1985514

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
1595 Wynkoop Street
Denver, CO 80202-1129
Phone 800-227-8917
www.epa.gov/region8

Ref: 8SEM-IO

Andrew Keim
Site Manager
U.S. Department of Energy
Office of Legacy Management
11035 Dover Street, Suite 600
Westminster, Colorado 80021

Re: Five Year Review Report for Rocky Flats Site, Jefferson County, Colorado CO7890010526

Dear Mr. Keim:

Thank you for submitting the Five-Year Review Report for Rocky Flats Site, Jefferson County, Colorado, Central Operable Unit (COU). The U.S. Environmental Protection Agency, in consultation with the State of Colorado, concurs with your assessment of protectiveness deferred for the remedy at this site. This information will be included in the EPA's annual Superfund Five-Year Review Report to the U.S. Congress.

The Five-Year Review Report concludes that a protectiveness determination of the remedy cannot be made at this time until further information is obtained regarding the potential risk of PFAS to human and ecological receptors. Further information will be obtained by (1) continuing the collection and evaluation of water samples for PFAS for eight quarters as previously agreed to by the Department of Energy, the EPA, and the Colorado Department of Public Health and Environment; (2) preparing and implementing a plan that identifies the data and information required to support an assessment of potential PFAS risk to human receptors and a PFAS screening-level ecological risk assessment (SLERA); and (3) completing an assessment of potential PFAS risk to human receptors and a PFAS SLERA. It is expected that these actions may take up to four years to complete, at which time a protectiveness determination will be made and a FYR report addendum will be due by June 30, 2026.

Please note that the due date for the next full five-year review report will be August 2, 2027. If you have any questions, please feel free to contact me at smidinger.betsy@epa.gov or (303) 312-6231.

Sincerely,

BETSY SMIDINGER
Digitally signed by BETSY SMIDINGER
Date: 2022.07.21 11:52:23 -06'00'

Betsy Smidinger, Director
Superfund and Emergency Management Division

cc: Lindsay Murl, Colorado Department of Public Health and Environment

LMS/RFS/S35622

Fifth Five-Year Review Report for the Rocky Flats Site Jefferson County, Colorado

May 2022

U.S. DEPARTMENT OF ENERGY | Legacy Management

This document has been designed for online viewing.

LMS/RFS/35622

Fifth Five-Year Review Report
for the Rocky Flats Site
Jefferson County, Colorado

May 2022

Approved by:

____ ____________________

Andrew Keim Date
U.S. Department of Energy
Office of Legacy Management

Contents

Figures

Tables

Appendixes

Abbreviations

95UCL	95th percent upper confidence limit of the arithmetic mean
ACF	area correction factor
AFFF	aqueous film-forming foam
^{241}Am	americium-241
Am	americium
AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
CAD/ROD	Corrective Action Decision/Record of Decision
CCR	*Code of Colorado Regulations*
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COU	Central Operable Unit
COVID-19	coronavirus disease 2019
CR	Contact Record
CRA	Comprehensive Risk Assessment
CRA WP	*Comprehensive Risk Assessment Work Plan and Methodology*
CRS	Colorado Revised Statutes
DDD	dichlorodiphenyldichloroethane
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ESV	ecological screening value
ETPTS	East Trenches Plume Treatment System
EU	Exposure Unit
ft	feet
FYR	Five-Year Review
GAO	U.S. Government Accountability Office
HAL	health advisory level
HQ	Hazard Quotient
IC	institutional control
LM	Office of Legacy Management

m^2	square meters
m^3/kg	cubic meters per kilogram
MCL	maximum contaminant level
MDC	maximum detected concentration
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/kg/d	milligrams per kilogram per day
mg/L	milligrams per liter
mrem/yr	millirem per year
MSPCS	Mound Site Plume Collection System
MSPTS	Mound Site Plume Treatment System
ng/L	nanograms per liter
NPL	National Priorities List
NWCS	North Walnut Creek Slump
OLF	Original Landfill
O&M	operations and maintenance
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCE	tetrachloroethene
pCi/g	picocuries per gram
PFAS	per- and polyfluoroalkyl substances
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonate
PLF	Present Landfill
PLFTS	Present Landfill Treatment System
POC	Point of Compliance
POE	Point of Evaluation
POU	Peripheral Operable Unit
PQL	practical quantitation limit
PRG	preliminary remediation goal
^{239}Pu	plutonium-239
$^{239/240}$Pu	plutonium-239/240
Pu	plutonium
RAO	Remedial Action Objective

RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosive
RFETS	Rocky Flats Environmental Technology Site
RFLMA	*Rocky Flats Legacy Management Agreement*
RFP	Rocky Flats Plant
RFS	Rocky Flats Site
RFSC	Rocky Flats Stewardship Council
RI/FS	Remedial Investigation/Feasibility Study
RSL	regional screening level
SLERA	screening-level ecological risk assessment
SPPTS	Solar Ponds Plume Treatment System
SVOC	semivolatile organic compound
TCE	trichloroethene
TVS	table value standard
^{234}U	uranium-234
^{235}U	uranium-235
^{238}U	uranium-238
U	uranium
USFWS	U.S. Fish and Wildlife Service
UU/UE	unlimited use and unrestricted exposure
UWOEU	Upper Woman Drainage Exposure Unit
VOC	volatile organic compound
WBEU	Wind Blown Area Exposure Unit
WQCC	Water Quality Control Commission
WRV	Wildlife Refuge Visitor
WRW	Wildlife Refuge Worker

Executive Summary

This report documents the fifth Five-Year Review (FYR) for the Rocky Flats Site, Colorado, Central Operable Unit (COU). The Rocky Flats Site is approximately 16 miles northwest of Denver and 12 miles north of Golden, Colorado. Because remaining contamination in the COU does not allow for unlimited use and unrestricted exposure (UU/UE), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that a review be conducted every 5 years to determine whether the remedy remains protective of human health and the environment. The U.S. Department of Energy (DOE) Office of Legacy Management (LM), as the lead agency, conducted the review with the assistance of the U.S. Environmental Protection Agency (EPA) and the Colorado Department of Public Health and Environment (CDPHE). This fifth FYR report covers remedy implementation at the COU for January 2017 through April 2022.

The COU comprises approximately 1300 acres and is surrounded by the Rocky Flats National Wildlife Refuge. Interim removal actions completed before selection of the final remedy for the COU included the removal of contaminated soils and sediments, decontamination and removal of equipment and buildings, construction of cover systems at two landfills, and construction and operation of four groundwater treatment systems. The final remedy selected for the COU in the 2006 Corrective Action Decision/Record of Decision (CAD/ROD) was institutional and physical controls, incorporating continued monitoring and maintenance. Requirements of the remedy are implemented in accordance with the CAD/ROD, 2011 CAD/ROD amendment, and *Rocky Flats Legacy Management Agreement* (RFLMA), as well as through a Restrictive Notice. The RFLMA is a Federal Facility Agreement between DOE, EPA, and CDPHE that provides the implementing regulatory framework for the COU remedy. The Restrictive Notice incorporates the institutional controls for the COU and is enforceable by CDPHE.

The COU remedy was reviewed according to EPA FYR guidance, which outlines a review process that includes community involvement, document and data review, site inspections, and a technical assessment of the protectiveness of the remedy. The technical assessment found that the remedy is functioning and supports achievement of the Remedial Action Objectives in the long term. Institutional controls are in place and effective in preventing unacceptable exposures to known residual contaminants by prohibiting building construction, controlling intrusive activities, restricting use of groundwater and surface water, and protecting engineered remedy components. Physical controls are in place and effective at minimizing the potential for inadvertent access to the COU by unauthorized parties. Monitoring at the COU includes sampling and analysis of groundwater and surface water at specified locations and frequencies, inspection and maintenance of the two landfill covers and groundwater collection and treatment systems, and inspection of institutional and physical controls. Monitoring and maintenance plans are in place to ensure the long-term integrity of the remedy. Routine inspections of remedy components ensure that maintenance and repairs are identified and implemented. Groundwater treatment systems continue to reduce contaminant load to surface water. Groundwater monitoring within the COU and surface water monitoring provides assurance that water quality at the COU boundary is protective. Although the technical assessment concluded that the risks posed to the Wildlife Refuge Worker (WRW) in the COU for known chemical and radiological constituents of concern remain at the lower end of the CERCLA acceptable risk range, the potential risk of per- and polyfluoroalkyl substances (PFAS) to the WRW, other potential human receptors, and ecological receptors has not been fully evaluated.

The detection of the emerging contaminants perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) in water samples collected in the COU in 2019 prompted a review of the potential risk of these compounds and other PFAS to human and ecological receptors at the site. PFAS are a group of manmade chemicals that have been used worldwide in industry and consumer products since the 1940s. Scientific studies have shown that exposure to some PFAS in the environment may be linked to harmful health effects in human and ecological receptors.

A limited screening of the potential risk of PFAS to human and ecological receptors at the site was completed as part of this FYR. Available PFAS data from surface water and groundwater samples collected at the site were compared to non-promulgated human health and ecological screening values. Because only water sample data were available, the screening was limited to potential exposure pathways involving surface water and groundwater. Other media (e.g., soil) and associated potential exposure pathways that may be present at the site were not considered; therefore, the potential risk of PFAS to human and ecological receptors in the COU has not been fully evaluated. As a result, a protectiveness determination of the remedy at the COU is deferred until further information is obtained to support evaluation of the potential risk of PFAS to human and ecological receptors. It is emphasized that the finding of deferred protectiveness does not suggest the existence of a human health or environmental threat from PFAS; rather, it means that sufficient information does not exist to make the protectiveness determination. The need for additional information has been identified as an issue in this FYR report, and recommendations to address the issue are proposed. Given the rapid advances in PFAS scientific knowledge, development of analytical methods, and the evolution of PFAS regulation, DOE will consult with EPA and CDPHE as this issue is addressed to ensure that relevant developments are considered in the evaluation of human health and ecological risks associated with PFAS.

Protectiveness Statements

COU: A protectiveness determination of the remedy cannot be made at this time until further information is obtained regarding the potential risk of PFAS to human and ecological receptors. Further information will be obtained by (1) continuing the collection and evaluation of water samples for PFAS for eight quarters as previously agreed to by DOE, EPA, and CDPHE; (2) preparing and implementing a plan that identifies the data and information required to support an assessment of potential PFAS risk to human receptors and a PFAS screening-level ecological risk assessment (SLERA); and (3) completing an assessment of potential PFAS risk to human receptors and a PFAS SLERA. It is expected that these actions may take up to 4 years to complete, at which time a protectiveness determination will be made and an FYR report addendum completed.

Sitewide: The FYR is limited to the COU and does not include the Peripheral Operable Unit (POU) and Operable Unit 3 (OU-3). The POU and OU-3 remain UU/UE for known contaminants, but it is recognized that the potential risk of PFAS to human and ecological receptors is unknown. A protectiveness determination of the remedy at the COU is deferred until further information is obtained on the potential risk of PFAS to human and ecological receptors. Therefore, a sitewide protectiveness statement is deferred until additional information on PFAS is available.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Rocky Flats Site		
EPA ID: CO7890010526		
Region: 8	**State:** CO	**City/County:** Jefferson County

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** U.S. Department of Energy
Author name (Federal or State Project Manager): Andrew Keim, Site Manager
Author affiliation: U.S. Department of Energy Office of Legacy Management
Review period: September 1, 2021–June 2, 2022
Date of site inspection: March 30–April 4, 2022
Type of review: Statutory
Review number: 5
Triggering action date: August 2, 2017
Due date *(five years after triggering action date)*: August 3, 2022

1.0 Introduction

This report documents the fifth Five-Year Review (FYR) for the Rocky Flats Site (RFS), Colorado, Central Operable Unit (COU). The RFS is approximately 16 miles northwest of Denver and 12 miles north of Golden, Colorado (Figure 1 inset). The purpose of this FYR is to evaluate the implementation and performance of the remedy at the RFS to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of this review are documented in this report, in addition to any issues and recommendations identified during the review.

This FYR was conducted in accordance with the requirements in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Contingency Plan (Title 40 *Code of Federal Regulations* Section 300.430(f)(4)(ii) [40 CFR 300.430(f)(4)(ii)]). Because remaining contamination in the COU does not allow for unlimited use and unrestricted exposure (UU/UE), CERCLA requires that a review be conducted every 5 years to determine whether the remedy remains protective of human health and the environment. The triggering action for this statutory review is the date of U.S. Environmental Protection Agency (EPA) concurrence on the previous FYR report (DOE 2017b). The U.S. Department of Energy (DOE) Office of Legacy Management (LM), as the lead agency, conducted this FYR with the assistance of EPA and the Colorado Department of Public Health and Environment (CDPHE). This fifth FYR report covers remedy implementation at the COU for January 2017 through April 2022. The cutoff date for inclusion of environmental monitoring data in this FYR is December 31, 2021, unless otherwise noted. This data cutoff is necessary to ensure that only validated data are considered in this review.

The Rocky Flats Plant (RFP) was established in 1952 as part of the nuclear weapons complex to manufacture nuclear weapons components under the control of the U.S. Atomic Energy Commission and its successor agencies. Manufacturing activities, accidental industrial fires and spills, and support activities resulted in the release of hazardous constituents to air, soil, sediment, groundwater, and surface water at the RFP. Contaminants released to the environment from activities at the RFP included the radionuclides plutonium (Pu), americium (Am), and uranium (U); organic solvents including trichloroethene (TCE), tetrachloroethene (PCE), and carbon tetrachloride; metals, such as chromium; and nitrates.

Throughout its history, the names and boundaries of the lands associated with the RFP changed. From 1952 to 1994, the federal property at Rocky Flats was referred to as the "Rocky Flats Plant." In 1989, the RFP was listed on the CERCLA National Priorities List (NPL). The NPL listing comprised the land areas referred to in this report as the COU, the Peripheral Operable Unit (POU), and Offsites Area Operable Unit 3 (OU-3). When the plant mission changed to cleanup and closure, the name was changed to the Rocky Flats Environmental Technology Site (RFETS). Throughout this FYR report, the COU may also be referred to as the RFS and represents the land area currently under DOE jurisdiction. The POU may also be referred to as the Rocky Flats National Wildlife Refuge and represents the land area managed by the U.S. Fish and Wildlife Service (USFWS). OU-3 comprises offsite areas adjacent to the POU that are not under federal control. The COU and POU are shown in Figure 1; a map that shows OU-3 may be found in Appendix C.

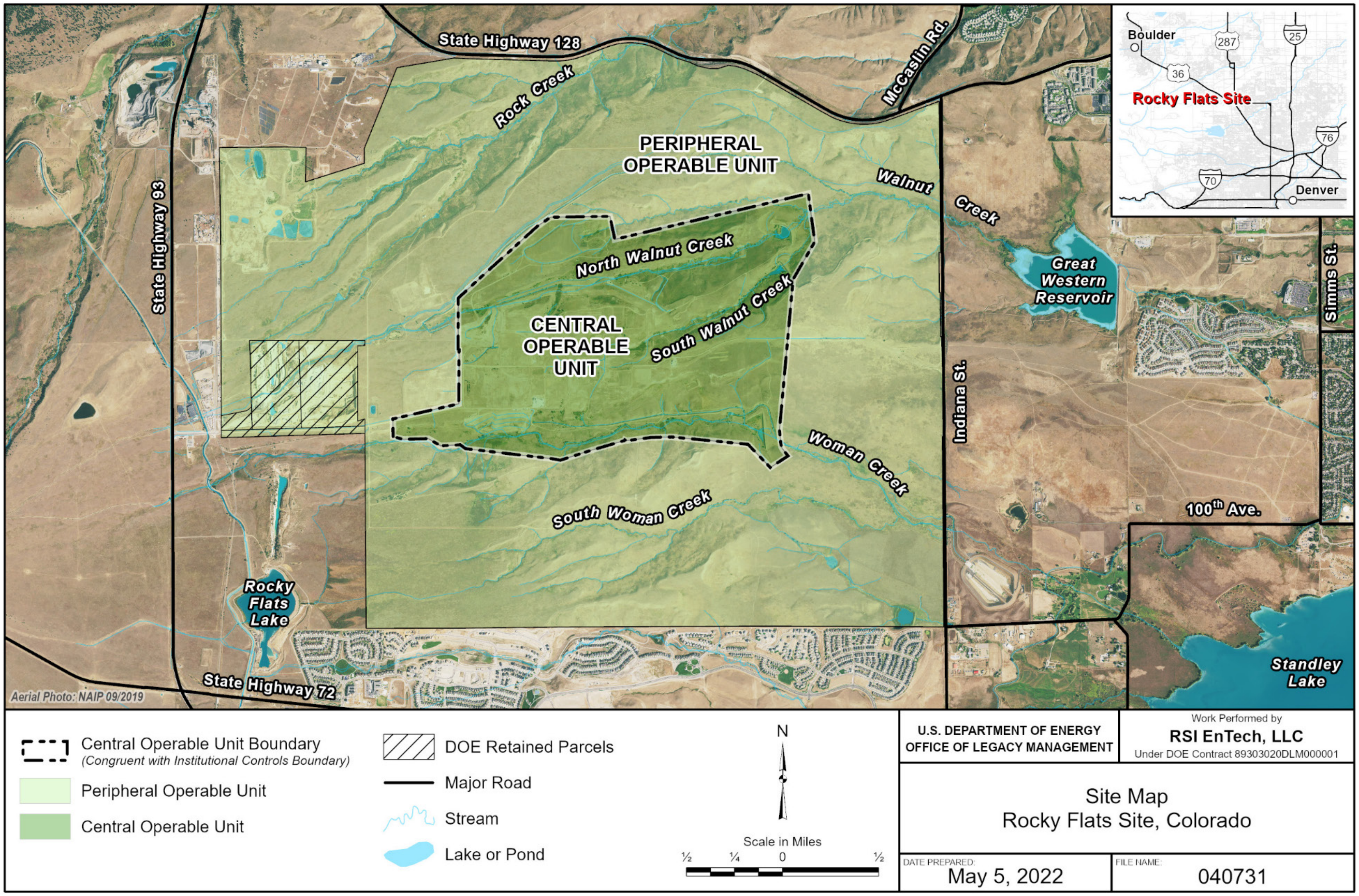


Figure 1. Rocky Flats Site Map

2.0 Background

This section presents a summary of major actions taken at the former RFP. A chronology of site activities is presented in Appendix A, and additional information on the history of the RFP may be found in the *Third Five-Year Review Report for the Rocky Flats Site, Jefferson and Boulder Counties, Colorado* (DOE 2012).

Investigation and cleanup of the RFP began in the 1980s, while the plant was still operating. In 1989, the RFP was placed on the CERCLA NPL. Soon thereafter, the RFP mission transitioned from nuclear weapons component production to investigation, cleanup, and closure, and the RFP was renamed the RFETS in 1995. Considerable remediation of the RFETS took place during the late 1990s and early 2000s as interim measures and interim removal actions under the Rocky Flats Cleanup Agreement. This agreement, between DOE, EPA, and CDPHE, outlined an accelerated action approach to cleanup. The interim measures and interim removal actions completed during accelerated cleanup from 1995 to 2005 included the construction and operation of four groundwater treatment systems, installation of engineered covers at the two landfills, decontamination and removal of buildings and other structures, and removal and offsite disposal of contaminated soils and sediments. DOE completed cleanup and closure of RFETS in 2005. An *RCRA Facility Investigation—Remedial Investigation/Corrective Measures Study—Feasibility Study for the Rocky Flats Environmental Technology Site* (DOE 2006), hereafter referred to as the Remedial Investigation/Feasibility Study (RI/FS) report, analyzed site conditions following interim remedial actions. The RI/FS report included a Comprehensive Risk Assessment (CRA) that assessed human health and ecological risk. The human health risk assessment calculated the risks posed by residual contaminants to the anticipated future land users and evaluated alternatives for the final remedial action. The receptors evaluated in the human health risk assessment were a Wildlife Refuge Worker (WRW) and a Wildlife Refuge Visitor (WRV). These receptors were based on the anticipated future land use of the site as a wildlife refuge. Workers and visitors could potentially contact or be exposed to contaminants in surface soil, subsurface soil, sediment, surface water, and groundwater. The *Final Comprehensive Risk Assessment Work Plan and Methodology* (DOE 2005a), also called the CRA WP, indicates that the current long-term stewardship activities conducted by LM within the COU are covered by the WRW scenario.

Based on the RI/FS report, the RFETS boundaries were reconfigured into two OUs in 2006:

- The COU, which included all areas that might require controls or further remedial action
- The POU, which comprised areas that would likely not require further action or controls

The primary contaminants, contaminated media, and waste remaining in the COU at site closure in 2005 included:

- Wastes disposed in two closed landfills, the Present Landfill (PLF) and the Original Landfill (OLF).
- Some subsurface soils with residual volatile organic compounds (VOCs), metals, and radionuclides.
- Disposal trenches and areas where former building and infrastructure components, debris, incinerator ash and other waste remain below the surface with levels of radionuclides (U, Pu, and Am), and VOCs that are below applicable action levels.

- Areas of groundwater contamination containing VOCs, nitrates, and U at levels above surface water quality standards.
- Areas of surface soil contaminated with low levels of Pu and Am.
- Some subsurface areas with VOC contamination at levels that could lead to inhalation of unacceptable VOC concentrations by building occupants if buildings were constructed in these areas.

The final remedy for each OU was selected in the *Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit, Jefferson and Boulder Counties, Colorado* (DOE, EPA, and CDPHE 2006), hereafter referred to as the Corrective Action Decision/Record of Decision (CAD/ROD). The selected remedy for the COU was institutional and physical controls, incorporating continued monitoring and maintenance. In 2007, the *Rocky Flats Legacy Management Agreement* (RFLMA) was signed by DOE, EPA, and CDPHE (DOE, EPA, and CDPHE 2007). This agreement superseded the Rocky Flats Cleanup Agreement and serves as the implementing regulatory framework for the COU remedy. Attachment 2 to the RFLMA (Appendix B) specifies remedy performance standards, monitoring, inspection, and maintenance requirements; criteria for evaluating monitoring and inspection results; and reporting requirements.

The selected remedy for the POU in the 2006 CAD/ROD was no action because this OU met the criteria for UU/UE. The POU was deleted from the NPL in May 2007. Most land in the POU (approximately 4000 acres) was transferred to USFWS in July 2007 for the purpose of establishing the Rocky Flats National Wildlife Refuge. In 2014, an additional 750 acres was transferred from DOE to USFWS following resolution of mineral rights ownership. The Rocky Flats National Wildlife Refuge was opened to the public in September 2018. DOE retained jurisdiction of a small parcel of land west of the COU (Figure 1), which is currently leased by a private party for use as a gravel quarry. An additional OU associated with the former RFP known as OU-3 (Offsite Areas) was addressed in a separate no action CAD/ROD in 1997 (DOE, EPA, and CDPHE 1997). This OU also met the conditions for UU/UE and was deleted from the NPL in May 2007. An assessment of the POU and OU-3 was completed during this FYR period to determine if changes to risk assessment factors (e.g., slope factors, reference doses) would impact the UU/UE determinations for these OUs. A summary of this assessment is provided in Appendix C. Because an FYR is not required for OUs that meet the criteria for UU/UE, OU-3 and the POU are not further evaluated in this document.

