA for the IHSS Group. Information provided in the Data Summary Report was used in the update to the HRR pertaining to the IHSS to further document the basis for NFAAs. If an accelerated action was taken, the confirmation sampling results were used to demonstrate that NFAA requirements were met for the IHSS.

Except in a few instances, groundwater contamination was not identified at specific IHSSs. However, IHSS-specific contaminated soil remedial activities generally reduced sources of soil contamination that could continue to impact groundwater and/or surface water quality. Accelerated actions for groundwater contamination were discussed below. If an accelerated action was determined to be required, it was proposed in a draft decision document for LRA approval. Three types of RFCA accelerated actions have been conducted in accordance with the following RFCA decision documents:

- Proposed Action Memorandums (PAMs) – Implemented when remedy selection was straightforward, and remedial activities were estimated to take less than 6 months from commencement of the physical work to completion;
- Interim Measure/Interim Remedial Actions (IM/IRAs) – Implemented when a formal evaluation of remedial options was necessary or remedial activities were estimated to take more than 6 months from commencement of physical work to completion; and
- RFCA Standard Operating Protocols (RSOPs) – Implemented for routine accelerated actions that were substantially similar in nature, for which standardized procedures were developed.

RFCA also provides that a RCRA/CHWA-permitted or interim status unit may be closed under a separate closure plan, or under an accelerated action decision document. At the completion of the accelerated action, regardless of the type of decision document implemented, a Closeout Report was prepared and submitted to the LRA for approval. The purpose of the Closeout Report was to document accelerated action activities for an IHSS Group. The Closeout Report summarized characterization data, the action taken, demarcation of excavation, confirmation sampling results, remediation waste volume and disposition, any changes in remediation approach and the rationale behind the change, stewardship recommendations, and the demarcation of residual contamination left in place. Information provided in the Closeout Report was used in the update to the HRR to further document the basis for No Further Accelerated Actions (NFAAs).

Groundwater

The RFCA consolidation of OUs emphasized prioritizing the individual IHSSs and conducting accelerated actions on contaminated soil that may have been contributing to contaminated groundwater plumes. Groundwater contamination was not identified as a separate OU; however IHSSs known to be a source of groundwater contamination were addressed through accelerated actions. One accelerated action goal was the removal or adequate containment of contaminated soil and waste to reduce impacts to surface water quality from known or suspected soil and groundwater contamination sources. Soil ALs were calculated based on soil ingestion and inhalation exposure pathways; the ALs do not include the soil-to-surface water or soil-to-groundwater pathways or any subsequent groundwater-to-surface water pathways. Therefore, it was necessary to also evaluate contaminated groundwater plumes and contaminated soil sources for potential impacts to surface water. In accordance with RFCA, levels of contamination in groundwater and soil were compared with groundwater and soil ALs specified in RFCA Attachment 5, ALF. For groundwater and soil concentrations that exceeded specified ALs, an evaluation, including impacts of cross-media contamination, was conducted in accordance with ALF to determine the appropriate response action. Accelerated groundwater actions currently in

operation were the collection barriers and passive treatment cells installed for the East Trenches Plume (DOE 1999b), Mound Site Plume (DOE 1997d), and Solar Ponds Plume (DOE 1999c). These accelerated actions were conducted to reduce contaminant loading to surface water. A system was also installed to collect and passively aerate a groundwater seep at the Present Landfill Area to remove low levels of benzene contamination prior to discharge to surface water (DOE 2004b). Additional evaluation for contaminated groundwater accelerated action decisions was deferred to a site wide evaluation, which was contained in the IM/IRA for Groundwater (Groundwater IM/IRA) (DOE 2005b). The Groundwater IM/IRA concluded that the following would have a positive long-term impact on groundwater and/or surface water quality:

- The already completed accelerated actions for soil source removals and enhancement through in situ biodegradation using a one-time placement of hydrogen releasing compound in the soil; and
- Addition of in situ biodegradation and phytoremediation technologies to enhance the improvement of groundwater quality being achieved by the ETPTS, SPPTS, and MSPTS.

Other soil source removals have eliminated potential sources of groundwater contamination. Those actions include decontamination and decommissioning of buildings and infrastructure, removing liquids in tanks and piping, plugging process lines and sewers left in place, and disrupting utility corridors.

Buildings

In accordance with RFCA, decommissioning activities were conducted as CERCLA removal actions. By October 2005, all buildings were removed except for the east and west vehicle inspection sheds retained for DOE and Service uses. As required by RFCA, a Decommissioning Program Plan (DPP) (K-H 1999) established the framework for the disposition of all facilities at RFETS. Decommissioning of contaminated facilities was conducted under a RFCA accelerated action decision document approved by the Lead Regulatory Agency (LRA). A building general disposition process was described below. Each RFETS facility was preliminarily screened as a Type 1, Type 2, or Type 3 facility based on the levels of contamination known or believed to exist within the facility. The EPA- and CDPHE-approved Decontamination and Decommissioning (D&D) Characterization Protocol (D&D Protocol) and the Reconnaissance-Level Characterization Plan, Appendix D of the D&D Protocol, guided the identification of hazards necessary for proper building typing. Generally, a building-specific Reconnaissance-Level Characterization Report (RLCR) was prepared that provided the basis for the building type for LRA concurrence. Prior to demolition of Type 2 or Type 3 buildings after decontamination, a Pre-Demolition Survey was conducted in accordance with the LRA-approved Pre-Demolition Survey Plan, and a Pre-Demolition Survey Report (PDSR) was prepared for LRA review and approval. Demolition was then conducted after the LRA approved the PDSR. In some instances, PDSRs or previous characterization information, such as knowledge of building use, was used in lieu of the RLCR for facility typing (primarily used for proposed Type 1 buildings). The buildings were identified as Type 1, 2, or 3 as follows:

- Type 1 - Buildings Free of Contamination. “Free of contamination” means that the following conditions were met:
  - Hazardous wastes, if any, were removed and any RCRA units were properly closed in accordance with regulatory requirements for unit closure prior to demolition;

− Routine surveys for radiological contamination showed the building was not contaminated;
− Surveys, if required, for hazardous substance contamination showed the building was not contaminated; and
− If any hazardous substances including polychlorinated biphenyls (PCBs) in light ballasts or friable asbestos were present, they were considered an integral part of the building's structural lighting, heating, electrical, insulation, or decorative material. As such, they were not considered contaminated. Friable asbestos and PCBs were removed for proper disposal before building demolition.

- Type 2 - Buildings Without Significant Contamination or Hazards, but in Need of Decontamination. Type 2 buildings contained some radiological contamination or hazardous substance contamination. The extent of the contamination was such that routine methods of decontamination sufficed and only a moderate potential existed for environmental releases during decommissioning. Most buildings where industrial operations occurred that used hazardous substances and/or radioactive materials fell into this category.
- Type 3 - Buildings With Significant Contamination and/or Hazards. Type 3 buildings contained extensive radiological contamination, usually as a result of plutonium processing operations or accidents. Contamination existed in gloveboxes, ventilation systems, and/or the building structure. Those buildings that were used for plutonium component production along with the major support buildings for such production included Buildings 371/374, 771/774, 707, 776/777, and 779.

For Type 2 and Type 3 buildings, four types of RFCA decision documents, which were approved by the LRA, were used for decommissioning activities:

- PAMs, written when activities took less than 6 months to complete;
- IM/IRAs, written when activities took more than 6 months to complete;
- Decommissioning Operations Plans (DOPs), used for Type 3 buildings; and
- RSOPs, used for repetitive decommissioning activities regardless of the facility type.

Decommissioning of Type 2 buildings was typically conducted under the RSOP for Facility Disposition (DOE 2000b) and the RSOP for Facility Component Removal, Size Reduction, and Decontamination Activities (DOE 2001), although several buildings were decommissioned under an IM/IRA or PAM. Type 3 buildings were decommissioned pursuant to DOPs. Closeout Reports document the completed building decommissioning activity. The Closeout Reports for Type 2 and 3 buildings were submitted for LRA approval. Closeout Reports for Type 1 buildings were provided to the LRA for information.

3.0 Sampling and Analysis

Data collected by DOE during the cleanup of Rocky Flats was reviewed and included as part of the Modified level III Survey. In addition, Service employees have been involved in the development of the Comprehensive Risk Assessment, and it is considered part of the Modified level III survey. The Service also collected surface soil and vegetation samples to confirm some of the assumptions that DOE has made in the RI/FS. In particular, the Service wanted to collect

samples from future trail locations, confirming extrapolated data that DOE had provided. The Service confirmed the level of contamination present on the surface and taken up into plants.

3.1 DOE RI/FS Data Review

In accordance with the DQOs (DOE 2004a), sources of releases at RFETS were characterized, the nature and extent of contamination of these releases were defined, and confirmation samples were collected to indicate that contamination resulting from these releases was removed. During the accelerated action process, additional surface soil sampling was conducted in the BZ (outside of known or suspected release areas) to support conclusions that releases to the environment did not occur. Soil data, generated during accelerated action evaluations and removal actions, were used in this nature and extent evaluation. These analytical results, together with sample event and location information, were stored in the Soil Water Database (SWD). A single "data record" in the database was an individual result, by analyte, for a specific sampling event at a specific location. SWD contains approximately 6.9 million records for all media, of which approximately 1.3 million records were for soil. Data were extracted from SWD and imported into a reporting tool database where additional fields, such as the PRGs, were appended to each record to facilitate data evaluation. The data were further processed through a series of data quality filters to ensure usability that supports the nature and extent of contamination evaluations. (Approximately 542,000 soil records were removed from the 1.3 million soil records as a result of this process.) Examples of the criteria used during this data processing step include samples that were no longer representative (NLR) of site conditions (for example, surface soil samples taken before an area was excavated), samples analyzed by field screening methods (gamma spectroscopy and x-ray fluorescence), and data that were rejected during data validation (a comprehensive list was provided in Appendix A, Volume 2, Attachment 2 of the RI/FS). Data used to make accelerated action decisions included field screening methods (gamma spectroscopy and x-ray fluorescence). These data were appropriate for an accelerated action decision because in accordance with approved SAPs (for example, the IABZSAP), field screening methods were approved as a conservative method to determine when to take an accelerated action. These data were inappropriate for decision making in the RI/FS, because field screening quality control (QC) elements do not meet specific RI/FS quality assurance (QA)/QC requirements (EPA 1988). Conclusions in the RI/FS report were therefore based on the "RI-ready" data and do not include field screening data used to make accelerated action decisions or represented in accelerated action Closeout Reports. The RI-ready data set that meets the nature and extent of contamination DQOs was determined. Only data identified as "RI-Ready = Yes" were used in the RI/FS report. The entire data set was contained on CD/ROM (Nature and Extent Soils data set) in Attachment 1 of the RI/FS report.

All reported values, including U-qualified data (nondetects), were used in this nature and extent evaluation. A value of one-half the detection limit was used for all U-qualified inorganic, metals, and organic data (EPA 2002). This does not apply to radionuclides, for which all reported values were treated as detects (DOE 1991). Approximately 820,000 data records constitute the data set used in this evaluation. The environmental medium classification for the samples used in this section was as documented during sample collection. That was, no attempt has been made to alter the environmental medium classification based on future hydrologic conditions or post-sampling land configuration. For example, confirmation samples collected

from the floor of excavation areas were designated as surface soil samples. Although the samples were not at the surface after imported clean backfill was placed in the excavation, the samples were still classified as surface soil samples in the database. Also, some of the soil sampling locations no longer exist as they were at the time of sampling (for example, areas were remediated). For this nature and extent evaluation, it was assumed that land surface contouring has not altered the surface and subsurface soil depth profile of the soil samples collected. Approximately 7,230 surface soil sampling locations; 12,250 subsurface soil sampling locations at depth intervals of 0.5 to 3 ft, 3 to 8 ft, and 8 to 12 ft; and 3,640 subsurface soil sampling locations at depth intervals of 12 to 30 ft, 30 to 50 ft, and greater than or equal to 50 ft were collected from June 28, 1991 through August 22, 2005. Various analytical suites were used in sampling and analysis based on the knowledge of IHSSs and the consultative process with the regulatory agencies. Soil sampling and analysis included the following suites of analyses from EPA's Target Compound List (TCL) (organics) and Target Analyte List (TAL) (metals and cyanide), which were included in this evaluation:

- Dioxins and furans;
- Explosives;
- Herbicides;
- Metals;
- Pesticides
- Polychlorinated biphenyls (PCBs) (Aroclors);
- Radionuclides
- Semivolatile organic compounds (SVOCs);
- VOCs; and
- Wet chemistry parameters (ammonia, anions [fluoride, nitrate/nitrite (as N) and nitrite], and cyanide).

3.1.1 Data Adequacy and Data Quality

Data at RFETS were considered adequate to use in the RI/FS report because:

- Historical IHSSs (sources) were identified and the extent of contamination was defined, including known or suspected migrations processes, through targeted sampling. These data were included in this evaluation.
- Historically, the distribution of soil data, both spatially and temporally, was assessed to determine that the nature and extent of contamination was well characterized. These data were included in this evaluation.
- Agency-approved SAPs described soil characterization and remediation sampling and analysis activities for all IHSSs and areas suspected of being contaminated.
- BZ grid sampling was conducted at the site to confirm that no additional sources of contamination existed at the site. These newly generated data were included in this evaluation.

In addition, data were considered adequate to bound the extent of contamination as defined in the RI/FS report. A data adequacy report of these data was provided in Appendix A, Volume 2, Attachment 3 of the RI/FS report.

Data quality was assessed using a standard Precision, Accuracy, Representativeness, Completeness and Comparability (PARCC) parameter analysis and was included in Appendix A, Volume 2, Attachment 2 of the RI/FS. Both laboratory and sample-specific QC data were evaluated on a sitewide basis. All data have been verified and/or validated using Verification and Validation (V&V) Guidelines for each analytical method developed for RFETS. The Data Quality Assessment (DQA) indicates the data meet the DQOs for nature and extent of contamination, and the data were adequate for use in the nature and extent of soil contamination evaluation.

The data evaluations considered the following environmental media: soil, groundwater, surface water, sediment, and air. These evaluations were conducted to show the types of analytes of interest (AOIs) remaining in the environmental media and their extent at RFETS following the completion accelerated actions. The purpose of identifying AOIs was to focus the nature and evaluation on constituents that were detected at concentrations that may contribute to the risk to future receptors and to show the overall spatial and temporal trends of those constituents on a sitewide basis. The evaluation put RI-ready data through a series of screening steps to focus on important areas, contaminants, and conditions at the site. These screens included:

For Soil:

- Comparison to background concentrations – This screen is to distinguish between contamination associated with RFETS activities and naturally occurring or other non-RFETS-related background conditions for inorganics, metals, and radionuclides.
- Comparison to Wildlife Refuge Worker Preliminary Remediation Goals (WRW PRG) - For each analyte where all sample results were below the WRW PRG, the analyte was eliminated as an AOI. For analytes that have one or more sample results above the WRW PRG, the analyte was carried forward to the next screening step.
- Process Knowledge/Frequency of Detection Evaluation – This screen involves the determination of whether certain analytes should be retained or eliminated as AOIs based on process knowledge and/or frequency of detection greater than the WRW PRG. The process knowledge evaluation takes into account historical RFETS-related manufacturing and operations that may have resulted in release of analytes. In addition, AOIs that passed the process knowledge screen but were detected only in a very small percentage of the samples collected (less than 1 percent) may reflect an isolated area of contamination rather than an area of widespread contamination.

For Groundwater:

- Nondetect and Background 99/99 Upper Threshold Limit (UTL) Comparison - groundwater analytes were screened to determine whether the analyte is detected in groundwater and, for naturally occurring analytes (that is, metals, radionuclides, and water quality parameters), compared with the corresponding background 99/99 UTL value to determine whether each analyte is above or below background. For those analytes where all past sample results are not detected or are below the corresponding background 99/99 UTL concentration, the analyte is removed from the screening process and not evaluated further. Analytes that have at least one sample result above the detection limit and above the background concentration are carried forward.

- Determination of Surface Water Standards - To evaluate the potential for impacts to surface water quality, this screening step determines whether a surface water standard exists for the groundwater constituent. For groundwater constituents that have a surface water standard and appropriate filtration state (that is, total [unfiltered] versus dissolved [filtered] analysis), the constituent is carried forward to the next screen. For groundwater constituents without a surface water standard, the constituent proceeds to a screening step where it is compared to Maximum Contaminant Levels (MCLs).
- Surface Water Standard Comparison - Groundwater results are compared with the corresponding surface water standard. The surface water standard is defined as the greater of the lowest surface water standard or the Practicable Quantification Limit (PQL). For groundwater analytes where all sample results are below the surface water standard, the analyte is eliminated as an AOI. Groundwater analytes that have at least one sample result above the surface water standard are retained.
- MCL Comparison - For groundwater analytes that do not have a surface water standard, groundwater results are compared with the corresponding MCL. For groundwater analytes where sample results are below the MCL, the analyte is eliminated as an AOI. Groundwater analytes that have one or more sample results above the MCL are retained.
- Determination of Contiguous, Mappable Plume - For each analyte that passes the two previous screens, the most recent available sample result from each well is mapped to assess whether a contiguous, mappable plume exists. The most recent result at a well was selected to reflect current groundwater conditions at the site. A contiguous, mappable plume is defined as three or more adjacent wells with groundwater results that exceed the surface water standard, MCL, or PQL. Based on the extensive well coverage in the UHSU at RFETS, three adjacent wells with groundwater contaminants above these standards are used as a basis for defining a contiguous plume. The surface water standard, MCL, or PQL is used in Screening Step 5 to delineate boundaries for a contiguous, mappable contaminant plume.
- Process Knowledge Evaluation - This screen involves the determination of whether a constituent that has a contiguous, mappable extent should be retained or eliminated as an AOI based on process knowledge or other criteria involving professional judgment. This screen involves an assessment of contaminants that cannot be reasonably expected to be AOIs based on historic site process knowledge, even though they may appear to form contiguous contaminant extents. The screen also involves other criteria (for example, the use of stainless-steel wells or pumps, improper well completion, and aquifer geochemistry) based on professional judgment, that may lead to the elimination of an analyte as an AOI. Process knowledge of an analyte's historical use at the site, or lack of use, and professional judgment involving an understanding of a constituent's natural occurrence and distribution in the environment, regional and local aquifer geochemistry, and well completion and sampling information, all provide useful information regarding whether an analyte is an AOI at the site.

For Surface Water:

- Determination of Surface Water Standard - To evaluate the potential for impacts to surface water quality, this screen determines whether a surface water standard exists for each constituent. The surface water quality standards are the RFETS site-specific and statewide standards listed in 5 CCR 1002:

- Statewide surface water radioactive materials standards in Section 31.11(2);
- Statewide surface water interim organic pollutant standards in Section 31.11(3); and
- Site-specific surface water quality standards for segments 4a, 4b, and 5 of Big Dry Creek in Section 38.6 of the South Platte Basin Classifications and Standards.

The surface water standard is defined as the greater of the lowest surface water standard or PQL. Basic surface water standards considered include water supply, water+fish, fish ingestion, acute aquatic, chronic aquatic, aquatic life class 2, agriculture, and site-specific surface water standards for Walnut and Woman Creeks. Constituents that have a surface water standard and appropriate methodology (that is, total versus dissolved analysis) are carried forward to the next screen. Constituents that do not have a surface water standard are eliminated and not considered further.

- Nondetect and Background Comparison - In this screen, surface water analytes are determined to be either not detected or detected. Analytes whose results are all nondetects are eliminated from further consideration. Detected surface water analyte results were compared against the background M2SD values presented in Appendix A, Volume 2, Attachment 5 where available. Background values are not available for organic constituents and other select inorganic and radionuclide constituents. Detections of these constituents above the detection limits are assumed to indicate their presence in the environment.
- Surface Water Standard Comparison - Surface water analyte results carried forward from the last screen are compared with the corresponding surface water standard. For surface water analytes where all sample results are below or equal to the surface water standard, the analyte is eliminated from further consideration. Surface water analytes that have at least one sample result above the surface water standard are retained.
- One (1) Percent Frequency of Detection Screen - Per agreement between the RFCA Parties, surface water AOIs are those analytes that are present with greater than a 1 percent frequency of detection above the surface water standard for samples collected between January 1, 2000, and July 31, 2005, which accounts for temporally representative data. Elimination of the less-than-1-percent frequency analytes is based on application of Colorado's guidance on data requirements and interpretation methods used to establish existing water quality. In particular, data should be ranked and the 85th percentile is used as the indicative value for dissolved parameters, while the 50th percentile is indicative of totals. Given the large number of samples for these analytes, more than 99 percent of the data below the identified standard are adequately representative to show that these contaminants do not adversely impact surface water quality.
- Process Knowledge Evaluation - This screen involves the determination of whether an AOI should be retained or eliminated based on process knowledge or other criteria involving professional judgment. The process knowledge evaluation involves an assessment of whether an analyte that reaches this screening step is reasonably expected to be an AOI based on historical site process knowledge. Process knowledge alone is not used to eliminate or retain an analyte as an AOI. Other analyte criteria such as its areal distribution relative to RFETS activities, its proximity to contaminant sources, accelerated actions performed to remove a contaminant source, and its natural occurrence

and distribution in the environment were also considered when evaluating whether to retain or eliminate a constituent as an AOI.

For Sediments:

- Preliminary Remediation Goal Identification - To evaluate the potential for impacts to sediments, this screen determines whether a WRW PRG exists for the sediment analyte. Analytes without a PRG are eliminated from further evaluation. Constituents that have a PRG are carried forward.
- Nondetect and Background Comparison - In this screen, sediment analytes were determined to be either not detected or detected. Analytes whose results are all nondetects are eliminated from further consideration. Detected sediment analytes were compared against the background Mean plus two Standard Deviations (M2SD) values presented in Appendix A, Volume 2, Attachment 5, where available. Background values are not available for organic constituents and other select inorganic and radionuclide constituents. Detection of these constituents above the detection limits indicates their presence in the environment.
- Preliminary Remediation Goal Comparison - This screen involves comparison of the sediment results with the WRW PRG. The WRW PRG values used to compare with the sediment results were developed in the CRA for a WRW based on a target excess carcinogenic risk of 1×10^{-6} or an HQ of 0.1. If a constituent's maximum result is less than or equal to the PRG, it is eliminated as an AOI. For constituents where the maximum result is greater than the PRG, it is retained as an AOI and carried forward.
- One (1) Percent Frequency of Detection - Per agreement between the RFCA Parties, sediment AOIs are those analytes that are present with greater than a 1 percent frequency of detection above the sediment WRW PRG. For each sediment analyte that passes the previous screen and has a frequency of detection above the WRW PRG greater than 1 percent, the analyte is carried forward to the next screen. The frequency of detection is based on all sitewide analytical results for each sediment analyte for the period between June 28, 1991, and July 31, 2005. For analytes whose frequency of detection above the WRW PRG is less than or equal to 1 percent, the analyte is eliminated from further consideration.
- Process Knowledge Evaluation - This screen involves the determination of whether an AOI should be retained or eliminated based on process knowledge or other criteria involving professional judgment. The process knowledge evaluation involves an assessment of whether an analyte that reaches this screening step is reasonably expected to be an AOI based on historical site process knowledge. Process knowledge alone is not used to eliminate or retain an analyte as an AOI. Other analyte criteria such as its areal distribution relative to RFETS activities, its proximity to contaminant sources, accelerated actions performed to remove a contaminant source, and its natural occurrence and distribution in the environment were also considered when evaluating whether to retain or eliminate a constituent as an AOI.

For Air:

- AOIs in air are due to the ongoing resuspension and movement of soil (fugitive dust) by wind, such as occurs on all open lands along the Front Range of Colorado. Ongoing

emissions are due to plutonium, americium, and uranium from the remaining soil areas with actinide contamination above background levels.

These evaluations identified 14 AOIs for surface soil, 14 AOIs for subsurface soil, 19 AOIs for groundwater, 18 AOIs for surface water, 5 AOIs for sediment, and 5 AOIs for air. Details on the nature and extent of contamination screening methodology, preliminary remediation goals (PRGs), standards or benchmarks used in the screen and results for the various media are found in the following sections of the RI/FS Report: Section 3.0 for soil, Section 4.0 for groundwater, Section 5.0 for surface water and sediment, and Section 6.0 for air.

3.1.2 Results of the Comprehensive Risk Assessment

The CRA consists of two parts: a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA). A risk assessment is an evaluation of potential adverse impacts to human health and the environment that may exist from contaminated environmental media associated with site-related activities. The CRA was designed to provide information to decision makers to help determine the final remedy that is adequately protective of human health and the environment. The entire details of the CRA are found in Appendix A of the RI/FS report.

Under the CERCLA, EPA considers environmental concentrations corresponding to a 1×10^{-6} to a 1×10^{-4} cancer risk range and a total noncancer hazard index (HI) less than or equal to1 to be adequately protective of human health (NCP 1990 and EPA 1989, respectively). CDPHE defines acceptable human health risk as a lifetime excess cancer risk less than 1×10^{-6} from exposure to carcinogenic compounds and/or a hazard quotient (HQ) less than 1.0 for noncarcinogenic compounds (CDPHE 1994).

The overall risk management goal identified for use in the ERA is the following:

> *Site conditions due to residual contamination should not represent significant risk of adverse ecological effects to receptors from exposure to site-related residual contamination.*

The ERA was designed and implemented to determine whether site conditions meet the goal.

Contaminants of concern (COCs) and ecological chemicals of potential concern (ECOPCs) were identified for the CRA on an Exposure Unit (EU) or Aquatic EU (AEU) basis using the processes outlined in the CRA Methodology (see RI/FS for more information). Quantitative risk characterization was then performed for the EUs and AEUs that had COCs and/or ECOPCs identified.

3.1.2.1 Human Health Risk Assessment

An HHRA was conducted separately for each of the 12 EUs identified for RFETS. COCs were quantitatively evaluated in the HHRA for the wildlife refuge worker (WRW) and wildlife refuge visitor (WRV) consistent with the anticipated future land use of RFETS as a wildlife refuge.

Soil and Sediment

Based on the steps of the COC identification process, no COCs were identified for subsurface soil/subsurface sediment in the HHRA for any of the EUs. The process identified 5 COCs for surface soil/surface sediment distributed in 5 of the 12 EUs as listed below:

- Upper Woman Drainage EU (UWOEU) (benzo[a]pyrene and dioxins);
- Industrial Area (IA) EU (IAEU) (arsenic and benzo[a]pyrene);
- Upper Walnut Drainage EU (UWNEU) (benzo[a]pyrene);
- Wind Blown Area EU (WBEU) (arsenic and plutonium-239/240); and
- No Name Gulch Drainage EU (NNEU) (vanadium).

COCs have been quantitatively evaluated for the WRW and WRV receptor. Cancer risks, noncancer health effects, and radiation doses have been calculated and are summarized in the RI/FS. The cancer risk estimates for the five EUs listed above are at the low end of EPA's 1×10^{-4} to 1×10^{-6} risk range (that is, less than 1×10^{-5}). The noncancer health effects estimates (HIs) are all below 1, indicating noncancer health effects are unlikely. Radiological dose estimates are less than 1 millirem per year (mrem/yr). From a risk management perspective, only one COC requires further evaluation. The surface soil COC for the WBEU is plutonium-239/240 with an estimated cancer risk of 2×10^{-6}. For the seven EUs that do not have COCs, risks are expected to be similar to those associated with background conditions.

Surface Water

Potential exposure to surface water by WRW or WRV receptors was evaluated in the CRA on a sitewide basis. For this sitewide evaluation, surface water concentrations were compared to WRW PRGs. Exceedances of surface water PRGs occurred within three EUs: the IAEU, UWNEU, and UWOEU. Several organics, inorganics, and radionuclides in surface water exceeded their PRGs. Further analyses for each analyte indicated that (1) the exceedances were generally slight and infrequent, and (2) the exceedances were in data from 1998 or older, whereas no exceedances occurred in the more recent data. The more recent data are more representative of current conditions at the site than the older data. For these reasons, significant exposure from the surface water pathway for the WRW or WRV is not expected. In some areas of the site, groundwater surfaces in seeps. Contact with groundwater in these seeps is theoretically possible for the WRW and WRV. However, because the chemical concentrations in the seeps are low and any contact with water in the seeps is expected to be infrequent and of short duration, the groundwater-to-surface water migration pathway is not considered significant. Surface water and sediment were evaluated in the ERA portion of the CRA on an AEU basis.

Groundwater

The RFCA Vision states that on-site groundwater, in the DOE retained land, will not be used for any purposes unrelated to RFETS cleanup activities. Therefore, the pathway for direct ingestion of groundwater is incomplete. DOE has stated that institutional controls have been put into place to make sure ingestion of groundwater does not happen.

Indoor Air Pathway

The indoor air pathway was evaluated on a sitewide basis. Volatile chemicals have been detected in the subsurface in some subsurface soil and groundwater sampling locations of the site. In these locations, the indoor air inhalation pathway is potentially significant if buildings were constructed there. In locations where there are no exceedances of the volatilization PRGs, the indoor air inhalation pathway is assumed to be insignificant. Institutional controls have been in place that prohibit the construction of buildings over VOC contaminated groundwater or soil.

3.1.2.2 Ecological Risk Assessment

A variety of ecological receptors of concern for the ERA were identified in the CRA Methodology, including the Preble's meadow jumping mouse (PMJM), a federally listed threatened species present at RFETS. The ERA was designed and implemented to determine whether site conditions meet the defined risk management goal of identifying adverse ecological effects. The overall conclusions from the ERA indicate there is no significant risk of adverse ecological effects to receptors from exposure to site-related residual contamination. However, additional surface water, sediment, and ecological sampling is included in the RI/FS to address uncertainties identified in the ERA.

3.2 Service Data Collection Approach

3.2.1 Targeted Surface Soil Sampling along Rocky Flats Trails

The Refuge Comprehensive Conservation Plan (CCP), would entail conversion of some existing roads to trails, would lead to the establishment of a select number of additional trails, and would allow seasonal off-trail use of portions of the southern BZ. The primary objective of this modified level III data collection was to produce additional information regarding soil contaminant concentrations in regions of the Rocky Flats BZ that will be accessible to the public via the proposed Refuge trail network. These samples are also to be used to validate assumptions that outlying areas of the BZ have not been impacted (e.g., low concentrations of contamination exist that were well below risk-based action levels for the site). In order to achieve these goals, surface soil samples were taken at a regular interval along proposed trail routes, and submitted to a certified laboratory and analyzed for metals and radionuclides according to the specifications of the SAP. Additional surface soil samples were taken off the trail locations in the southern buffer-zone, a region of the site that may be accessible through future, seasonal, off-trail uses (FWS, 2005). Sample locations are presented on Figure 2. Results of this sampling effort was be reviewed in conjunction with additional surface soil data from the BZ (e.g. DOE surface samples taken to support of the site's CRA) to assess the spatial comprehensiveness of contaminants data, and to identify areas of concern for potential further investigation.

A subset of the sampling locations will include expanded, full-suite analyses, including pesticides, PCBs, dioxins, and SVOCs. These samples were positioned to achieve a representative spatial distribution along the trails, but additional, select samples will target areas

of specific concern, including sites identified in the 1999 Colorado Department of Public Health and Environment assessment of the RFETS buffer zone (CDPHE, 1999).

3.2.2 Vegetation Sampling in Potential Future Prescribed Burn Areas

Prescribed fire has been identified as a grassland management tool in the CCP (FWS, 2005). This prescription would apply to lands managed by the Service, and not lands retained by the DOE. Prescribed fires would be subject to approved plans, and factors such as weather conditions, fuel conditions, adequate fire breaks, and the preparedness of fire management and emergency response crews. Prescribed fire would be carried out in accordance with approved vegetation management plans and an approved Fire Management Plan. Currently, even though studies have shown it to be safe, no prescribed fires are planned for the Central OU or the windblown area. There is no concern for wildfire response in those areas.

The periodic use of fire would result in localized, short-term increases in smoke and airborne particulates. The amount of smoke and particulates generated by a prescribed fire would depend on several variables, including wind, soil and vegetation moisture, and fire intensity. In order to assess prescribed fire as a potential radionuclide inhalation pathway for the future wildlife-refuge worker, vegetation samples from across the site were harvested and analyzed for select radionuclides of concern (Figure 3). Results from these analyses, in conjunction with existing RFETS information obtained during an April 2000 test burn in the southwestern buffer zone, were used to assess radionuclide-specific risks resulting from the use of prescribed fire as a vegetation management tool on the future Refuge.

3.3 Field Sampling Methodologies

3.3.1 Surface Soils

Forty-one surface-soil grab samples were collected as a part of this sampling effort. A global positioning system (GPS) unit was used to locate the exact position of these samples on the site map. In order to meet quality assurance standards for this site, ten percent of the samples were duplicated and submitted blindly to the lab. Therefore, a total of four field duplicate samples were collected from four sampling locations selected at random, for a total effort of 45 surface soil samples. Concentrations of metals and radionuclides were assessed in all soil samples, while full-suite analyses were performed on a targeted subset (20 + 2 duplicates) of all sites.

Surface-soil samples were collected from undisturbed soils at each sampling location. Samples were collected from 0-2 inches below the ground surface, with vegetation, coarse material, and litter removed to reach native soil. A stainless steel trowel was used to place soils into a stainless steel bowl, through a number 10 screen made out of stainless steel. Soil was mixed in the bowl and transferred to appropriate, pre-labeled sample containers, in accordance with the specifications of the laboratory selected to complete the analyses. Depth of sampling was confirmed with a measuring rule. Following each sample collection, all sampling equipment was washed in an Alconox detergent solution, rinsed with distilled water, and allowed to air dry.

3.3.2 Vegetation

Vegetation samples (11 + 1 duplicate) were obtained by randomly selecting an area in the vicinity of the sampling locations indicated in Figure 1 of the Sampling and Analysis Plan. Sample volumes from the 0.25 meter square proposed in the SAP were insufficient for the laboratory to run a quality analysis. Vegetation was clipped and bagged, until four gallon bags were full. A GPS unit was used to locate the exact position of these samples on the site map. A Service ecologist was present during the harvest of plant material to catalog species harvested. Loose vegetative litter residing within the sample location was also collected, and bagged with the vegetation. The vegetative material was shipped to the selected laboratory for radionuclide analyses. The laboratory was notified that plant material should not be rinsed prior to digestion.

4.0 Data Presentation

Results of the sample analysis confirm the data that DOE had been collecting. Results that we obtained through this sampling are very similar to data that DOE has in their database. All data points were lower than the maximum detected concentrations from the DOE database. Data for surface soils are presented in Tables 4-1 to 4-6. Data for vegetation are presented in Table 4-7. It is important to note that the presence of contaminants does not mean there is an adverse effect. The adverse effects would be determined in a risk assessment or by long-term biomonitoring.

4.1 Surface Soils

Surface soil samples were collected the week of May 8, 2006 as described in section 3.3.1 above and in the SAP. Radiological and metals analysis were performed on all of the surface soil samples. Semi-volatiles, PCBs, Dioxin/Furans, and Pesticides were run on one half of the samples, randomly selected. Results of these analyses were compared to results of the RI/FS report.

4.1.1 Surface Soil - Radiochemistry

Results of the surface soil radiochemistry analysis are presented in Table 4.1. When compared to the RI/FS defined background values, there were twelve samples that were substantially above background for Americium 241 (Am 241) and Plutonium 239/240 (Pu 239/240). There were no samples that were substantially above the Uranium 234 (U 234), Uranium 235/236 (U 235/236), or Uranium 238 (U238) background values. For the most part, results of this study detected levels of radiochemistry lower than the mean values of DOE's database.

4.1.1.1 Americium

The RI/FS defines surface soil background for Am 241 as 0.022 pCi/g, which is the mean of the samples taken as background plus two standards of deviation (all background values are set using that methodology). Surface soil samples taken for this study ranged from 0.0043 pCi/g in surface soil sample twenty two (06SS022) to a high of 5.27 pCi/g in surface soil sample 41 (06SS041). The second highest sample value is 0.430 pCi/g for surface soil sample twenty six (06SS026). The locations of 06SS041 and 06SS026 are "downwind" of the windblown area of

Rocky Flats. 06SS041 is directly east of the wind blown area and 06SS026 is east-southeast of the windblown area.

4.1.1.2 Plutonium

The RI/FS defines surface soil background for Pu 239/240 as 0.066 pCi/g. Surface soil samples taken for this study ranged from a low of 0.004 pCi/g in 06SS002 to a high of 21.8 pCi/g in 06SS041. The duplicate sample of 06SS041 is 06SS043 that had a result of 19.8 pCi/g. The second highest sample value is 2.04 pCi/g in sample 06SS026. 06SS041 is directly east of the windblown area of the site and 06SS026 is east-southeast of the windblown area. In addition, our sample result for 06SS041 match with samples that DOE had taken in a study done by Iggy Litor, also taken at 0 to 2 inches in the same vicinity of Rocky Flats. Most DOE samples were taken at 0 to 6 inches for surface soil and are harder to compare.

4.1.1.3 Uranium

Uranium results are divided into isotope groups due to relative activity of each isotope.

4.1.1.3.1 Uranium 234

Previous sampling has determined that surface soil background for U 234 is 2.25 pCi/g at Rocky Flats. Surface soil samples taken for this study range from a low of 0.585 pCi/g in 06SS034, to a high of 1.58 pCi/g in 06SS041, with the next highest at 1.29 pCi/g in sample 06SS028. All of our samples are below background levels established in the RI/FS.

4.1.1.3.2 Uranium 235/236

The RI/FS defines surface soil background for U 235/236 as 0.095 pCi/g. Surface soil samples taken for this study ranged from a low of 0.033 pCi/g in sample 06SS008 to a high of 0.107 pCi/g in 06SS041. The second highest sample value is 0.097 in sample 06SS011. Sample 06SS041 is located directly downwind of the windblown area of Rocky Flats. Although the data show our results above the background level, they are only slightly elevated from what is considered background.

4.1.1.3.3 Uranium 238

The RI/FS defines surface soil background for U 238 as 2.00 pCi/g. Surface soil samples taken for this study ranged from a low of 0.551 pCi/g in sample 06SS034 to a high of 1.61 pCi/g in sample 06SS041. The second highest sample value is 1.30 pCi/g in sample 06SS028. All of our samples are below surface soil background levels established in the RI/FS.

4.1.2 Surface Soil Metals

Results of the surface soil metals analysis are presented in Table 4-2. When compared to the RI/FS defined site specific surface soil background values, there were twenty-eight samples that were substantially above surface soil background for one or more metal analyte. Nine samples

exceeded only one analyte; three exceeded the Calcium level, two exceeded the Barium level, two exceeded the Potassium level, one the Sodium level, and one exceeded the Iron level. This is comparable to what was found in the RI/FS, so the authors of the RI/FS started looking at regional background levels (Western United States). Rather than looking outside of Rocky Flats, a comparison to subsurface soil background levels is appropriate since it is the major source of surface soil at Rocky Flats. When results of this sampling event is compared to both surface and subsurface background levels, only eleven samples remain with concentrations above those found in background samples. Only lead, magnesium, potassium, and zinc concentrations are higher than background, none are substantially higher.