3.0 Remedial Actions

3.1 Remedy Selection

The selected remedy for the COU is institutional and physical controls, incorporating continued monitoring and maintenance (DOE, EPA, and CDPHE 2006):

- Monitoring at the COU includes sampling and analysis of groundwater and surface water at specified locations and frequencies, inspection and maintenance of the landfills and groundwater treatment systems, and inspection of institutional and physical controls

- Institutional controls (ICs) prohibit unauthorized soil disturbance activities, activities that could damage the landfill covers or other remedy components, construction of buildings for human occupancy, and the non-remedy-related use of surface water or groundwater (Table 1)
- Physical controls consist of signs with use restrictions and DOE contact information posted at access points to the COU, and signs prohibiting unauthorized access posted around the COU perimeter

3.2 Remedial Action Objectives (RAOs)

RAOs are the remediation goals that a remedial action is designed to achieve. The RAOs for the COU were developed for groundwater, surface water, and soil and are presented in the 2006 CAD/ROD (DOE, EPA, and CDPHE 2006):

- **Groundwater RAO 1:** Meet groundwater quality standards, which are the Colorado Water Quality Control Commission (WQCC) surface water standards, at groundwater Area of Concern (AOC) wells.
- **Groundwater RAO 2:** Restore contaminated groundwater that discharges directly to surface water as base flow and that is a significant source of surface water to its beneficial use of surface water protection wherever practicable in a reasonable time frame. This is measured at groundwater Sentinel wells. Prevent significant risk of adverse ecological effects.
- **Groundwater RAO 3:** Prevent domestic and irrigation use of groundwater contaminated at levels above maximum contaminant levels (MCLs).
- **Surface Water RAO:** Meet surface water quality standards, which are the Colorado WQCC surface water standards.
- **Soil RAO 1:** Prevent migration of contaminants to groundwater that would result in exceedances of groundwater RAOs.
- **Soil RAO 2:** Prevent migration of contaminants that would result in exceedances of the surface water RAO.
- **Soil RAO 3:** Prevent exposures that result in an unacceptable risk to the WRW. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when applicable or relevant and appropriate requirements (ARARs) are not available or are not sufficiently protective because of the presence of multiple contaminants at the site or multiple pathways of exposure (40 CFR 300.430[e][2][i][A][2]). Prevent significant risk of adverse ecological effects.

As stated in the CAD/ROD, the RAOs for each medium are interdependent and were developed based on this premise (DOE, EPA, and CDPHE 2006). The remedy components selected in the CAD/ROD that support achievement of the RAOs include institutional and physical controls, surface and groundwater monitoring, and maintenance of remedy engineered components (e.g., landfill covers, groundwater treatment systems).

3.3 Remedy Implementation

3.3.1 Regulatory Framework

Requirements of the remedy are implemented in accordance with the CAD/ROD, the 2011 CAD/ROD amendment, and RFLMA and through a Restrictive Notice. The CAD/ROD is the decision document in which the final remedy was selected and the technical requirements of the remedy (e.g., RAOs, ICs, ARARs, remedy performance standards) were identified. The RFLMA provides the regulatory framework for implementing the substantive requirements of the CAD/ROD. The Restrictive Notice incorporates the ICs for the COU and is enforceable by CDPHE. The Restrictive Notice was recorded with Jefferson County in April 2017 and supersedes the Environmental Covenant put in place following site closure.

As stated in the CAD/ROD, the purpose of the RFLMA is to "…establish the regulatory framework for implementing the final response action, serve as the enforceable agreement for postclosure requirements, and ensure that the final response action remains protective of human health and the environment" (DOE, EPA, and CDPHE 2006). The RFLMA does not supplant the CAD/ROD; instead, it provides the detail necessary to implement the requirements of the CAD/ROD. Attachment 2 to the RFLMA is referenced frequently throughout this FYR report because it contains specifics regarding remedy performance standards, monitoring, inspection and maintenance requirements, criteria for evaluating monitoring and inspection results, and reporting. Information and monitoring data collected in accordance with the RFLMA are used in this FYR to assess remedy performance and evaluate progress toward achieving the RAOs. A determination that a particular RAO has been met is based on these data and other relevant information (e.g., risk assessment results, IC effectiveness).

The RFLMA contains a provision that requires DOE, EPA, and CDPHE to follow a consultative process in implementing the requirements of the agreement. The consultative process is a cooperative approach to decision-making that promotes discussion and resolution of issues at the staff level. Throughout this FYR report, reference is made to "reportable conditions" and "Contact Records" (CRs), which are terms associated with the consultative process. The consultative process is initiated for all reportable conditions defined in the RFLMA, for other conditions not considered reportable, or at the request of the RFLMA Parties. As stated in the RFLMA, "The objective of the consultation will be to determine a course of action to address the reportable condition and to ensure the remedy remains protective" (DOE, EPA, and CDPHE 2007). The outcome of consultation is documented in RFLMA CRs or other written correspondence, which are available to the public on the LM website. Appendix D provides a list of RFLMA CRs and other written correspondence referenced in this FYR report. The complete collection of CRs and written correspondence is found at https://www.energy.gov/lm/rocky-flats-site-colorado-contact-records.

3.3.2 Institutional and Physical Controls

The selected remedy in the CAD/ROD requires implementation of institutional and physical controls at the COU. The CAD/ROD was amended in 2011 to clarify certain soil disturbance and excavation ICs and to reflect the objectives and rationale of the ICs more accurately (DOE, EPA, and CDPHE 2011). The effectiveness of the institutional and physical controls is integral to the evaluation of groundwater, surface water, and soil RAOs and the assessment of protectiveness.

ICs applicable to the COU consist of a set of use restrictions that restrict or prohibit activities that may adversely impact the remedy or result in unacceptable exposures (Table 1). These use restrictions are recorded in a Restrictive Notice that was established in April 2017 in accordance with Section 25-15-318.5, Colorado Revised Statutes (CRS). The COU boundary defined in the Restrictive Notice represents the extent of the area where ICs are appropriate and necessary (Figure 1). The Restrictive Notice allows CDPHE to enforce ICs on certain third parties, including DOE, as necessary to maintain the protectiveness of the remedy in the long term. In addition, DOE may file suit in district court to enjoin actual or threatened IC violations. The Restrictive Notice is binding on all current and future owners of the affected land and any individuals possessing an interest in the land.

The physical controls implemented at the COU include signs at access points and around the perimeter. DOE inspected the condition of signs quarterly throughout this FYR period.

During this FYR period, DOE determined the effectiveness of the ICs by inspecting the COU at least annually for any evidence of violations of those controls (see Section 5.4). DOE also annually verified that the Restrictive Notice remained in the Administrative Record and on file with Jefferson County.

Table 1. Rocky Flats Institutional Controls

Controls	Use Restrictions
1	The construction and use of buildings that will be occupied on a permanent or temporary basis (such as for residences or offices) is prohibited. The construction and use of storage sheds or other, non-occupied structures is permitted, consistent with the restrictions contained in controls 2 and 3 below, and provided such use does not impair any aspect of the response action at Rocky Flats.
	Objective: Prevent unacceptable exposures via the indoor air pathway. **Rationale:** The analysis of the indoor air pathway in the Comprehensive Risk Assessment indicated that subsurface volatile organic compounds were at levels in certain portions of the COU that could pose a risk of unacceptable exposure to the WRW if occupied structures were built in these areas.
2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the COU, and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.
3	No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan (including Surface Water Protection Plans submitted to EPA under the Clean Water Act) approved by CDPHE or EPA. Soil disturbance that will not restore the soil surface to preexisting grade or higher may not be performed without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent migration of residual surface soil contamination to surface water. **Rationale:** Certain surface soil contaminants, notably plutonium-239/240, were identified in the fate and transport evaluation in the Remedial Investigation as having complete pathways to surface water if disturbed. This restriction minimizes the possibility of such disturbance and resultant impacts to surface water. Restoring the soil surface to preexisting grade maintains the current depth to subsurface contamination or contaminated structures.
4	Surface water may not be used for drinking water or agricultural purposes.
	Objective: Prevent unacceptable exposure to local surface water contamination above the terminal ponds. **Rationale:** While the Comprehensive Risk Assessment did not evaluate the risks posed by the use of surface water for drinking or agricultural purposes, the nature and extent of contamination evaluation in the Remedial Investigation showed that certain contaminants were found at levels exceeding standards above the terminal ponds. This restriction reduces the possibility of unacceptable exposures to future users from this source.
5	The construction or operation of groundwater wells is prohibited, except for remedy-related purposes.
	Objective: Prevent unacceptable exposure to contaminated groundwater. **Rationale:** While the Comprehensive Risk Assessment did not evaluate the risks posed by the use of groundwater for drinking or agricultural purposes, the nature and extent of contamination evaluation in the Remedial Investigation identified areas in the COU where groundwater contaminants exceeded water quality standards or MCLs. This restriction reduces the possibility of unacceptable exposures to future users from this source. Additionally, it prevents the disruption of groundwater flow paths so as to avoid impacts on groundwater collection and treatment systems.
6	Digging, drilling, tilling, grading, excavation, construction of any sort (including construction of any structures, paths, trails or roads), and vehicular traffic are prohibited on the covers of the Present Landfill and the Original Landfill, except for authorized response actions.
	Objective: Ensure the continued proper functioning of the landfill covers. **Rationale:** This restriction helps ensure the integrity of the landfill covers.
7	Activities that may damage or impair the proper functioning of any engineered component of the response action, including but not limited to any treatment system, monitoring well, landfill cap, or surveyed benchmark, are prohibited. The preceding sentence shall not be construed to prohibit the modification, removal, replacement, or relocation of any engineered component of the response action in accordance with the action determinations in RFLMA Attachment 2.
	Objective: Ensure the continued proper functioning of engineered portions of the remedy. **Rationale:** This restriction helps ensure the integrity of other engineered components of the remedy, including monitoring and survey points.

Note: This table incorporates changes made as a result of the 2011 CAD/ROD amendment (DOE, EPA, and CDPHE 2011). These ICs are included in the Restrictive Notice established in 2017 (see Section 3.3.2).

3.3.3 Remedy Monitoring and Maintenance

The selected remedy in the CAD/ROD requires environmental monitoring of groundwater and surface water and continued operation and maintenance of engineered remedy components (landfill covers and groundwater treatment systems).

Groundwater monitoring is performed in accordance with the RFLMA. The groundwater monitoring network includes four classifications of monitoring wells: AOC, Sentinel, Evaluation, and Resource Conservation and Recovery Act (RCRA). AOC wells are downgradient of contaminant plumes and are monitored to determine if groundwater contaminants are reaching surface water. Surface water monitoring location SW018 (classified as a Surface Water Support location) is monitored on the same routine schedule as the AOC wells to assess groundwater impacts to surface water from specific source areas in the COU. The locations of AOC wells and location SW018 (which is included and discussed with AOC wells in this document) are shown in Figure 2. Sentinel wells are near downgradient edges of contaminant plumes and downgradient of the groundwater treatment systems. These wells are monitored to determine if concentrations of contaminants are increasing, indicating possible plume migration or treatment system issues. A discussion of AOC and Sentinel well data is presented in Section 6.1.2. Evaluation wells are within groundwater contaminant plumes and near plume source areas. Data from these wells support various objectives, such as providing input to groundwater modeling efforts, modification of groundwater monitoring and treatment requirements, or evaluation of changing contaminant conditions as indicated by downgradient AOC or Sentinel wells. RCRA wells are at the PLF and OLF and are used to monitor groundwater conditions upgradient and downgradient of each landfill.

Surface water monitoring is performed in accordance with the RFLMA. The surface water monitoring network includes three types of locations: Points of Compliance (POCs), Points of Evaluation (POEs), and performance monitoring locations. The two POCs are on the eastern boundary of the COU on Woman and Walnut Creeks and are monitored to determine water quality as it leaves the COU. Data collected at the POCs are evaluated against surface water quality standards according to criteria specified in Attachment 2 to the RFLMA. A discussion of POC data is presented in Section 6.1.3.1. The three POEs are located upstream of the POCs and provide an early indication of potential downstream impacts at the POCs. The POC and POE locations are shown in Figure 2. Data collected at performance monitoring locations are used to determine the short- and long-term effectiveness of specific remedies (e.g., groundwater treatment systems). A map showing the performance monitoring locations is presented in Appendix E.

The following specific remedy monitoring and maintenance activities are required in accordance with the CAD/ROD and the RFLMA:

- **Residual subsurface contamination:** DOE must monitor the COU for significant erosion annually and after major precipitation events. DOE will evaluate whether the erosion is near the subsurface features shown on RFLMA Attachment 2, Figures 3 and 4 (Appendix B of this report). Monitoring will include visual observation and measurements, if necessary, of precursor evidence of significant erosion (e.g., cracks, rills, slumping, subsidence, and sediment deposition).

- **Physical controls:** DOE must inspect the condition of signs quarterly.
- **ICs:** DOE must determine the effectiveness of the ICs described in RFLMA Attachment 2 and in the Restrictive Notice by inspecting the COU at least annually for any evidence of violations of those controls. DOE must also annually verify that the Restrictive Notice remains in the Administrative Record and on file with Jefferson County.

The engineered components of the remedy defined in the CAD/ROD consist of landfill covers and groundwater collection and treatment systems. Each engineered component has associated groundwater and surface water monitoring locations that support the evaluation of remedy performance.

- **Landfills:** Inspection and maintenance requirements for the PLF and OLF remedies are provided in the approved monitoring and maintenance plans (DOE 2009; DOE 2014). At the OLF, the remedy involved the construction of a 2-foot-thick soil cover with a buttress at the toe of the landfill and the installation of perimeter drainage channels and cover diversion berms to control surface water run-on and runoff. The remedy at the PLF includes an RCRA-compliant cover consisting of a geosynthetic composite cover with a rock layer and surface water run-on and runoff controls. Performance of the landfill cover systems is discussed in Sections 6.1.4.1 and 6.1.4.2.
- **Groundwater treatment systems:** At a minimum, each system is monitored for untreated influent, treated effluent, and impacts to surface water downstream of the effluent discharge point. The remedy in the CAD/ROD incorporated the four passive groundwater treatment systems in place when the COU was closed in 2005: the Present Landfill Treatment System (PLFTS), the Solar Ponds Plume Treatment System (SPPTS), the Mound Site Plume Treatment System (MSPTS), and the East Trenches Plume Treatment System (ETPTS). Optimization and reconfiguration of three of these treatment systems (SPPTS, MSPTS, and ETPTS) has taken place since site closure and is documented in the RFLMA annual reports. As a result of reconfiguration of the MSPTS, this system is now referred to as the Mound Site Plume Collection System (MSPCS); see Appendix E for additional detail. Performance of these systems is discussed in Sections 6.1.4.1 (PLFTS) and 6.1.4.3 (SPPTS, MSPCS, and ETPTS).

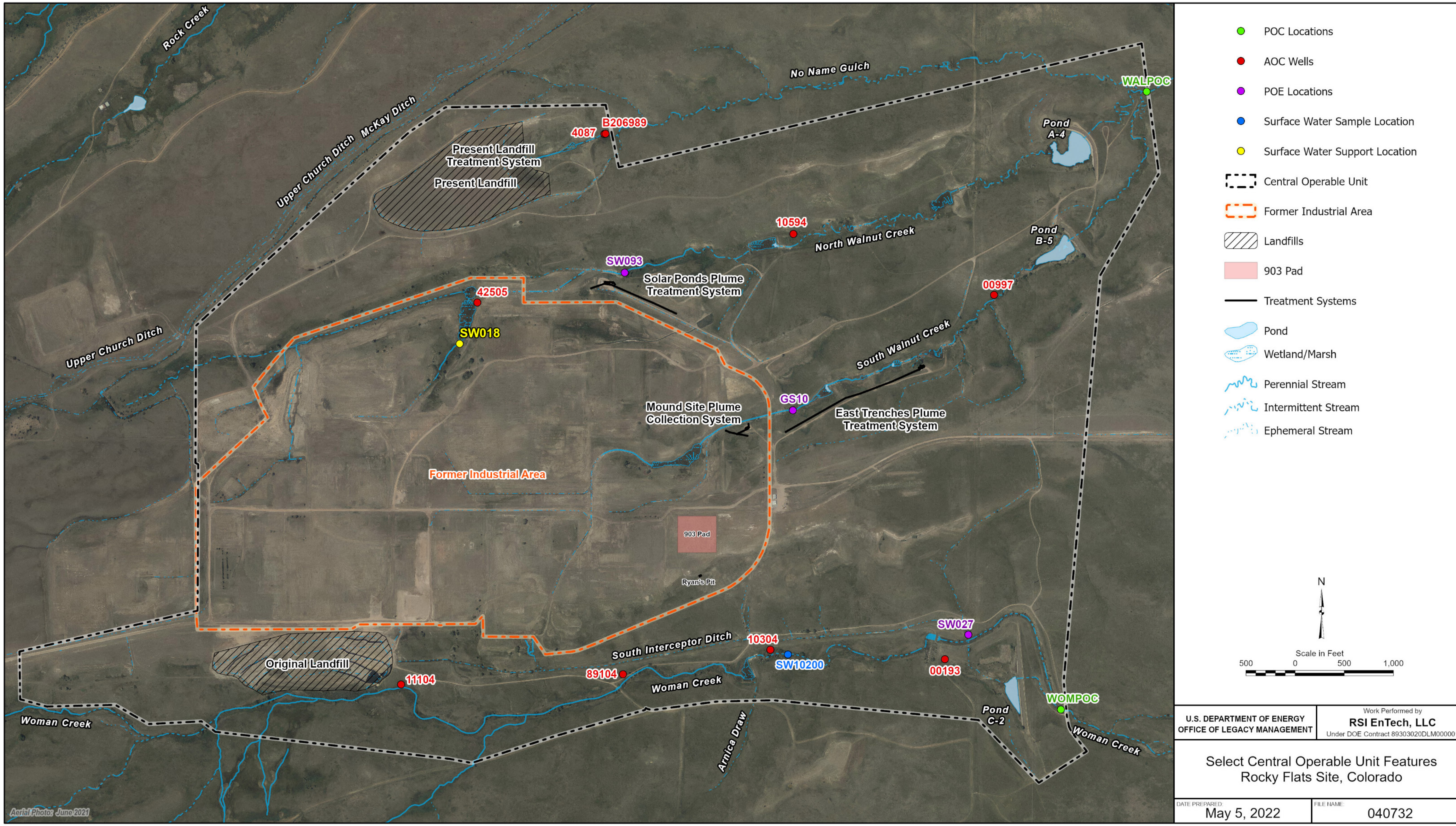


Figure 2. Central Operable Unit Features

4.0 Progress Since the Last Five-Year Review

The protectiveness statement from the previous FYR report is as follows (DOE 2017b):

The remedy at the COU is protective of human health and the environment.

Interim removal actions completed prior to the CAD/ROD included the removal of contaminated soils and sediments, decontamination and removal of equipment and buildings, construction of cover systems at the two landfills, and construction and operation of four groundwater treatment systems. A monitoring and maintenance plan is in place to assure the long-term integrity of the remedy. Routine inspections of remedy components ensure that maintenance and repairs are identified and implemented. Groundwater treatment systems continue to reduce contaminant load to surface water. Surface and groundwater monitoring provide assurance that water quality at the COU boundary is protective. Institutional controls are effective in preventing unacceptable exposures to residual contamination by prohibiting building construction, controlling intrusive activities, restricting use of groundwater and surface water, and protecting engineered remedy components. Physical controls are effective at controlling access to the COU.

Because the remedial actions at the COU are protective and the other OUs associated with the former Rocky Flats Plant (POU and OU3) are suitable for unlimited use and unrestricted exposure, the site is protective of human health and the environment.

The fourth FYR report did not identify any issues or recommendations to be addressed in this FYR period.

5.0 Five-Year Review Process

5.1 Community Notification and Involvement

A public notice announcing the start of this FYR was distributed to RFS stakeholders via email and posted to the LM website in September 2021. The notice included an overview of the FYR process, the LM website link to the 2017 FYR report, LM contact information, and the address to submit questions or input related to the FYR. In addition, the notice announced the LM FYR presentation to be provided at the Rocky Flats Stewardship Council (RFSC) meeting in November. To meet the FYR report schedule, the notice requested that public input be provided no later than December 31, 2021.

The FYR team gave a presentation on this FYR at the November 1, 2021, RFSC meeting, which was open to the public. The RFSC serves as a forum to promote community involvement with the RFS, including the FYR. The FYR presentation included an overview of the FYR process for the RFS and included direction on how the public could submit input on the FYR.

EPA guidance includes consideration of whether interviews with local residents or other stakeholders are needed to identify issues that might be included in the FYR. The RFLMA Parties keep the public and local community governments informed by making all

RFLMA-required reports and CRs available on the LM public website, making quarterly presentations at RFSC meetings, and holding periodic technical meetings with local community governments. Based on these continual public participation activities and the steps taken to inform the public about the FYR process, interviews were not conducted.

Written FYR input was received during the submittal period from three city governments, one nonprofit organization, and members of the public. In addition, verbal input and questions from stakeholders were offered at RFSC and other stakeholder meetings. Stakeholder input was consolidated by topic, where possible, to remain consistent with past FYR practices. A summary of this public input and the agency responses are presented in Appendix I.

5.2 Document Review

Documents reviewed for this FYR are listed in Appendix F. Where appropriate, references to documents in which additional information or data may be found are cited throughout this report.

5.3 Data Review

The remedy selected in the CAD/ROD includes routine monitoring of surface water and groundwater. The data from these monitoring activities are considered, along with other remedy performance information, in determining if the RAOs are being met. The RFLMA quarterly and annual reports contain monitoring and maintenance information pertaining to surface water and groundwater, the PLF and OLF, and the groundwater treatment systems. This information was used to assess remedy performance and progress in meeting the RAOs during this FYR period.

RFLMA Attachment 2 implements the substantive requirements of the CAD/ROD and provides the details necessary to evaluate remedy performance standards and implement remedy requirements (Appendix B). These standards and requirements are numerical values or narrative descriptions of conditions or restrictions, designed to protect existing or potential uses, against which remedy performance can be measured. These standards (e.g., state surface water quality standards) and requirements (e.g., landfill inspections) were established in the final CAD/ROD. The remedy performance standards for surface water in the COU are shown in Table 1 of RFLMA Attachment 2. This table was modified in December 2018 as described in CR 2018-05 (Appendix D). Standards in the table were retained, removed, or modified based on an evaluation of site contaminants and postclosure groundwater and surface water monitoring data. The evaluation also considered Colorado surface water standards and practical quantitation limits (PQLs).

Because groundwater discharges to surface water before exiting the COU, the groundwater use classification at the COU is surface water protection. Therefore, the numeric values for measuring potential effects of contaminated groundwater on surface water quality are also the surface water standards shown in Table 1 of RFLMA Attachment 2. Surface water and groundwater monitoring data are evaluated annually (at a minimum) by comparing results to these standards and conducting RFLMA-required statistical analyses. The results of these evaluations are presented in the quarterly and annual reports required by the RFLMA and available on the LM website.

If the data evaluation specified in RFLMA Attachment 2 identifies reportable conditions defined in the RFLMA, the RFLMA Parties consult and develop a plan for evaluating and addressing the condition. During this fifth FYR period, reportable conditions were documented at:

- AOC well 10304 (CR 2015-10; Consultation Posting 010819)
- POC location WALPOC (CR 2017-02; CR 2018-04)
- POE location SW027 (CR 2015-05; CR 2019-01; CR 2021-03 [in progress])
- POE location GS10 (CR 2021-02)

These reportable conditions are discussed in Sections 6.1.2 and 6.1.3 and Appendix E. Because of the hydrologic connection of groundwater with surface water within the COU, it is therefore appropriate to assess surface water quality in combination with groundwater results in evaluating overall remedy protectiveness.

5.4 Site Inspections

EPA guidance indicates that the FYR should include a recent site inspection to visually confirm and document the conditions of the remedy, the site, and the surrounding area (EPA 2001). The CAD/ROD and RFLMA also require annual and weather-related inspections of the COU and more frequent routine and weather-related inspections of remedy components at the PLF and OLF. During this FYR period, all routine inspections and several weather-related inspections were conducted and reported in accordance with RFLMA requirements.

This section summarizes the results of the annual inspections of the COU conducted during this FYR period; the results of routine and weather-related inspections at the PLF and OLF are summarized in Sections 6.1.4.1 and 6.1.4.2, respectively. The inspection of soil erosion and slumping on the North Walnut Creek hillside near the SPPTS is discussed in Section 6.1.4.3. The inspection completed in April 2022 is the most recent annual site inspection; the results of this inspection are included in Appendix G. Inspection results from other years within the FYR period may be found in the RFLMA quarterly and annual reports.

The following are assessed during each annual COU inspection:

- Evidence of significant erosion in the COU and evaluation of the proximity of any significant erosion to subsurface features left in place at closure. This monitoring includes visual observation for precursors of significant erosion (e.g., cracks, rills, slumping, subsidence, sediment deposition).
- The effectiveness of ICs, as determined by any evidence of violation.
- Evidence of adverse biological conditions, such as unexpected morbidity or mortality, observed during the inspection and monitoring activities.

Quarterly and weather-related inspections for erosion in areas where building features remain in the subsurface were completed as required during this FYR period. On the southeast side of former building 881, a subsidence measuring approximately 3 feet (ft) in diameter and 3 ft deep was identified during the 2019 fourth quarter inspection. The subsidence was filled in and compacted in November 2020. There were no other significant changes identified in the former building areas with respect to depressions or subsidence.