Sample number	Lead 54.6 mg/kg	Magnesium 5,526 mg/kg	Potassium 3,227 mg/kg	Zinc 78.3 mg/kg
06SS011		6,000	5,300	
06SS012		5,700	4,400	83
06SS018	59			
06SS029			4,100	
06SS031			5,200	
06SS032			4,400	
06SS035	65			
06SS036			4,600	
06SS037			4,400	
06SS038			4,200	
06SS041		4,200	5,200	

Results of this study fall within the range of results in the DOE database, and on the whole are very similar in values.

4.1.3 Surface Soil - Semi-Volatiles Organic Compounds (SVOCs)

A subset of samples (half of the samples) was analyzed for additional suites of chemicals. One of those suites was for semi-volatile organic compounds (SVOCs). All SVOCs detected in surface soils were below the reporting limits set by the laboratory, as shown on Table 4-3, and therefore are estimated values. The SVOC contamination detected can easily be attributed to ubiquitous incomplete combustion products (from motor vehicles and other sources) and laboratory contamination. It would be nearly impossible to link the SVOC analyses to unregulated releases of hazardous substances to the environment. Concentrations of SVOCs found in this study were consistently lower than mean concentrations found in the DOE database and near the bottom of the range of values of the database.

4.1.4 Surface Soil – Polychlorinated Biphenyls (PCBs)

Polychlorinated Biphenyls (PCBs) were analyzed on the subset of samples by congener analysis rather than arochlor analysis so that if additional risk assessment needed to be done, it could be done on a congener specific method. Detected PCBs are presented in Table 4-4. The vast

majorities of PCBs detected were below the reporting limits and therefore estimated values. Two samples had PCBs above the reporting limits of the laboratory. Those samples 06SS026 and 06SS041 are both located downwind of the windblown area of the Rocky Flats cleanup site. They are also the sample locations with the highest Am241 and Pu 239/240 counts. All values of the PCB congener analysis were at the lower end of the method detection level. Overall, the concentrations of PCBs that were found would not increase risk levels substantially, however, some PCBs do have dioxin-like toxicity and are discussed in the following section.

4.1.5. Surface Soil – Polychlorinated Dibenzodioxins and Polychlorinated Dibenzofurans (Dioxin/Furans)

The subset of samples was also subjected to trace dioxin/furan analysis. There are a total of 75 dioxin congeners and 135 furan congeners. Each sample was analyzed for each individual dioxin and furan (congeners) that are thought to have dioxin-like toxicity, a total of 7 dioxin congeners and 10 furan congeners. Dioxins/furans are usually found in complex mixtures. Detected dioxin/furans are presented in Table 4-5. The combined equivalent toxicity resulting from the complex mixture of dioxin/furans can be calculated using toxic equivalency factors (TEFs) and assuming the toxicities are additive, giving a single toxic equivalency (TEQ) for the entire mixture. TEQs can be easily compared to each other. TEFs were assigned to each congener according to the RI/FS report and TEQs were calculated. Some PCB congeners will also exhibit dioxin-like toxicity and therefore have also been assigned TEFs to add to an overall TEQ. A study done by EPA (EPA, 2001) studied "ambient" dioxin/furan levels in the Denver metro area to determine the current background level of dioxin/furans. EPA found that about 2 parts per trillion (picogram of TEQ/gram of soil) is what can be considered background for open space and agricultural areas within the Denver metro area. The TEQs calculated for samples in this study are as follows:

Sample number	Dioxin-TEQ ug/g
06SS002	0.151
06SS003	0.303
06SS004	0.202
06SS005	0.105
06SS007	0.316
06SS011	0.328
06SS014	0.792
06SS015	0.144
06SS017	0.047
06SS018	1.228
06SS022	0.025
06SS024	0.385
06SS025	0.013
06SS026	1.991
06SS027	0.461
06SS028	0.941
06SS035	0.173
06SS036	0.070
06SS038	0.456
06SS041	1.823

Note that only three samples, 06SS018, 06SS026, and 06SS041 approach the background level, but no sample result exceeded that level. 06SS026 and 06SS041 are located downwind of the Industrial Area on Rocky Flats and 06SS018 is the sample that is closest to Highway 93. These locations are where it is expected to see some influence of dioxin due to, if nothing else, vehicle traffic. DOE's database contains results that range from 0.05 ug/g to 74 ug/g with a mean of 9ug/g.

4.1.6 Surface Soil – Pesticides

Very few of the subset of samples had detectable amounts of pesticides in them, as shown in Table 4-5. Those that were detected were below reportable limits and were therefore estimated. Only Azinphos-methyl was detected in sample 06SS026 above the reportable limit. An organophosphate insecticide first registered in 1959, azinphos-methyl is widely used in agriculture and provides important pest control benefits to growers of orchard fruit, nut, and other crops. The most frequent identified pesticide was naled, an organophosphate (OP) insecticide that has been registered since 1959 for use in the United States. It is used primarily for controlling adult mosquitoes, but naled is also used on food and feed crops, and in greenhouses. However, confirmatory column samples were not within acceptable range of relative percent difference, making the results questionable. It is also difficult to compare to DOE's database because many of the analyses that DOE performed were non-detected as well.

4.2 Vegetation

Vegetation samples were collected the week of May 8, 2006 as described in section 3.3.2 above and the SAP. Only radiological analyses were performed on the vegetation samples. All vegetation results were an order of magnitude less than comparable soil samples taken in the general area. Results are shown in Table 4-7.

4.2.1 Americium 241 (Am 241) results ranged from 0.0014 pCi/g in vegetation sample number three (06Veg003) to 0.2430 pCi/g in vegetation sample number eight (06Veg008). The RI/FS reports the average background plus two standard deviations concentration for Am 241 in surface soil as 0.022 pCi/g. The second highest vegetation sample value was vegetation sample number 9, at 0.0123 pCi/g. Arthur and Alldredge (1982) showed that much of the radioactivity from vegetation samples came from external particulate contamination on the plant, due to rain splash and dust deposition. Both vegetation samples 06Veg008 and 06Veg009 were located just beyond the exterior boundary of the windblown area, where higher levels of Americium activity would be expected. 06Veg008 is in an area that has higher soil contamination then anywhere else in the future refuge property, but at levels that are still lower than the preliminary remediation goals set forth in the RI/FS. Soil results in this area show soil Am 241 levels at around 5.2 pCi/g, so 06Veg008 is greater than an order of magnitude lower than the corresponding soil samples in the vicinity

4.2.2 Plutonium 239/240 (Pu 239/240) results ranged from 0.0038 pCi/g in 06Veg011 to 1.02 pCi/g in 06Veg008. The RI/FS reports the average background surface soil concentration plus two standards of deviation for Pu 239/240 as 0.066 pCi/g. Again, 06Veg009 had the second highest activity, behind 06Veg008, at an activity of 0.0448 pCi/g. Soil results in this wind blown

area show soil activity for Pu 239/240 at around 20 pCi/g, still more than a magnitude difference between the soil and the vegetation.

4.2.3 Uranium 234 (U 234) results ranged from 0.0228 pCi/g in 06Veg 001 to 0.165 pCi/g in 06Veg008. The RI/FS reports the average background surface soil concentration plus two standards of deviation for U 234 as 2.25 PCi/g. Sample 06Veg004 had the second highest activity of 0.0719 pCi/g for U 234.

4.2.4 Uranium 235/235 (U 235/236) results ranged from 0.0012 pCi/g in 06Veg007 to 0.0140 in 06Veg008. The RI/FS reports the average background surface soil activity plus two standard of deviation for U 235/236 as 0.095 pCi/g. Sample 06Veg004 had the second highest activity of 0.0068 pCi/g for U235/236.

4.2.5 Uranium 238 (U 238) results ranged from 0.0227 pCi/g in 06Veg011 to 0.181 pCi/g in 06Veg008. The RI/FS reports the average background surface soil activity plus two standards of deviation for U 238 as 2.00 pCi/g. Sample 06Veg008 was collected in the wind blown area of the eastern buffer zone. Sample 06Veg004 had the second highest activity of 0.0742 pCi/g for U 238.

5.0 Conclusions

The purpose of the modified Level III Preacquisition Environmental Contaminants Survey was to meet the goals to the preacquisition survey process. In particular, the first objective was to identify potential hazardous substance-related threats to fish, wildlife, their habitats, and other environmental problems prior to real property acquisition. The second objective is to determine if hazardous substances were present on the real property or that there were effects of such hazardous substances present at the site, and extensive work was required to determine the extent of any hazardous substance, obtain an estimate of the remediation or other cleanup costs, and determine whether reprogramming was required (USFWS, 1996). The review of the data collected by DOE and their contractors and stored in the RI-ready database showed that the database used for the Remedial Investigation was of adequate quality to make determinations on the clean up process and the comprehensive risk assessment. The Service was included in the comprehensive risk assessment workgroup and was presented the opportunity, along with the US EPA and CDPHE to comment on the development and assumptions used in the risk assessment. The comprehensive risk assessment was conservative enough in its assumptions that clean up work that was completed by DOE and its contractor, for all receptors at the Rocky Flats NWR, are protective of human health and the environment in the Peripheral OU. Supplementary/confirmatory sampling done by Service personnel supported the database used by DOE and its contractor and the CRA. Service sampling results were, although not always at or below background levels, well within the range of results that DOE presented in their RI-ready database.

It is important for refuge staff or regional office staff to review any and all environmental monitoring data that will be collected by DOE or its contractor after the Peripheral OU is transferred to the Service. This monitoring will be an early indicator of any problems occurring in the Central OU that may have an impact on the Refuge property. In addition, land form

monitoring for erosion and slumping is another aspect that needs to be reviewed by Service staff. Remaining contamination in the Central OU is below three of soil, but may be brought to the surface by erosion or slumping of slopes.

Another concern is that there is no literature in the scientific journals that follows the long-term chronic exposure to low-level radiation, in particular over several generations. Because of this unknown, it is imperative that the refuge staff pay attention to the reproductive success of wildlife on the Refuge and note any unusual diseases, tumors, or malformations during normal operations on the Refuge. If literature is produced that resolves some of these unknowns, less attention can be paid to the above mentioned issues.

Note: Primary jurisdiction for the Central OU 1300 acres will be retained by DOE and will not be included in this survey. If, in the future, the Service contemplates taking some type of responsibility with the DOE retained area, an additional Preacquisition Survey should be completed.

6.0 References

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7.0 Certification

The surveyed real property or a portion thereof, contains hazardous substances or other environmental problems as determined by the environmental site assessment. The owner of that real estate has cleaned up the hazardous substances or other environmental problems to bureau specifications (As presented in the RI/FS report). No further investigation is required. Reprogramming of funds will not be required for the remediation or other cleanup costs for this property.

Signed _____ Print Name R. Mark Sattelberg

Date _____ Title Supervisory Fish and Wildlife Biologist

7.1 Reprogramming

Because the cost estimate of potential remediation, other cleanup costs, or monetary damages are non-existent for the Service, no reprogramming of budget is required.

7.2 Review and Concurrence

_____ _____
Steve Berendzen, RMA Refuge Manager Date

_____ _____
Larry Gamble, R6 Contaminants Coordinator Date

7.3 Approval

_____ _____
Mitch King, R6 Regional Director Date

Figure 1 - General Location of Rocky flats

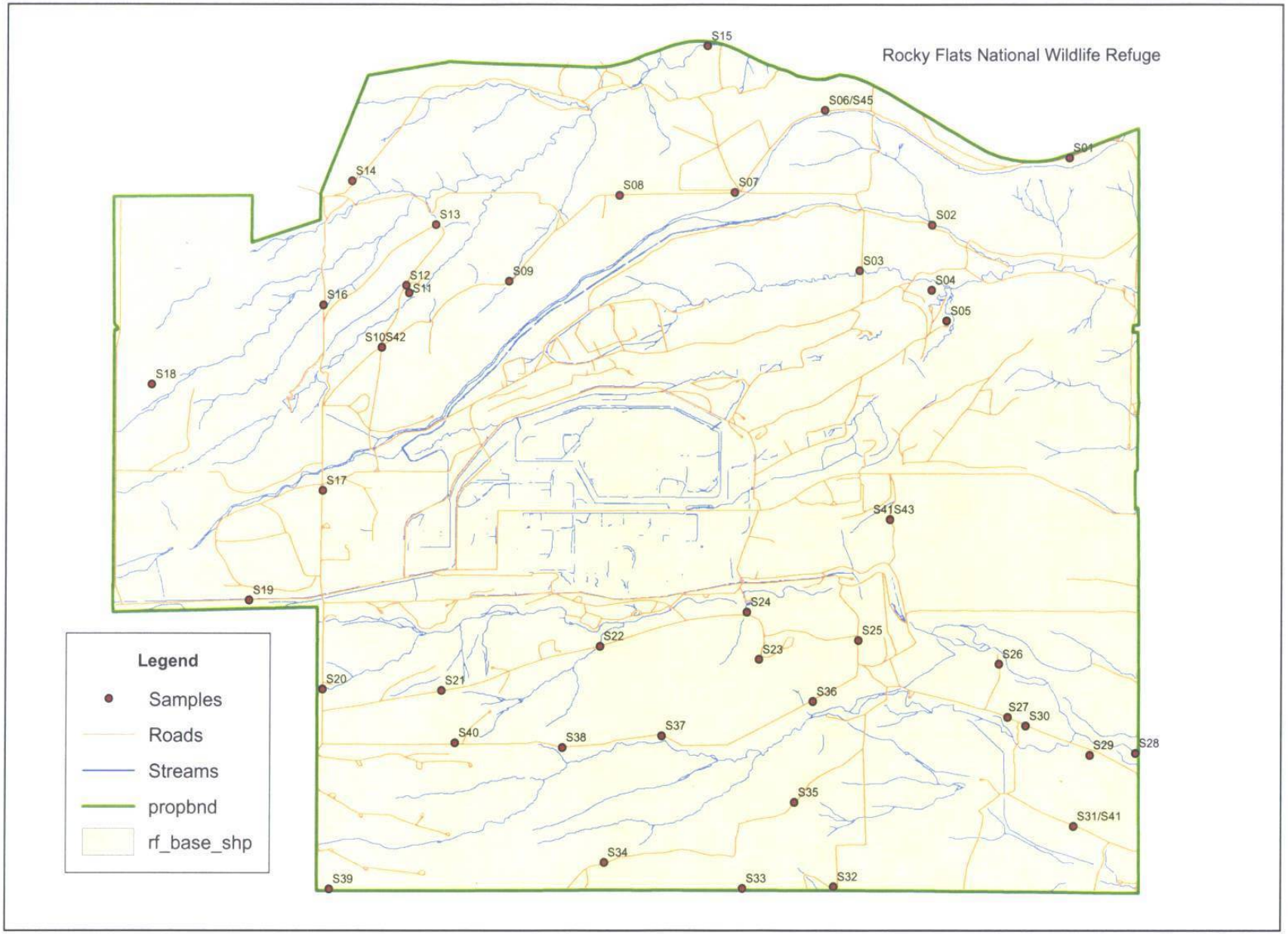

Figure 2 - Level 3 Contaminant Sampling -- Surface Soils.

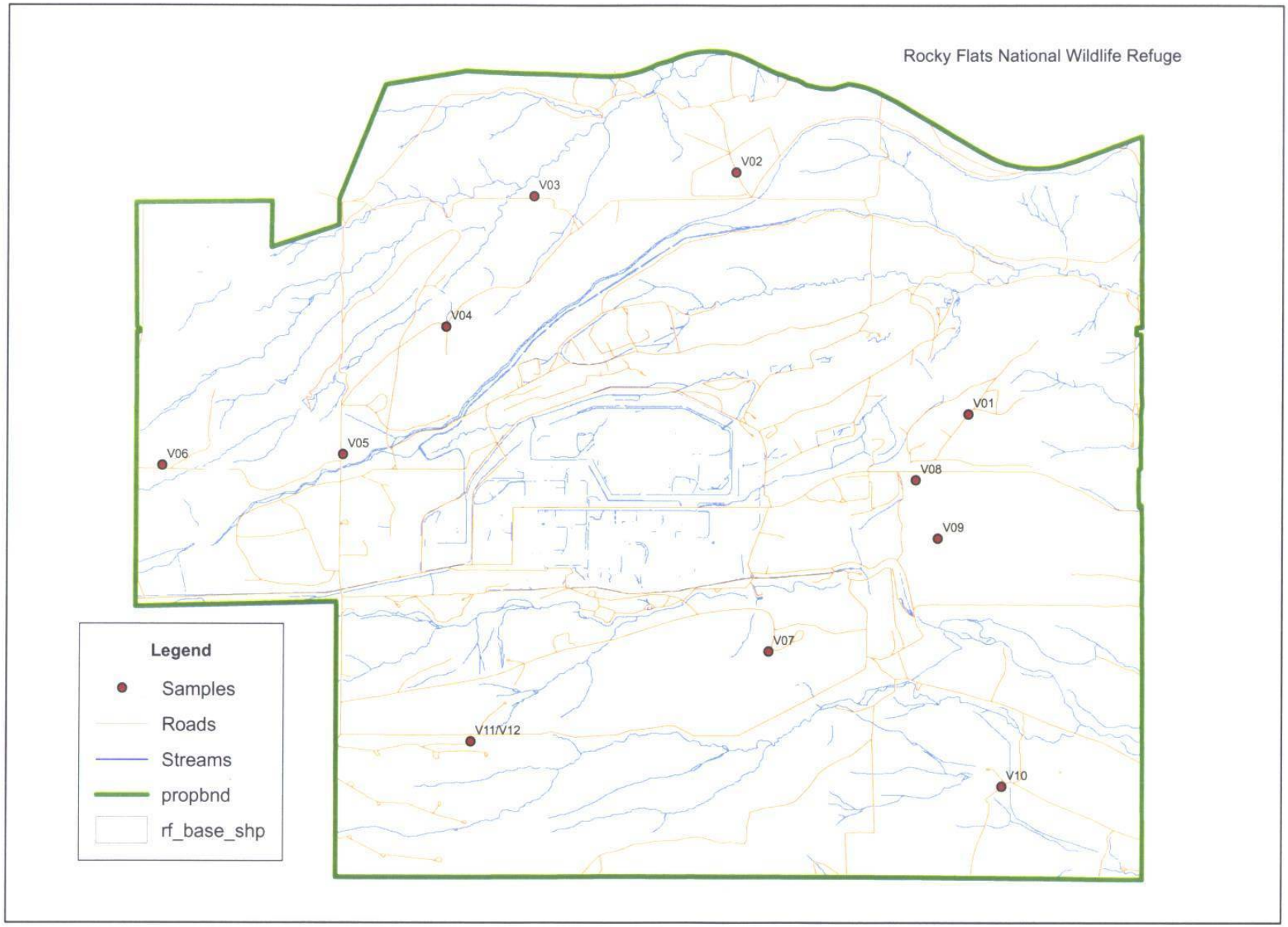

Figure 3 - Level 3 Contaminant Sampling -- Vegetation.