No evidence of violations of ICs or physical controls was observed in any of the annual inspections. In conjunction with each annual inspection, the presence of the Restrictive Notice in the Administrative Record and Jefferson County records was verified. The physical controls required by the remedy (i.e., signs at the COU boundary and access points) were inspected quarterly throughout this FYR period. A few signs were added or replaced, and faded stickers were replaced, as needed. The signs continue to function as intended to identify the COU boundary and use restrictions and minimize the potential for inadvertent access to the COU by unauthorized parties.

No adverse biological conditions were noted during any of the COU inspections during this FYR period.

6.0 Technical Assessment

This section documents the technical assessment of the performance of the remedy. This assessment includes:

- Consideration of monitoring and maintenance information and data.
- Information on postremedy decisions documented in the 2011 CAD/ROD amendment, the 2016 explanation of significant differences, and RFLMA CRs.
- Evaluation of remedy performance against the RAOs described in the CAD/ROD.
- Changes to remedy ARARs.
- Changes to toxicity factors, exposure parameters, or assumptions that might affect the level of risk posed by residual contamination.
- Any new information that may call into question the protectiveness of the remedy.

6.1 Question A: Is the Remedy Functioning as Intended by the Decision Documents?

The remedy is functioning as intended. ICs are in place and effective in meeting the objectives presented in Table 1. Physical controls are in place to notify visitors to the Refuge and others of the COU boundary and the ICs applicable to the COU. Required groundwater and surface water monitoring is ongoing and supports achievement of RAOs in the long term. Operations and maintenance (O&M) of remedy components at the PLF, OLF, and groundwater collection and treatment systems is ongoing and supports achievement of RAOs in the long term. A summary of the status of the RAOs for the remedy at the RFS is presented in Table 2.

Table 2. Remedial Action Objective Status

Remedial Action Objective	Remedy Components	Status
Groundwater		
1. Meet groundwater quality standards, which are the Colorado WQCC surface water standards, at groundwater AOC wells.	• Groundwater monitoring at AOC wells	This RAO was mostly met at all AOC wells during this FYR period. There was a reportable condition at AOC well 10304 within this FYR period that ended in 2019. However, the most recent data from this well and one other AOC well suggest a reportable condition may occur in 2022 (Section 6.1.2.1).
2. (Part 1) Restore contaminated groundwater that discharges directly to surface water as base flow and that is a significant source of surface water to its beneficial use of surface water protection, wherever practicable, in a reasonable time frame. This is measured at groundwater Sentinel wells. (Part 2) Prevent significant risk of adverse ecological effects.	• Groundwater monitoring at Sentinel wells • Monitoring and maintenance of groundwater treatment systems • Groundwater treatment before reaching surface water	Part 1 of this RAO is not met at all Sentinel wells. Sentinel well data were above applicable RFLMA standards for some VOCs, nitrate, or U during this FYR period (Section 6.1.2.2). Optimization of the treatment systems has resulted in reductions of nitrate and VOC concentrations in treated groundwater; a permanent uranium treatment component at the SPPTS has yet to be constructed but is planned for the next FYR period (Section 6.1.4.3). The status of Part 2 of this RAO is uncertain because the potential risk of PFAS to ecological receptors has not been fully evaluated (Section 6.2.3). No evidence of adverse biological conditions (e.g., unexpected mortality or morbidity) was observed during this FYR period.
3. Prevent domestic and irrigation use of groundwater contaminated at levels above MCLs.	ICs: • Unauthorized groundwater well drilling is prohibited • Unauthorized activities that interfere with remedy are prohibited	This RAO is met. ICs recorded in the Restrictive Notice effectively restrict drilling in the COU, thereby preventing groundwater use for domestic and irrigation purposes.
Surface Water		
1. Meet surface water quality standards, which are the Colorado WQCC surface water standards.	• Surface water monitoring at POCs • Groundwater treatment before reaching surface water • Repair and maintenance of landfill covers and vegetation • Repair of erosion, soil disturbance, or subsidence in areas with residual contamination	This RAO is not met because surface water standards are not always met at surface water monitoring locations within the COU upstream of the POCs. However, surface water remains compliant with WQCC regulations (i.e., no exceedances of the standards based on the 12-month average at the POCs).
Soil		
1. Prevent migration of contaminants to groundwater that would result in exceedances of groundwater RAOs.	• Groundwater monitoring at Sentinel wells • Groundwater treatment before reaching surface water	This RAO is not met. Sentinel well data were above applicable RFLMA standards for some VOCs, nitrate, or U during this FYR period (Section 6.1.2.2).
2. Prevent migration of contaminants that would result in exceedances of the surface water RAO.	• Repair and maintenance of landfill covers and vegetation • Repair of erosion or soil disturbance in areas with residual contamination IC: • Soil disturbance restrictions	This RAO is not met because surface water standards are not always met at surface water monitoring locations within the COU upstream of the POCs. However, surface water remains compliant with WQCC regulations (i.e., no exceedances of the standards based on the 12-month average at POCs) and ICs are in place that prohibit soil disturbance without appropriate controls. Inspection and monitoring at the PLF indicate that the landfill cover and stormwater management system remain intact and effective in preventing unacceptable exposure to buried wastes. The PLFTS is operating as designed and is effective in removing trace VOCs from groundwater and seeps at the landfill. Although some non-VOC analytes in PLFTS effluent were detected above the applicable RFLMA standards during this FYR period, these occurrences were short lived, within normal variability, and did not impact downstream surface water quality. A reportable condition relating to the effectiveness of the OLF cover was identified in 2013 and continued through this FYR period until August 2020. Implementation of the OLF maintenance project, described in Section 6.1.4.2 and CR 2019-02, resolved this reportable condition. Groundwater and surface water monitoring data collected during this FYR period do not suggest the hillside instability and subsequent maintenance project at the OLF has negatively affected groundwater or surface water quality.
3. (Part 1) Prevent exposures that result in an unacceptable risk to the WRW. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARs are not available or are not sufficiently protective because of the presence of multiple contaminants at the site or multiple pathways of exposure (40 CFR 300.430[e][2][i][A][2]). (Part 2) Prevent significant risk of adverse ecological effects.	(Part 1) • Repair and maintenance of landfill covers and vegetation • Repair of erosion, soil disturbance, or subsidence in areas with residual contamination • Perimeter signage ICs: • Unauthorized groundwater well drilling is prohibited • Surface water use restrictions • Soil disturbance restrictions • Construction restrictions • Unauthorized activities that interfere with remedy are prohibited (Part 2) • Repair and maintenance of landfill covers and vegetation • Repair of erosion, soil disturbance, or subsidence in areas with residual contamination	The status of Part 1 of this RAO is uncertain because the potential risk of PFAS to human receptors has not been fully evaluated. For known contaminants, however, ICs and physical controls are in place and effective in preventing unacceptable exposures, land use and exposure assumptions for a WRW used in the CRA remain valid, and human health risk remains at the lower end of the EPA acceptable risk range (Section 6.2.2). See PLF, PLFTS, and OLF status in Soil RAO 2. The status of Part 2 of this RAO is uncertain because the potential risk of PFAS to ecological receptors has not been fully evaluated (Section 6.2.3). No evidence of adverse biological conditions (e.g., unexpected mortality or morbidity) was observed during this FYR period. See PLF, PLFTS, and OLF status in Soil RAO 2.

Abbreviation:
PFAS = per- and polyfluoroalkyl substances.

6.1.1 Institutional and Physical Controls

The ICs and physical controls required by the remedy are in place and effective in preventing unacceptable exposures. The effectiveness of ICs is determined by annually inspecting the COU for evidence of violations. Less formal inspections and observations are recorded, as appropriate, throughout the year by site staff as they perform regular monitoring and maintenance activities. No evidence of IC violations was discovered during this FYR period. The presence of the Restrictive Notice in the Administrative Record and Jefferson County records is verified annually and was last verified on April 4, 2022. Physical controls required by the remedy identify the COU boundary and applicable use restrictions, thereby minimizing the potential for inadvertent access to the COU by unauthorized parties. Trespassers were encountered in the COU on two occasions during this FYR period. On both occasions, the individual was immediately escorted offsite by site personnel. In March 2022, LM posted additional warning signs around the COU perimeter to warn Refuge visitors and others that the COU is not open to the public. These signs supplement the existing warning signs around the COU boundary.

The importance of the ICs and the Restrictive Notice was demonstrated in 2018, when a private corporation filed permit applications with the Colorado Oil and Gas Conservation Commission to drill horizontal wells into the land underlying the COU. The private corporation was notified that the ICs established for the COU were applicable to the proposed drilling and that further environmental analysis of the project would be required before it could proceed. Although the corporation ultimately withdrew the permit applications, this experience demonstrated how the Restrictive Notice would have been used to ensure the protection of the remedy at the COU. That is, if the corporation had pursued drilling activities, the Restrictive Notice would have required that the potential impacts to the remedy be identified and any necessary mitigation measures taken to ensure protectiveness of human health and the environment.

6.1.2 Groundwater Monitoring

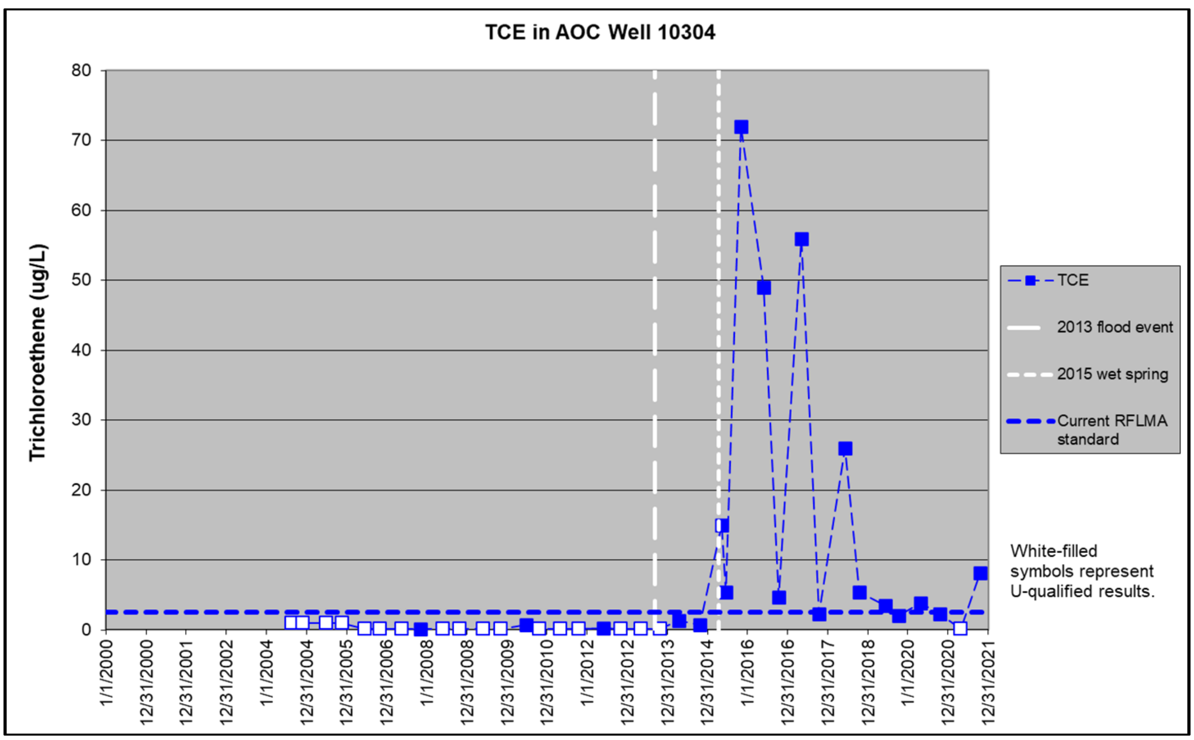
The groundwater monitoring network in the COU consists of four well classifications (AOC, Sentinel, Evaluation, and RCRA) and one surface water location classification (Surface Water Support). In total, 88 groundwater monitoring wells are part of this network; all of these wells are screened in the upper hydrostratigraphic unit. Data from groundwater monitoring at AOC and Sentinel wells and the Surface Water Support location are directly relevant to assessing remedy performance in relation to groundwater RAOs 1 and 2 and soil RAO 1. Remedy performance for the AOC and Sentinel wells and Surface Water Support location is discussed in this section. A summary of the status of the RAOs for the remedy at the RFS is presented in Table 2. Data from Evaluation wells are discussed in Appendix E; data from RCRA wells are discussed in Sections 6.1.4.1 and 6.1.4.2. Appendix E also includes an assessment of the well network and recommendations for potential groundwater monitoring modifications.

6.1.2.1 AOC Wells

The existing AOC well network consists of nine wells from which routine RFLMA monitoring samples are collected twice a year (i.e., semiannually); surface water samples from the associated Surface Water Support location, identified as SW018 (Figure 2), are also collected semiannually. Remedy performance is measured at AOC wells and the Surface Water Support location by an evaluation of routine monitoring results as compared to RFLMA standards.

The RFLMA Attachment 2 decision logic flowchart Figure 7, “Area of Concern Wells and SW018” (Appendix B), describes the evaluation of these data. If the results for an individual analyte in two consecutive routine samples are greater than its respective RFLMA standard, a reportable condition exists and consultation with EPA and CDPHE is required.

There was one reportable condition at an AOC well during the previous FYR period that recurred in this FYR period. AOC well 10304 was installed in 2004 to evaluate groundwater quality adjacent to Woman Creek, downgradient of the VOC contaminant plume caused by subsurface contamination at the 903 Pad and Ryan’s Pit (Figure 2). TCE exceeded the RFLMA standard of 2.5 micrograms per liter (µg/L) in samples from this well in 2015 (CR 2015-10 [Appendix D]); this reportable condition continued until the fourth quarter of 2017. The decrease in TCE concentrations was short lived, and the well was again reportable for TCE beginning in the fourth quarter of 2018 (Consultation Posting 010819); concentrations again decreased below the RFLMA standard in the fourth quarter of 2019, and the well has not been reportable since. The highest concentration of TCE reported in this FYR period at this well was 56 µg/L in the sample collected in May 2017. Groundwater modeling performed before site closure predicted that concentrations of TCE would increase in this area following periods of higher-than-normal precipitation; see the *Final Interim Measure/Interim Remedial Action for Groundwater at the Rocky Flats Environmental Technology Site* (Kaiser-Hill 2005) and the *Fate and Transport Modeling of Volatile Organic Compounds at the Rocky Flats Environmental Technology Site* (Kaiser-Hill 2004). The precipitation received in September 2013 caused flooding, and 2015 represented the wettest spring recorded by the RFS water monitoring network. Since 2015, concentrations of TCE at well 10304 have been steadily but irregularly decreasing (Figure 3) as the effects of those wet periods wane.



Note: A temporary modification to the TCE standard was in effect until the end of 2009. For simplicity, this standard is not shown on the figure above; the current TCE water quality standard of 2.5 µg/L is presented.

Figure 3. TCE Concentrations at AOC Well 10304 (2004–2021)

The plan for addressing the reportable condition that was developed by DOE in consultation with EPA and CDPHE in accordance with the RFLMA was implemented in the previous FYR period but continued into this FYR period. The plan included the collection of surface water samples from Woman Creek downgradient of well 10304 to assess potential impacts to surface water quality. Surface water samples were collected from downgradient Woman Creek location SW10200 (Figure 2) concurrently with samples from the well for as long as the well was reportable. TCE was not detected in any of the surface water samples.

The reportable condition for TCE at AOC well 10304 during this FYR period demonstrates the continued need for groundwater monitoring as part of the remedy. Groundwater monitoring will continue at the site and reportable conditions will be addressed through the RFLMA consultation process. As designed in the RFLMA, reportable conditions prompt the timely evaluation of site conditions and the identification of response actions that may be necessary to ensure continued protection of human health and the environment.

The reportable condition for TCE at AOC well 10304 ended in 2019. However, data from fourth quarter 2021 sampling at this well show TCE at a concentration above the RFLMA standard. According to RFLMA evaluation protocols, if the TCE concentration is above the standard in the next routine sample from well 10304 (scheduled to be collected in the second quarter of 2022), there will be a reportable condition for TCE at the well. Similarly, data from the fourth quarter 2021 sampling at AOC well B206989 show uranium at a concentration above the RFLMA groundwater threshold. If the next routine sample from this well has uranium above that concentration, there will be a reportable condition for uranium for that well. If a reportable condition is triggered at either of these wells, LM will consult with EPA and CDPHE to develop a plan to evaluate the conditions and propose mitigating actions if necessary.

6.1.2.2 Sentinel Wells

Sentinel wells are typically near downgradient edges of contaminant plumes, in drainages, at groundwater treatment systems, and along contaminant pathways to surface water (Figure 4). These wells are monitored to determine whether concentrations of contaminants indicate plume migration or treatment system problems that may result in impacts to surface water quality. The existing Sentinel well network consists of 27 wells from which routine monitoring samples are collected semiannually. The RFLMA Attachment 2 decision logic flowchart Figure 8, “Sentinel Wells” (Appendix B), describes the evaluation of these data. Groundwater quality in Sentinel wells at the end of this FYR period was generally consistent with conditions at the time of closure. Groundwater does not meet RFLMA standards for some VOCs, U, or nitrate at many Sentinel well locations. While there are no indications of significant plume migration that impact the continued protectiveness of the remedy, groundwater RAO 2 and soil RAO 1 are not currently met at all Sentinel wells (Table 2). The CAD/ROD states that no additional removal, containment, or treatment actions could be reasonably taken to address these RAOs at the time and recognizes that the remedial actions undertaken as a part of closure of the COU were “not expected to eliminate groundwater contamination in the short term but are expected to have a positive long-term impact on groundwater and surface water quality” (DOE, EPA, CDPHE 2006). These statements remain valid for this FYR period, and, therefore, continued monitoring of the Sentinel wells is necessary.

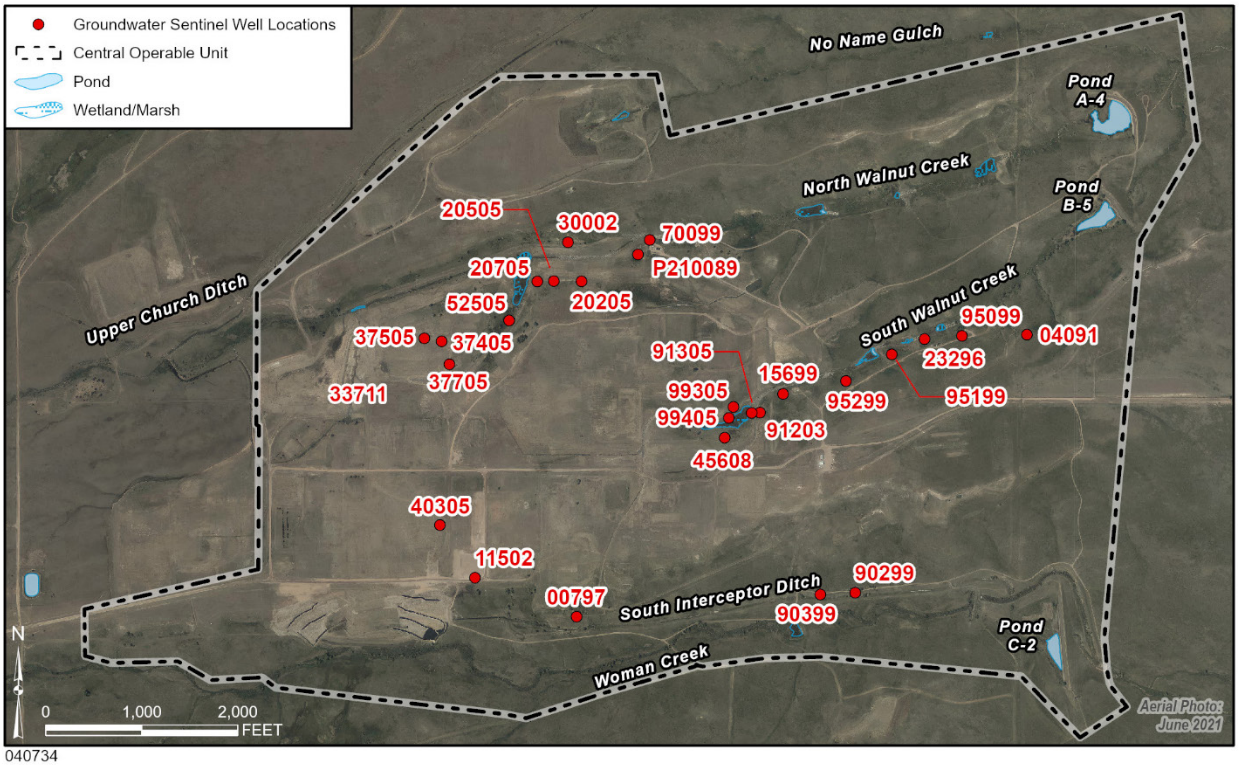


Figure 4. Rocky Flats Site Sentinel Well Locations

6.1.3 Surface Water Monitoring

The surface water monitoring network in the COU consists of three types of locations: POCs, POEs, and performance monitoring locations. Monitoring data from these and other surface water monitoring locations were considered in this FYR and were used to assess RAO progress. A summary of the status of the RAOs for the remedy at the RFS is presented in Table 2.

The POCs are the surface water monitoring locations where remedy performance, in terms of compliance with RFLMA surface water standards, is evaluated. Data from surface water monitoring at the POCs are discussed in this section; data from surface water monitoring at POEs and performance monitoring locations are discussed in Appendix E.

6.1.3.1 Points of Compliance

The WOMPOC (within Woman Creek) and WALPOC (within Walnut Creek) surface water POCs are used to measure remedy performance against applicable RFLMA surface water standards at the COU boundary prior to surface water leaving the COU. Remedy performance at the POCs is measured through a comparison of the volume-weighted 12-month rolling average of the composite sample analyte concentrations collected at each POC to the applicable RFLMA surface water quality standards. The volume-weighted 30-day average of these analyte concentrations is also evaluated. The RFLMA Attachment 2 decision logic flowchart Figure 5, "Points of Compliance" (Appendix B), describes the evaluation of these data. An exceedance of either calculated average is a reportable condition under RFLMA that requires consultation with EPA and CDPHE.

During this FYR period, none of the 12-month rolling averages at WOMPOC and WALPOC and none of the 30-day averages at WOMPOC exceeded the RFLMA standards for analytes sampled at these locations. However, the 30-day average at WALPOC exceeded the RFLMA standard for U on two occasions during this FYR period:

- As reported in the fourth FYR report, in early December 2016, the 30-day average for U at WALPOC (16.9 µg/L) exceeded the RFLMA standard of 16.8 µg/L, resulting in a reportable condition (CR 2017-02 [Appendix D]). This reportable condition (U at 16.9–21.9 µg/L) continued into this FYR period until April 2017, when the 30-day average fell below the standard.
- In February 2018, the 30-day average for U at WALPOC (18.0 µg/L) exceeded the RFLMA standard of 16.8 µg/L, triggering a reportable condition at WALPOC (CR 2018-04 [Appendix D]). This reportable condition (U at 16.9–20.7 µg/L) continued until April 2018, when the 30-day average fell below the standard.

Figure 5 presents the U data for WALPOC from 2011 through the end of 2021. For each reportable condition during this FYR period, DOE consulted with EPA and CDPHE and developed a plan for responding to the condition (CR 2017-02 and CR 2018-04 [Appendix D]).

Other information considered during the RFLMA evaluation of the U reportable conditions at WALPOC included the following:

1. The data do not suggest a new source of U contamination.
2. The exceedances did not persist; U concentrations at WALPOC ultimately decreased to below the RFLMA standard.
3. Not all U detected at WALPOC is contamination from former RFP operations. Based on the isotopic analysis of 39 composite surface water samples collected at WALPOC from 2011 to 2018, 69–87% of the total U concentration is naturally occurring U (WWE 2021).
4. The standard for U that applies to surface water at the site is 16.8 µg/L. This standard is a level at which there are no known or anticipated adverse effects on the health of a person and which allows a margin of safety. It is based on a 70-kilogram adult consuming 2 liters of water per day for a lifetime. WALPOC has an intermittent flow of water and Walnut Creek is not a source of drinking water.
5. All exceedances were well below the EPA MCL of 30 µg/L for U in drinking water. Although this MCL is not directly applicable to the COU, comparison with the drinking water standard offers perspective on the quality of surface water before leaving the COU.

Although there were two reportable conditions for the 30-day average for U at WALPOC, the 12-month rolling average, as a measure of remedy performance, remained below the RFLMA standard during this FYR period. As of December 2021, the 30-day average for U and the 12-month rolling average for U are both below the RFLMA standard.

Because U concentrations are influenced by changing environmental conditions, varying U concentrations at WALPOC are anticipated. While significant U concentration variability can be seen in both individual sample results and in the 30-day averages, the observed variability is not outside of anticipated ranges. In 2015, a comprehensive evaluation of the distribution, transport mechanisms, sources, and isotopic composition of U in North and South Walnut Creeks was completed to evaluate the reportable conditions that occurred during the fourth FYR period (WWE 2015). This evaluation was updated in 2019 and 2021 (WWE 2019; WWE 2021). Among other things, the evaluation suggests a predictable relationship between precipitation and U concentrations in surface water. Specifically, heavy precipitation events (1) increase the mobility of U in soil, which allows increased migration of U to groundwater; (2) increase groundwater discharge to surface water; and (3) increase U concentrations in surface water once direct runoff has diminished. This evaluation also suggests that approximately 10% of the U detected at WALPOC comes from SPPTS effluent and as such, SPPTS effluent does not have a large impact on U concentrations measured at WALPOC (WWE 2019). As discussed in Section 6.1.4.3, plans are currently in development for the addition of a U treatment component at the SPPTS. The degree to which additional U treatment at SPPTS will affect U concentrations observed at WALPOC is uncertain. However, additional U treatment is expected to have a positive impact on overall surface water quality at the site and will support achievement of the RAOs in the long term.

The two 30-day average reportable conditions for U at WALPOC during this FYR period demonstrate the continued need for surface water monitoring as part of the remedy. Surface water monitoring will continue at the site and reportable conditions will be addressed through the RFLMA consultation process. As designed in the RFLMA, reportable conditions prompt the timely evaluation of site conditions and the identification of response actions, as warranted, to ensure continued protection of human health and the environment.

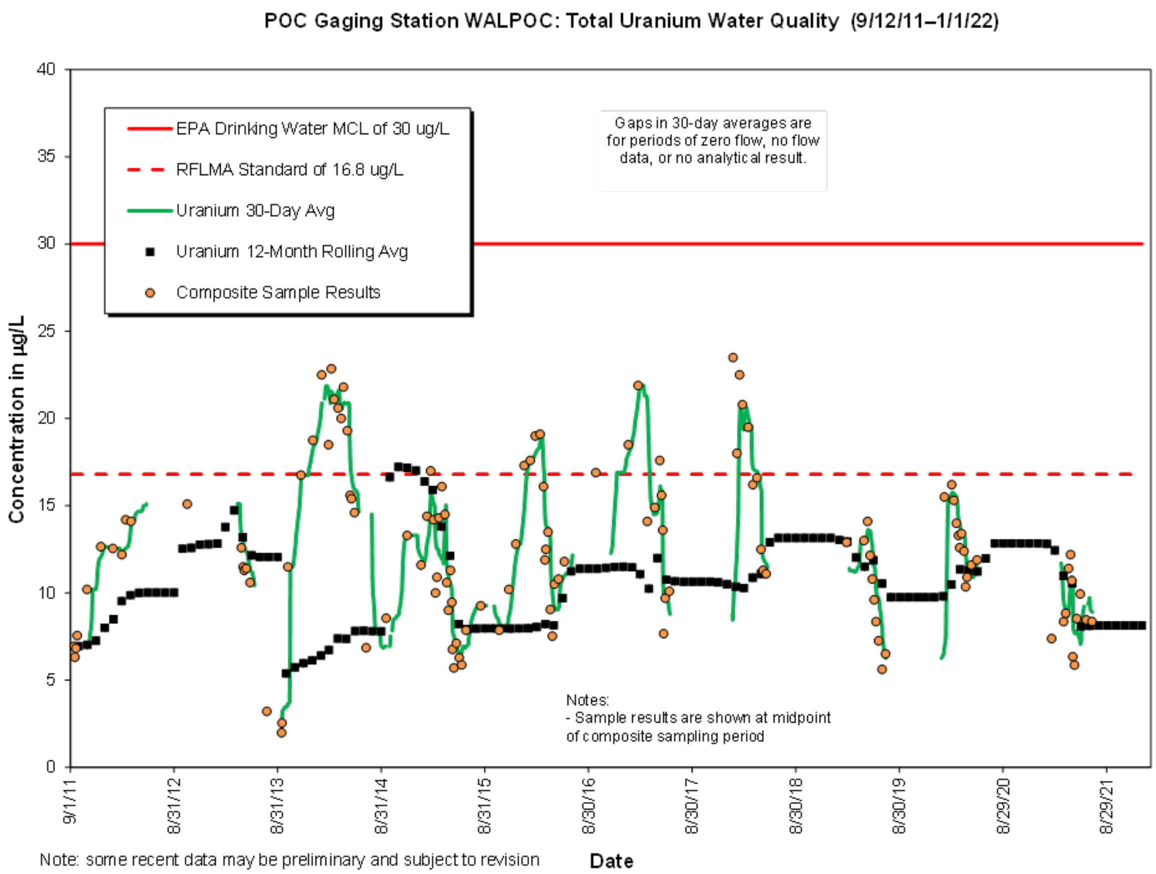


Figure 5. Uranium Concentrations at WALPOC

6.1.4 O&M of Remedy Components

The engineered components of the remedy include the two landfill covers and the groundwater collection and treatment systems. The O&M of the PLF and OLF covers are directly relevant to surface water RAO 1 and soil RAOs 2 and 3; groundwater treatment system O&M are directly relevant to groundwater RAO 2, surface water RAO 1, and soil RAO 1. A summary of the status of the RAOs for the remedy at the RFS is presented in Table 2.

6.1.4.1 PLF

The PLF began operations in 1968 and was used for the disposal of solid wastes, such as construction debris, and hazardous wastes, such as paints and solvents. Procedures were implemented to discontinue the disposal of hazardous waste in the PLF in 1986. The PLF remained in operation until 1998, at which time it was placed in a contingent closure status and seeded to stabilize soil and control erosion. In 2005, the landfill was closed in place with the construction of an approximately 22-acre RCRA-compliant composite cover, monitoring wells, and the PLFTS. A diversion channel surrounds the landfill and diverts stormwater runoff away from the landfill. Subsurface groundwater controls minimize groundwater incursion into the landfill. A passive gas extraction system is also built into the landfill to allow gases to vent to the atmosphere. Fifteen landfill settlement monuments are surveyed annually to confirm that conditions lie within the expected calculations. The locations of the PLF and PLFTS are shown in Figure 6. The PLFTS consists of a passive air stripper (an arrangement of concrete steps over which water flows) designed to remove VOCs. The PLFTS treats landfill seep water and groundwater intercepted by the Groundwater Intercept System, which was constructed to minimize upgradient flow into the PLF.

The evaluation of remedy performance at the PLF considers monitoring data from upgradient and downgradient RCRA wells, the PLFTS, downstream surface water location NNG01, and information obtained in routine inspections.

There are three upgradient and three downgradient RCRA groundwater monitoring wells at the PLF (Figure 6). These wells are sampled for VOCs and metals quarterly[1]. The RFLMA Attachment 2 decision logic flowchart in Figure 10, "RCRA Wells" (Appendix B), describes the evaluation of these data. The RFLMA requires that statistical analyses be conducted on RCRA well data from the PLF to compare analyte concentrations in groundwater at upgradient and downgradient RCRA wells and to determine concentration trends in downgradient wells. These statistical evaluations are conducted annually, and details are presented in the corresponding RFLMA annual reports. The comparison of upgradient versus downgradient wells shows several metals at higher concentrations downgradient than upgradient of the landfill. In some cases, there is an increasing trend for a few metals concentrations within individual downgradient wells. The majority of metals identified in these statistical evaluations are represented by datasets comprising large numbers of nondetects or estimated values. Two of the metals identified in these evaluations are present at elevated concentrations in one or more downgradient wells. Selenium concentrations are consistently above the RFLMA standard in two wells, and uranium infrequently exceeds the RFLMA value in one well. Though these and other metals identified in the statistical evaluations are naturally present in the environment, the data suggest that the

[1] RFLMA Attachment 2 Table 1 was modified during this FYR period (CR 2018-05 [Appendix D]) in part to support changes to analytical methods required to achieve the lower detection limits needed for some analytes.

landfill may be the source of elevated concentrations in downgradient wells. Note that references to "metals" in this context is based on analytes that are identified via the metals analytical methods used for samples collected at the site, even though some analytes may be chemically characterized as nonmetals (such as selenium) or metalloids (such as boron and arsenic). The full report of each statistical evaluation for this FYR period may be found in the RFLMA annual reports (DOE 2018; DOE 2019a; DOE 2020a; DOE 2021b; DOE 2022). The RFLMA Parties consulted annually during this FYR period regarding these results, and no actions were required other than continued monitoring and evaluation (CR 2011-03 [Appendix D]).

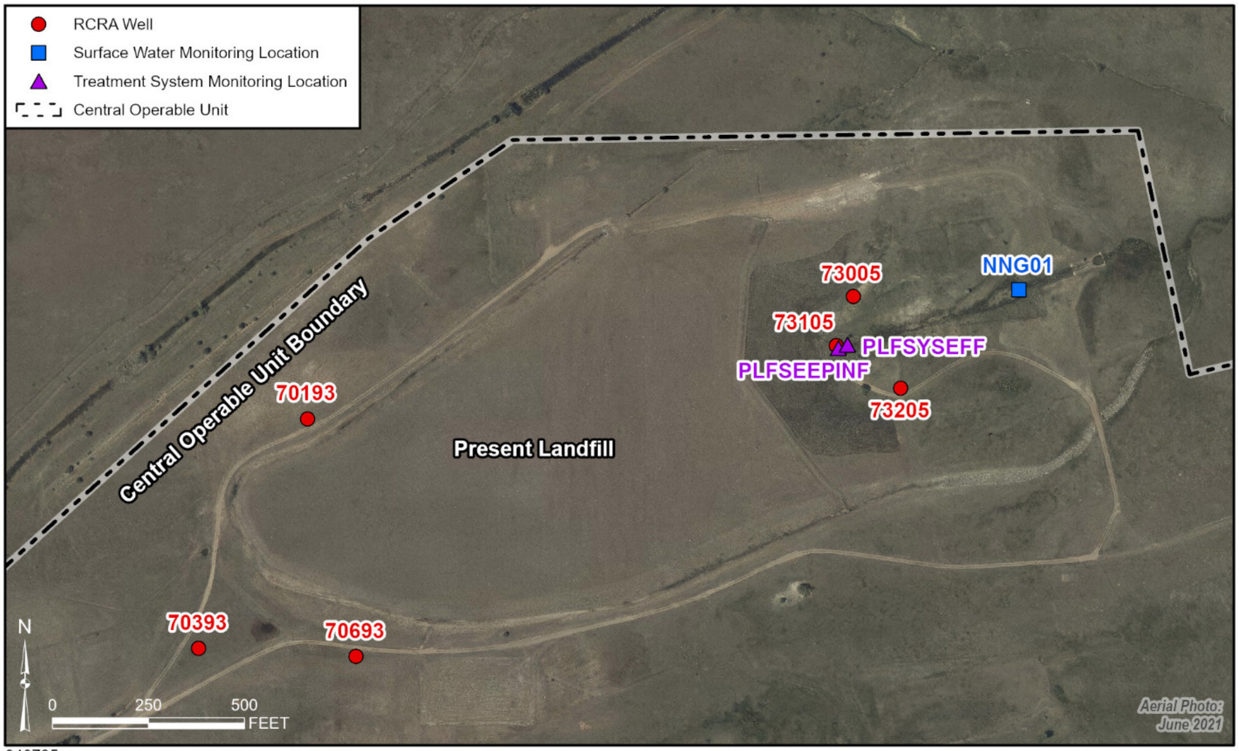


Figure 6. Rocky Flats Site PLF Monitoring Locations

The RFLMA requires monitoring of the influent and effluent from the PLFTS to assess the operation of this passive treatment system. The influent and effluent locations are sampled quarterly for VOCs and metals; the effluent location is also sampled for semivolatile organic compounds (SVOCs). The RFLMA Attachment 2 decision logic flowchart in Figure 11, "Groundwater Treatment Systems" (Appendix B), describes the evaluation of these data. Arsenic was detected above RFLMA standards intermittently in PLFTS effluent during this FYR period, triggering additional sampling in each instance. Subsequent effluent sample results were below RFLMA standards. As a result, sampling of downstream surface water location NNG01 and consultation with the RFLMA Parties was not required. PLFTS effluent meets the applicable RFLMA standards at the end of this review period. All routine maintenance was performed at the PLFTS during this FYR period.

The inspection frequency for the PLF is quarterly, and settlement monuments are surveyed annually. Appendix G contains the results of the most recent PLF quarterly inspection (March 2022). Additional inspections are required following specific weather events defined in the RFLMA. The PLF inspection includes groundwater and surface water monitoring facilities, subsidence and consolidation, slope stability, soil cover, seeps on and around the soil cover, stormwater management structures, and erosion in surrounding features. During this FYR period, no notable conditions were observed during PLF inspections. Vegetation at the PLF is well established. There has been no evidence of soil erosion or other conditions that could potentially impact the integrity of the landfill cover. Nine settlement monuments on the landfill cover measure consolidation and settlement of the landfill. The PLF design included an allowable amount of consolidation and settlement over a 30-year period after closure. Annual settlement monument survey data are compared to the expected settlement calculated in the final design to determine the degree of subsidence at the landfill. Settlement and consolidation have been below expected parameters for 15 years since construction was completed in May 2005, with no differential settlement detected. The quarterly inspection frequency and annual settlement monument surveying at PLF is recommended to continue.

The remedy at the PLF is working as intended by the decision documents. The landfill cover and stormwater management system at the PLF remain intact and effective in preventing unacceptable exposure to buried wastes. Physical controls required by the remedy identify the COU boundary and applicable use restrictions, thereby minimizing the potential for inadvertent access to the COU and the PLF by unauthorized parties. ICs specific to the PLF prohibit unauthorized activities on the landfill cover to ensure that the integrity of the cover is maintained and unacceptable exposures do not occur. Monitoring data at the PLFTS indicate that the system is operating as designed and is effective in removing trace VOCs from groundwater and seeps at the landfill. While some analytes in PLFTS effluent were detected above the applicable RFLMA standards during this FYR period, these occurrences were short lived and did not impact downstream surface water quality.

6.1.4.2 OLF

The OLF was used to dispose of solid sanitary wastes and construction debris from 1952 to 1968. Other wastes potentially disposed in the landfill included solvents, paints, oils, pesticides, and items contaminated with beryllium and U. There is no information indicating that the OLF was used for routine disposal of radioactive material or hazardous wastes. The OLF was closed in 2005. The closure included cutting, filling, and regrading the original surface; constructing a 20-foot-high, 1000-foot-long soil buttress at the toe of the landfill; and placing a 2-foot-thick soil cover over the regraded surface. Stormwater control features were also installed and included a series of diversion berms and channels on the cover to divert surface water run-on and runoff to drainage channels installed on the east and west perimeter of the landfill. The approximately 20-acre landfill is on a south-facing hillside in the southwestern portion of the COU (Figure 2).

The natural geologic and hydrologic conditions at the OLF, and similar areas in the Colorado Front Range, make it prone to slumping and settling that can be exacerbated by heavy precipitation. These conditions existed before waste was first placed on the hillside in the early 1950s and are visible in the earliest aerial photos from 1937. These natural geologic conditions remained even after improvements to the OLF were completed in September 2005 as part of site closure. Following closure of the OLF in 2005, the hillside remained stable until 2007, when landfill inspections identified localized slumping and settling in the westernmost portion of the cover. In response, maintenance was conducted that included the expansion and addition of subsurface seep drains and reconfiguration of stormwater features in the impacted area. Over the next decade, varying degrees of slumping, settlement, and cracking were observed, particularly in the easternmost portion of the constructed hillside, requiring regular maintenance at the landfill. In addition, several repair efforts were conducted that included enhancing drainage to capture groundwater, regrading surface areas to promote runoff, and compacting soils to reduce infiltration. Although there has been cracking and slumping in the western and eastern edges of the OLF hillside, the central portion of this hillside that overlies the bulk of the buried waste (i.e., waste footprint) and is supported by the soil buttress has remained stable. Seeps, however, continued to be observed during this FYR period in several areas of the landfill.

In addition to the maintenance and repair of the slumping, cracking, and displacements that occurred at the edges of the landfill, additional geotechnical investigations and slope stability evaluations were completed. Engineering recommendations for stabilizing the unstable sides of the OLF were developed. The presence of groundwater in and around the OLF has played a key role in slumping and the occurrence of seeps, since even before the existence of the landfill. Groundwater flows toward the OLF and Woman Creek from the pediment area north of the OLF. Some seeps have been observed to daylight intermittently on the landfill cover and others flow continuously. In addition, ponding of precipitation and snowmelt has been observed in the upgradient portions of the diversion berm channels. The slumping observed within the OLF area has occurred mainly because of the introduction of water into the relatively weak subsurface materials.

Following the geotechnical investigations and engineering recommendations, engineering design work for the OLF maintenance project designed to stabilize portions of this hillside began in 2018 and was completed in 2019. Field work to perform the corresponding mechanical stabilization commenced in August 2019 and was completed in 2020 (CR 2019-02 [Appendix D]). The engineered stabilization on the east and west sides of the OLF reduces the potential for slumping and other movement that would have destabilized larger portions of the OLF over time. Key features of the OLF maintenance project included the addition of subsurface groundwater diversion drains that channel groundwater away from the landfill, upgrades to the existing stormwater control features on the east and west perimeter of the landfill, and installation of several rows of ground anchors with reaction blocks to provide structural support to the affected areas of the OLF hillside. On the east and west sides of the landfill, a total of 267 anchors and reaction blocks were installed. The ground anchors and reaction blocks are used to prevent landslide-type movements from occurring by anchoring the reaction blocks into the underlying competent bedrock and restraining slide prone materials. The subsurface drain system lowers the groundwater level, providing further stabilization.

Major OLF activities are included in Appendix A, "Site Chronology." The RFLMA annual reports provide more detailed accounts of OLF maintenance activities and associated geotechnical investigations completed in previous years in response to hillside movement.

The evaluation of remedy performance at the OLF considers monitoring data from upgradient and downgradient RCRA wells, monitoring data from upstream and downstream surface water locations GS05 and GS59, and information obtained in routine inspections.

There are three downgradient and one upgradient RCRA groundwater monitoring wells at the OLF (Figure 7). These wells are sampled quarterly for VOCs, SVOCs, and metals. The RFLMA Attachment 2 decision logic flowchart in Figure 10, "RCRA Wells" (Appendix B), describes the evaluation of these RCRA well data. The RFLMA requires that statistical analyses be conducted on RCRA well data from the OLF to compare analyte concentrations in groundwater at upgradient and downgradient RCRA wells and to determine concentration trends in downgradient wells. These statistical evaluations are conducted annually, and details are presented in the corresponding RFLMA annual reports. As with the PLF RCRA wells, results of statistical analyses for OLF RCRA well data were very similar for each year within this FYR period. The comparison of groundwater data from upgradient versus downgradient wells shows several metals at higher concentrations downgradient than upgradient of the landfill. In some cases, there is an increasing trend for a few metals concentrations within individual downgradient wells. These metals are present at concentrations below the applicable RFLMA standards and are largely represented by nondetects or estimated values; in addition, many are naturally present in the environment. Note that references to “metals” in this context is based on analytes that are identified via the metals analytical methods used for samples collected at the site, even though some analytes may be chemically characterized as nonmetals (such as selenium) or metalloids (such as boron and arsenic). The full report of each statistical analysis for this FYR period may be found in the RFLMA annual reports (DOE 2018; DOE 2019a; DOE 2020a; DOE 2021b; DOE 2022). DOE has consulted with EPA and CDPHE annually on these results, and no action has been required other than continued monitoring and evaluation (CR 2011-03 [Appendix D]).

Monitoring at the OLF also includes the collection of surface water samples at locations in Woman Creek upstream (GS05) and downstream (GS59) of the landfill (Figure 7). These locations are sampled quarterly for VOCs and metals[2]. The RFLMA Attachment 2 decision logic flowchart in Figure 12, “Original Landfill Surface Water” (Appendix B), describes the evaluation of these data. During this FYR period, the quarterly mean concentrations for all sample results at location GS59 were below the applicable RFLMA standards. The results of surface water monitoring at the OLF for each year in this FYR period may be found in RFLMA annual reports.

[2] Samples for metals other than mercury are currently collected as automated flow-paced composite samples.

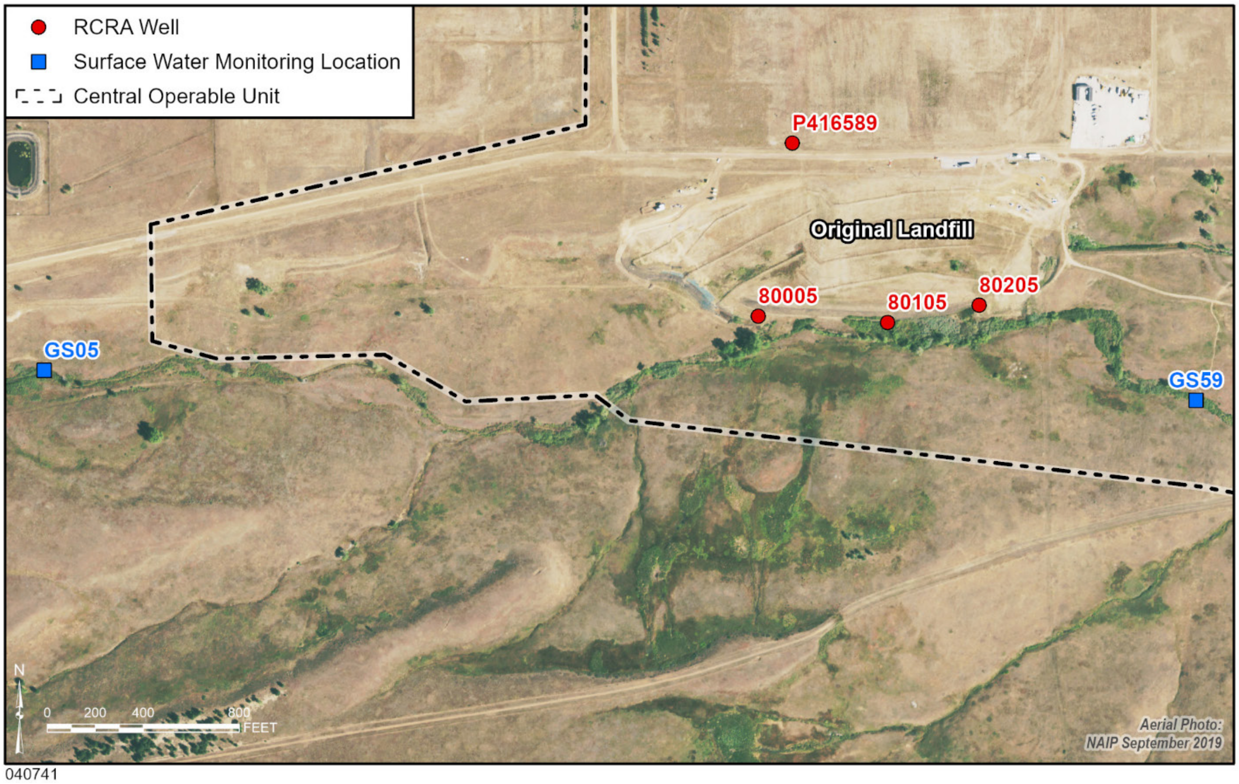


Figure 7. Rocky Flats Site OLF Monitoring Locations

During the first 3 years of this FYR period, routine and weather-related inspections at the OLF identified localized slumping and cracking along the eastern and western edges of the landfill consistent with past observations. Repair and maintenance activities were performed in response to these conditions (see CR 2017-04, CR 2018-01, and Notification 020818 [Appendix D]). In addition, previously established measures to divert groundwater and seepage away from the landfill continued to operate. The significant precipitation events in 2013 and 2015 prompted LM to evaluate a longer-term solution to hillside instability at the OLF, culminating in the maintenance project described above and illustrated in Figure 8. At the end of this FYR period, these engineered structures will have been in place for about 1.5 years. Hillside movement has not been visible in that time despite the fairly moist spring of 2021. The long-term effectiveness of the project and its bearing on the protectiveness of the remedy at the OLF will continue to be assessed in future FYRs.