Table 4.1 – Surface Soil Data – Radiochemistry

Client Sample ID: 06 SS 001

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC
Americium 241	**0.0131**		**0.0094**	**0.0100**	**0.012**
Plutonium 238	0.0019	U	0.0051	0.0100	0.0091
Plutonium 239/40	**0.0279**		**0.0081**	**0.0100**	**0.0013**
Uranium 234	**0.700**		**0.095**	**0.010**	**0.003**
Uranium 235/236	**0.029**		**0.013**	**0.010**	**0.004**
Uranium 238	**0.628**		**0.087**	**0.010**	**0.010**

Client Sample ID: 06 SS 001 DUP

Americium 241	0.012	U	0.014	0.010	0.023
Plutonium 238	0.0028	U	0.0036	0.0100	0.0059
Plutonium 239/40	**0.0185**		**0.0059**	**0.0100**	**0.0011**
Uranium 234	**0.637**		**0.088**	**0.010**	**0.008**
Uranium 235/236	**0.040**		**0.016**	**0.010**	**0.004**
Uranium 238	**0.593**		**0.083**	**0.010**	**0.003**

Client Sample ID: 06 SS 002

Americium 241	0.002	U	0.013	0.010	0.023
Plutonium 238	0.0004	U	0.0039	0.0100	0.0074
Plutonium 239/40	0.0018	U	0.0022	0.0100	0.0033
Uranium 234	**0.75**		**0.10**	**0.01**	**0.008**
Uranium 235/236	**0.028**		**0.013**	**0.010**	**0.004**
Uranium 238	**0.721**		**0.098**	**0.010**	**0.008**

Client Sample ID: 06 SS 003

Americium 241	0.002	U	0.013	0.010	0.023
Plutonium 238	0.0043	U	0.0037	0.0100	0.0051
Plutonium 239/40	**0.0167**		**0.0057**	**0.0100**	**0.0012**
Uranium 234	**0.95**		**0.12**	**0.01**	**0.008**
Uranium 235/236	**0.063**		**0.020**	**0.010**	**0.004**
Uranium 238	**0.89**		**0.12**	**0.01**	**0.003**

Client Sample ID: 06 SS 004

Americium 241	0.009	U	0.013	0.010	0.022
Plutonium 238	0.0005	U	0.0036	0.0100	0.0071
Plutonium 239/40	**0.0370**		**0.0098**	**0.0100**	**0.0037**
Uranium 234	**0.86**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.054**		**0.019**	**0.010**	**0.010**
Uranium 238	**0.76**		**0.10**	**0.01**	**0.01**

Client Sample ID: 06 SS 005

Americium 241	0.009	U	0.011	0.010	0.019
Plutonium 238	0.0036	U	0.0039	0.0100	0.0060
Plutonium 239/40	**0.0362**		**0.0087**	**0.0100**	**0.0030**
Uranium 234	**0.80**		**0.11**	**0.01**	**0.008**
Uranium 235/236	**0.049**		**0.017**	**0.010**	**0.004**
Uranium 238	**0.84**		**0.11**	**0.01**	**0.003**

Client Sample ID: 06 SS 006

Americium 241	0.009	U	0.013	0.010	0.021
Plutonium 238	0.0008	U	0.0026	0.0100	0.0049
Plutonium 239/40	**0.0276**		**0.0074**	**0.0100**	**0.0011**
Uranium 234	**0.661**		**0.091**	**0.010**	**0.01**
Uranium 235/236	**0.049**		**0.017**	**0.010**	**0.01**
Uranium 238	**0.743**		**0.0997**	**0.0100**	**0.0079**

Client Sample ID: 06 SS 007

Americium 241	0.012	U	0.016	0.010	0.026
Plutonium 238	0.0022	U	0.0037	0.0100	0.0063
Plutonium 239/40	**0.0231**		**0.0072**	**0.0100**	**0.0041**
Uranium 234	**0.665**		**0.091**	**0.010**	**0.012**
Uranium 235/236	**0.025**		**0.014**	**0.010**	**0.014**
Uranium 238	**0.678**		**0.092**	**0.010**	**0.008**

Client Sample ID: 06 SS 008

Americium 241	0.009	U	0.013	0.010	0.022
Plutonium 238	-0.0008	U	0.0025	0.0100	0.0056
Plutonium 239/40	**0.0096**	**J**	**0.0042**	**0.0100**	**0.0029**
Uranium 234	**0.684**		**0.094**	**0.010**	**0.016**
Uranium 235/236	**0.021**		**0.012**	**0.010**	**0.010**
Uranium 238	**0.722**		**0.098**	**0.010**	**0.008**

Client Sample ID: 06 SS 009

Americium 241	0.004	U	0.016	0.010	0.029
Plutonium 238	0.0016	U	0.0025	0.0100	0.0043
Plutonium 239/40	**0.0163**		**0.0058**	**0.0100**	**0.0043**
Uranium 234	**0.709**		**0.096**	**0.010**	**0.008**
Uranium 235/236	**0.040**		**0.016**	**0.010**	**0.004**
Uranium 238	**0.736**		**0.099**	**0.010**	**0.012**

Client Sample ID: 06 SS 010

Americium 241	0.0063	U	0.0089	0.0100	0.015
Plutonium 238	0.0060	U	0.0046	0.0100	0.0061
Plutonium 239/40	**0.0222**		**0.0072**	**0.0100**	**0.0014**
Uranium 234	**0.630**		**0.086**	**0.010**	**0.011**
Uranium 235/236	**0.041**		**0.015**	**0.010**	**0.009**
Uranium 238	**0.732**		**0.097**	**0.010**	**0.009**

Client Sample ID: 06 SS 011

Americium 241	0.004	U	0.010	0.010	0.018
Plutonium 238	0.0012	U	0.0034	0.0100	0.0061
Plutonium 239/40	**0.0139**		**0.0054**	**0.0100**	**0.0044**
Uranium 234	**0.88**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.075**		**0.022**	**0.010**	**0.012**
Uranium 238	**0.92**		**0.12**	**0.01**	**0.003**

Client Sample ID: 06 SS 012

Americium 241	0.010	U	0.012	0.010	0.019
Plutonium 238	0.0055	U	0.0049	0.0100	0.0074
Plutonium 239/40	**0.0089**	**J**	**0.0045**	**0.0100**	**0.0046**
Uranium 234	**0.95**		**0.12**	**0.01**	**0.009**
Uranium 235/236	**0.044**		**0.017**	**0.010**	**0.011**
Uranium 238	**0.99**		**0.13**	**0.01**	**0.01**

Client Sample ID: 06 SS 013

Americium 241	**0.019**		**0.012**	**0.010**	**0.014**
Plutonium 238	0.0020	U	0.0040	0.0100	0.0070
Plutonium 239/40	**0.0155**		**0.0060**	**0.0100**	**0.0037**
Uranium 234	**0.86**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.036**		**0.014**	**0.010**	**0.003**
Uranium 238	**0.89**		**0.12**	**0.01**	**0.01**

Client Sample ID: 06 SS 014

Americium 241	0.015	U	0.014	0.010	0.021
Plutonium 238	0.0008	U	0.0031	0.0100	0.0058
Plutonium 239/40	**0.0456**		**0.00996**	**0.0100**	**0.0036**
Uranium 234	**0.736**		**0.099**	**0.010**	**0.012**
Uranium 235/236	**0.027**		**0.013**	**0.010**	**0.01**
Uranium 238	**0.691**		**0.094**	**0.010**	**0.008**

Client Sample ID: 06 SS 015

Americium 241	0.010	U	0.015	0.010	0.025
Plutonium 238	-0.0019	U	0.0028	0.0100	0.0065
Plutonium 239/40	**0.0148**		**0.0051**	**0.0100**	**0.0011**
Uranium 234	**0.75**		**0.10**	**0.01**	**0.01**
Uranium 235/236	**0.042**		**0.016**	**0.010**	**0.004**
Uranium 238	**0.78**		**0.10**	**0.01**	**0.01**

Client Sample ID: 06 SS 016

Americium 241	0.005	U	0.011	0.010	0.019
Plutonium 238	0.0031	U	0.0032	0.0100	0.0048
Plutonium 239/40	**0.0040**	**J**	**0.0028**	**0.0100**	**0.0012**

Uranium 234	**0.615**		**0.086**	**0.010**	**0.008**
Uranium 235/236	**0.054**		**0.019**	**0.010**	**0.004**
Uranium 238	**0.654**		**0.091**	**0.010**	**0.003**

Client Sample ID: 06 SS 017

Americium 241	0.006	U	0.011	0.010	0.020
Plutonium 238	0.0014	U	0.0035	0.0100	0.0064
Plutonium 239/40	**0.0059**	**J**	**0.0036**	**0.0100**	**0.0033**
Uranium 234	**0.684**		**0.095**	**0.010**	**0.003**
Uranium 235/236	**0.032**		**0.014**	**0.010**	**0.004**
Uranium 238	**0.646**		**0.091**	**0.010**	**0.003**

Client Sample ID: 06 SS 018

Americium 241	**0.040**		**0.018**	**0.010**	**0.021**
Plutonium 238	**0.0099**	**J**	**0.0045**	**0.0100**	**0.0043**
Plutonium 239/40	**0.182**		**0.027**	**0.010**	**0.004**
Uranium 234	**0.712**		**0.098**	**0.010**	**0.008**
Uranium 235/236	**0.041**		**0.016**	**0.010**	**0.004**
Uranium 238	**0.73**		**0.10**	**0.01**	**0.003**

Client Sample ID: 06 SS 019

Americium 241	0.013	U	0.012	0.010	0.017
Plutonium 238	0.0022	U	0.0027	0.0100	0.0042
Plutonium 239/40	0.0027	U	0.0028	0.0100	0.0042
Uranium 234	**0.73**		**0.10**	**0.01**	**0.009**
Uranium 235/236	**0.042**		**0.017**	**0.010**	**0.004**
Uranium 238	**0.73**		**0.10**	**0.01**	**0.009**

Client Sample ID: 06 SS 020

Americium 241	0.0059	U	0.0071	0.0100	0.011
Plutonium 238	0.0033	U	0.0035	0.0100	0.0053
Plutonium 239/40	**0.0053**	**J**	**0.0036**	**0.0100**	**0.0044**
Uranium 234	**0.84**		**0.11**	**0.01**	**0.008**
Uranium 235/236	**0.041**		**0.016**	**0.010**	**0.004**
Uranium 238	**0.89**		**0.12**	**0.01**	**0.008**

Client Sample ID: 06 SS 021

Americium 241	**0.0144**		**0.0089**	**0.0100**	**0.0096**
Plutonium 238	-0.0020	U	0.0066	0.0100	0.013
Plutonium 239/40	0.0072	U	0.0053	0.0100	0.0072
Uranium 234	**0.82**		**0.11**	**0.01**	**0.003**
Uranium 235/236	**0.051**		**0.020**	**0.010**	**0.015**
Uranium 238	**0.87**		**0.12**	**0.01**	**0.003**

Client Sample ID: 06 SS 022

Americium 241	-0.0024	U	0.0067	0.0100	0.016
Plutonium 238	0.017	U	0.012	0.010	0.017
Plutonium 239/40	**0.0098**	**J**	**0.0060**	**0.0100**	**0.0056**
Uranium 234	**0.73**		**0.10**	**0.01**	**0.003**
Uranium 235/236	**0.037**		**0.016**	**0.010**	**0.004**
Uranium 238	**0.78**		**0.11**	**0.01**	**0.01**

Client Sample ID: 06 SS 023

Americium 241	**0.027**		**0.016**	**0.010**	**0.021**
Plutonium 238	0.0010	U	0.0068	0.0100	0.012
Plutonium 239/40	**0.083**		**0.016**	**0.010**	**0.005**
Uranium 234	**0.651**		**0.093**	**0.010**	**0.012**
Uranium 235/236	**0.038**		**0.017**	**0.010**	**0.012**
Uranium 238	**0.77**		**0.11**	**0.01**	**0.01**

Client Sample ID: 06 SS 024

Americium 241	**0.219**		**0.041**	**0.010**	**0.016**
Plutonium 238	**0.0186**		**0.0081**	**0.0100**	**0.0094**
Plutonium 239/40	**1.11**		**0.14**	**0.01**	**0.005**
Uranium 234	**0.689**		**0.098**	**0.010**	**0.015**
Uranium 235/236	**0.033**		**0.016**	**0.010**	**0.015**
Uranium 238	**0.73**		**0.10**	**0.01**	**0.003**

Client Sample ID: 06 SS 025

Americium 241	0.014	U	0.011	0.010	0.014
Plutonium 238	0.0038	U	0.0064	0.0100	0.011
Plutonium 239/40	**0.060**		**0.013**	**0.010**	**0.001**
Uranium 234	**0.84**		**0.11**	**0.01**	**0.02**
Uranium 235/236	**0.047**		**0.018**	**0.010**	**0.011**
Uranium 238	**0.89**		**0.12**	**0.01**	**0.02**

Client Sample ID: 06 SS 026

Americium 241	**0.369**		**0.061**	**0.010**	**0.019**
Plutonium 238	**0.030**		**0.010**	**0.010**	**0.011**
Plutonium 239/40	**1.82**		**0.22**	**0.01**	**0.001**
Uranium 234	**0.82**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.056**		**0.020**	**0.010**	**0.014**
Uranium 238	**0.84**		**0.11**	**0.01**	**0.01**

Client Sample ID: 06 SS 027

Americium 241	**0.027**		**0.014**	**0.010**	**0.017**
Plutonium 238	0.0031	U	0.0086	0.0100	0.015
Plutonium 239/40	**0.111**		**0.022**	**0.010**	**0.01**
Uranium 234	**0.79**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.049**		**0.018**	**0.010**	**0.011**
Uranium 238	**0.85**		**0.11**	**0.01**	**0.003**

Client Sample ID: 06 SS 028

Americium 241	**0.249**		**0.046**	**0.010**	**0.014**
Plutonium 238	**0.0160**		**0.0065**	**0.0100**	**0.0058**
Plutonium 239/40	**0.87**		**0.11**	**0.01**	**0.004**
Uranium 234	**1.14**		**0.15**	**0.01**	**0.003**
Uranium 235/236	**0.050**		**0.018**	**0.010**	**0.004**
Uranium 238	**1.15**		**0.15**	**0.01**	**0.009**

Client Sample ID: 06 SS 029

Americium 241	**0.046**		**0.016**	**0.010**	**0.010**
Plutonium 238	0.0062	U	0.0051	0.0100	0.0075
Plutonium 239/40	**0.238**		**0.034**	**0.010**	**0.003**
Uranium 234	**0.84**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.042**		**0.017**	**0.010**	**0.011**
Uranium 238	**0.89**		**0.12**	**0.01**	**0.009**

Client Sample ID: 06 SS 030

Americium 241	**0.049**		**0.017**	**0.010**	**0.012**
Plutonium 238	0.0033	U	0.0072	0.0100	0.013
Plutonium 239/40	**0.199**		**0.034**	**0.010**	**0.009**
Uranium 234	**0.657**		**0.094**	**0.010**	**0.009**
Uranium 235/236	**0.043**		**0.017**	**0.010**	**0.004**
Uranium 238	**0.74**		**0.10**	**0.01**	**0.009**

Client Sample ID: 06 SS 031

Americium 241	0.0102	U	0.0087	0.0100	0.012
Plutonium 238	0.0066	U	0.0074	0.0100	0.012
Plutonium 239/40	**0.0241**		**0.0087**	**0.0100**	**0.0065**
Uranium 234	**0.82**		**0.11**	**0.01**	**0.02**
Uranium 235/236	**0.034**		**0.015**	**0.010**	**0.004**
Uranium 238	**0.87**		**0.12**	**0.01**	**0.02**

Client Sample ID: 06 SS 032

Americium 241	0.0087	U	0.0093	0.0100	0.014
Plutonium 238	**0.0126**		**0.0078**	**0.0100**	**0.011**
Plutonium 239/40	**0.0175**		**0.0070**	**0.0100**	**0.0059**
Uranium 234	**0.640**		**0.091**	**0.010**	**0.012**
Uranium 235/236	**0.028**		**0.014**	**0.010**	**0.011**
Uranium 238	**0.73**		**0.10**	**0.01**	**0.01**

Client Sample ID: 06 SS 033

Americium 241	**0.026**		**0.012**	**0.010**	**0.011**
Plutonium 238	0.0042	U	0.0068	0.0100	0.011
Plutonium 239/40	**0.124**		**0.022**	**0.010**	**0.006**

Uranium 234	**0.576**		**0.084**	**0.010**	**0.009**
Uranium 235/236	**0.036**		**0.017**	**0.010**	**0.017**
Uranium 238	**0.655**		**0.093**	**0.010**	**0.012**

Client Sample ID: 06 SS 034

Americium 241	**0.0167**		**0.0094**	**0.0100**	**0.0082**
Plutonium 238	0.0028	U	0.0055	0.0100	0.0096
Plutonium 239/40	**0.0245**		**0.0075**	**0.0100**	**0.0043**
Uranium 234	**0.510**		**0.075**	**0.010**	**0.011**
Uranium 235/236	0.019	U	0.015	0.010	0.020
Uranium 238	**0.479**		**0.072**	**0.010**	**0.016**

Client Sample ID: 06 SS 035

Americium 241	**0.044**		**0.016**	**0.010**	**0.013**
Plutonium 238	0.0014	U	0.0039	0.0100	0.0070
Plutonium 239/40	**0.116**		**0.020**	**0.010**	**0.004**
Uranium 234	**0.80**		**0.11**	**0.01**	**0.02**
Uranium 235/236	**0.030**		**0.017**	**0.010**	**0.018**
Uranium 238	**0.79**		**0.11**	**0.01**	**0.004**

Client Sample ID: 06 SS 036

Americium 241	0.013	U	0.011	0.010	0.017
Plutonium 238	0.0083	U	0.0080	0.0100	0.012
Plutonium 239/40	**0.0248**		**0.0090**	**0.0100**	**0.0068**
Uranium 234	**0.79**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.039**		**0.017**	**0.010**	**0.012**
Uranium 238	**0.89**		**0.12**	**0.01**	**0.01**

Client Sample ID: 06 SS 037

Americium 241	**0.0176**		**0.0095**	**0.0100**	**0.0081**
Plutonium 238	0.0028	U	0.0047	0.0100	0.0080
Plutonium 239/40	0.0069	U	0.0050	0.0100	0.0069
Uranium 234	**0.77**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.058**		**0.021**	**0.010**	**0.012**
Uranium 238	**0.90**		**0.12**	**0.01**	**0.003**

Client Sample ID: 06 SS 038

Americium 241	**0.015**		**0.011**	**0.010**	**0.013**
Plutonium 238	-0.0036	U	0.0061	0.0100	0.012
Plutonium 239/40	**0.0145**		**0.0074**	**0.0100**	**0.0079**
Uranium 234	**0.73**		**0.10**	**0.01**	**0.02**
Uranium 235/236	**0.039**		**0.016**	**0.010**	**0.004**
Uranium 238	**0.76**		**0.10**	**0.01**	**0.009**

Client Sample ID: 06 SS 039

Americium 241	**0.028**		**0.015**	**0.010**	**0.018**
Plutonium 238	0.0055	U	0.0053	0.0100	0.0080
Plutonium 239/40	**0.053**		**0.012**	**0.010**	**0.001**
Uranium 234	**0.80**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.038**		**0.018**	**0.010**	**0.013**
Uranium 238	**0.76**		**0.11**	**0.01**	**0.01**

Client Sample ID: 06 SS 040

Americium 241	0.01	U	0.012	0.010	0.019
Plutonium 238	0.0056	U	0.0061	0.0100	0.0096
Plutonium 239/40	**0.0235**		**0.0076**	**0.0100**	**0.0038**
Uranium 234	**0.76**		**0.11**	**0.01**	**0.01**
Uranium 235/236	**0.045**		**0.019**	**0.010**	**0.015**
Uranium 238	**0.75**		**0.11**	**0.01**	**0.01**

Client Sample ID: 06 SS 041

Americium 241	**4.70**		**0.57**	**0.01**	**0.02**
Plutonium 238	**0.315**		**0.060**	**0.010**	**0.021**
Plutonium 239/40	**19.6**		**2.2**	**0.01**	**0.01**
Uranium 234	**1.40**		**0.18**	**0.01**	**0.02**
Uranium 235/236	**0.083**		**0.024**	**0.010**	**0.013**
Uranium 238	**1.43**		**0.18**	**0.01**	**0.003**

Client Sample ID: 06 SS 042

Americium 241	0.0048	U	0.0085	0.0100	0.015
Plutonium 238	0.01	U	0.018	0.010	0.030
Plutonium 239/40	**0.027**		**0.016**	**0.010**	**0.014**
Uranium 234	**0.78**		**0.11**	**0.01**	**0.02**
Uranium 235/236	**0.047**		**0.018**	**0.010**	**0.014**
Uranium 238	**0.84**		**0.11**	**0.01**	**0.003**

Client Sample ID: 06 SS 043

Americium 241	**4.58**		**0.57**	**0.01**	**0.02**
Plutonium 238	**0.303**		**0.059**	**0.010**	**0.027**
Plutonium 239/40	**17.8**		**2.0**	**0.01**	**0.005**
Uranium 234	**1.18**		**0.15**	**0.01**	**0.01**
Uranium 235/236	**0.073**		**0.024**	**0.010**	**0.017**
Uranium 238	**1.19**		**0.15**	**0.01**	**0.009**

Client Sample ID: 06 SS 044

Americium 241	**0.024**		**0.015**	**0.010**	**0.018**
Plutonium 238	0.0019	U	0.0057	0.0100	0.0095
Plutonium 239/40	**0.042**		**0.011**	**0.010**	**0.005**

Uranium 234	**0.90**		**0.12**	**0.01**	**0.003**
Uranium 235/236	**0.051**		**0.020**	**0.010**	**0.014**
Uranium 238	**0.97**		**0.13**	**0.01**	**0.003**

Client Sample ID: 06 SS 045

Americium 241	0.011	U	0.014	0.010	0.023
Plutonium 238	0.0043	U	0.0058	0.0100	0.0090
Plutonium 239/40	**0.0336**		**0.0095**	**0.0100**	**0.0042**
Uranium 234	**0.73**		**0.10**	**0.01**	**0.01**
Uranium 235/236	**0.039**		**0.016**	**0.010**	**0.011**
Uranium 238	**0.77**		**0.11**	**0.01**	**0.01**

NOTE(S)

Data are incomplete without the case narrative.