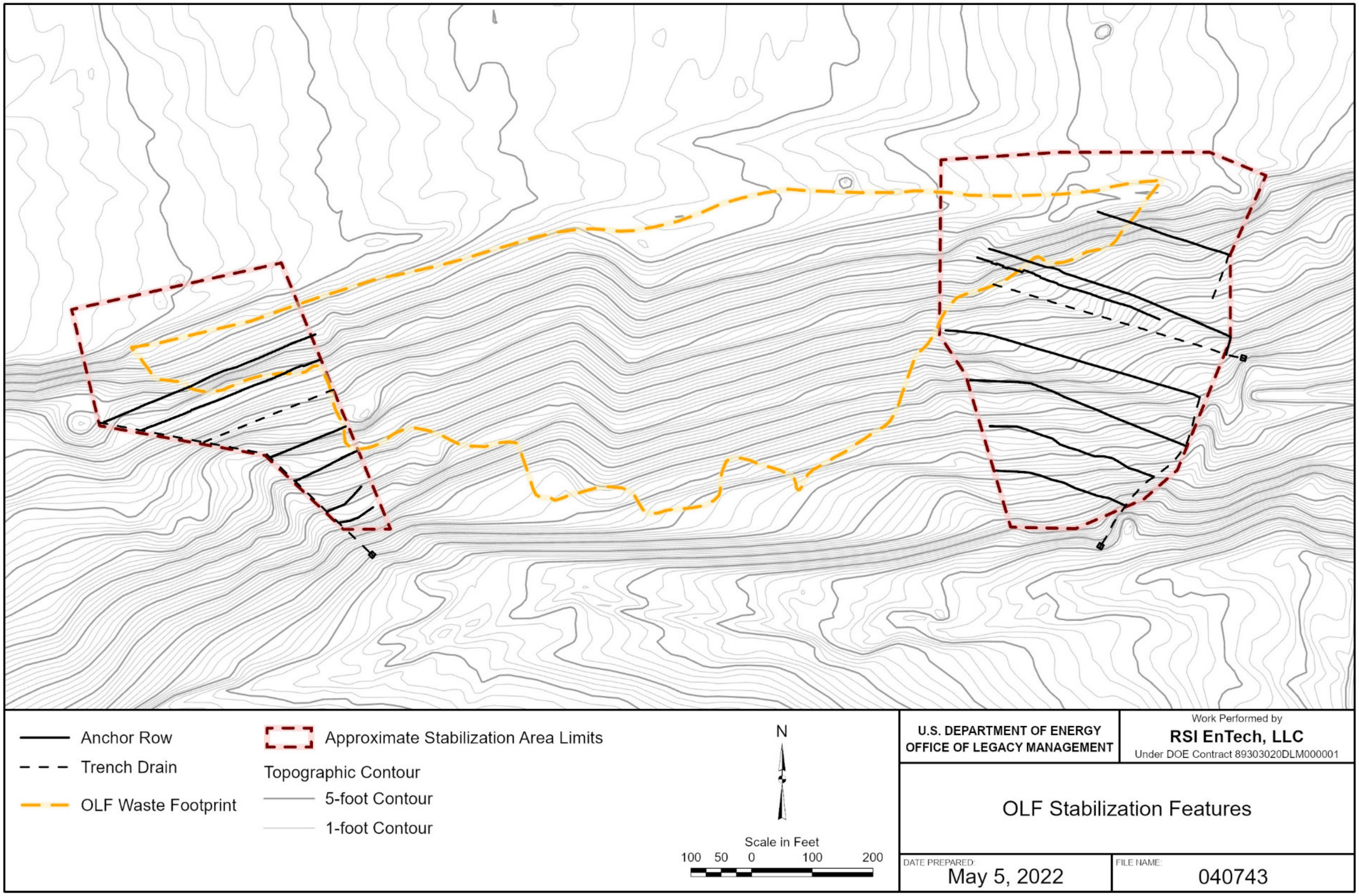


Figure 8. OLF Stabilization Design Features

The current inspection frequency for the OLF is monthly, and settlement monuments are surveyed quarterly. Appendix G contains the results of the most recent OLF monthly inspection (March 2022). Additional inspections are required following specific weather events defined in the RFLMA. Inspection information includes subsidence and consolidation, slope stability, soil cover, stormwater management structures, and erosion in surrounding features. When the OLF was closed in 2005, eight settlement monuments were placed on the landfill cover to monitor consolidation and settlement. Quarterly settlement monument survey data are compared to the expected settlement calculated in the final design to determine the degree of subsidence at the landfill. The eight settlement monuments were surveyed quarterly during this FYR period, with one exception. One of the monuments (monument E) was located within the construction area of the OLF maintenance project and had to be temporarily removed. As a result, this monument was not surveyed in the second quarter of 2020. The monument was reinstalled slightly uphill from its original location in the third quarter of 2020. Quarterly surveying of this monument resumed in the third quarter of 2020 with a new baseline survey. The total elevation change before relocation and reestablishment of the baseline survey at this monument is within the acceptable limits established at closure. The vertical settling at all other monuments is within the acceptable limits established at closure and the total observed settlement has not exceeded the normal range of vertical survey error.

The remedy at the OLF was designed to (1) prevent direct contact with landfill soil and commingled waste and (2) control soil erosion caused by stormwater run-on and runoff (DOE 2005b). The areas that were unstable before the maintenance project are on the margins of the constructed hillside (almost entirely outside the waste footprint), while the central portion (waste footprint) has remained stable because of the engineered buttress at the base of the hillside. Because the central portion of the landfill remained stable, the soil cover was effective in preventing exposure to buried waste. However, the continued slumping on the east and west portions of the landfill highlighted the need for maintenance to ensure the continued integrity of the cover. Thus, stabilization of the hillside margins during the OLF maintenance project was designed to minimize additional instability that might otherwise propagate into the waste footprint portion of the landfill. Additional soil was placed on the east and west edges of the landfill as part of the project. This ensured that the soil cover in the areas of slumping was restored to a minimum of 2 ft of soil cover, as required by the landfill closure design.

Maintenance actions have ensured that the remedy continues to work as intended by the decision documents and remains protective of human health and the environment. Maintenance and repair activities have been completed throughout this FYR period as required to maintain the integrity of the landfill cover and prevent exposure to buried wastes. Physical controls required by the remedy identify the COU boundary and applicable use restrictions, thereby minimizing the potential for inadvertent access to the COU and OLF by unauthorized parties. ICs specific to the OLF are in place and effective. These ICs prohibit unauthorized activities on the landfill cover to ensure that the integrity of the cover is maintained and unacceptable exposures do not occur. Groundwater and surface water monitoring data collected during this FYR period suggest that the past hillside instability at the OLF has not negatively affected groundwater or surface water quality.

6.1.4.3 Groundwater Treatment Systems

The remedy in the CAD/ROD included the four groundwater treatment systems operating when the COU was closed in 2005: the PLFTS, SPPTS, MSPTS, and ETPTS. Contaminated groundwater continues to be collected at all four systems, but, in 2016, the number of groundwater treatment systems was reduced from four to three (CR 2016-02 [Appendix D] and the 2016 annual report [DOE 2017a]). Since that time, groundwater collected at the former MSPTS has been transferred to the nearby ETPTS for treatment; the MSPTS is now referred to as the MSPCS. The three treatment systems continue to remove target contaminants from groundwater (VOCs, nitrate, U) and reduce contaminant load to surface water. Reducing the contaminant load in the effluent of these treatment systems will consequently reduce incidences of exceeding concentration-based surface water standards. Each groundwater treatment system is monitored, at a minimum, for untreated influent and treated effluent and for impacts to surface water downstream of the systems. Evaluation of groundwater treatment system performance determines if (1) influent water quality indicates that treatment is still necessary, (2) effluent water quality indicates that system maintenance is required, and (3) surface water quality suggests impacts from inadequate treatment of influent. Monitoring data associated with the groundwater treatment systems are evaluated in accordance with RFLMA Attachment 2 decision logic flowchart in Figure 11, “Groundwater Treatment Systems” (Appendix B). A summary of treatment system performance during this FYR period for the SPPTS, MSPCS, and ETPTS is provided in the following sections; additional detail is found in Appendix E. PLFTS system performance is discussed in Section 6.1.4.1.

SPPTS

The SPPTS is functioning as intended by the decision documents with respect to nitrate treatment and overall reduction of nitrate and U loads to surface water. In 2018, final adjustments and upgrades were completed at the SPPTS to convert the full-scale, interim nitrate treatment lagoon installed in 2016 to a long-term nitrate treatment component. During this FYR period, treated groundwater leaving the SPPTS almost always met the RFLMA standard for nitrate but not the standard for U, as discussed in this section. Additional information on the SPPTS is found in Appendix E.

In accordance with the RFLMA, the SPPTS influent, effluent, and downstream surface water location GS13 (see Appendix E) are sampled semiannually for U and nitrate. Additional samples were collected biweekly at the SPPTS to support other data needs; all data collected at the SPPTS were considered in this FYR.

Throughout this FYR period, nitrate treatment effectiveness overall has been very good, with very few instances in which nitrate in SPPTS effluent exceeded the RFLMA standard of 10 milligrams per liter (mg/L) as N (see Appendix E, Section E1.1.4.2). In fact, the last instance when nitrate in system effluent exceeded the RFLMA standard was in January 2020. For this FYR period, nitrate concentrations (as N) in SPPTS influent averaged slightly more than 576 mg/L and in effluent averaged 1.63 mg/L, based on 121 samples each. Of the 121 effluent samples, 7 exceeded the RFLMA standard and 114 were below that level, including 66 in which nitrate was nondetect.

Uranium concentrations are being reduced by treatment at the SPPTS, as is the U load to surface water; however, U treatment requires improvement to meet RFLMA standards. Over the last several years, numerous treatability studies have been performed to test U removal. During the last FYR period, an alternatives evaluation was conducted that determined a short list of possible treatment approaches. Final testing of U treatment approaches will be conducted at laboratory and bench scale in 2022. Results will lead to selection of a treatment approach for longer-duration testing at pilot scale in the 2022–2023 time frame. A full-scale U treatment design will then be developed, and construction is planned for the 2023–2024 time frame.

During this FYR period, U was detected above the RFLMA standard in some samples from downstream surface water locations GS13 and WALPOC. As discussed in Section 6.1.3.1, the 30-day average U concentration at WALPOC, which is downstream of GS13, exceeded the RFLMA standard twice during this FYR period. However, according to a multiyear study of U variability in the Walnut Creek watershed, the U in SPPTS effluent comprises only approximately 10% of the U detected at WALPOC (WWE 2019). This suggests that effluent from the SPPTS does not have a large impact on U concentrations detected in Walnut Creek at WALPOC.

The SPPTS comprises treatment facilities and a subsurface network of groundwater collection and transfer components. A large portion of the subsurface network underlies a north-facing hillside that slopes toward North Walnut Creek. Cracks on this hillside have been observed since before site closure and showed increased movement in the years after closure. Following the wet spring of 2015, a pronounced scarp (referred to as the North Walnut Creek Slump [NWCS]) appeared on the hillside. Since that time, DOE has implemented measures to stem hillside movement, but the hillside has continued to move (CR 2017-03 [Appendix D]; DOE 2017a; DOE 2018; DOE 2019a; DOE 2020a; DOE 2021b; DOE 2022). During this FYR period, slump movement has largely consisted of slow creep that averages approximately 2 ft per year at the approximate location of the original scarp face. The NWCS has not impacted groundwater monitoring activities in the vicinity, and there is no evidence that groundwater treatment at the SPPTS has been affected. Hillside conditions are monitored and evaluated routinely, and more intensive geotechnical evaluations were conducted during this FYR period. DOE will continue to monitor movement of the hillside and will evaluate options for addressing hillside instability, as appropriate, through the RFLMA consultative process.

In October 2019, a swale and rock crossing were constructed upgradient of the NWCS as a best management practice (CR 2019-03 [Appendix D]). These features, combined with a preexisting roadside ditch, are intended to minimize stormwater run-on from the area south of the SPPTS access road to the slump area. The swale was specifically designed to reduce the impact of high-intensity storms on the slump.

MSPCS and ETPTS

The MSPCS and ETPTS are functioning as intended by the decision documents. In accordance with the RFLMA, MSPCS influent, ETPTS influent, ETPTS effluent, and the associated downstream surface water location POM2 (see Appendix E) are sampled semiannually for VOCs. Although influent is sampled separately at MSPCS and ETPTS, the effluent and surface water sample locations are the same because groundwater collected in the MSPCS is combined with ETPTS influent and treated at the ETPTS. During this FYR period, VOCs were detected without exception in MSPCS and ETPTS influent at concentrations above their RFLMA standards. VOCs were not detected in ETPTS effluent above the RFLMA standards. Low concentrations of VOCs were occasionally detected at the downstream surface location POM2 during this FYR period, but no VOCs have ever exceeded their respective RFLMA standards at this location. The ETPTS has been extremely effective in reducing VOC concentrations in groundwater treated by the system and reducing contaminant load to surface water. Additional information on the MSPCS and ETPTS is found in Appendix E.

The configuration of the MSPCS and ETPTS remained unchanged throughout this FYR period after the extensive reconfigurations completed in the previous FYR period. The ETPTS uses air stripping technology to treat VOC-contaminated groundwater. After passing through the air stripper, treated water is routed to a holding tank, from which it is pumped out at a controlled rate to a below-grade discharge gallery. Hard-water scale (calcium carbonate) has accumulated in the effluent pipeline. A portion of the pipeline was temporarily replaced in late 2021, and the effluent piping and discharge gallery were replaced in early 2022 (CR 2021-04 and CR 2021-05 [Appendix D]).

In 2020, the 96 lead-acid batteries that powered the air stripper at the ETPTS were replaced with eight lithium-iron-phosphate batteries. The lead-acid batteries required replacement every 5–6 years, whereas the lithium-iron-phosphate batteries have an anticipated lifespan of more than 20 years. At the same time the batteries were replaced, the system was optimized to improve efficiency, which involved minor rewiring of the photovoltaic panels and replacement of some electrical components.

6.1.5 O&M Costs

The O&M costs of the selected remedy were estimated in the RI/FS report and presented in the 2006 Proposed Plan. The total annual estimated O&M costs in 2005 dollars were $2,757,000, which included groundwater treatment systems media replacement estimated at $728,000 every 5 years for each of the three systems that utilized treatment media at that time.

The remedy-related implementation cost for this FYR period was compiled using actual costs for fiscal years 2017–2021. The O&M and capital costs associated with the following activities were considered:

- Groundwater and surface water monitoring, including equipment capital costs, as well as operation, inspection, and maintenance of the groundwater treatment systems
- SPPTS nitrate treatment component optimization
- Continuation of U treatment technology investigation and demonstration at the SPPTS
- ETPTS battery replacement and electrical streamlining
- Inspection and monitoring of physical controls and ICs
- RFLMA-required data collection and reporting, including public participation activities
- Implementation of the RFLMA consultative process
- PLF and OLF inspections and cover vegetation management, including weed control
- Engineering design and planning for the OLF maintenance project

- OLF maintenance, including several interim maintenance projects, and completion of the OLF maintenance project
- Monitoring and maintenance of the North Walnut Creek hillside, including a regrade of the area in late 2017, minor regrading and maintenance each year, and construction of a swale and rock crossings for stormwater control
- Transport and placement of approximately 1700 cubic yards of excess soil from NWCS to East Trenches to augment existing soil cover
- Road maintenance, including 2018 west access gate bridge maintenance
- Erosion controls, subsidence repair, and revegetation monitoring throughout the COU
- Conducting the FYR
- Updating the geochemistry evaluation for water quality in Walnut Creek
- Evaluating reportable conditions at locations WALPOC, SW027, and GS10 and AOC well 10304 and associated actions (e.g., additional sampling)
- Monitoring and consultation regarding threatened and endangered species and wetlands
- Project management and overhead costs, including development and implementation of coronavirus disease 2019 (COVID-19) pandemic response actions related to O&M activities

The total O&M and capital cost for this period is approximately $35.3 million. The RI/FS report projected that the 5-year cost for implementing the selected remedy would be approximately $20.2 million in escalated 2005 (2.5% per year) dollars. The remedy implementation costs are higher than the projected costs for this FYR period due to the following factors:

- OLF maintenance requirements were significantly higher than projected due to interim maintenance actions and the planning and execution of the OLF maintenance project, which was necessary for long-term stabilization of the hillside. Completion of this project is expected to significantly lower future O&M costs for the OLF.
- The use of American-made materials, specifically American-made steel, was required.
- Additional costs were incurred as part of the battery replacement project at the ETPTS. In order to streamline and optimize performance of the system, additional electrical work was performed that included replacement of electrical components and rewiring the solar panels for greater efficiency.
- The COVID-19 pandemic caused unanticipated increases in the costs for travel, vehicle use and disinfection, materials and equipment, subcontractor services, information technology expenditures, and support for sitewide monitoring and inspections.
- The original groundwater treatment systems were passive systems designed to require limited human interaction. The current systems, which provide significantly more effective treatment, no longer rely on treatment media, but do require more labor for O&M. Costs were incurred in this FYR period to continue nitrate treatment optimization and U treatment improvement efforts at the SPPTS.
- Increased instability of the North Walnut Creek hillside required additional monitoring, more frequent maintenance, and completion of interim measures to promote stability.

6.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and RAOs Used at the Time of the Remedy Still Valid?

Based on the evaluation presented in this section, the exposure assumptions, toxicity levels, cleanup levels, and RAOs used at the time of the remedy are still valid, and revision of the RAOs is not necessary. There were no changes in exposure pathways or assumptions during this FYR period; land use in the COU remains consistent with the Rocky Flats Wildlife Refuge land use assumption in the CAD/ROD. The risk of known residual chemical and radiological constituents to the WRW in the COU remains at the lower end of the CERCLA acceptable risk range. However, the potential risk of per- and polyfluoroalkyl substances (PFAS) to the WRW, other potential human receptors, and ecological receptors has not been fully evaluated. In this FYR period, there were some revisions to surface water quality standards and toxicity levels, which are discussed in the following sections.

6.2.1 Evaluation of Changes in Standards

A review of the CAD/ROD ARARs was conducted to determine if there were any promulgated changes during this FYR period to statutes or regulations that could potentially impact remedy protectiveness. Appendix H is a table of changes to the CAD/ROD ARARs and other potentially applicable regulations considered in this FYR evaluation. Newly promulgated or modified ARARs contribute to the evaluation of protectiveness and are considered in the FYR.

6.2.1.1 Surface Water Standards

The remedy performance standards for surface water and groundwater at the COU are the Colorado surface water quality standards identified as ARARs in the CAD/ROD. The surface water standards applicable to the COU are based on (1) Colorado WQCC regulation No. 31, "Colorado Basic Standards and Methodologies for Surface Waters" (Volume 5 *Code of Colorado Regulations* Section 1002-31 [5 CCR 1002-31]), which are statewide basic standards, and (2) Colorado WQCC regulation No. 38, "Classification and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin" (5 CCR 1002-38), which are site-specific standards. In 2020, revisions to the stream segments and descriptions applicable to the COU were adopted in WQCC regulation No. 38. As a result, the streams in the COU now comprise Big Dry Creek segments 4a, 5a, and 5b of the South Platte River Basin. This revision was part of a statewide change that created new "lakes and reservoirs" segments with their own site-specific standards separate from stream segments. For the COU, former segment 5 was separated into 5a ("North Walnut Creek from the western edge of the COU and South Walnut Creek from its source, including all tributaries and wetlands, to the eastern boundary of the COU") and 5b ("All lakes and reservoirs from the western edge of the COU to the eastern boundary of the COU and Pond C-2 on Woman Creek"). The only change to segment 4a was the stream description, which is now "Mainstem and all tributaries to Woman and Walnut Creeks from sources to Standley Lake and Great Western Reservoir respectively, except for listings in Segments 4b and 5a." For reference, segment 4b is defined as "North Walnut Creek from its source to the western edge of the Central Operable Unit. North and South Walnut Creek and Walnut Creek, from the eastern edge of the Central Operable Unit on Rocky Flats Property to Indiana Street." The creation of segment 5b does not impact remedy protectiveness because all water bodies within the COU, including Pond C-2, ultimately drain to the two POCs, where remedy performance is monitored. The changes to the segment descriptions are administrative in nature and do not affect remedy protectiveness.

The basic surface water standards for seven polycyclic aromatic hydrocarbons (PAHs) and the table value standard (TVS) equation for cadmium were revised in this FYR period. In addition, four new chemicals were added to the basic standards.

Of the seven PAHs, two are monitored at the RFS[3]: benzo(a)pyrene and dibenzo(a,h)anthracene. The standard for benzo(a)pyrene decreased (i.e., is now more stringent) and the standard for dibenzo(a,h)anthracene increased (i.e., is now less stringent). Because standard analytical methods cannot currently detect these two constituents in RFS water at or below the surface water standard, the PQL for each constituent serves as the compliance threshold. The PQLs for the constituents monitored at the RFS (Table 1 of RFLMA Attachment 2) were reviewed and revised through the RFLMA consultation process in 2018 (CR 2018-05 [Appendix D]). The PQLs were revised considering CDPHE PQL guidance (CDPHE 2015), available laboratory analytical methods, and postclosure groundwater and surface water monitoring data. The CDPHE PQL guidance considered in the 2018 review was not updated during this FYR period. Because the PQLs are the compliance thresholds for benzo(a)pyrene and dibenzo(a,h)anthracene and they have not changed, the changes to the surface water standards for these analytes do not impact protectiveness.

Four of the seven PAHs (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene) are no longer monitored at the RFS, so changes to these standards do not impact protectiveness. Removal of these PAHs from the list of analytes in 2018 was approved by DOE, EPA, and CDPHE through the RFLMA modification process (see Section 5.3).

The surface water standard for cadmium is a TVS that is calculated using site-specific input (in this case, water hardness). The equation used to calculate the cadmium TVS was revised in 2020 (5 CCR 1002-38, Appendix 38-1). The revised equation resulted in a calculated standard for cadmium (0.94 µg/L) that is higher than the previous calculated standard of 0.56 µg/L. Therefore, the protectiveness of the remedy is not impacted.

In 2020, four new chemicals were added to the basic surface water standards: Hexahydro-1,3,5-trinitro-1,3,5-triazine (i.e., Royal Demolition Explosive [RDX]), 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene (5 CCR 1002-31). The only standards promulgated for these four chemicals apply to streams with a water supply use classification. The water supply use classification is applicable to each of the COU stream segments (4a, 5a, and 5b). RDX is an explosives compound that is unlikely to have been used at the RFS. An assessment of the other three chemicals is ongoing to determine the applicability of these standards to COU stream segments. However, the addition of these four standards to the Colorado regulations does not impact protectiveness of human health and the environment because (1) ICs are in place to prevent the use of surface water for drinking, (2) the COU streams are not currently used as a water supply, and (3) no aquatic life-based standards were promulgated for these chemicals.

[3] The list of analytes that require monitoring at Rocky Flats is in Table 1 of RFLMA Attachment 2. Revisions to the list of analytes and the PQLs in Table 1 were proposed and approved by DOE, EPA, and CDPHE in 2018 through the RFLMA consultation process (CR 2018-05).

6.2.1.2 List of Impaired Waters

In 2019, two COU stream segments (COSPBD04a and COSPBD05) were added to the Clean Water Act 303(b) list of impaired and threatened waters (5 CCR 1002-93.118). Segment 4a was added to the list for total iron; segment 5 was added for nitrate + nitrite (5 CCR 1002-93.3). The addition of these stream segments to the 303(b) list has no impact on remedy protectiveness because there are no standards or requirements associated with these listings at this time. Although this regulation (5 CCR 1002-93) is not an ARAR identified in the 2006 CAD/ROD, future action associated with these listings, including potential adoption of stream-specific standards by the state of Colorado, will be reviewed as part of future FYRs.