MDC is determined by instrument performance only.
Bold results are greater than the MDC

J Result is greater than sample detection limit but less than stated reporting limit.

U Result is less than the sample detection limit.

Table 4.2 – Surface Soil Data – Metals

Client Sample ID: 06 SS 001

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Aluminum	11000	10	mg/kg
Arsenic	5.6	1.0	mg/kg
Barium	100	1.0	mg/kg
Beryllium	0.63	0.52	mg/kg
Cadmium	0.51 B	0.52	mg/kg
Calcium	7700	21	mg/kg
Chromium	13	1.0	mg/kg
Cobalt	4.9	1.0	mg/kg
Copper	18	2.1	mg/kg
Iron	11000	10	mg/kg
Lead	22	0.84	mg/kg
Magnesium	2200	21	mg/kg
Manganese	230	1.0	mg/kg
Nickel	10	4.2	mg/kg
Potassium	2700	310	mg/kg
Sodium	64 B	520	mg/kg
Vanadium	24	2.1	mg/kg
Zinc	49 J	2.1	mg/kg
Mercury	0.022 B	0.035	mg/kg

Client Sample ID: 06 SS 002

Aluminum	11000	11	mg/kg
Arsenic	5.3	1.1	mg/kg
Barium	170	1.1	mg/kg
Beryllium	0.66	0.53	mg/kg
Cadmium	0.52 B	0.53	mg/kg
Chromium	12	1.1	mg/kg
Cobalt	6.6	1.1	mg/kg
Copper	14	2.1	mg/kg

Iron	13000	11	mg/kg
Lead	15	0.86	mg/kg
Magnesium	2300	21	mg/kg
Manganese	230	1.1	mg/kg
Nickel	13	4.3	mg/kg
Potassium	2600	320	mg/kg
Vanadium	29	2.1	mg/kg
Zinc	54 J	2.1	mg/kg
Mercury	0.022 B	0.035	mg/kg

Client Sample ID: 06 SS 003

Aluminum	11000	11	mg/kg
Arsenic	5.4	1.1	mg/kg
Barium	110	1.1	mg/kg
Beryllium	0.68	0.55	mg/kg
Cadmium	0.52 B	0.55	mg/kg
Calcium	3600	22	mg/kg
Chromium	14	1.1	mg/kg
Cobalt	5.9	1.1	mg/kg
Copper	12	2.2	mg/kg
Iron	12000	11	mg/kg
Lead	15	0.89	mg/kg
Magnesium	2000	22	mg/kg
Manganese	210	1.1	mg/kg
Nickel	11	4.4	mg/kg
Potassium	2300	330	mg/kg
Vanadium	30	2.2	mg/kg
Zinc	43 J	2.2	mg/kg
Mercury	0.028 B	0.037	mg/kg

Client Sample ID: 06 SS 004

Aluminum	13000	11	mg/kg
Antimony	0.46 B	1.1	mg/kg

Arsenic	9.7	1.1	mg/kg
Barium	88	1.1	mg/kg
Beryllium	0.88	0.53	mg/kg
Cadmium	1.0	0.53	mg/kg
Calcium	2500	21	mg/kg
Chromium	15	1.1	mg/kg
Cobalt	8.3	1.1	mg/kg
Copper	16	2.1	mg/kg
Iron	24000	11	mg/kg
Lead	26	0.84	mg/kg
Magnesium	2400	21	mg/kg
Manganese	420	1.1	mg/kg
Nickel	17	4.2	mg/kg
Potassium	3200	320	mg/kg
Vanadium	47	2.1	mg/kg
Zinc	63 J	2.1	mg/kg
Mercury	0.022 B	0.035	mg/kg

Client Sample ID: 06 SS 005

Aluminum	16000	11	mg/kg
Arsenic	6.4	1.1	mg/kg
Barium	140	1.1	mg/kg
Beryllium	0.87	0.53	mg/kg
Cadmium	0.74	0.53	mg/kg
Calcium	3600	21	mg/kg
Chromium	17	1.1	mg/kg
Cobalt	7.0	1.1	mg/kg
Copper	17	2.1	mg/kg
Iron	15000	11	mg/kg
Lead	24	0.85	mg/kg
Magnesium	2900	21	mg/kg
Manganese	230	1.1	mg/kg
Nickel	15	4.2	mg/kg
Potassium	3800	320	mg/kg
Tin	1.3 B,J	11	mg/kg
Vanadium	43	2.1	mg/kg
Zinc	67 J	2.1	mg/kg
Mercury	0.022 B	0.035	mg/kg

Client Sample ID: 06 SS 006

Aluminum	13000	11	mg/kg
Arsenic	7.0	1.1	mg/kg
Barium	130	1.1	mg/kg
Beryllium	0.73	0.54	mg/kg
Cadmium	0.68	0.54	mg/kg
Calcium	3700	21	mg/kg
Chromium	15	1.1	mg/kg
Cobalt	7.3	1.1	mg/kg
Copper	15	2.1	mg/kg
Iron	13000	11	mg/kg
Lead	31	0.86	mg/kg
Magnesium	2300	21	mg/kg
Manganese	310	1.1	mg/kg
Nickel	12	4.3	mg/kg
Potassium	3400	320	mg/kg
Tin	1.0 B,J	11	mg/kg
Vanadium	33	2.1	mg/kg
Zinc	49 J	2.1	mg/kg
Mercury	0.029 B	0.035	mg/kg

Client Sample ID: 06 SS 007

Aluminum	15000	11	mg/kg
Arsenic	7.9	1.1	mg/kg
Barium	110	1.1	mg/kg
Beryllium	0.72	0.54	mg/kg
Cadmium	0.68	0.54	mg/kg
Calcium	4000	22	mg/kg
Chromium	16	1.1	mg/kg
Cobalt	5.9	1.1	mg/kg
Copper	15	2.2	mg/kg
Iron	14000	11	mg/kg
Lead	26	0.87	mg/kg
Magnesium	2500	22	mg/kg

Manganese	260	1.1	mg/kg
Nickel	13	4.3	mg/kg
Potassium	3800	330	mg/kg
Sodium	84 B	540	mg/kg
Tin	1.1 B,J	11	mg/kg
Vanadium	35	2.2	mg/kg
Zinc	48 J	2.2	mg/kg
Mercury	0.029 B	0.036	mg/kg

Client Sample ID: 06 SS 008

Aluminum	12000	10	mg/kg
Arsenic	7.4	1.0	mg/kg
Barium	78	1.0	mg/kg
Beryllium	0.69	0.52	mg/kg
Cadmium	0.39 B	0.52	mg/kg
Calcium	1500	21	mg/kg
Chromium	14	1.0	mg/kg
Cobalt	5.5	1.0	mg/kg
Copper	9.2	2.1	mg/kg
Iron	13000	10	mg/kg
Lead	14	0.84	mg/kg
Magnesium	1600	21	mg/kg
Manganese	190	1.0	mg/kg
Nickel	10	4.2	mg/kg
Potassium	2300	310	mg/kg
Vanadium	31	2.1	mg/kg
Zinc	32 J	2.1	mg/kg
Mercury	0.017 B	0.035	mg/kg

Client Sample ID: 06 SS 009

Aluminum	8300	10	mg/kg
Arsenic	5.2	1.0	mg/kg
Barium	69	1.0	mg/kg
Beryllium	0.45 B	0.52	mg/kg

Cadmium	0.39 B	0.52	mg/kg
Calcium	1300	21	mg/kg
Chromium	9.5	1.0	mg/kg
Cobalt	4.3	1.0	mg/kg
Copper	8.1	2.1	mg/kg
Iron	8900	10	mg/kg
Lead	15	0.84	mg/kg
Magnesium	1200	21	mg/kg
Manganese	200	1.0	mg/kg
Nickel	7.4	4.2	mg/kg
Potassium	1700	310	mg/kg
Vanadium	21	2.1	mg/kg
Zinc	26 J	2.1	mg/kg
Mercury	0.016 B	0.034	mg/kg

Client Sample ID: 06 SS 010

Aluminum	9400	11	mg/kg
Arsenic	6.1	1.1	mg/kg
Barium	120	1.1	mg/kg
Beryllium	0.49 B	0.53	mg/kg
Cadmium	0.47 B	0.53	mg/kg
Calcium	3800	21	mg/kg
Chromium	12	1.1	mg/kg
Cobalt	5.3	1.1	mg/kg
Copper	12	2.1	mg/kg
Iron	12000	11	mg/kg
Lead	19	0.84	mg/kg
Magnesium	2800	21	mg/kg
Manganese	270	1.1	mg/kg
Nickel	10	4.2	mg/kg
Potassium	2000	320	mg/kg
Sodium	71 B	530	mg/kg
Tin	0.91 B,J	11	mg/kg
Vanadium	23	2.1	mg/kg
Zinc	40 J	2.1	mg/kg

Mercury	0.019 B	0.035	mg/kg

Client Sample ID: 06 SS 011

Aluminum	23000	12	mg/kg
Arsenic	6.1	1.2	mg/kg
Barium	260	1.2	mg/kg
Beryllium	0.94	0.58	mg/kg
Cadmium	0.71	0.58	mg/kg
Calcium	8400	23	mg/kg
Chromium	25	1.2	mg/kg
Cobalt	7.0	1.2	mg/kg
Copper	18	2.3	mg/kg
Iron	21000	12	mg/kg
Lead	29	0.92	mg/kg
Magnesium	6000	23	mg/kg
Manganese	320	1.2	mg/kg
Nickel	17	4.6	mg/kg
Potassium	5300	350	mg/kg
Selenium	1.6	1.5	mg/kg
Sodium	120 B	580	mg/kg
Tin	1.4 B,J	12	mg/kg
Vanadium	43	2.3	mg/kg
Zinc	76 J	2.3	mg/kg
Mercury	0.028 B	0.038	mg/kg

Client Sample ID: 06 SS 012

Aluminum	25000	11	mg/kg
Arsenic	7.1	1.1	mg/kg
Barium	260	1.1	mg/kg
Beryllium	1.1	0.53	mg/kg
Cadmium	0.83	0.53	mg/kg
Calcium	4400	21	mg/kg
Chromium	28	1.1	mg/kg
Cobalt	8.9	1.1	mg/kg

Copper	20	2.1	mg/kg
Iron	23000	11	mg/kg
Lead	29	0.85	mg/kg
Magnesium	5700	21	mg/kg
Manganese	430	1.1	mg/kg
Nickel	20	4.3	mg/kg
Potassium	4400	320	mg/kg
Sodium	96 B	530	mg/kg
Tin	1.5 B,J	11	mg/kg
Vanadium	51	2.1	mg/kg
Zinc	83 J	2.1	mg/kg
Mercury	0.022 B	0.035	mg/kg

Client Sample ID: 06 SS 013

Aluminum	14000	10	mg/kg
Arsenic	7.7	1.0	mg/kg
Barium	100	1.0	mg/kg
Beryllium	0.74	0.52	mg/kg
Cadmium	0.53	0.52	mg/kg
Calcium	2000	21	mg/kg
Chromium	15	1.0	mg/kg
Cobalt	6.2	1.0	mg/kg
Copper	12	2.1	mg/kg
Iron	13000	10	mg/kg
Lead	19	0.83	mg/kg
Magnesium	1900	21	mg/kg
Manganese	260	1.0	mg/kg
Nickel	12	4.2	mg/kg
Vanadium	33	2.1	mg/kg
Zinc	37 J	2.1	mg/kg
Mercury	0.020 B	0.034	mg/kg

Client Sample ID: 06 SS 014

Aluminum	12000	10	mg/kg

Arsenic	8.8	1.0	mg/kg
Barium	120	1.0	mg/kg
Beryllium	0.56	0.52	mg/kg
Cadmium	0.86	0.52	mg/kg
Calcium	2900	21	mg/kg
Chromium	13	1.0	mg/kg
Cobalt	4.4	1.0	mg/kg
Copper	12	2.1	mg/kg
Iron	12000	10	mg/kg
Lead	44	0.84	mg/kg
Magnesium	1900	21	mg/kg
Manganese	220	1.0	mg/kg
Nickel	9.0	4.2	mg/kg
Potassium	2500	310	mg/kg
Sodium	72 B	520	mg/kg
Vanadium	27	2.1	mg/kg
Mercury	0.027 B	0.035	mg/kg

Client Sample ID: 06 SS 015

Aluminum	9500	12	mg/kg
Arsenic	5.2	1.2	mg/kg
Barium	120	1.2	mg/kg
Beryllium	0.59	0.58	mg/kg
Cadmium	0.58	0.58	mg/kg
Calcium	4600	23	mg/kg
Chromium	10	1.2	mg/kg
Cobalt	6.1	1.2	mg/kg
Copper	12	2.3	mg/kg
Iron	13000	12	mg/kg
Lead	19	0.93	mg/kg
Magnesium	2000	23	mg/kg
Manganese	280	1.2	mg/kg
Nickel	10	4.7	mg/kg
Potassium	2900	350	mg/kg

Vanadium	26	2.3	mg/kg
Zinc	51 J	2.3	mg/kg
Mercury	0.021 B	0.038	mg/kg

Client Sample ID: 06 SS 016

Aluminum	14000	10	mg/kg
Arsenic	3.6	1.0	mg/kg
Barium	83	1.0	mg/kg
Beryllium	0.76	0.52	mg/kg
Cadmium	0.27 B	0.52	mg/kg
Calcium	1800	21	mg/kg
Chromium	13	1.0	mg/kg
Cobalt	7.1	1.0	mg/kg
Copper	8.5	2.1	mg/kg
Iron	12000	10	mg/kg
Lead	9.7	0.83	mg/kg
Magnesium	2400	21	mg/kg
Manganese	260	1.0	mg/kg
Nickel	9.9	4.1	mg/kg
Potassium	1300	310	mg/kg
Tin	0.89 B,J	10	mg/kg
Vanadium	23	2.1	mg/kg
Zinc	20 J	2.1	mg/kg
Mercury	0.025 B	0.034	mg/kg

Client Sample ID: 06 SS 017

Aluminum	7000	10	mg/kg
Arsenic	3.9	1.0	mg/kg
Barium	61	1.0	mg/kg
Beryllium	0.42 B	0.52	mg/kg
Cadmium	0.24 B	0.52	mg/kg
Calcium	1400	21	mg/kg

Chromium	8.5	1.0	mg/kg
Cobalt	3.2	1.0	mg/kg
Copper	13	2.1	mg/kg
Iron	8800	10	mg/kg
Lead	7.4	0.83	mg/kg
Magnesium	1100	21	mg/kg
Manganese	160	1.0	mg/kg
Nickel	6.7	4.1	mg/kg
Potassium	1100	310	mg/kg
Sodium	74 B	520	mg/kg
Vanadium	19	2.1	mg/kg
Zinc	19 J	2.1	mg/kg
Mercury	0.0078 B	0.034	mg/kg

Client Sample ID: 06 SS 018

Aluminum	11000	12	mg/kg
Arsenic	9.9	1.2	mg/kg
Barium	150	1.2	mg/kg
Beryllium	0.59 B	0.60	mg/kg
Cadmium	1.1	0.60	mg/kg
Calcium	2200	24	mg/kg
Chromium	12	1.2	mg/kg
Cobalt	12	1.2	mg/kg
Copper	11	2.4	mg/kg
Iron	13000	12	mg/kg
Lead	59	0.95	mg/kg
Magnesium	1600	24	mg/kg
Manganese	540	1.2	mg/kg
Nickel	8.0	4.8	mg/kg
Potassium	1800	360	mg/kg
Tin	1.0 B,J	12	mg/kg
Vanadium	29	2.4	mg/kg
Zinc	51 J	2.4	mg/kg
Mercury	0.031 B	0.039	mg/kg

Client Sample ID: 06 SS 019

Aluminum	6000	10	mg/kg
Arsenic	1.6	1.0	mg/kg
Barium	60	1.0	mg/kg
Beryllium	0.28 B	0.52	mg/kg
Cadmium	0.26 B	0.52	mg/kg
Calcium	1200	21	mg/kg
Chromium	11	1.0	mg/kg
Cobalt	3.5	1.0	mg/kg
Copper	11	2.1	mg/kg
Iron	10000	10	mg/kg
Lead	8.0	0.83	mg/kg
Magnesium	2300	21	mg/kg
Manganese	160	1.0	mg/kg
Nickel	7.0	4.2	mg/kg
Potassium	2300	310	mg/kg
Sodium	230 B	520	mg/kg
Vanadium	18	2.1	mg/kg
Zinc	26 J	2.1	mg/kg

Client Sample ID: 06 SS 020

Aluminum	24000	13	mg/kg
Arsenic	8.8	1.3	mg/kg
Barium	160	1.3	mg/kg
Beryllium	1.2	0.67	mg/kg
Cadmium	0.61 B	0.67	mg/kg
Calcium	3200	27	mg/kg
Chromium	22	1.3	mg/kg
Cobalt	7.9	1.3	mg/kg
Copper	15	2.7	mg/kg
Iron	20000	13	mg/kg
Lead	17	1.1	mg/kg

Magnesium	3200	27	mg/kg
Manganese	270	1.3	mg/kg
Nickel	17	5.4	mg/kg
Potassium	2800	400	mg/kg
Sodium	120 B	670	mg/kg
Tin	1.2 B,J	13	mg/kg
Vanadium	46	2.7	mg/kg
Zinc	79 J	2.7	mg/kg
Mercury	0.046	0.044	mg/kg

Client Sample ID: 06 SS 021

Aluminum	13000	12	mg/kg
Arsenic	8.4	1.2	mg/kg
Barium	94	1.2	mg/kg
Beryllium	0.75	0.60	mg/kg
Cadmium	0.53 B	0.60	mg/kg
Calcium	1800	24	mg/kg
Chromium	15	1.2	mg/kg
Cobalt	4.8	1.2	mg/kg
Copper	9.7	2.4	mg/kg
Iron	13000	12	mg/kg
Lead	17	0.95	mg/kg
Magnesium	1500	24	mg/kg
Manganese	220	1.2	mg/kg
Nickel	10	4.8	mg/kg
Potassium	2300	360	mg/kg
Vanadium	35	2.4	mg/kg
Zinc	29 J	2.4	mg/kg
Mercury	0.031 B	0.039	mg/kg

Client Sample ID: 06 SS 022

Aluminum	29000	12	mg/kg
Arsenic	7.8	1.2	mg/kg
Barium	290	1.2	mg/kg
Beryllium	1.3	0.62	mg/kg

Cadmium	0.92	0.62	mg/kg
Calcium	26000	25	mg/kg
Chromium	28	1.2	mg/kg
Cobalt	8.5	1.2	mg/kg
Copper	22	2.5	mg/kg
Iron	22000	12	mg/kg
Lead	20	1.0	mg/kg
Magnesium	5500	25	mg/kg
Manganese	280	1.2	mg/kg
Nickel	22	5.0	mg/kg
Potassium	3600	370	mg/kg
Sodium	98 B	620	mg/kg
Tin	1.2 B,J	12	mg/kg
Vanadium	61	2.5	mg/kg
Zinc	73 J	2.5	mg/kg
Mercury	0.039 B	0.041	mg/kg

Client Sample ID: 06 SS 023

Aluminum	16000	12	mg/kg
Arsenic	5.8	1.2	mg/kg
Barium	110	1.2	mg/kg
Beryllium	0.86	0.58	mg/kg
Cadmium	0.59	0.58	mg/kg
Calcium	2700	23	mg/kg
Chromium	15	1.2	mg/kg
Cobalt	6.6	1.2	mg/kg
Copper	16	2.3	mg/kg
Iron	15000	12	mg/kg
Lead	18	0.93	mg/kg
Magnesium	2800	23	mg/kg
Manganese	330	1.2	mg/kg
Nickel	14	4.6	mg/kg
Potassium	2800	350	mg/kg
Tin	1.1 B,J	12	mg/kg

Vanadium	40	2.3	mg/kg
Zinc	47 J	2.3	mg/kg
Mercury	0.018 B	0.038	mg/kg

Client Sample ID: 06 SS 024

Aluminum	14000	12	mg/kg
Arsenic	5.1	1.2	mg/kg
Barium	90	1.2	mg/kg
Beryllium	0.76	0.61	mg/kg
Cadmium	0.51 B	0.61	mg/kg
Calcium	2600	25	mg/kg
Chromium	13	1.2	mg/kg
Cobalt	5.1	1.2	mg/kg
Copper	14	2.5	mg/kg
Iron	12000	12	mg/kg
Lead	14	0.98	mg/kg
Magnesium	2700	25	mg/kg
Manganese	230	1.2	mg/kg
Nickel	12	4.9	mg/kg
Potassium	2900	370	mg/kg
Vanadium	35	2.5	mg/kg
Zinc	37 J	2.5	mg/kg
Mercury	0.018 B	0.040	mg/kg

Client Sample ID: 06 SS 025

Aluminum	20000	12	mg/kg
Arsenic	6.2	1.2	mg/kg
Barium	200	1.2	mg/kg
Beryllium	0.95	0.59	mg/kg
Cadmium	0.69	0.59	mg/kg
Calcium	7300	24	mg/kg
Chromium	21	1.2	mg/kg

Cobalt	7.7	1.2	mg/kg
Copper	16	2.4	mg/kg
Iron	19000	12	mg/kg
Lead	16	0.95	mg/kg
Magnesium	4300	24	mg/kg
Manganese	310	1.2	mg/kg
Nickel	18	4.7	mg/kg
Potassium	3200	360	mg/kg
Sodium	100 B	590	mg/kg
Tin	1.1 B,J	12	mg/kg
Vanadium	47	2.4	mg/kg
Zinc	58 J	2.4	mg/kg
Mercury	0.015 B	0.039	mg/kg

Client Sample ID: 06 SS 026

Aluminum	8700	11	mg/kg
Arsenic	7.3	1.1	mg/kg
Barium	120	1.1	mg/kg
Beryllium	0.61	0.54	mg/kg
Cadmium	1.3	0.54	mg/kg
Calcium	2400	22	mg/kg
Chromium	12	1.1	mg/kg
Cobalt	5.7	1.1	mg/kg
Copper	16	2.2	mg/kg
Iron	18000	11	mg/kg
Lead	37	0.86	mg/kg
Magnesium	1600	22	mg/kg
Manganese	330	1.1	mg/kg
Nickel	11	4.3	mg/kg
Potassium	2400	320	mg/kg
Vanadium	34	2.2	mg/kg
Zinc	63 J	2.2	mg/kg

Mercury	0.026 B	0.036	mg/kg

Client Sample ID: 06 SS 027

Aluminum	12000	11	mg/kg
Arsenic	2.9	1.1	mg/kg
Barium	67	1.1	mg/kg
Beryllium	0.50 B	0.55	mg/kg
Cadmium	0.71	0.55	mg/kg
Calcium	11000	22	mg/kg
Chromium	13	1.1	mg/kg
Cobalt	7.0	1.1	mg/kg
Copper	39	2.2	mg/kg
Iron	17000	11	mg/kg
Lead	11	0.89	mg/kg
Magnesium	5000	22	mg/kg
Manganese	360	1.1	mg/kg
Nickel	12	4.4	mg/kg
Potassium	3400	330	mg/kg
Sodium	1300	550	mg/kg
Vanadium	46	2.2	mg/kg
Zinc	45 J	2.2	mg/kg
Mercury	0.0079 B	0.037	mg/kg

Client Sample ID: 06 SS 028

Aluminum	8600	11	mg/kg
Arsenic	4.9	1.1	mg/kg
Barium	92	1.1	mg/kg
Beryllium	0.53	0.53	mg/kg
Cadmium	0.78	0.53	mg/kg
Calcium	1600	21	mg/kg
Chromium	12	1.1	mg/kg
Cobalt	7.4	1.1	mg/kg
Copper	16	2.1	mg/kg
Iron	12000	11	mg/kg
Lead	28	0.85	mg/kg
Magnesium	2100	21	mg/kg
Manganese	380	1.1	mg/kg
Nickel	11	4.3	mg/kg

Potassium	2500	320	mg/kg
Sodium	330 B	530	mg/kg
Tin	5.1 B,J	11	mg/kg
Vanadium	29	2.1	mg/kg
Zinc	45 J	2.1	mg/kg
Mercury	0.021 B	0.035	mg/kg

Client Sample ID: 06 SS 029

Aluminum	15000	12	mg/kg
Arsenic	7.8	1.2	mg/kg
Barium	140	1.2	mg/kg
Beryllium	0.78	0.60	mg/kg
Cadmium	0.90	0.60	mg/kg
Calcium	3400	24	mg/kg
Chromium	17	1.2	mg/kg
Cobalt	7.4	1.2	mg/kg
Copper	16	2.4	mg/kg
Iron	19000	12	mg/kg
Lead	23	0.96	mg/kg
Magnesium	2900	24	mg/kg
Manganese	360	1.2	mg/kg
Nickel	16	4.8	mg/kg
Potassium	4100	360	mg/kg
Vanadium	44	2.4	mg/kg
Zinc	59 J	2.4	mg/kg
Mercury	0.027 B	0.040	mg/kg

Client Sample ID: 06 SS 030

Aluminum	13000	11	mg/kg
Arsenic	5.3	1.1	mg/kg

Barium	110	1.1	mg/kg
Beryllium	0.70	0.53	mg/kg
Cadmium	0.77	0.53	mg/kg
Calcium	13000	21	mg/kg
Chromium	15	1.1	mg/kg
Cobalt	6.1	1.1	mg/kg
Copper	21	2.1	mg/kg
Iron	17000	11	mg/kg
Lead	15	0.84	mg/kg
Magnesium	3300	21	mg/kg
Manganese	340	1.1	mg/kg
Nickel	14	4.2	mg/kg
Potassium	3600	320	mg/kg
Sodium	250 B	530	mg/kg
Vanadium	38	2.1	mg/kg
Zinc	46 J	2.1	mg/kg
Mercury	0.016 B	0.035	mg/kg

Client Sample ID: 06 SS 031

Aluminum	20000	11	mg/kg
Arsenic	8.0	1.1	mg/kg
Barium	190	1.1	mg/kg
Beryllium	0.96	0.57	mg/kg
Cadmium	1.0	0.57	mg/kg
Calcium	4200	23	mg/kg
Chromium	21	1.1	mg/kg
Cobalt	8.4	1.1	mg/kg
Copper	18	2.3	mg/kg
Iron	22000	11	mg/kg
Lead	24	0.92	mg/kg
Magnesium	4100	23	mg/kg
Manganese	440	1.1	mg/kg
Nickel	19	4.6	mg/kg

Potassium	5200	340	mg/kg
Selenium	1.0 B	1.5	mg/kg
Tin	1.2 B,J	11	mg/kg
Vanadium	49	2.3	mg/kg
Zinc	67 J	2.3	mg/kg
Mercury	0.021 B	0.038	mg/kg

Client Sample ID: 06 SS 032

Aluminum	19000	11	mg/kg
Arsenic	7.0	1.1	mg/kg
Barium	210	1.1	mg/kg
Beryllium	0.88	0.57	mg/kg
Cadmium	0.83	0.57	mg/kg
Calcium	25000	23	mg/kg
Chromium	19	1.1	mg/kg
Cobalt	6.5	1.1	mg/kg
Copper	16	2.3	mg/kg
Iron	17000	11	mg/kg
Lead	20	0.92	mg/kg
Magnesium	4100	23	mg/kg
Manganese	290	1.1	mg/kg
Nickel	16	4.6	mg/kg
Potassium	4400	340	mg/kg
Tin	0.99 B,J	11	mg/kg
Vanadium	42	2.3	mg/kg
Zinc	55 J	2.3	mg/kg
Mercury	0.023 B	0.038	mg/kg

Client Sample ID: 06 SS 033

Aluminum	11000	11	mg/kg
Arsenic	6.9	1.1	mg/kg
Barium	150	1.1	mg/kg

Beryllium	0.64	0.53	mg/kg
Cadmium	0.91	0.53	mg/kg
Calcium	3000	21	mg/kg
Chromium	12	1.1	mg/kg
Cobalt	4.6	1.1	mg/kg
Copper	14	2.1	mg/kg
Iron	13000	11	mg/kg
Lead	28	0.86	mg/kg
Magnesium	2300	21	mg/kg
Manganese	160	1.1	mg/kg
Nickel	12	4.3	mg/kg
Potassium	2700	320	mg/kg
Tin	1.1 B,J	11	mg/kg
Vanadium	29	2.1	mg/kg
Zinc	62 J	2.1	mg/kg
Mercury	0.033 B	0.035	mg/kg

Client Sample ID: 06 SS 034

Aluminum	9500	12	mg/kg
Arsenic	7.7	1.2	mg/kg
Barium	98	1.2	mg/kg
Beryllium	0.51 B	0.58	mg/kg
Cadmium	0.75	0.58	mg/kg
Calcium	83000	23	mg/kg
Chromium	9.3	1.2	mg/kg
Cobalt	4.8	1.2	mg/kg
Copper	13	2.3	mg/kg
Iron	8300	12	mg/kg
Lead	24	0.93	mg/kg
Magnesium	2100	23	mg/kg
Manganese	200	1.2	mg/kg
Nickel	12	4.6	mg/kg
Potassium	2400	350	mg/kg

Vanadium	21	2.3	mg/kg
Zinc	34 J	2.3	mg/kg
Mercury	0.033 B	0.038	mg/kg

Client Sample ID: 06 SS 035

Aluminum	13000	11	mg/kg
Arsenic	12	1.1	mg/kg
Barium	100	1.1	mg/kg
Beryllium	0.72	0.56	mg/kg
Cadmium	1.5	0.56	mg/kg
Calcium	1800	22	mg/kg
Chromium	14	1.1	mg/kg
Cobalt	6.1	1.1	mg/kg
Copper	18	2.2	mg/kg
Iron	13000	11	mg/kg
Lead	65	0.90	mg/kg
Magnesium	2200	22	mg/kg
Manganese	340	1.1	mg/kg
Nickel	13	4.5	mg/kg
Potassium	3100	340	mg/kg
Selenium	0.96 B	1.5	mg/kg
Tin	1.0 B,J	11	mg/kg
Vanadium	32	2.2	mg/kg
Zinc	61 J	2.2	mg/kg
Mercury	0.054	0.037	mg/kg

Client Sample ID: 06 SS 036

Aluminum	23000	11	mg/kg
Arsenic	7.0	1.1	mg/kg
Barium	200	1.1	mg/kg
Beryllium	1.0	0.57	mg/kg
Cadmium	0.87	0.57	mg/kg
Calcium	11000	23	mg/kg
Chromium	23	1.1	mg/kg

Cobalt	7.6	1.1	mg/kg
Copper	18	2.3	mg/kg
Iron	20000	11	mg/kg
Lead	18	0.91	mg/kg
Magnesium	5000	23	mg/kg
Manganese	300	1.1	mg/kg
Nickel	19	4.5	mg/kg
Potassium	4600	340	mg/kg
Vanadium	48	2.3	mg/kg
Zinc	64 J	2.3	mg/kg
Mercury	0.018 B	0.038	mg/kg

Client Sample ID: 06 SS 037

Aluminum	23000	11	mg/kg
Arsenic	7.0	1.1	mg/kg
Barium	210	1.1	mg/kg
Beryllium	1.1	0.57	mg/kg
Cadmium	0.90	0.57	mg/kg
Calcium	8600	23	mg/kg
Chromium	24	1.1	mg/kg
Cobalt	8.2	1.1	mg/kg
Copper	19	2.3	mg/kg
Iron	20000	11	mg/kg
Lead	19	0.92	mg/kg
Magnesium	4800	23	mg/kg
Manganese	320	1.1	mg/kg
Nickel	20	4.6	mg/kg
Potassium	4400	340	mg/kg
Tin	1.2 B,J	11	mg/kg
Vanadium	50	2.3	mg/kg
Zinc	68 J	2.3	mg/kg
Mercury	0.021 B	0.038	mg/kg

Client Sample ID: 06 SS 038

Aluminum	18000	11	mg/kg
Arsenic	7.6	1.1	mg/kg
Barium	130	1.1	mg/kg
Beryllium	0.93	0.56	mg/kg
Cadmium	0.70	0.56	mg/kg
Calcium	5500	22	mg/kg
Chromium	17	1.1	mg/kg
Cobalt	7.4	1.1	mg/kg
Copper	14	2.2	mg/kg
Iron	16000	11	mg/kg
Lead	16	0.89	mg/kg
Magnesium	3200	22	mg/kg
Manganese	310	1.1	mg/kg
Nickel	15	4.5	mg/kg
Potassium	4200	330	mg/kg
Tin	1.0 B,J	11	mg/kg
Vanadium	37	2.2	mg/kg
Zinc	46 J	2.2	mg/kg
Mercury	0.024 B	0.037	mg/kg

Client Sample ID: 06 SS 039

Aluminum	11000	11	mg/kg
Arsenic	8.5	1.1	mg/kg
Barium	100	1.1	mg/kg
Beryllium	0.55 B	0.57	mg/kg
Cadmium	0.94	0.57	mg/kg
Calcium	1500	23	mg/kg
Chromium	13	1.1	mg/kg
Cobalt	4.1	1.1	mg/kg
Copper	12	2.3	mg/kg
Iron	11000	11	mg/kg
Lead	44	0.90	mg/kg

Magnesium	1400	23	mg/kg
Manganese	230	1.1	mg/kg
Nickel	8.1	4.5	mg/kg
Potassium	2300	340	mg/kg
Vanadium	27	2.3	mg/kg
Zinc	48 J	2.3	mg/kg
Mercury	0.039	0.037	mg/kg

Client Sample ID: 06 SS 040

Aluminum	9400	11	mg/kg
Arsenic	7.9	1.1	mg/kg
Barium	82	1.1	mg/kg
Beryllium	0.57	0.54	mg/kg
Cadmium	0.66	0.54	mg/kg
Calcium	1600	22	mg/kg
Chromium	12	1.1	mg/kg
Cobalt	4.2	1.1	mg/kg
Copper	9.0	2.2	mg/kg
Iron	11000	11	mg/kg
Lead	21	0.86	mg/kg
Magnesium	1200	22	mg/kg
Manganese	220	1.1	mg/kg
Nickel	7.8	4.3	mg/kg
Potassium	2200	320	mg/kg
Vanadium	28	2.2	mg/kg
Zinc	30 J	2.2	mg/kg
Mercury	0.027 B	0.036	mg/kg

Client Sample ID: 06 SS 041

Aluminum	20000	13	mg/kg
Arsenic	6.6	1.3	mg/kg
Barium	170	1.3	mg/kg

Beryllium	0.98	0.64	mg/kg
Cadmium	0.79	0.64	mg/kg
Calcium	5400	26	mg/kg
Chromium	22	1.3	mg/kg
Cobalt	8.2	1.3	mg/kg
Copper	21	2.6	mg/kg
Iron	19000 J	13	mg/kg
Lead	37	1.0	mg/kg
Magnesium	4200	26	mg/kg
Manganese	600 J	1.3	mg/kg
Nickel	17	5.1	mg/kg
Potassium	5200	380	mg/kg
Tin	1.6 B,J	13	mg/kg
Vanadium	39	2.6	mg/kg
Zinc	75 J	2.6	mg/kg
Mercury	0.033 B	0.042	mg/kg

Client Sample ID: 06 SS 042

Aluminum	9000	11	mg/kg
Arsenic	6.1	1.1	mg/kg
Barium	100	1.1	mg/kg
Beryllium	0.54	0.53	mg/kg
Cadmium	0.22 B	0.53	mg/kg
Calcium	3600	21	mg/kg
Chromium	12	1.1	mg/kg
Cobalt	5.1	1.1	mg/kg
Copper	11	2.1	mg/kg
Iron	12000 J	11	mg/kg
Lead	18	0.84	mg/kg
Magnesium	2700	21	mg/kg
Manganese	240 J	1.1	mg/kg
Nickel	9.7	4.2	mg/kg

Potassium	1900	320	mg/kg
Vanadium	23	2.1	mg/kg
Zinc	38 J	2.1	mg/kg
Mercury	0.016 B	0.035	mg/kg

Client Sample ID: 06 SS 043

Aluminum	20000	12	mg/kg
Arsenic	6.8	1.2	mg/kg
Barium	160	1.2	mg/kg
Beryllium	0.97	0.59	mg/kg
Cadmium	0.77	0.59	mg/kg
Calcium	4900	23	mg/kg
Chromium	22	1.2	mg/kg
Cobalt	8.0	1.2	mg/kg
Copper	20	2.3	mg/kg
Iron	19000 J	12	mg/kg
Lead	35	0.94	mg/kg
Magnesium	4200	23	mg/kg
Manganese	530 J	1.2	mg/kg
Nickel	16	4.7	mg/kg
Potassium	4900	350	mg/kg
Sodium	72 B	590	mg/kg
Tin	1.3 B,J	12	mg/kg
Vanadium	38	2.3	mg/kg
Zinc	72 J	2.3	mg/kg
Mercury	0.026 B	0.039	mg/kg

Client Sample ID: 06 SS 044

Aluminum	20000	11	mg/kg
Arsenic	10	1.1	mg/kg
Barium	170	1.1	mg/kg
Beryllium	1.1	0.57	mg/kg
Cadmium	0.44 B	0.57	mg/kg

Calcium	4200	23	mg/kg
Chromium	22	1.1	mg/kg
Cobalt	8.5	1.1	mg/kg
Copper	19	2.3	mg/kg
Iron	27000 J	11	mg/kg
Magnesium	4000	23	mg/kg
Manganese	460 J	1.1	mg/kg
Nickel	20	4.6	mg/kg
Potassium	4900	340	mg/kg
Tin	1.2 B,J	11	mg/kg
Vanadium	55	2.3	mg/kg
Zinc	69 J	2.3	mg/kg
Mercury	0.019 B	0.038	mg/kg

Client Sample ID: 06 SS 045

Aluminum	12000	11	mg/kg
Arsenic	6.6	1.1	mg/kg
Barium	110	1.1	mg/kg
Beryllium	0.74	0.53	mg/kg
Cadmium	0.41 B	0.53	mg/kg
Calcium	3400	21	mg/kg
Chromium	14	1.1	mg/kg
Cobalt	6.9	1.1	mg/kg
Copper	14	2.1	mg/kg
Iron	12000 J	11	mg/kg
Lead	29	0.85	mg/kg
Magnesium	2100	21	mg/kg
Manganese	270 J	1.1	mg/kg
Nickel	11	4.3	mg/kg
Potassium	3200	320	mg/kg
Tin	0.92 B,J	11	mg/kg
Vanadium	30	2.1	mg/kg

Zinc	45 J	2.1	mg/kg
Mercury	0.025 B	0.035	mg/kg

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

B Estimated result. Result is less than RL.