6.2.1.3 State of Colorado Corrective Action Regulations

In 2018, CDPHE added perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) and their anions, perfluorooctanoate and perfluorooctane sulfonate, respectively, to the list of hazardous constituents in Appendix VIII to Part 261 of the Colorado hazardous waste regulations (6 CCR 1007-3). These regulations are ARARs listed in the CAD/ROD. The addition of these chemicals to Appendix VIII expands the universe of contaminants regulated by CDPHE under the corrective action program. PFOA and PFOS are included in a group of emerging contaminants known as PFAS. Additional detail on these emerging contaminants is found in Section 6.2.3.

6.2.2 Evaluation of Changes in Exposure Assumptions and Toxicity Data

For the last FYR in 2017, an extensive evaluation was completed to identify changes in exposure assumptions and toxicity values that had occurred since completion of the CRA in 2006. This FYR evaluation builds on the 2017 FYR evaluation, focusing on changes in the 5 years since the last FYR. The same methodology applied in the 2017 FYR evaluation was utilized in this FYR evaluation and is described in Appendix C.

There were no changes to exposure assumptions during this FYR period. The assumptions used for the WRW remain valid. Exposure assumptions are conservative (i.e., likely overestimate actual risk) and appropriate based on actual land use. There were some changes to toxicity values since the last FYR, which are discussed in the following sections.

6.2.2.1 Chemical Constituents

The evaluation performed in the 2017 FYR was essentially a complete update of the screening process used in the CRA to account for any chemical-specific changes in toxicity values. In lieu of recalculating the soil preliminary remediation goals (PRGs), the then-current industrial regional screening levels (RSLs)[4] were used as a proxy for updated WRW PRGs (EPA 2016). As described in Appendix C, the default exposure assumptions for the industrial soil scenario used to develop the corresponding 2016 RSLs were comparable but more conservative (i.e., health protective) than those used for the WRW described in the CRA. The RSLs are conservative screening values that are used in this FYR to identify individual contaminants that may require further evaluation. The development of RSLs does not use site-specific analytical data because RSLs represent concentrations based on a target risk level rather than a calculated risk from measured concentrations.

[4] The EPA RSLs are updated regularly and presented in generic tables available on the EPA website. The values are based on conservative exposure assumptions and inputs and do not include site-specific considerations.

This FYR evaluation used the 2016 RSLs included in the last FYR evaluation as a baseline to evaluate changes in toxicity values over the past 5 years. The exposure assessment methods and default input values in the 2021 soil RSLs for an industrial worker have not changed since the last FYR evaluation (EPA 2021b). Any changes to toxicity values since the last FYR are included in the 2021 RSLs. Therefore, the 2021 RSLs are appropriate for use as a screening tool to represent updated WRW PRGs in this FYR evaluation.

The process used in this FYR to evaluate chemical constituents is shown in Figure 9; this process is consistent with the screening process used in the 2006 CRA and the 2017 FYR. Additional detail on the chemical constituent evaluation process may be found in Appendix C. Changes to the toxicity values used in calculating the current RSLs were identified by comparing the 2021 RSLs to the 2016 RSLs. Because no RSL exposure parameter values have changed since the last FYR, the vast majority of the 2021 RSLs are unchanged. The 2021 RSLs that are greater than the 2016 RSLs or remain unchanged are identified as still protective for screening at a Hazard Quotient (HQ) of 0.1 and a cancer risk of 1×10^{-6}. The RSLs for three analytes detected in COU surface soil/sediments were revised since the last FYR (Appendix C). All three analytes (dichlorodiphenyldichloroethane [DDD], Aroclor 1248, and naphthalene) now have more stringent (i.e., lower) RSL values. The current DDD RSL is based on a screening-level reference dose (0.00003 milligram per kilogram per day [mg/kg/d]) described as being “of limited use to risk assessors” and not of sufficient quality for quantitative risk assessment (EPA 2017). The 2016 DDD RSL was based on carcinogenic effects associated with the cancer slope factor and unit risk. There was a negligible change in the Aroclor 1248 RSL because of a decrease in the volatilization factor from 6.3 cubic meters per kilogram (m^3/kg) in the 2016 RSL table to 5.1 m^3/kg in the 2021 RSL table. The current naphthalene RSL is based on the addition of a California EPA cancer slope factor of 0.12 $(mg/kg/d)^{-1}$ (EPA 2021b). Previously, no oral slope factor was used in the RSL derivation for naphthalene.

The maximum detected concentrations (MDCs) and the 95th percent upper confidence limit of the arithmetic mean (95UCL) values used in the next two steps of the process were taken directly from the 2006 CRA; no new soil sample analytical data were collected for this FYR risk evaluation (Table 3). Following the process outlined in Figure 9, the MDC of each of the three analytes (DDD, Aroclor 1248, and naphthalene) in soil/sediment in each Exposure Unit (EU) was compared to the 2021 RSL. Of these analytes, only naphthalene had an MDC in surface soil that exceeded the RSL value (Table 3). The MDC for naphthalene was 41 milligrams per kilogram (mg/kg) in the Upper Woman Drainage EU (UWOEU). The UWOEU is the only EU in which the MDC of naphthalene exceeds the 2021 RSL. The next step in the evaluation was to compare the 95UCL concentration of naphthalene in the UWOEU to the 2021 RSL (Table 3). The 95UCL concentration is a conservative estimate of the average constituent concentration to which the WRW might be exposed. The maximum 95UCL value for naphthalene was 1.4 mg/kg in the UWOEU. This 95UCL value is less than the 2021 RSL; therefore, RFS surface soil is still protective for the WRW, and no new potential soil/sediment contaminants of concern (COCs) are identified. Additionally, as described in Appendix C, no COCs were identified for subsurface soil based on this evaluation. These conclusions are consistent with the CRA and the 2017 FYR.

Table 3. RSL Comparison for Chemicals in COU Surface Soil

Analyte[a]	2016 Surface Soil RSL[b] (mg/kg)	2021 Surface Soil RSL[c] (mg/kg)	MDC—All EUs[d] (mg/kg)	MDC Exceeds 2021 RSL?	Maximum 95UCL—All EUs[e] (mg/kg)	95UCL Exceeds 2021 RSL?	Identified as COC?
DDD	9.6	2.5	0.01	No	NA	No	No
Aroclor 1248	0.95	0.94	0.84	No	NA	No	No
Naphthalene[f]	17	8.6	41	Yes	1.4	No	No

Notes:
All MDCs and 95UCLs are from the 2006 CRA.
[a] Includes only those analytes detected in COU surface soil/sediment with 2021 RSL values that are less than the corresponding 2016 RSL values.
[b] 2016 RSL table values for an industrial worker at a cancer risk of 1 × 10^{-6} and an HQ of 0.1 (EPA 2016).
[c] 2021 RSL table values for an industrial worker at a cancer risk of 1 × 10^{-6} and an HQ of 0.1 (EPA 2021b).
[d] MDC among all EUs (DOE, EPA, and CDPHE 2006).
[e] Maximum 95UCL among all EUs (DOE, EPA, and CDPHE 2006).
[f] The MDC among all COU EUs and the maximum 95UCL occurred at the UWOEU.

Abbreviation:
NA = not applicable

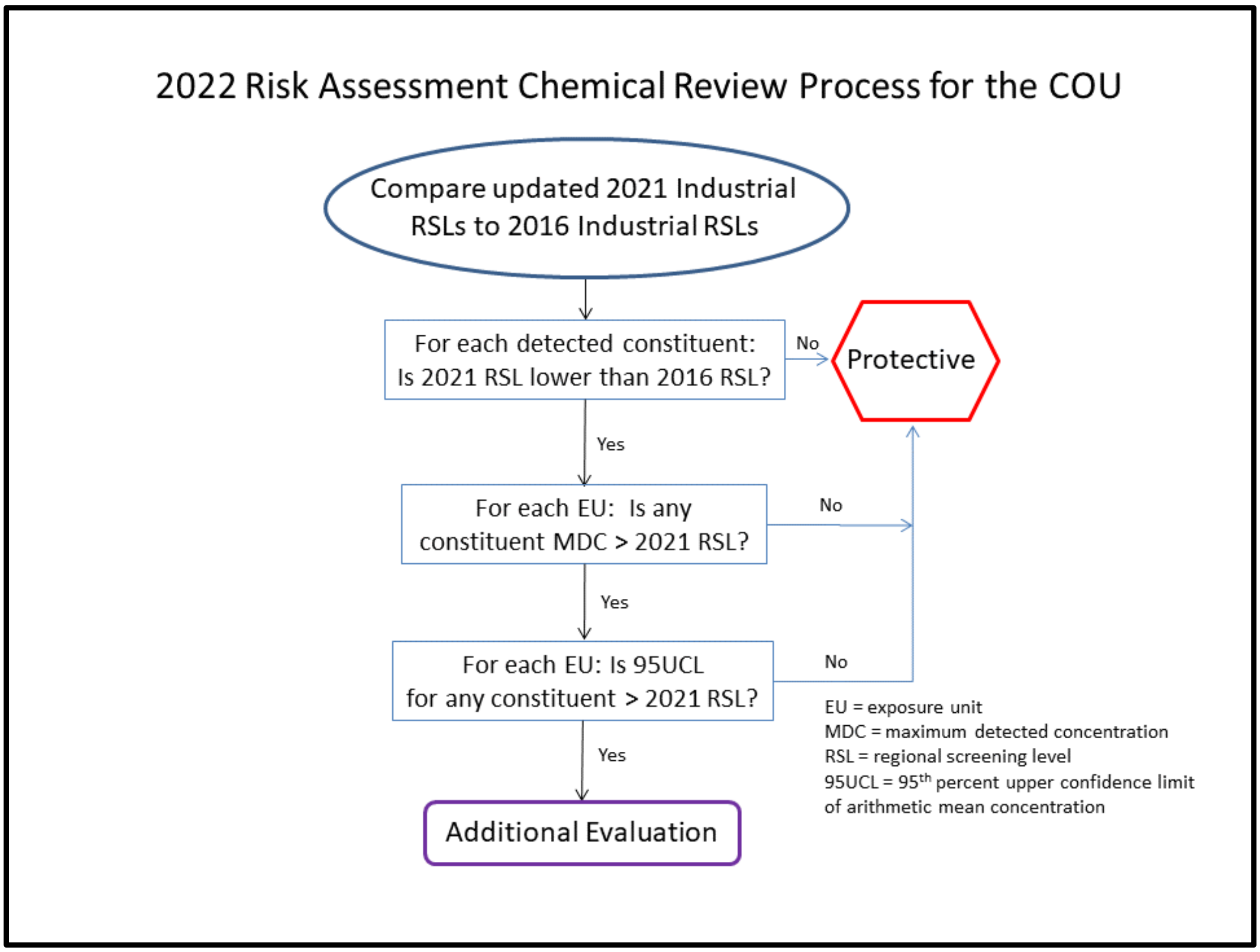


Figure 9. Risk Assessment Chemical Review Process

6.2.2.2 Radionuclide Constituents

Radiological Risk

This 2022 FYR risk evaluation for radiological constituents followed the same approach to evaluating radiological risk as the 2017 FYR evaluation. Both evaluations utilized the EPA online "Preliminary Remediation Goals for Radionuclides" calculator (PRG calculator) to calculate updated radiological PRGs (EPA 2021a) to determine if the risk from radionuclides to the WRW in the COU remains within the acceptable risk range. The acceptable risk range for CERCLA sites is an added cancer risk of less than 1 in 1,000,000 (1×10^{-6}) to a maximum of 1 in 10,000 (1×10^{-4}). The approach in this FYR evaluation is consistent with the methodology utilized in the 2017 FYR and is described in Appendix C.

The PRGs calculated by the PRG calculator are conservative screening values used in this FYR to identify individual contaminants that may require further evaluation. This methodology does not require input of site-specific analytical data because PRGs represent concentrations based on a target risk level rather than a calculated risk from measured concentrations. As such, no new analytical data were collected for this FYR risk evaluation. For completeness, this FYR radiological risk review considered $^{239/240}Pu$ (the only radionuclide COC identified in the 2006 CRA), ^{241}Am, ^{234}U, ^{235}U, and ^{238}U. The Am and U isotopes represent the other primary radionuclides associated with RFP historical operations.

As shown in Table 4, the 2022 PRGs for all isotopes at the 1×10^{-6} risk level are less than the PRGs calculated in 2006 and 2017 at the same risk level. As indicated in the fourth FYR report, the differences between the PRGs calculated in 2017 and the 2006 PRGs were primarily attributed to increases in the inhalation and external radiation slope factors for these isotopes adopted by EPA since 2006. Although there have been no changes to radiation slope factors for these isotopes since the 2017 FYR, the calculated 2022 PRGs in this FYR evaluation are different than those calculated in the 2017 FYR. The reasons for these differences are detailed in Appendix C but are largely attributable to the application of a more conservative soil area correction factor (ACF). A database of isotope-specific ACF values is included in the current PRG calculator, with the actual ACF values dependent on the area (in square meters [m^2]) of the site. For this FYR, the largest site area listed in the PRG calculator of 1,000,000 m^2 (247 acres) was selected in the calculation of the 2022 PRGs, which resulted in an ACF value of 1.0 for all isotopes. A smaller site area that is less representative of the area of the COU was selected to calculate the 2017 PRGs and resulted in correspondingly less-conservative values, as shown on Table 4. An ACF of 0.9 was used in the 2006 PRGs[5] based on guidance that was current at the time. Because of the differences in how the 2017 and 2022 PRGs were calculated and the fact that the 2022 PRGs are all less than the 2006 PRGs, this FYR focused on a comparison of the 2022 PRGs against the 2006 PRGs as a conservative measure. Using the more conservative ACF resulted in 2022 PRGs that are 1.5 to 2.3 times lower than the 2006 PRGs. In terms of risk, this means that if the 2006 PRGs were used in a COC screening process today, the calculated risk associated with the 2006 PRGs would be greater than 1×10^{-6} by a factor of 1.5 to 2.3, depending on the isotope. For example, the 2006 PRG for ^{239}Pu was 9.8 picocuries per gram (pCi/g), which

[5] The PRGs used in the 2006 CRA were calculated in 2005 and presented in the *Final Comprehensive Risk Assessment Work Plan and Methodology* (DOE 2005a). Throughout this report, the term "2006 CRA" refers to these PRGs calculated in 2005 and used in the 2006 CRA.

at the time equated to a risk of 1×10^{-6}. Based on the 2022 PRGs, the risk associated with ^{239}Pu at this concentration[6] would be greater than 1×10^{-6} (approximately 1.9×10^{-6}) but still at the lower end of the acceptable risk range (i.e., between 1×10^{-6} and 1×10^{-5}).

This FYR evaluation also included a comparison of the MDCs and 95UCLs used in the 2006 CRA to the 2022 PRGs for each of the isotopes in this review (Table 4). No new soil sample analytical data were collected for this FYR risk evaluation. Consistent with the process outlined in Figure 9, the MDC for each of the isotopes was compared to the 2022 PRG. If an MDC was above the 2022 PRG, the 95UCL was then compared to the corresponding 2022 PRG. As shown in Table 4, $^{239/240}$Pu in the Wind Blown Area EU (WBEU) is the only isotope with a 95UCL (12.1 pCi/g) that exceeds its 2022 PRG (5.2 pCi/g). The cumulative risk associated with the WBEU would be 3×10^{-6} based on the results of ^{241}Am and $^{239/240}$Pu and the 2022 PRGs shown in Table 5; cumulative risks of the other EUs would be negligible (i.e., less than 1×10^{-6}). Thus, the calculated risk associated with the 95UCL of 12.1 pCi/g is still within the acceptable risk range, and, in fact, is closer to the lower bound (i.e., more protective) of the range (Table 4).

The only radiological COC identified in the 2006 CRA was $^{239/240}$Pu in the WBEU (see Appendix C for a map of EUs). If the 2022 PRGs had been used in the CRA, the selection of COCs would have been unaffected and $^{239/240}$Pu would still be identified as a COC in the WBEU. A comparison of radiological data from the 2006 CRA to the 2022 PRGs at the 1×10^{-6} risk level results in no additional radiological COCs identified for the COU, indicating the CRA outcome would be the same whether the 2006 or 2022 PRGs were used for screening. Therefore, $^{239/240}$Pu in surface soil at the WBEU remains the only radiological COC for the COU.

In summary, although the calculated PRGs for the isotopes in Table 4 have decreased, the calculated risk to a WRW in the COU remains at the lower (i.e., more protective) end of the acceptable risk range considered by EPA to be protective of human health; therefore, the remedy in the COU remains protective for these radionuclides. A comparison of radiological data from the 2006 CRA to the 2022 PRGs at the 1×10^{-6} risk level results in no additional radiological COCs identified for the COU, indicating the CRA outcome would be the same whether the 2006 or 2022 PRGs were used for screening. Therefore, $^{239/240}$Pu in surface soil at the WBEU remains the only radiological COC for the COU.

[6] Calculation of risk level associated with 2022 ^{239}Pu PRG: $[(9.8\text{pCi/g})/(5.2\text{ pCi/g})] \times (1 \times 10^{-6})$.

Table 4. Radionuclide PRG Comparison for WRW

Isotope	2006 PRG[a] (pCi/g)	2017 PRG[b] (pCi/g)	2022 PRG (pCi/g)		
Risk Level	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-5}**	**1×10^{-4}**
^{241}Am	7.7	11.5	5.1	51	510
^{239}Pu	9.8	9.3	5.2	52	520
^{240}Pu	9.8	9.3	5.2	52	520
^{234}U	25.3	20.0	10.9	109	1090
^{235}U	1.1	4.5	0.75	7.5	75
^{238}U	29.3	22.9	12.6	126	1260

Notes:
The calculated risk to a WRV in the COU is less than the calculated risk to a WRW, primarily due to the difference in exposure frequency. The WRW scenario exposure frequency is 1840 hours per year; the WRV scenario exposure frequency is 250 hours per year.
[a] From the *Final Comprehensive Risk Assessment Work Plan and Methodology* (DOE 2005a). Values have been rounded to the first decimal place.
[b] From the fourth FYR report (DOE 2017b).

Abbreviation:
^{240}Pu = plutonium-240

Table 5. PRG Comparison for Radionuclides in COU

Isotope	2022 PRGs[a]	Industrial Area EU		Upper Woman Drainage EU		Wind Blown Area EU		No Name Gulch EU		Upper Walnut Drainage EU		Lower Woman Drainage EU	
		MDC	**95UCL**	**MDC**	**95UCL**	**MDC**	**95UCL**	**MDC**	**95UCL**	**MDC**	**95UCL**	**MDC**	**95UCL**
^{241}Am	5.1	**51.2**	0.8	0.802	NA	**15.6**	2.4	1.15	NA	**6.89**	0.81[b]	1.66	NA
$^{239/240}$Pu	5.2	**183**	2.0	**17.1**	0.15	**49**	**12.1**	2.31	NA	**22.4**	2.0	**12.2**	1.3
^{234}U	10.9	**34.5**	1.4	**47.5**	2.6	7.96	NA	1.79	NA	3.7	NA	3.19	NA
^{235}U	0.8	**1.69**	0.08	**2.24**	0.16	0.68	NA	0.276	NA	0.285	NA	0.405	NA
^{238}U	12.6	**59**	1.9	**209**	8.3	3.78	NA	1.75	NA	6.1	NA	3.39	NA

Notes:
All values are in pCi/g.
Bolded values exceed the 2022 PRG.
All MDCs and 95UCLs are from the 2006 CRA.
A map of EUs is in Appendix C.
[a] Calculated at a cancer risk level of 1×10^{-6}.
[b] Value is conservatively estimated as described in Appendix C.

Abbreviation:
NA = MDC is less than the PRG

Radiological Dose

The CAD/ROD identified select Colorado radiation protection standards as ARARs for the COU. For radiological sites that do not allow UU/UE, as is the case for the COU, Colorado regulations require that ICs be in place that reasonably assure that the total effective dose equivalent from residual radioactivity within the COU does not exceed 25 millirem per year (mrem/year) (6 CCR 1007-1, Part 4, Section 61.2). To demonstrate compliance with this ARAR at closure, DOE completed a dose assessment in 2006 using version 6.3 of the RESRAD computer model. In the 2017 FYR, the dose was evaluated by entering the same input parameters and analytical data values used in 2006 into the most recent RESRAD version (version 7.2) (ANL 2016) to determine the relative impact of changes within the FYR period. A comparison of the RESRAD version 6.3 dose results from 2006 and the RESRAD version 7.2 dose results using the current International Commission on Radiological Protection 107 slope factors and dose coefficients (ICRP 2008) from 2017 indicated little change in total dose, and the doses for all scenarios assessed are well below 25 millirem per year (Table 6).

Table 6. Radiological Dose Results from 2017 FYR

RESRAD Exposure Scenario	2006 Calculation of Maximum Total Dose (mrem/year)	2017 Calculation of Maximum Total Dose (mrem/year)
Resident Adult—Subsurface Soil Am and Pu Ash Pits	0.00089	0.00099
Resident Child—Surface Soil Am and Pu Solar Ponds	1.499	1.361
WRW—Subsurface Soil Windblown U	0.00850	0.00926
WRW—Surface Soil Windblown Am and Pu	0.4159	0.5602

There have been no updates to the RESRAD computer model since version 7.2; therefore, the 2017 results are still current, and a reevaluation of radiological dose for this FYR is not necessary. The conclusion reached in the last FYR that the dose ARAR is met and the remedy in the COU is protective remains valid for this FYR period. Additional information on the methodology employed and results of the 2017 FYR dose evaluation may be found in the fourth FYR report (DOE 2017b).

6.2.3 Emerging Contaminants

Since the 2017 FYR, additional information has become available about a group of emerging contaminants known as PFAS, which is a group of manmade chemicals that have been used worldwide since the 1940s. These compounds, which include PFOA and PFOS, have been used in a variety of commercial and industrial products, including firefighting foams and plating operations, as well as a wide range of consumer products from dental floss, cosmetics, and food packaging to stain- and water-resistant treatments and nonstick cookware, among many other applications. PFAS have become a concern at sites throughout the country because scientific studies have shown that exposure to some PFAS in the environment may be linked to harmful health effects in human and ecological receptors.

A limited screening of the potential risk of PFAS to human and ecological receptors at the site was completed as part of this FYR. Available PFAS data from surface water and groundwater samples collected at the site were compared to non-promulgated human health and ecological screening values (ESVs). Because only water sample data were available, the screening was limited to potential exposure pathways involving surface water and groundwater. Other media (e.g., soil) and associated potential exposure pathways that may be present at the site were not considered; thus, the potential risk of PFAS to human and ecological receptors in the COU has not been fully evaluated. As a result, a protectiveness determination for the COU remedy is deferred until further information is obtained to support evaluation of the potential risk of PFAS to human and ecological receptors (Section 8.0).

6.2.3.1 Human Health Risk

In May 2016, EPA issued a lifetime drinking water health advisory level (HAL) for PFOA and PFOS of 70 nanograms per liter (ng/L) (parts per trillion), either individually or combined when both are present. The HAL is applicable to drinking water and is not enforceable; an MCL for PFOA or PFOS has not been promulgated. The HAL is the concentration of PFOA and PFOS in drinking water at or below which adverse human health effects are not anticipated to occur over a lifetime of exposure (Grevatt 2016). The HAL is based on the ingestion of drinking water and does not account for other potentially applicable exposure pathways (e.g., skin contact) that would be evaluated in a CERCLA risk assessment. Groundwater and surface water within the COU and surface water exiting the COU at the POCs are not current or anticipated future sources of drinking water. In addition, ICs that restrict surface water and groundwater use in the COU are in place and effective in preventing human exposure to water that may contain PFAS. Because groundwater and surface water at the RFS is not used for drinking, the HAL is included in this FYR report as a point of reference only. In the context of this FYR report, the HAL is utilized as a conservative screening value for PFOA and PFOS to identify locations on the site that may warrant further consideration. To date, a HAL has not been issued by EPA for any other PFAS.

In 2018, DOE completed a records search to determine if PFOA and PFOS may have been used, released, or stored at the RFS (DOE 2019b). A few records, including one material safety data sheet, were identified that referenced the firefighting foam known as aqueous film-forming foam (AFFF). Because the RFP had an active fire department for most of its operational history, DOE also conducted interviews with former RFS fire department personnel about the potential use of firefighting chemicals containing PFAS. The interviews confirmed that the fire department used firefighting foam, including AFFF, but its use was not extensive due to the high cost of the product. This firefighting foam was not used in routine fire-training exercises, although firefighters did receive hands-on training with the product.

Given the historical presence of a fire department, metallurgical and plating operations, and other potential sources at the RFS, and at CDPHE's request, DOE performed a limited screening of groundwater and surface water for PFOA and PFOS in the second and fourth quarters of 2019. This screening compared site-specific PFOA and PFOS groundwater and surface water data to the EPA HAL. As reported in the *Summary Report: Results of Assessment for PFOA/PFOS at the Rocky Flats Site, Colorado* (DOE 2020b), two of the eight sample locations had PFOA, PFOS, or both above the EPA HAL of 70 ng/L. One of the locations was well 33502 near the former Fire Station (B331) and associated fire training area (Figure 10). The MDCs of PFOA and PFOS at this well were 120 ng/L and 310 ng/L, respectively (430 ng/L combined). The other location was at the influent to the PLFTS (PLFSEEPINF on Figure 10), where the MDCs of PFOA and PFOS were 69 ng/L and 23 ng/L, respectively (92 ng/L combined). Based on subsequent discussions, DOE, EPA, and CDPHE agreed to additional sampling for PFOA and PFOS that includes four new sample locations and an expanded analyte list of over 25 PFAS, including PFOA and PFOS. This additional sampling began in the third quarter of 2021 and will continue for a total of eight quarters. Because EPA has only issued a HAL for PFOA and PFOS, the screening completed for this FYR was limited to these two compounds. Analytical data from the third quarter of 2021 yielded similar results for well 33502 and location PLFSEEPINF. The sample from well 33502 showed PFOA at 66 ng/L and PFOS at 250 ng/L, respectively (316 ng/L combined). The sample from PLFSEEPINF showed PFOA at 55 ng/L and PFOS at 21 ng/L, respectively (76 ng/L combined). Of the four new sample locations, only well 33905 yielded PFOA and PFOS above the HAL at 35 ng/L PFOA and 150 ng/L PFOS, respectively (185 ng/L combined). PFOA and PFOS were not detected, individually or combined, above the HAL in samples from the POCs that monitor surface water exiting the COU. The comparison table of the HAL and Rocky Flats PFOA and PFOS data is presented in Appendix C.

A limited assessment of potential risk from PFOA and PFOS to two site-specific human receptors, the WRW and an LM worker, was also completed for this FYR. As stated previously, other media (e.g., soil) and associated potential exposure pathways that may be present at the site were not considered in this limited assessment.

The objective of the WRW assessment was to confirm that the exposure assumptions for the WRW considered in the 2006 CRA were valid for PFOA and PFOS, given what is currently known about these chemicals. Human exposure to groundwater was identified in the CRA WP (DOE 2005a) and CRA (DOE 2006) as an incomplete pathway via dermal and oral pathways to the WRW, which is the most health-protective receptor evaluated in the CRA. Inhalation of chemicals volatilized from groundwater was identified in the CRA WP as an insignificant exposure pathway. WRW exposure to surface water was identified in the CRA WP as insignificant for oral, dermal, and inhalation pathways. In the CRA, all significant pathways were quantitatively evaluated and insignificant and incomplete exposure pathways were qualitatively addressed. The presence of these PFAS in groundwater and surface water (i.e., PLF seep) in the COU does not change the conclusion of the CRA WP with respect to these exposure pathways for the WRW.

With respect to exposure to LM workers, the CRA WP states, "It is assumed that exposures due to monitoring, maintenance, and other stewardship activities will be less than that for the WRW scenario. This is because environmental workers will conduct work in accordance with appropriate site Health and Safety Plans (as site workers do currently), and appropriate protective equipment will be used." These statements are still valid regarding exposure to the groundwater and surface water by LM sampling personnel who collect samples for PFAS analysis, based on the following:

- Ingestion of groundwater and surface water are incomplete exposure pathways because sampling activities do not include ingestion of site groundwater or surface water, and implementation of the PFAS SAP and health and safety protocols ensure that aqueous media are not splashed.
- Dermal contact with groundwater and surface water are incomplete exposure pathways because following the PFAS SAP ensures that nitrile gloves are used for hand protection to eliminate potential contact via spillage, and implementation of the PFAS SAP and health and safety protocols ensure that aqueous media are not splashed. Absorption of PFOA and PFOS through the skin is limited and is of minimal concern as an exposure route.
- Inhalation of volatilized PFAS from groundwater and surface water are regarded as either insignificant pathways as described in the CRA WP based on dilution to the air or as incomplete pathways because PFOS and PFOA are of negligible volatility.

In addition, the WRW is a full-time, long-term worker, whereas an LM worker is present approximately 4 days per year during the PFAS sampling program; the infrequent exposure by the sampling personnel would further minimize any insignificant exposure pathways.

6.2.3.2 Ecological Risk

A limited screening of the potential risk of PFAS to ecological receptors at the site was also completed as part of this FYR. PFAS water data collected in 2019 and 2021 were compared to PFAS surface water ESVs published by Argonne National Laboratory in the fall of 2021 (ANL 2021). ESVs for eight PFAS were developed by ANL, in cooperation with U.S. Department of Defense and EPA subject matter experts, to support screening-level ecological risk assessments (SLERAs) at U.S. Department of Defense sites. The surface water ESVs[7] represent PFAS concentrations in surface water at or below which ecological receptors are not expected to be adversely affected and ecological risks are unlikely. For this FYR comparison, surface water ESVs for aquatic life, aquatic-dependent mammals, and aquatic-dependent birds were compared to PFAS groundwater and surface water data collected in 2019 and 2021 at the RFS. Note that groundwater concentrations are compared to surface water ESVs for informational purposes, and that exceedances of surface water ESVs in groundwater alone do not constitute an ecological threat. PFOA and PFOS data were available for all twelve locations sampled in 2019 and 2021; data for the expanded PFAS analyte list was only available for samples collected in 2021. As a result, data from all locations were compared to PFOA and PFOS surface water ESVs, but only the 2021 data could be compared to the other 6 PFAS surface water ESVs. Of the eight PFAS for which ESVs were published, only the surface water PFOS ESV for aquatic-dependent mammals was exceeded, and only in groundwater samples. All surface water sampled to date has had PFAS concentrations below the most stringent ESVs for the protection of wildlife and aquatic receptors. The PFOS ESV for aquatic-dependent mammals (0.117 µg/L), which is the lowest of the surface water ESVs published for any PFAS, was exceeded in groundwater samples from wells 33502 and 33905 (Figure 10). Well 33502 has been sampled three times with PFOS results of 0.310, 0.240, and 0.250 µg/L. Well 33905 has been sampled once with PFOS detected at 0.150 µg/L. None of the samples collected at the other 10 sample locations exceeded any of the ESVs. Available 2019 and 2021 sample results for WOMPOC and WALPOC[8] are 1 to 2 orders of magnitude less than the PFOS ESV. The comparison table of ESVs and Rocky Flats PFAS data is included in Appendix C.

6.2.4 RAO Status

The RAOs were established in the CAD/ROD as contaminant-specific remedy cleanup goals. The RAOs were reviewed in this FYR to determine if they remain valid and to assess progress in meeting the goals. The review of the RAOs considered the information and conclusions from this FYR technical assessment and the resulting protectiveness determination. Consistent with the rest of this FYR report, only validated analytical data from samples collected through December 31, 2021, were considered as part of the RAO review.

[7] ESVs for soil are also presented in ANL 2021.

[8] WOMPOC and WALPOC were not sampled in the third quarter of 2021 because these locations were dry. WALPOC remained dry for the remainder of the year, but WOMPOC was sampled in the fourth quarter 2021.

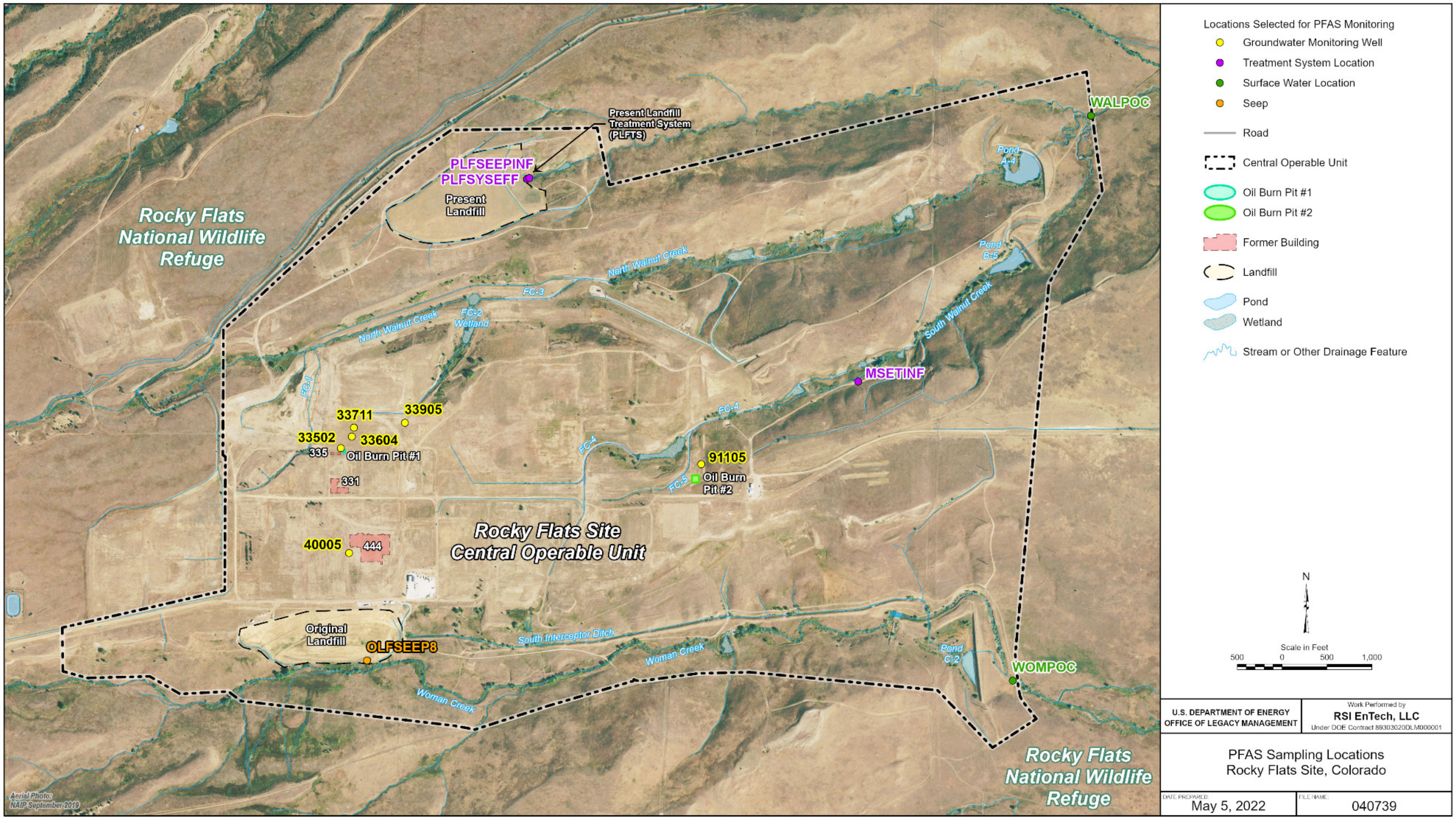


Figure 10. PFAS Sampling Locations

The status of each RAO, as well as the status of the RAO when the CAD/ROD was issued, is as follows:

- **Groundwater RAO 1**: Meet groundwater quality standards, which are the Colorado WQCC surface water standards, at groundwater AOC wells.

  This RAO was mostly met at all AOC wells during this FYR period. There was a reportable condition at an AOC well within this FYR period that ended in 2019. However, the most recent data from this well and one other AOC well suggest a reportable condition may occur in 2022 (Section 6.1.2.1). AOC wells will continue to be monitored.

  At the time of the CAD/ROD, this RAO was met at all AOC wells.

- **Groundwater RAO 2:** (Part 1) Restore contaminated ground water that discharges directly to surface water as base flow and that is a significant source of surface water to its beneficial use of surface water protection wherever practicable in a reasonable time frame. This is measured at groundwater Sentinel wells. (Part 2) Prevent significant risk of adverse ecological effects.

  Part 1 of this RAO is not met at all Sentinel wells. Sentinel well data were above applicable RFLMA standards for some VOCs, nitrate, or U during this FYR period (Section 6.1.2.2). Minor optimization and technical improvement opportunities at the SPPTS, MSPCS (formerly the MSPTS), and ETPTS were identified and implemented during this FYR period. Optimization of the treatment systems has resulted in reductions of nitrate and VOC concentrations in treated groundwater (Section 6.1.4.3); a permanent uranium treatment component has yet to be constructed at the SPPTS but is planned for the next FYR period. The status of Part 2 of this RAO is uncertain because the potential risk of PFAS to ecological receptors has not been fully evaluated. However, no evidence of adverse biological conditions (e.g., unexpected mortality or morbidity) was observed during this FYR period. The successful establishment of the prairie communities, wetland habitat, and Preble's meadow jumping mouse habitat at the site is documented by over 15 years of postclosure ecological monitoring data. No observable signs of toxicological stress to flora or fauna have been observed during field activities conducted during this FYR period. Progress toward meeting Parts 1 and 2 of this RAO will continue to be monitored.

  At the time of the CAD/ROD, Part 1 of this RAO was not met at all Sentinel wells. The CAD/ROD stated that no additional removal, containment, or treatment actions could reasonably be taken to address this RAO. It was recognized that the remedial actions undertaken as a part of site closure were "…not expected to eliminate groundwater contamination in the short term but are expected to have a positive long-term impact on groundwater and surface water quality" (DOE, EPA, and CDPHE 2006). Part 2 of this RAO was met at the time of the CAD/ROD.

- **Groundwater RAO 3:** Prevent domestic and irrigation use of groundwater contaminated at levels above MCLs.

  This RAO is met. This RAO was met in 2007 when the ICs at the COU were established. Although the concentrations of groundwater contaminants at some wells continue to be at levels above MCLs, the ICs recorded in the Restrictive Notice effectively restrict drilling in the COU, thereby preventing groundwater use for domestic or irrigation purposes.

At the time of the CAD/ROD, this RAO was not met. The concentration of groundwater contaminants at some wells were at levels above MCLs, and ICs for the COU had not yet been established to restrict groundwater use.

- **Surface Water RAO:** Meet surface water quality standards, which are the Colorado WQCC surface water standards.

  This RAO is not met because surface water standards are not always met at surface water monitoring locations within the COU upstream of the POCs. Reportable conditions for U at POE GS10 and for Pu at POE SW027 occurred during this FYR period (Appendix E). However, surface water remains compliant with WQCC regulations (i.e., no exceedances of the standards based on the 12-month average at the POCs). Progress toward meeting this RAO will continue to be monitored.

  At the time of the CAD/ROD, this RAO was met at the POCs. The CAD/ROD recognized that surface water in the COU does not always meet surface water quality standards.

- **Soil RAO 1:** Prevent migration of contaminants to groundwater that would result in exceedances of groundwater RAOs.

  This RAO is not met. Sentinel well data were above applicable RFLMA standards for some VOCs, nitrate, or U during this FYR period (Section 6.1.2.2). Progress toward meeting this RAO will continue to be monitored.

  At the time of the CAD/ROD, this RAO was not met everywhere in the COU. It was acknowledged that some remaining subsurface contamination has complete pathways to surface water (via groundwater), resulting in contaminant concentrations above surface water standards at a few Sentinel wells. However, the CAD/ROD recognized that at the time, no additional removal, containment, or treatment actions were practicable.

- **Soil RAO 2:** Prevent migration of contaminants that would result in exceedances of the surface water RAO.

  This RAO is not met because surface water standards are not always met at surface water monitoring locations within the COU upstream of the POCs (see Appendix E). However, surface water remains compliant with WQCC regulations (i.e., no exceedances of the standards based on the 12-month average at POCs) and ICs are in place that prohibit soil disturbance without appropriate controls. Soil erosion control measures are implemented for site activities that may result in soil disturbances. Annual inspections of the COU identify areas of soil erosion and mitigating measures are taken when warranted. The site ecology program assesses vegetation in areas prone to soil erosion and augments these areas as needed. Soil erosion caused by precipitation (rain, snowmelt) has periodically resulted in the exceedance of surface water standards.

  Inspection and monitoring at the PLF indicate that the landfill cover and stormwater management system remain intact and effective in preventing unacceptable exposure to buried wastes. The PLFTS is operating as designed and is effective in removing trace VOCs from groundwater and seeps at the landfill. Although some non-VOC analytes in PLFTS effluent were detected above the applicable RFLMA standards during this FYR period, these occurrences were short lived, within normal variability, and did not impact downstream surface water quality (Appendix E).

  A reportable condition relating to the effectiveness of the OLF cover was identified in 2013 and continued through this FYR period until August 2020. Implementation of the OLF maintenance project, described in Section 6.1.4.2 and CR 2019-02, resolved this reportable condition. Groundwater and surface water monitoring data collected during this FYR period do not suggest the hillside instability and subsequent maintenance project at the OLF has negatively affected groundwater or surface water quality. Progress toward meeting this RAO will continue to be monitored.

The CAD/ROD stated that this RAO is met if residual contamination in surface soil is not disturbed, as there is a complete pathway to surface water for Pu and ^{241}Am in soil. It was recognized in the CAD/ROD that erosion from soil disturbance may cause migration of contaminants to surface water, resulting in surface water concentrations above the standards.

- **Soil RAO 3:** (Part 1) Prevent exposures that result in unacceptable risk to the WRW. The 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when applicable or relevant and appropriate requirements (ARARs) are not available or are not sufficiently protective because of the presence of multiple contaminants at the RFS or multiple pathways of exposure (40 CFR 300.430[e][2][i][A][2]). (Part 2) Prevent significant risk of adverse ecological effects.

  The status of Part 1 of this RAO is uncertain because the potential risk of PFAS to human receptors has not been fully evaluated. For known contaminants, ICs and physical controls are in place and effective in preventing unacceptable exposures, land use and exposure assumptions used in the CRA for a WRW remain valid, and human health risk remains at the lower end of the EPA acceptable risk range (Section 6.2.2). The status of Part 2 of this RAO is uncertain because the potential risk of PFAS to ecological receptors has not been fully evaluated. However, no evidence of adverse biological conditions (e.g., unexpected mortality or morbidity) was observed during this FYR period. The successful establishment of the prairie communities, wetland habitat, and Preble's meadow jumping mouse habitat at the site is documented by over 15 years of postclosure ecological monitoring data. No observable signs of toxicological stress to flora or fauna have been observed during field activities conducted during this FYR period. Progress toward meeting Parts 1 and 2 of this RAO will continue to be monitored.

  At the time of the CAD/ROD, Part 1 of this RAO was not met for human health. The CAD/ROD stated that Soil RAO 3 cannot be met for surface soil unless all exposure assumptions inherent in the CRA were met. For subsurface soil, the CRA concluded that the indoor air pathway is potentially significant if buildings were constructed and occupied in portions of the COU where there are exceedances of volatilization WRW PRGs in subsurface soil and groundwater. Part 2 of Soil RAO 3 was met at the time of the CAD/ROD. The ecological risk assessment in the CRA concluded that soil conditions do not represent significant risk of adverse ecological effects.

This review concluded that the RAOs in the CAD/ROD remain relevant in addressing residual contamination and potential exposure pathways at the COU and assessing remedy protectiveness. Not all RAOs were met during this FYR period; however, the remedy is designed to achieve RAOs in the long term. It was acknowledged in the CAD/ROD that residual contamination in subsurface soil and groundwater would likely persist in the environment for decades to hundreds of years. Therefore, the selected remedy for the COU included ICs and monitoring to ensure protectiveness in the long term. The CAD/ROD also mandated the establishment of the RFLMA to implement the remedy and provide for a consultative process whereby DOE, EPA, and CDPHE evaluate and address site conditions that may affect the remedy or protectiveness. No revisions to the RAOs established in the CAD/ROD are recommended at this time; however, the

RAOs will be reviewed when the potential risk of PFAS to human and ecological receptors has been fully evaluated (see Section 7.0).

6.3 Question C: Has Any Other Information Come to Light That Could Call into Question the Protectiveness of the Remedy?

No other information has come to light that could call into question the protectiveness of the remedy.

EPA guidance suggests that the impacts of natural disasters on the remedy be discussed in this section. While there were no natural disasters at the RFS during this FYR period, the site was subjected to weather extremes including drought and colder-than-normal temperatures. As discussed below, the remedy includes several features inherent in its design that allow for flexibility and adaptation in response to weather variability and future climate change. As a result, performance of the remedy was not impacted by these extremes during this FYR period.

In May 2021, LM gave a presentation, "Climate Change Resilience at the Rocky Flats Site, Colorado," to the RFSC at their quarterly meeting (Nelson et al. 2021). The presentation was based on decades of data and experience implementing the remedy at the site. This section contains a summary of the presentation, which is available on the LM webpage at Rocky Flats Site, Colorado | Department of Energy.

6.3.1 Climate Adaptation and Resilience

Within the Colorado Front Range, the RFS experiences four seasons and is subject to extreme weather variability. As discussed in the 2017 FYR report, the site withstood two major precipitation/flood events that affirmed the robustness of the CERCLA remedy (DOE 2017b). During much of this FYR period, the site experienced moderate to severe drought (NOAA 2021). The performance of the remedy during these extreme conditions can provide insight into how well the remedy will respond to potential climate changes in the future, which may include increases in temperature, storm frequency and intensity, and wildfires; ecosystem changes; longer periods of drought; and climate zone shifts. As discussed in the following sections, existing remedy design features and continued ecological stewardship of the site directly address some of the predicted impacts of climate change. Additionally, the consultative process under RFLMA allows for adjustments and adaptation when changing conditions are observed.

The large-scale effects of climate change will be gradual, allowing resilience measures to be adopted as conditions change. The RFS will continue to be subject to extreme weather events regardless of overall climate change trends. The existing components of the remedy are robust and have withstood several extreme weather events since closure, with minimal impact. LM will continue to assess the impacts of extreme weather on the remedy as additional information becomes available. RFLMA quarterly, annual, and FYR reports, together with associated briefings, will continue to communicate and inform stakeholders, and climate change impacts will continue to be assessed as part of RFS FYRs.

6.3.1.1 Groundwater Treatment Systems

The groundwater treatment systems were originally designed for flexibility. The reconfiguration and optimization in the years following site closure have improved the systems' ability to respond to changing conditions. The systems can accommodate a large range of flow rates, contaminant concentrations, and water volumes. For example, the SPPTS uses less than one quarter of its current treatment capacity and could accommodate more or less water. The reconfiguration of the MSPTS and ETPTS has increased the systems' resilience to weather variability and extremes. The ETPTS operates in a batch treatment mode, with the air stripper operating at a constant flow rate. This allows the system to accommodate a wide range of groundwater flows with a consistent level of treatment. The treatment systems also feature remote access monitoring capabilities that allow for the manual or automatic shutoff of individual system components in response to changing conditions. In addition, the battery banks have several days of excess capacity during which they could continue to power the treatment components without being recharged by their solar arrays. Battery banks are also designed to be recharged using an external generator, if necessary. In 2020, the ETPTS solar power facility was upgraded and outfitted with longer-lasting batteries that provide even more excess capacity to power the treatment systems. The solar panels and battery storage containers are in graveled areas or in areas kept mowed. This practice has several purposes, including reducing potential wildfire impact.

During periods of extreme cold, the denitrifying bacteria that remove nitrate from the groundwater at the SPPTS become less effective. By anticipating environmental conditions and proactively adjusting nutrient dosing and residence time during these cold periods, nitrate concentrations in treatment system effluent have remained stable. In winter 2020–2021, an extended period of extreme cold was mitigated through these adjustments, and nitrate treatment continued to achieve treatment goals throughout the winter.

6.3.1.2 Surface Water Infrastructure

The design of the surface water infrastructure and the management of monitoring programs have always considered the probability and effects of weather variability. The functional channels in the COU were designed to convey 100-year runoff events with adequate freeboard according to the *Urban Storm Drainage Criteria Manual* (MHFD 2016). During the September 2013 flood event, these channels experienced no damage.