J Method blank contamination. The associated method blank contains the target analyte at a reportable level.

Table 4.3 – Surface Soil Data – Semivolatiles

Client Sample ID: 06 SS 002

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Acetophenone	180 J	350	ug/kg	21
Anthracene	120 J	350	ug/kg	18
Benzo(a)anthracene	40 J	350	ug/kg	21
bis(2-Ethylhexyl) phthalate	46 J	350	ug/kg	33
2-Methylphenol	260 J	350	ug/kg	31
3-Methylphenol & 4-Methylphenol	190 J	350	ug/kg	57
Phenanthrene	65 J	350	ug/kg	18
Phenol	190 J	350	ug/kg	19

Client Sample ID: 06 SS 003

bis(2-Ethylhexyl) phthalate	98 J	370	ug/kg	34

Client Sample ID: 06 SS 004

3-Methylphenol & 4-Methylphenol	160 J	350	ug/kg	56
Phenanthrene	57 J	350	ug/kg	18
Phenol	160 J	350	ug/kg	19

Client Sample ID: 06 SS 005

bis(2-Ethylhexyl) phthalate	41 J	350	ug/kg	33
Phenanthrene	64 J	350	ug/kg	18

Client Sample ID: 06 SS 007

No detections.

Client Sample ID: 06 SS 011

No detections.

Client Sample ID: 06 SS 014

No detections.

Client Sample ID: 06 SS 015

No detections.

Client Sample ID: 06 SS 017

No detections.

Client Sample ID: 06 SS 018

Fluoranthene	43 J	390	ug/kg	43

Client Sample ID: 06 SS 022

No detections.

Client Sample ID: 06 SS 024

Anthracene	150 J	400	ug/kg	21
Fluoranthene	86 J	400	ug/kg	44
Phenanthrene	89 J	400	ug/kg	21

Client Sample ID: 06 SS 025

No Detections.

Client Sample ID: 06 SS 026

No Detections.

Client Sample ID: 06 SS 027

No Detections.

Client Sample ID: 06 SS 028

Fluoranthene	58 J	350	ug/kg	38

Client Sample ID: 06 SS 035

Fluoranthene	44 J	370	ug/kg	40

Client Sample ID: 06 SS 036

No Detections.

Client Sample ID: 06 SS 038

No Detections.

Client Sample ID: 06 SS 041

Anthracene	160 J	420	ug/kg	22
Fluoranthene	89 J	420	ug/kg	46
Phenanthrene	94 J	420	ug/kg	22

Client Sample ID: 06 SS 042

No detections.

Client Sample ID: 06 SS 043

Benzo(a)anthracene	41 J	390	ug/kg	23
Benzo(b)fluoranthene	230 J,K	390	ug/kg	62
Benzo(a)pyrene	180 J	390	ug/kg	23
Chrysene	47 J	390	ug/kg	32
Fluoranthene	82 J	390	ug/kg	42
Indeno(1,2,3-cd)pyrene	160 J	390	ug/kg	26
Phenanthrene	39 J	390	ug/kg	20

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

J Estimated result. Result is less than RL.

K Benzo(b&k)fluoranthene unresolved-matrix.Total reported as Benzo(b)fluoranthene.

Table 4.4 – Surface Soil Data – PCBs

Client Sample ID: 06 SS 002

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
PCB 31 (BZ)	0.38 J,COL	9.6	ug/kg	0.22
PCB 206 (BZ)	0.14 J	0.96	ug/kg	0.12

Client Sample ID: 06 SS 003

PCB 31 (BZ)	0.35 J,COL	10	ug/kg	0.23
PCB 138 (BZ)	0.30 J	1.0	ug/kg	0.18
PCB 153 (BZ)	0.35 J	1.0	ug/kg	0.12

Client Sample ID: 06 SS 004

PCB 31 (BZ)	0.37 J,COL	10	ug/kg	0.23

Client Sample ID: 06 SS 005

PCB 31 (BZ)	0.29 J	9.6	ug/kg	0.22
PCB 110 (BZ)	0.17 J	0.96	ug/kg	0.11
PCB 153 (BZ)	0.29 J	0.96	ug/kg	0.11

Client Sample ID: 06 SS 007

PCB 31 (BZ)	0.40 J,COL	9.8	ug/kg	0.22
PCB 99 (BZ)	0.27 J	0.98	ug/kg	0.12
PCB 101 (BZ)	0.53 J	0.98	ug/kg	0.22
PCB 110 (BZ)	0.58 J	0.98	ug/kg	0.11
PCB 118 (BZ)	0.54 J	0.98	ug/kg	0.082
PCB 119 (BZ)	0.13 J,B,COL	0.98	ug/kg	0.089
PCB 138 (BZ)	0.36 J,COL	0.98	ug/kg	0.18
PCB 149 (BZ)	0.40 J	0.98	ug/kg	0.27
PCB 149 (BZ)	0.40 J	0.98	ug/kg	0.27
PCB 206 (BZ)	0.13 J	0.98	ug/kg	0.12

Client Sample ID: 06 SS 011

PCB 31 (BZ)	0.41 J,COL	9.8	ug/kg	0.23
PCB 110 (BZ)	0.19 J	0.98	ug/kg	0.11
PCB 206 (BZ)	0.15 J	0.98	ug/kg	0.12

Client Sample ID: 06 SS 014

PCB 31 (BZ)	0.47 J,COL	10	ug/kg	0.23
PCB 101 (BZ)	0.29 J	1.0	ug/kg	0.23
PCB 138 (BZ)	0.20 J	1.0	ug/kg	0.18
PCB 153 (BZ)	0.38 J	1.0	ug/kg	0.12
PCB 206 (BZ)	0.15 J	1.0	ug/kg	0.12

Client Sample ID: 06 SS 015

PCB 31 (BZ)	0.33 J,COL	9.9	ug/kg	0.23
PCB 119 (BZ)	0.13 J,B,COL	0.99	ug/kg	0.090
PCB 206 (BZ)	0.14 J	0.99	ug/kg	0.12

Client Sample ID: 06 SS 017

PCB 31 (BZ)	0.38 J,COL	9.8	ug/kg	0.23
PCB 206 (BZ)	0.13 J	0.98	ug/kg	0.12

Client Sample ID: 06 SS 018

PCB 31 (BZ)	0.40 J,COL	9.5	ug/kg	0.22
PCB 101 (BZ)	0.30 J	0.95	ug/kg	0.22
PCB 153 (BZ)	0.39 J	0.95	ug/kg	0.11
PCB 174 (BZ)	0.28 J,COL,EST	0.95	ug/kg	0.25
PCB 202 (BZ)	0.28 J,COL,EST	0.95	ug/kg	0.082
PCB 206 (BZ)	0.12 J	0.95	ug/kg	0.11

Client Sample ID: 06 SS 022

PCB 31 (BZ)	0.33 J,COL	10	ug/kg	0.23

Client Sample ID: 06 SS 024

PCB 31 (BZ)	0.33 J,COL	9.8	ug/kg	0.23
PCB 101 (BZ)	0.31 J	0.98	ug/kg	0.23
PCB 138 (BZ)	0.32 J	0.98	ug/kg	0.18
PCB 153 (BZ)	0.45 J	0.98	ug/kg	0.12
PCB 202 (BZ)	0.21 J,EST	0.98	ug/kg	0.084
PCB 206 (BZ)	0.15 J	0.98	ug/kg	0.12

Client Sample ID: 06 SS 025

PCB 31 (BZ)	0.38 J,COL	9.5	ug/kg	0.22

Client Sample ID: 06 SS 026

PCB 101 (BZ)	0.59 J	0.97	ug/kg	0.22
PCB 110 (BZ)	0.51 J	0.97	ug/kg	0.11
PCB 118 (BZ)	0.37 J	0.97	ug/kg	0.082
PCB 126 (BZ)	0.33 J,B,COL	0.97	ug/kg	0.20
PCB 128 (BZ)	0.26 J,COL	0.97	ug/kg	0.11
PCB 132 (BZ)	0.48 J	0.97	ug/kg	0.34
PCB 138 (BZ)	1.4 EST	0.97	ug/kg	0.17
PCB 141 (BZ)	0.34 J,COL	0.97	ug/kg	0.17
PCB 151 (BZ)	0.34 J	0.97	ug/kg	0.13
PCB 153 (BZ)	1.4	0.97	ug/kg	0.12
PCB 170 (BZ)	0.80 J	0.97	ug/kg	0.23
PCB 174 (BZ)	0.84 J,EST	0.97	ug/kg	0.25
PCB 177 (BZ)	0.39 J	0.97	ug/kg	0.097
PCB 180 (BZ)	1.5	0.97	ug/kg	0.56
PCB 183 (BZ)	0.26 J	0.97	ug/kg	0.11
PCB 187 (BZ)	0.76 J	0.97	ug/kg	0.12
PCB 194 (BZ)	0.38 J	0.97	ug/kg	0.12
PCB 201 (BZ)/199 (IUPAC)	0.32 J	0.97	ug/kg	0.23
PCB 202 (BZ)	0.84 J,EST	0.97	ug/kg	0.084
PCB 206 (BZ)	0.23 J	0.97	ug/kg	0.12

Client Sample ID: 06 SS 027

PCB 31 (BZ)	0.33 J,COL	10	ug/kg	0.23

Client Sample ID: 06 SS 028

PCB 31 (BZ)	0.36 J,COL	9.6	ug/kg	0.22
PCB 66 (BZ)	0.32 J,COL	0.96	ug/kg	0.096
PCB 101 (BZ)	0.36 J	0.96	ug/kg	0.22
PCB 110 (BZ)	0.36 J	0.96	ug/kg	0.11
PCB 118 (BZ)	0.36 J	0.96	ug/kg	0.080
PCB 128 (BZ)	0.21 J	0.96	ug/kg	0.11
PCB 153 (BZ)	0.46 J,COL	0.96	ug/kg	0.11

Client Sample ID: 06 SS 035

PCB 31 (BZ)	0.39 J,COL	9.5	ug/kg	0.22
PCB 110 (BZ)	0.19 J	0.95	ug/kg	0.10
PCB 138 (BZ)	0.30 J	0.95	ug/kg	0.17
PCB 153 (BZ)	0.31 J	0.95	ug/kg	0.11
PCB 206 (BZ)	0.17 J	0.95	ug/kg	0.11

Client Sample ID: 06 SS 036

PCB 31 (BZ)	0.31 J,COL	9.7	ug/kg	0.22

Client Sample ID: 06 SS 038

PCB 31 (BZ)	0.26 J,COL	10	ug/kg	0.23

Client Sample ID: 06 SS 041

PCB 31 (BZ)	0.49 J,COL	9.6	ug/kg	0.22
PCB 52 (BZ)	0.24 J	0.96	ug/kg	0.15
PCB 87 (BZ)	0.33 J,COL	0.96	ug/kg	0.17
PCB 99 (BZ)	0.31 J	0.96	ug/kg	0.12
PCB 101 (BZ)	0.62 J	0.96	ug/kg	0.22
PCB 105 (BZ)	0.38 J	0.96	ug/kg	0.16
PCB 110 (BZ)	0.56 J	0.96	ug/kg	0.11
PCB 118 (BZ)	0.66 J,COL	0.96	ug/kg	0.081
PCB 119 (BZ)	0.16 J,B,COL	0.96	ug/kg	0.087
PCB 128 (BZ)	0.35 J	0.96	ug/kg	0.11
PCB 138 (BZ)	1.2	0.96	ug/kg	0.17
PCB 141 (BZ)	0.26 J	0.96	ug/kg	0.16
PCB 153 (BZ)	1.2	0.96	ug/kg	0.12
PCB 156 (BZ)	0.17 J	0.96	ug/kg	0.12
PCB 170 (BZ)	0.36 J	0.96	ug/kg	0.23
PCB 174 (BZ)	0.32 J,EST	0.96	ug/kg	0.25
PCB 177 (BZ)	0.15 J	0.96	ug/kg	0.096
PCB 187 (BZ)	0.30 J	0.96	ug/kg	0.12
PCB 202 (BZ)	0.32 J,EST	0.96	ug/kg	0.083
PCB 206 (BZ)	0.17 J	0.96	ug/kg	0.12

Client Sample ID: 06 SS 042

PCB 31 (BZ)	0.34 J,COL	10	ug/kg	0.23

Client Sample ID: 06 SS 043

PCB 31 (BZ)	0.32 J,COL	10	ug/kg	0.23
PCB 87 (BZ)	0.30 J,COL	1.0	ug/kg	0.18
PCB 101 (BZ)	0.60 J,COL	1.0	ug/kg	0.23
PCB 105 (BZ)	0.32 J	1.0	ug/kg	0.17
PCB 110 (BZ)	0.44 J	1.0	ug/kg	0.11
PCB 118 (BZ)	0.57 J	1.0	ug/kg	0.084
PCB 141 (BZ)	0.26 J	1.0	ug/kg	0.17
PCB 153 (BZ)	1.1	1.0	ug/kg	0.12
PCB 156 (BZ)	0.15 J	1.0	ug/kg	0.12
PCB 167 (BZ)	0.15 J,COL	1.0	ug/kg	0.10
PCB 170 (BZ)	0.54 J	1.0	ug/kg	0.24
PCB 174 (BZ)	0.39 J,EST	1.0	ug/kg	0.26
PCB 180 (BZ)	0.83 J	1.0	ug/kg	0.58
PCB 194 (BZ)	0.30 J	1.0	ug/kg	0.12

PCB 202 (BZ)	0.39 J,EST	1.0	ug/kg	0.086
PCB 206 (BZ)	0.22 J	1.0	ug/kg	0.12

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

J Estimated result. Result is less than RL.

COL More than 40% RPD between primary and confirmation column results. The lower of the two results is reported.

B Method blank contamination. The associated method blank contains the target analyte at a reportable level.

EST Estimated value. See narrative for details.

Table 4.5 – Surface Soil Data – Dioxin

Client Sample ID: 06 SS 002

PARAMETER	RESULT	DETECTION LIMIT	UNITS	METHOD
1,2,3,6,7,8-HxCDD	0.21 Q,J	5.3	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	0.29 Q,J	5.3	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	6.6 B	5.3	pg/g	SW846 8290
OCDD	58 B	11	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.095 Q,J	5.3	pg/g	SW846 8290
2,3,4,6,7,8-HxCDF	0.071 Q,J	5.3	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	1.4 B,J	5.3	pg/g	SW846 8290
1,2,3,4,7,8,9-HpCDF	0.16 Q,B,J	5.3	pg/g	SW846 8290
OCDF	2.9 B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 003

1,2,3,6,7,8-HxCDD	1.0 J	5.5	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	0.31 Q,J	5.5	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	13 B	5.5	pg/g	SW846 8290
OCDD	85 B	11	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.16 Q,J	5.5	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	1.7 Q,B,J	5.5	pg/g	SW846 8290
OCDF	1.8 B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 004

1,2,3,6,7,8-HxCDD	0.52 J	5.3	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	0.57 J	5.3	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	5.8 B	5.3	pg/g	SW846 8290
OCDD	42 B	11	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.19 Q,J	5.3	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	1.2 Q,B,J	5.3	pg/g	SW846 8290
OCDF	1.9 Q,B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 005

1,2,3,7,8,9-HxCDD	0.44 Q,J	5.3	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	4.5 B,J	5.3	pg/g	SW846 8290
OCDD	38 B	11	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	1.2 B,J	5.3	pg/g	SW846 8290
OCDF	2.5 B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 007

1,2,3,6,7,8-HxCDD	0.59 J	5.4	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	0.68 Q,J	5.4	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	11 B	5.4	pg/g	SW846 8290
OCDD	74 B	11	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.29 Q,J	5.4	pg/g	SW846 8290
2,3,4,6,7,8-HxCDF	0.18 J	5.4	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	2.4 Q,B,J	5.4	pg/g	SW846 8290
OCDF	4.6 B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 011

1,2,3,6,7,8-HxCDD	0.52 Q,J	5.8	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	0.35 Q,J	5.8	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	11 B	5.8	pg/g	SW846 8290
OCDD	98 B	12	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.34 J	5.8	pg/g	SW846 8290
1,2,3,6,7,8-HxCDF	0.20 Q,J	5.8	pg/g	SW846 8290
2,3,4,6,7,8-HxCDF	0.18 Q,J	5.8	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	4.8 B,J	5.8	pg/g	SW846 8290
OCDF	8.0 B,J	12	pg/g	SW846 8290

Client Sample ID: 06 SS 014

1,2,3,7,8-PeCDD	0.31 J	5.2	pg/g	SW846 8290
1,2,3,4,7,8-HxCDD	0.36 J	5.2	pg/g	SW846 8290
1,2,3,6,7,8-HxCDD	0.61 J	5.2	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	0.51 Q,J	5.2	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	8.4 B	5.2	pg/g	SW846 8290
OCDD	57 B	10	pg/g	SW846 8290
1,2,3,7,8-PeCDF	0.21 Q,J	5.2	pg/g	SW846 8290
2,3,4,7,8-PeCDF	0.21 Q,J	5.2	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.33 Q,J	5.2	pg/g	SW846 8290
1,2,3,6,7,8-HxCDF	0.24 J	5.2	pg/g	SW846 8290
2,3,4,6,7,8-HxCDF	0.19 Q,J	5.2	pg/g	SW846 8290
1,2,3,7,8,9-HxCDF	0.22 B,J	5.2	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	2.6 B,J	5.2	pg/g	SW846 8290
1,2,3,4,7,8,9-HpCDF	0.47 B,J	5.2	pg/g	SW846 8290
OCDF	4.5 B,J	10	pg/g	SW846 8290

Client Sample ID: 06 SS 015

1,2,3,6,7,8-HxCDD	0.21 Q,J	5.8	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	0.37 Q,J	5.8	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	5.1 B,J	5.8	pg/g	SW846 8290
OCDD	44 B	12	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.20 J	5.8	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	0.99 Q,B,J	5.8	pg/g	SW846 8290
OCDF	2.7 B,J	12	pg/g	SW846 8290

Client Sample ID: 06 SS 017

1,2,3,4,6,7,8-HpCDD	3.7 B,J	5.2	pg/g	SW846 8290
OCDD	30 B	10	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	0.70 Q,B,J	5.2	pg/g	SW846 8290

OCDF	1.7 B,J	10	pg/g	SW846 8290

Client Sample ID: 06 SS 018

1,2,3,7,8-PeCDD	0.28 Q,J	6.0	pg/g	SW846 8290
1,2,3,4,7,8-HxCDD	0.48 Q,J	6.0	pg/g	SW846 8290
1,2,3,6,7,8-HxCDD	1.2 J	6.0	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	1.2 J	6.0	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	20 B	6.0	pg/g	SW846 8290
OCDD	150 B	12	pg/g	SW846 8290
2,3,7,8-TCDF	0.65 Q,J	1.2	pg/g	SW846 8290
1,2,3,7,8-PeCDF	0.22 Q,J	6.0	pg/g	SW846 8290
2,3,4,7,8-PeCDF	0.31 J	6.0	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.77 Q,J	6.0	pg/g	SW846 8290
1,2,3,6,7,8-HxCDF	0.29 Q,J	6.0	pg/g	SW846 8290
2,3,4,6,7,8-HxCDF	0.39 Q,J	6.0	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	6.5 B	6.0	pg/g	SW846 8290
1,2,3,4,7,8,9-HpCDF	0.25 Q,B,J	6.0	pg/g	SW846 8290
OCDF	10 B,J	12	pg/g	SW846 8290

Client Sample ID: 06 SS 022

1,2,3,4,6,7,8-HpCDD	1.9 B,J	6.2	pg/g	SW846 8290
OCDD	17 B	12	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	0.43 Q,B,J	6.2	pg/g	SW846 8290
OCDF	0.99 B,J	12	pg/g	SW846 8290

Client Sample ID: 06 SS 024

1,2,3,4,7,8-HxCDD	0.29 Q,J	6.1	pg/g	SW846 8290
1,2,3,6,7,8-HxCDD	0.79 J	6.1	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	0.45 Q,J	6.1	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	11 B	6.1	pg/g	SW846 8290
OCDD	85 B	12	pg/g	SW846 8290
2,3,7,8-TCDF	0.33 Q,J	1.2	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.42 J	6.1	pg/g	SW846 8290
2,3,4,6,7,8-HxCDF	0.13 Q,J	6.1	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	2.3 Q,B,J	6.1	pg/g	SW846 8290
1,2,3,4,7,8,9-HpCDF	0.23 Q,B,J	6.1	pg/g	SW846 8290
OCDF	4.1 B,J	12	pg/g	SW846 8290

Client Sample ID: 06 SS 025

1,2,3,4,6,7,8-HpCDD	1.2 B,J	5.9	pg/g	SW846 8290
OCDD	11 B,J	12	pg/g	SW846 8290
OCDF	0.65 B,J	12	pg/g	SW846 8290

Client Sample ID: 06 SS 026

1,2,3,7,8-PeCDD	0.51 Q,J	5.4	pg/g	SW846 8290
1,2,3,4,7,8-HxCDD	0.85 J	5.4	pg/g	SW846 8290
1,2,3,6,7,8-HxCDD	2.5 J	5.4	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	2.4 B,J	5.4	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	46 B	5.4	pg/g	SW846 8290
OCDD	330 B	11	pg/g	SW846 8290
2,3,4,7,8-PeCDF	0.29 B,J	5.4	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.73 J	5.4	pg/g	SW846 8290
1,2,3,6,7,8-HxCDF	0.50 Q,J	5.4	pg/g	SW846 8290
2,3,4,6,7,8-HxCDF	0.41 B,J	5.4	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	6.9 B	5.4	pg/g	SW846 8290
1,2,3,4,7,8,9-HpCDF	0.32 Q,J	5.4	pg/g	SW846 8290
OCDF	15 B	11	pg/g	SW846 8290

Client Sample ID: 06 SS 027

1,2,3,7,8-PeCDD	0.23 Q,J	5.5	pg/g	SW846 8290
1,2,3,6,7,8-HxCDD	0.49 J	5.5	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	0.51 Q,B,J	5.5	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	8.9 B	5.5	pg/g	SW846 8290
OCDD	78 B	11	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.20 Q,J	5.5	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	1.4 Q,B,J	5.5	pg/g	SW846 8290
OCDF	3.3 B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 028

1,2,3,4,7,8-HxCDD	0.52 J	5.3	pg/g	SW846 8290
1,2,3,6,7,8-HxCDD	2.1 J	5.3	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	1.3 Q,B,J	5.3	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	34 B	5.3	pg/g	SW846 8290
OCDD	210 B	11	pg/g	SW846 8290
2,3,7,8-TCDF	0.34 Q,J	1.1	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.55 J	5.3	pg/g	SW846 8290
1,2,3,6,7,8-HxCDF	0.28 Q,J	5.3	pg/g	SW846 8290
2,3,4,6,7,8-HxCDF	0.16 Q,B,J	5.3	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	5.0 Q,B,J	5.3	pg/g	SW846 8290
1,2,3,4,7,8,9-HpCDF	0.36 J	5.3	pg/g	SW846 8290
OCDF	12 B	11	pg/g	SW846 8290

Client Sample ID: 06 SS 035

1,2,3,4,6,7,8-HpCDD	9.9 B	5.6	pg/g	SW846 8290
OCDD	77 B	11	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.40 J	5.6	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	2.6 Q,B,J	5.6	pg/g	SW846 8290
OCDF	4.5 Q,B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 036

1,2,3,4,6,7,8-HpCDD	5.5 B,J	5.7	pg/g	SW846 8290
OCDD	49 B	11	pg/g	SW846 8290

1,2,3,4,6,7,8-HpCDF	0.96 B,J	5.7	pg/g	SW846 8290
OCDF	1.6 B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 038

1,2,3,7,8-PeCDD	0.33 Q,J	5.6	pg/g	SW846 8290
1,2,3,6,7,8-HxCDD	0.30 Q,J	5.6	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	3.7 B,J	5.6	pg/g	SW846 8290
OCDD	30 B	11	pg/g	SW846 8290
1,2,3,6,7,8-HxCDF	0.17 Q,J	5.6	pg/g	SW846 8290
1,2,3,7,8,9-HxCDF	0.31 B,J	5.6	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	0.82 Q,B,J	5.6	pg/g	SW846 8290
OCDF	1.8 B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 041

1,2,3,7,8-PeCDD	0.66 Q,J	6.4	pg/g	SW846 8290
1,2,3,4,7,8-HxCDD	0.54 J	6.4	pg/g	SW846 8290
1,2,3,6,7,8-HxCDD	1.3 J	6.4	pg/g	SW846 8290
1,2,3,7,8,9-HxCDD	1.4 Q,B,J	6.4	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	12 B	6.4	pg/g	SW846 8290
OCDD	85 B	13	pg/g	SW846 8290
2,3,7,8-TCDF	0.57 Q,J	1.3	pg/g	SW846 8290
1,2,3,7,8-PeCDF	0.93 B,J	6.4	pg/g	SW846 8290
2,3,4,7,8-PeCDF	0.49 Q,B,J	6.4	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.64 J	6.4	pg/g	SW846 8290
1,2,3,6,7,8-HxCDF	0.40 Q,J	6.4	pg/g	SW846 8290
2,3,4,6,7,8-HxCDF	0.45 Q,B,J	6.4	pg/g	SW846 8290
1,2,3,7,8,9-HxCDF	1.8 B,J	6.4	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	2.6 Q,B,J	6.4	pg/g	SW846 8290
1,2,3,4,7,8,9-HpCDF	0.66 Q,J	6.4	pg/g	SW846 8290
OCDF	5.4 B,J	13	pg/g	SW846 8290

Client Sample ID: 06 SS 042

1,2,3,7,8,9-HxCDD	0.48 Q,B,J	5.3	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	5.7 B	5.3	pg/g	SW846 8290
OCDD	44 B	11	pg/g	SW846 8290
1,2,3,7,8-PeCDF	0.42 B,J	5.3	pg/g	SW846 8290
1,2,3,7,8,9-HxCDF	0.31 Q,B,J	5.3	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	1.2 Q,B,J	5.3	pg/g	SW846 8290
OCDF	2.9 B,J	11	pg/g	SW846 8290

Client Sample ID: 06 SS 043

1,2,3,6,7,8-HxCDD	0.59 Q,J	5.9	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDD	12 B	5.9	pg/g	SW846 8290
OCDD	94 B	12	pg/g	SW846 8290
1,2,3,4,7,8-HxCDF	0.59 Q,J	5.9	pg/g	SW846 8290
1,2,3,6,7,8-HxCDF	0.43 J	5.9	pg/g	SW846 8290
1,2,3,7,8,9-HxCDF	0.48 Q,B,J	5.9	pg/g	SW846 8290
1,2,3,4,6,7,8-HpCDF	2.3 Q,B,J	5.9	pg/g	SW846 8290
OCDF	4.6 B,J	12	pg/g	SW846 8290

NOTE(S) :

Results and reporting limits have been adjusted for dry weight.

Q Estimated maximum possible concentration (EMPC).

J Estimated result. Result is less than the reporting limit.

B Method blank contamination. The associated method blank contains the target analyte at a reportable level.

Table 4.6 – Surface Soil Data – Pesticides

Client Sample ID: 06 SS 002

PARAMETER	RESULT	REPORTING LIMIT	UNITS	MDL
Naled	13 J,COL	35	ug/kg	6.4

Client Sample ID: 06 SS 003

No detections.

Client Sample ID: 06 SS 004

Naled	12 J,COL	35	ug/kg	6.3

Client Sample ID: 06 SS 005

No detections.

Client Sample ID: 06 SS 007

No detections.

Client Sample ID: 06 SS 011

4,4'-DDE	18 J	20	ug/kg	2.7

Client Sample ID: 06 SS 014

No detections.

Client Sample ID: 06 SS 015

No detections.

Client Sample ID: 06 SS 017

No detections.

Client Sample ID: 06 SS 018

No detections.

Client Sample ID: 06 SS 022

No detections.

Client Sample ID: 06 SS 024

No detections.

Client Sample ID: 06 SS 025

Naled	14 J,COL	39	ug/kg	7.1

Client Sample ID: 06 SS 026

Azinphos-methyl	15	14	ug/kg	3.8
Coumaphos	5.7 J	14	ug/kg	3.0

Client Sample ID: 06 SS 027

Naled	13 J,COL	37	ug/kg	6.6

Client Sample ID: 06 SS 028

No detections.

Client Sample ID: 06 SS 035

No detections.

Client Sample ID: 06 SS 036

No detections.

Client Sample ID: 06 SS 038

No detections.

Client Sample ID: 06 SS 041

No detections.

Client Sample ID: 06 SS 042

No detections.

Client Sample ID: 06 SS 043

Isodrin	14 J,B	20	ug/kg	1.3

NOTE(S):

Results and reporting limits have been adjusted for dry weight.

J Estimated result. Result is less than RL.

B Method blank contamination. The associated method blank contains the target analyte at a reportable level.

COL More than 40% RPD between primary and confirmation column results. The lower of the two results is reported.

Table 4.7 - Vegetation Radiological Results

Client Sample ID: 06 VEG 001

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	**0.0059**	**J**	**0.0039**	**0.0100**	**0.0042**	**05/24/06**	**05/30/06**
Plutonium 238	-0.0034	U	0.0038	0.0100	0.0079	05/24/06	05/30/06
Plutonium 239/40	**0.0165**		**0.0059**	**0.0100**	**0.0052**	**05/24/06**	**05/30/06**
Uranium 234	**0.0174**		**0.0054**	**0.0100**	**0.0035**	**05/24/06**	**05/28/06**
Uranium 235/236	0.0012	U	0.0022	0.0100	0.0038	05/24/06	05/28/06
Uranium 238	**0.0187**		**0.0055**	**0.0100**	**0.0030**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 002

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	0.0019	U	0.0017	0.0100	0.0022	05/24/06	05/30/06
Plutonium 238	0.0006	U	0.0014	0.0100	0.0025	05/24/06	05/30/06
Plutonium 239/40	**0.0059**	**J**	**0.0022**	**0.0100**	**0.0017**	**05/24/06**	**05/30/06**
Uranium 234	**0.0278**		**0.0049**	**0.0100**	**0.0012**	**05/24/06**	**05/28/06**
Uranium 235/236	0.00082	U	0.00088	0.0100	0.0012	05/24/06	05/28/06
Uranium 238	**0.0276**		**0.0049**	**0.0100**	**0.0012**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 003

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	0.00008	U	0.0013	0.0100	0.0026	05/24/06	05/30/06
Plutonium 238	-0.0007	U	0.0016	0.0100	0.0033	05/24/06	05/30/06
Plutonium 239/40	0.0010	U	0.0012	0.0100	0.0019	05/24/06	05/30/06
Uranium 234	**0.0221**		**0.0046**	**0.0100**	**0.0005**	**05/24/06**	**05/28/06**
Uranium 235/236	**0.00085**	**J**	**0.00096**	**0.0100**	**0.00058**	**05/24/06**	**05/28/06**
Uranium 238	**0.0197**		**0.0043**	**0.0100**	**0.0016**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 004

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	**0.0040**	**J**	**0.0033**	**0.0100**	**0.0035**	**05/24/06**	**05/30/06**
Plutonium 238	0.0016	U	0.0021	0.0100	0.0033	05/24/06	05/30/06
Plutonium 239/40	**0.0056**	**J**	**0.0023**	**0.0100**	**0.0019**	**05/24/06**	**05/30/06**
Uranium 234	**0.0622**		**0.0097**	**0.0100**	**0.0017**	**05/24/06**	**05/28/06**
Uranium 235/236	**0.0046**	**J**	**0.0022**	**0.0100**	**0.0017**	**05/24/06**	**05/28/06**
Uranium 238	**0.0643**		**0.0099**	**0.0100**	**0.0017**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 005

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	0.00008	U	0.0032	0.0100	0.0062	05/24/06	05/30/06
Plutonium 238	0.0008	U	0.0021	0.0100	0.0036	05/24/06	05/30/06
Plutonium 239/40	**0.0030**	**J**	**0.0017**	**0.0100**	**0.0018**	**05/24/06**	**05/30/06**
Uranium 234	**0.0530**		**0.0083**	**0.0100**	**0.0019**	**05/24/06**	**05/28/06**
Uranium 235/236	**0.0029**	**J**	**0.0017**	**0.0100**	**0.0018**	**05/24/06**	**05/28/06**
Uranium 238	**0.0576**		**0.0088**	**0.0100**	**0.0004**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 006

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	0.0033	U	0.0041	0.0100	0.0062	05/24/06	05/30/06
Plutonium 238	0.0043	U	0.0052	0.0100	0.0081	05/24/06	05/30/06
Plutonium 239/40	0.0021	U	0.0029	0.0100	0.0046	05/24/06	05/30/06
Uranium 234	**0.0315**		**0.0087**	**0.0100**	**0.0063**	**05/24/06**	**05/28/06**
Uranium 235/236	0.0010	U	0.0021	0.0100	0.0038	05/24/06	05/28/06
Uranium 238	**0.0377**		**0.0094**	**0.0100**	**0.0055**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 007

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	0.0002	U	0.0018	0.0100	0.0035	05/24/06	05/30/06
Plutonium 238	-0.0005	U	0.0016	0.0100	0.0032	05/24/06	05/30/06
Plutonium 239/40	0.0027	U	0.0021	0.0100	0.0028	05/24/06	05/30/06
Uranium 234	**0.0248**		**0.0052**	**0.0100**	**0.0017**	**05/24/06**	**05/28/06**
Uranium 235/236	0.0002	U	0.0010	0.0100	0.0022	05/24/06	05/28/06
Uranium 238	**0.0232**		**0.0050**	**0.0100**	**0.0017**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 008

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	**0.203**		**0.040**	**0.010**	**0.014**	**05/24/06**	**05/30/06**
Plutonium 238	**0.0133**		**0.0045**	**0.0100**	**0.0037**	**05/24/06**	**05/30/06**
Plutonium 239/40	**0.91**		**0.11**	**0.01**	**0.0007**	**05/24/06**	**05/30/06**
Uranium 234	**0.145**		**0.020**	**0.010**	**0.003**	**05/24/06**	**05/28/06**
Uranium 235/236	**0.0102**		**0.0038**	**0.0100**	**0.0023**	**05/24/06**	**05/28/06**
Uranium 238	**0.159**		**0.022**	**0.010**	**0.002**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 009

Americium 241	**0.0075**	**J**	**0.0048**	**0.0100**	**0.0061**	**05/24/06**	**05/30/06**
Plutonium 238	0.001	U	0.0023	0.0100	0.0040	05/24/06	05/30/06
Plutonium 239/40	**0.0374**		**0.0074**	**0.0100**	**0.0016**	**05/24/06**	**05/30/06**
Uranium 234	**0.0255**		**0.0057**	**0.0100**	**0.0025**	**05/24/06**	**05/28/06**
Uranium 235/236	0.0009	U	0.0013	0.0100	0.0021	05/24/06	05/28/06
Uranium 238	**0.0259**		**0.0057**	**0.0100**	**0.0006**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 010

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	-0.0005	U	0.0021	0.0100	0.0040	05/24/06	05/30/06
Plutonium 238	0.00070	U	0.00077	0.0100	0.0011	05/24/06	05/30/06
Plutonium 239/40	**0.0054**	**J**	**0.0018**	**0.0100**	**0.0009**	**05/24/06**	**05/30/06**
Uranium 234	**0.0196**		**0.0038**	**0.0100**	**0.0003**	**05/24/06**	**05/28/06**
Uranium 235/236	**0.0016**	**J**	**0.0011**	**0.0100**	**0.0004**	**05/24/06**	**05/28/06**
Uranium 238	**0.0192**		**0.0037**	**0.0100**	**0.0009**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 011

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	0.0007	U	0.0022	0.0100	0.0038	05/24/06	05/30/06
Plutonium 238	0.0002	U	0.0011	0.0100	0.0021	05/24/06	05/30/06
Plutonium 239/40	**0.0024**	**J**	**0.0014**	**0.0100**	**0.0014**	**05/24/06**	**05/30/06**
Uranium 234	**0.0191**		**0.0042**	**0.0100**	**0.0012**	**05/24/06**	**05/28/06**
Uranium 235/236	0.00021	U	0.00058	0.0100	0.00056	05/24/06	05/28/06
Uranium 238	**0.0186**		**0.0041**	**0.0100**	**0.0012**	**05/24/06**	**05/28/06**

Client Sample ID: 06 VEG 012

Parameter	Result	Qual	Total Uncert. (2 σ+/-)	RL	MDC	Prep Date	Analysis Date
Americium 241	0.0039	U	0.0033	0.0100	0.0041	06/01/06	06/05/06
Plutonium 238	0.0002	U	0.0014	0.0100	0.0027	05/24/06	05/30/06
Plutonium 239/40	**0.0049**	**J**	**0.0022**	**0.0100**	**0.0014**	**05/24/06**	**05/30/06**
Uranium 234	**0.189**		**0.025**	**0.010**	**0.003**	**05/24/06**	**05/28/06**
Uranium 235/236	**0.0115**		**0.0038**	**0.0100**	**0.0007**	**05/24/06**	**05/28/06**
Uranium 238	**0.203**		**0.026**	**0.010**	**0.003**	**05/24/06**	**05/28/06**

NOTE(S)

MDC is determined by instrument performance only.
Bold results are greater than the MDC

J **Result is greater than sample detection limit but less than stated reporting limit.**

U **Result is less than the sample detection limit.**