Surface water flow measuring devices (e.g., flumes) are designed to measure an extremely wide range of flow rates. Current devices in use at the site can accommodate peak flows that are 1000 times higher than base flows. These devices can also be modified or reconstructed at moderate cost to handle larger events. Automated samplers are used to collect flow-paced composite samples, and, at some locations, additional backup samplers already have been installed for the potential of larger events. The monitoring network uses automated equipment that is programmable to accommodate changes in water quantity or quality. Adjustments to automated samplers are made periodically to make sure the appropriate number of samples are collected to ensure confidence in decision-making.

Because the COU has no line power available, groundwater treatment system components and surface water monitoring infrastructure are powered entirely by solar energy via solar panels and batteries. These solar power units are designed to limit power interruptions and allow for operation in all weather conditions. This means that RFS systems will continue to operate even if the electrical power grid fails. High intensity winds are common on the Colorado Front Range and at the RFS. The solar/battery power facilities are designed to withstand wind loadings of 130 miles per hour. If power requirements increase, additional capacity may be added to the systems.

6.3.1.3 Landfills

In accordance with the CAD/ROD, the PLF and OLF were constructed to meet ARARs for landfill closures. The landfills were designed to convey 100-year runoff events with adequate freeboard according to the *Urban Storm Drainage Criteria Manual* (MHFD 2016). The OLF recently underwent extensive structural reinforcements along the eastern and western margins of the hillside in response to continuing localized hillside instability and slumping. The design incorporated stabilization and drainage measures to withstand existing weather variation and more extreme future events that may result from climate change. The original design of the PLF included several structural enhancements to reduce the potential for future problems. These include a French drain to divert groundwater away from the landfill, a slurry wall to minimize groundwater encroachment, surface water diversions to minimize run-on to the landfill, and a cover design that minimizes infiltration. The largest risk factor to the landfills is wildfire. Wildfire could damage the various liners that make up the cover system at the PLF, as well as destroy vegetation that protects against soil erosion at the OLF and the PLF. Wildfire can also contribute sediment and ash into designed stormwater and drainage channels, reducing their effectiveness.

6.3.1.4 Ecological Stewardship

Ecosystems are dynamic by nature; they are in a constant state of flux in response to changing environmental conditions. The potential impacts of climate change to the ecology of the RFS include changes in plant community extent (e.g., loss or increase of wetland extent), plant community composition (e.g., shifts in dominant plant species, increases in weed species and dominance, loss or increases in specific plant species), increased wildland fires, or changes in wildlife abundance from habitat changes. However, any long-term changes to ecosystems are likely to take years or decades to manifest. RFS revegetation areas have been seeded with the native, deep-rooted, drought-tolerant plants native to the site. With more than 640 species of plants known to occur in the greater Rocky Flats area, there is a lot of native plant material available with a wide range of tolerance and genetic variability to adjust to changes in climate over time.

6.3.2 Vulnerability Assessment

In 2020, the U.S. Government Accountability Office (GAO) issued a report on LM’s environmental liability in relation to climate change (GAO 2020). The report recommended that LM develop plans to assess the effect of climate change on LM sites and to mitigate any significant impacts. In response to the GAO report, LM initiated a nationwide assessment of LM sites and their susceptibility to climate change impacts. It is expected that this LM nationwide assessment will be completed by fall 2022.

In August 2021, DOE released its *2021 Climate Adaptation and Resilience Action Plan* (DOE 2021a), which identifies and prioritizes DOE's adaptation and resilience efforts. The first priority identified in the plan is the assessment of vulnerabilities and implementation of resilience solutions at DOE sites. The accompanying *Climate Adaptation Policy Statement* signed by the Secretary of Energy commits DOE to conduct vulnerability assessments and develop resilience plans no later than 1 year from issuance of the plan.

6.4 Technical Assessment Summary

The final remedy of ICs and physical controls, incorporating continued monitoring and maintenance, was selected for the COU in the 2006 CAD/ROD. ICs are in place and effective in preventing unacceptable exposures to known residual contaminants by prohibiting building construction, controlling intrusive activities, restricting use of groundwater and surface water, and protecting engineered remedy components. Physical controls are in place and effective at minimizing the potential for inadvertent access to the COU by unauthorized parties. Groundwater treatment systems continue to reduce contaminant load to surface water. Monitoring and maintenance plans are in place to ensure the long-term integrity of the remedy. Routine inspections of remedy components ensure that maintenance and repairs are identified and implemented. Surface and groundwater monitoring provide assurance that water quality at the COU boundary is protective of human health and the environment.

The exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy are still valid, although some changes to standards and toxicity values have occurred within this FYR period. The risk of known residual chemical and radiological constituents to the WRW in the COU remains at the lower end (i.e., more protective) of the CERCLA acceptable risk range (10^{-4} to 10^{-6}); however, the potential risk of PFAS to the WRW and other potential human receptors has not been fully evaluated. The detection of emerging contaminants PFOA and PFOS in water samples collected in the COU in 2019 prompted a limited assessment of the potential risk of PFAS to human and ecological receptors at the site. Although ICs are in place and effective in preventing the use of groundwater and surface water for drinking and agriculture purposes, other media (e.g., soil) and associated potential exposure pathways that may be present at the site were not considered in the limited assessment. Therefore, the potential risk of PFAS to human and ecological receptors in the COU has not been fully evaluated. As a result, a protectiveness determination for the COU remedy is deferred until further information is obtained to support evaluation of the potential risk of PFAS to human and ecological receptors (Section 8.0).

Not all RAOs were met during this FYR period; however, the remedy is designed to achieve RAOs in the long term. The RAOs will be revisited to determine if revision is necessary once further information is collected and the risk of PFAS to human and ecological receptors has been fully evaluated. Although the RFS is vulnerable to the potential impacts associated with climate change, the remedy at the COU is robust and has inherent design features that make it adaptable and resilient.

7.0 Issues and Recommendations

The only issue identified in this FYR with the potential to impact current or future protectiveness is that the potential risk of PFAS to human and ecological receptors at the site has not been fully evaluated. The recommendations to address this issue are in Table 7.

Table 7. Issues and Recommendations

<table>
<tr><th colspan="5">Issues/Recommendations</th></tr>
<tr><td colspan="5">OU(s) Without Issues/Recommendations Identified in the Five-Year Review:</td></tr>
<tr><td colspan="5">None</td></tr>
<tr><td colspan="5">Issues and Recommendations Identified in the Five-Year Review:</td></tr>
<tr><td rowspan="3">OU(s):

COU
POU
OU-3</td><td colspan="4">Issue Category: Changed Site Conditions</td></tr>
<tr><td colspan="4">Issue: The potential risk of PFAS to human and ecological receptors at the site has not been fully evaluated.</td></tr>
<tr><td colspan="4">Recommendation: It is recommended that DOE (1) continue the collection and evaluation of water samples for PFAS for eight quarters as previously agreed to by DOE, EPA, and CDPHE; (2) prepare and implement a plan that identifies the data and information required to support an assessment of potential PFAS risk to human receptors and a PFAS SLERA; and (3) complete an assessment of potential PFAS risk to human receptors and a PFAS SLERA. Because the FYR is limited to the COU, no PFAS characterization work is currently planned for the POU and OU-3.

Given the rapid advances in PFAS scientific knowledge and the evolution of PFAS regulation, DOE will consult with EPA and CDPHE throughout this process to ensure that relevant developments are considered in analyzing PFAS human health and ecological risk.</td></tr>
<tr><td>Affect Current Protectiveness</td><td>Affect Future Protectiveness</td><td>Implementing Party</td><td>Oversight Party</td><td>Milestone Date</td></tr>
<tr><td>Unknown</td><td>Unknown</td><td>Federal Facility</td><td>EPA/State</td><td>06/30/2026</td></tr>
</table>

Other Findings: The following recommendations were identified in this FYR that will improve U treatment performance and address necessary maintenance at the SPPTS but do not affect current or future protectiveness:

- **SPPTS:** Continue activities related to the evaluation of a U treatment component at the SPPTS. See Section 6.1.4.3.
- **NWCS:** Continue monitoring the condition of the NWCS, giving particular attention to hillside movement that may impact nearby remedy components. Efforts to identify a long-term solution should also continue. See Section 6.1.4.3.

8.0 Protectiveness Statement

Protectiveness Statement(s)		
Operable Unit: COU	*Protectiveness Determination:* Protectiveness Deferred	*Addendum Due Date (if applicable):* 06/30/2026
Protectiveness Statement: A protectiveness determination of the remedy at the COU cannot be made at this time until further information is obtained regarding the potential risk of PFAS to human and ecological receptors. Further information will be obtained by (1) continuing the collection and evaluation of water samples for PFAS for eight quarters as previously agreed to by DOE, EPA, and CDPHE; (2) preparing and implementing a plan that identifies the data and information required to support an assessment of the potential risk of PFAS to human receptors and a PFAS SLERA; and (3) completing an assessment of the potential risk of PFAS to human receptors and a PFAS SLERA. It is expected that these actions may take up to 4 years to complete, at which time a protectiveness determination will be made and an FYR report addendum completed.		
Sitewide Protectiveness Statement		
Protectiveness Determination: Protectiveness Deferred		*Addendum Due Date (if applicable):* 06/30/2026
Protectiveness Statement: The FYR is limited to the COU and does not include the POU and OU-3. The POU and OU-3 remain UU/UE for known contaminants, but it is recognized that the potential risk of PFAS to human and ecological receptors is unknown. A protectiveness determination of the remedy at the COU is deferred until further information is obtained on the potential risk of PFAS to human and ecological receptors. Therefore, a sitewide protectiveness statement is deferred until additional information on PFAS is available.		

9.0 Next Review

Contaminants at the COU are expected to remain at levels that do not allow UU/UE and will require continued remedy implementation for the foreseeable future. Thus, a sixth FYR will be required. The due date for the next FYR report is August 3, 2027.

10.0 References

5 CCR 1002-31, “Colorado Basic Standards and Methodologies for Surface Waters,” *Code of Colorado Regulations*.

5 CCR 1002-38, “Classification and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin,” *Code of Colorado Regulations*.

5 CCR 1002-93, “Colorado’s Section 303(d) List of Impaired Waters and Monitoring and Evaluation List,” *Code of Colorado Regulations*.

6 CCR 1007-3, Part 261. “Identification and Listing of Hazardous Waste,” *Code of Colorado Regulations*.

6 CCR 1007-1, Part 4. "Standards for Protection Against Radiation," *Code of Colorado Regulations*.

40 CFR 300. "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*.

ANL (Argonne National Laboratory), 2016. "RESRAD ON-SITE," Version 7.2, https://resrad.evs.anl.gov/codes/resrad-onsite/, accessed November 5, 2021.

ANL (Argonne National Laboratory), 2021. *Derivation of PFAS Ecological Screening Values*, completed under an Interagency Agreement between DOE, ANL, and the Air Force Civil Engineer Center, September.

CDPHE (Colorado Department of Public Health and Environment), 2015. Implementation Policy CW-6, *Practical Quantitation Limits (PQLs),* Water Quality Control Division, February.

CRS 25-15-318.5. "Nature of a Notice of Environmental Use Restrictions," Colorado Revised Statutes.

DOE (U.S. Department of Energy), 2005a. *Final Comprehensive Risk Assessment Work Plan and Methodology*, Revision 1, prepared by the Kaiser-Hill Company, LLC for the U.S. Department of Energy, September.

DOE (U.S. Department of Energy), 2005b. *Final Interim Measure/Interim Remedial Action for the Original Landfill*, IA-A-002617, March.

DOE (U.S. Department of Energy), 2006. *RCRA Facility Investigation—Remedial Investigation /Corrective Measures Study—Feasibility Study for the Rocky Flats Environmental Technology Site,* prepared by the Kaiser-Hill Company, LLC for the U.S. Department of Energy, June.

DOE (U.S. Department of Energy), 2009. *Original Landfill Monitoring and Maintenance Plan, U.S. Department of Energy Rocky Flats, Colorado, Site*, LMS/RFS/S05516, Office of Legacy Management, September.

DOE (U.S. Department of Energy), 2012. *Third Five-Year Review Report for the Rocky Flats Site, Jefferson and Boulder Counties, Colorado*, LMS/RFS/S07693, Office of Legacy Management, July.

DOE (U.S. Department of Energy), 2014. *Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan, U.S. Department of Energy Rocky Flats, Colorado, Site*, LMS/RFS/S03965, Office of Legacy Management, December.

DOE (U.S. Department of Energy), 2017a. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2016*, LMS/RFS/S15402, Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2017b. *Fourth Five-Year Review Report for the Rocky Flats Site, Jefferson County, Colorado*, LMS/RFS/S15528, Office of Legacy Management, June.

DOE (U.S. Department of Energy), 2018. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2017*, LMS/RFS/S18141, Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2019a. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2018*, LMS/RFS/S23330, Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2019b. *Sampling Plan for PFOA/PFOS at the Rocky Flats Site, Colorado,* LMS/RFS/S22080, Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2020a. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2019*, LMS/RFS/S27935, Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2020b. *Summary Report: Results of Assessment for PFOA/PFOS at the Rocky Flats Site, Colorado,* LMS/RFS/S29191, Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2021a. *2021 Climate Adaptation and Resilience Action Plan*, Report to the White House, National Climate Task Force and Federal Chief Sustainability Officer, Office of Legacy Management, May.

DOE (U.S. Department of Energy), 2021b. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2020*, LMS/RFS/S32449, Office of Legacy Management, April.

DOE (U.S. Department of Energy), 2022. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2021*, LMS/RFS/S38162, Office of Legacy Management, April.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 1997. *Corrective Action Decision/Record of Decision, Operable Unit 3, the Offsite Areas, Rocky Flats Environmental Technology Site, Golden, Colorado*, April.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2006. *Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit*, *Jefferson and Boulder Counties, Colorado*, September.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2007. *Rocky Flats Legacy Management Agreement*, March 14, Attachment 2 revised in December 2018.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2011. *Corrective Action Decision/Record of Decision Amendment for Rocky Flats Plant (USDOE) Central Operable Unit, Jefferson and Boulder Counties, Colorado,* September 21.

EPA (U.S. Environmental Protection Agency), 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007, Office of Emergency and Remedial Response, June.

EPA (U.S. Environmental Protection Agency), 2016. "Regional Screening Levels (RSLs)," https://www.epa.gov/risk/regional-screening-levels-rsls, accessed November 16, 2021.

EPA (U.S. Environmental Protection Agency), 2017. *Provisional Peer-Reviewed Toxicity Values for* p,p′*-Dichlorodiphenyldichloroethane* (p,p′*-DDD)*, Superfund Health Risk Technical Support Center National Center for Environmental Assessment Office of Research and Development. Cincinnati, OH, EPA/690/R-17/006F, December.

EPA (U.S. Environmental Protection Agency), 2021a. "Preliminary Remediation Goals for Radionuclides (PRG)," online calculator, https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search, accessed November 16, 2021.

EPA (U.S. Environmental Protection Agency), 2021b. "Regional Screening Levels (RSLs)–Generic Tables", https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables, accessed November 16, 2021.

GAO (U.S. Government Accountability Office), 2020. *Environmental Liabilities: DOE Needs to Better Plan for Post-Cleanup Challenges Facing Sites*, GAO-20-373, May 13.

Grevatt, 2016. Peter C. Grevatt, Director, Office of Ground Water and Drinking Water, U.S. Environmental Protection Agency, letter ("Clarification about the Appropriate Application of the PFOA and PFOS Drinking Water Health Advisories") to Water Division Directors, Regions I-X, U.S. Environmental Protection Agency, November 15.

ICRP (International Commission on Radiological Protection), 2008. "Nuclear Decay Data for Dosimetric Calculations," ICRP Publication 107, *Annals of the ICRP* 38 (3).

Kaiser-Hill (Kaiser-Hill Company, LLC), 2004. *Fate and Transport Modeling of Volatile Organic Compounds at the Rocky Flats Environmental Technology Site*, Final, SWA-A-004953, April.

Kaiser-Hill (Kaiser-Hill Company, LLC), 2005. *Final Interim Measure/Interim Remedial Action for Groundwater at the Rocky Flats Environmental Technology Site.*

MHFD (Mile High Flood District), 2016. *Urban Storm Drainage Criteria Manual*, January.

Nelson, J., J. Boylan, and G. Squibb, 2021. "Climate Change Resilience at the Rocky Flats Site, Colorado," at Rocky Flats Stewardship Council May 2021 Quarterly Meeting, Westminster, Colorado, May 3.

NOAA (National Oceanic and Atmospheric Administration), 2021. "National Integrated Drought Information System," https://www.drought.gov/states/colorado/county/jefferson, accessed November 16, 2021.

WWE (Wright Water Engineers, Inc.), 2015. *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site*, Rev. 1, September.

WWE (Wright Water Engineers, Inc.), 2019. *2019 Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site*, July.

WWE (Wright Water Engineers, Inc.), 2021. *2021 Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site*, December.

Appendix A

Site Chronology

This appendix contains a chronology of major events that have occurred at the Rocky Flats Plant (RFP) since nuclear production operations began in 1952. The history of the RFP spans more than 65 years, of which approximately 40 years were dedicated to production in support of the U.S. nuclear weapons program; approximately 10 years to cleanup and remedy implementation; and, to date, over 15 years of postclosure monitoring. This chronology provides a high-level overview of key dates in this long history and provides detail for events over the 5-year period covered by this report. It is by no means all-inclusive.

Some of the contact records (CRs) and written correspondence referenced in this appendix may be found in Appendix D. The entire collection of CRs and written correspondence for the Rocky Flats Site, Colorado (RFS), including all of those referenced in this appendix, are found on the Office of Legacy Management (LM) website at: https://lmpublicsearch.lm.doe.gov/SitePages/default.aspx?sitename=Rocky_Flats.

Rocky Flats Plant Chronology

Date	Event
April 1952	Operations to produce a plutonium component for use in atomic weapons begin at the RFP.
September 1957	A fire in Building 771 causes extensive contamination to the building and release of some plutonium to the environment.
1967	Large-scale leaking of waste oil drums being stored on the 903 Pad occurs, contaminating the soils with plutonium, machining lubricants, and chlorinated solvents.
May 1969	A plutonium glovebox fire that started in Building 776 spreads to several hundred connected gloveboxes in Building 776 and Building 777. This caused extensive damage and contamination to the buildings and release of some plutonium to the environment.
1968–1970	Some of the radiologically contaminated material is removed from the 903 Pad and Lip Area, some of the surrounding Lip Area is regraded, and much of the area is covered by an imported base coarse material. Contaminated soil becomes windborne and contaminates the area east of the 903 Pad. An asphalt cap is placed over the most contaminated area of the Pad.
September 1973	A tritium release is discovered in a water sample collected from Woman Creek by the Colorado Department of Health (now known as the Colorado Department of Public Health and Environment [CDPHE]). A U.S. Environmental Protection Agency (EPA) report indicates that 50–100 curies of tritium reached Great Western Reservoir, just east of the RFP.
September 1984	Cleanup of a 0.25 mile strip of soil on the 903 Lip Area is conducted.
July 1986	A Compliance Agreement between the U.S. Department of Energy (DOE), EPA, and CDPHE defines roles and established milestones for major environmental operations and response actions at the RFP. These efforts identify over 2000 waste generation points and 178 Solid Waste Management Units and Resource Conservation and Recovery Act (RCRA)/Colorado Hazardous Waste Act-regulated closure sites.
June 1989	Federal Bureau of Investigation and EPA agents carry out a search warrant to search for evidence of alleged criminal violations of RCRA and the Federal Water Pollution Control Act.
September 1989	The RFP is added to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL).
December 1989	Nuclear production work at the RFP is halted to address environmental and safety concerns.
January 1990	Construction begins for a system to remove chemical contaminants from groundwater at the Operable Unit 1 (OU-1) (881 Hillside Area), a designated high-priority cleanup site at the RFP. The action follows EPA and CDPHE approval of an Interim Measure/Interim Remedial Action Plan for OU-1.
January 1991	An interagency agreement (IA) between DOE, EPA, and CDPHE is signed; the IA replaces the 1986 Compliance Agreement. The agreement outlines multiyear schedules for environmental restoration investigations and remediation.
1993	The Secretary of Energy formally announces the end of nuclear production at the RFP; the facility mission changes to cleanup and closure.

Date	Event
1994	The RFP name is changed to the Rocky Flats Environmental Technology Site (RFETS).
November 1994	A no action Corrective Action Decision/Record of Decision (CAD/ROD) is issued for OU-16 (Low Priority Sites). This is the first OU to be officially closed under the IA.
October 1995	No action CAD/RODs are issued for OU-11 (West Spray Field) and OU-15 (Inside Building Closures).
July 1996	The Rocky Flats Closure Project begins, and the Rocky Flats Cleanup Agreement is signed, which supersedes the 1991 IA. This agreement establishes the accelerated action framework, describes the goals for cleanup and closure, and defines the regulatory approach for review and approval of work to ultimately delete the RFP from the NPL. All buildings and Individual Hazardous Substance Sites are to be dispositioned through accelerated actions. OUs are reconfigured into the Industrial Area and Buffer Zone OUs. Several IA OUs are retained because progress toward CAD/RODs for those OUs was expected.
March 1997	A CAD/ROD for OU-1 (881 Hillside Area) is issued, requiring soil excavation, treatment of contaminated groundwater, and institutional controls.
June 1997	The CAD/ROD for OU-3 (Offsite Areas) is approved; the remedy selected for OU-3 is no action.
August 1998	Groundwater treatment operations at the Mound Site Plume Treatment System (MSPTS) commence.
October 1998	The existing seep treatment system at the Present Landfill (PLF) is modified to include passive aeration.
September 1999	Groundwater treatment operations at the East Trenches Plume Treatment System (ETPTS) and Solar Ponds Plume Treatment System (SPPTS) commence.
September 2000	A major modification of the OU-1 CAD/ROD is issued, deleting the soil excavation requirement and providing criteria for ceasing groundwater treatment and continued monitoring based on further investigation results.
December 2001	Rocky Flats National Wildlife Refuge Act is signed into law.
September 2002	First Five-Year Review (FYR) report is issued. Completion of this report was triggered by the completion date for the CAD/ROD for OU-3. This review evaluated OU-1, OU-3, and several key accelerated actions at Individual Hazardous Substance Sites as well as the installed groundwater treatment systems for the Mound Site, East Trenches, and Solar Pond Plumes and the seep at the PLF.
October 2002	Solar energy is first used to provide power at the RFETS. A system of solar panels and storage batteries is constructed to provide power to a pump used in the groundwater collection system at the SPPTS.
January 2005	Closeout reports for 903 Pad and 903 Lip Area are approved. These projects involved the removal of approximately 20,213 and 49,800 cubic yards of contaminated soil from the 903 Pad and the 903 Lip Area, respectively.
October 2005	Decontamination and decommissioning of approximately 815 structures in the Industrial Area concludes with the demolition of Building 371. Physical completion of accelerated Closure Project at the former RFP. Construction of the RCRA-compliant cover on the PLF is completed; the seep treatment cascade system is installed at the Present Landfill Treatment System (PLFTS). Grading and installation of a 2-foot cover of the Original Landfill (OLF) is completed.
June/July 2006	The Remedial Investigation/Feasibility Study (RI/FS) report and Comprehensive Risk Assessment for the Central Operable Unit (COU) and the Peripheral OU (POU) are published. The RI/FS report documented conditions after completion of all Rocky Flats Cleanup Agreement accelerated actions, evaluated three remedial alternatives for the COU, and proposed no action for the POU. The Sitewide Proposed Plan is issued for public review and comment.
September 2006	The CAD/ROD for the COU and the POU is approved. The remedy selected for the COU is institutional and physical controls and monitoring; the remedy selected for the POU is no action.
December 2006	The Environmental Covenant, a legal instrument restricting use and access to the COU as stated in the CAD/ROD, is signed by DOE and CDPHE.

Date	Event
March 2007	The CERCLA Federal Facility Agreement and Consent Order (also known as the *Rocky Flats Legacy Management Agreement* [RFLMA]) is signed by DOE, EPA, and CDPHE. This agreement establishes the regulatory framework for implementing the remedy at the COU and ensuring it remains protective of human health and the environment.
May 2007	The POU and OU-3 are deleted from the NPL. This is considered a partial deletion of the former RFP because the COU is retained on the NPL.
June 2007	Elevated concentrations of nitrate and uranium in water on the surface adjacent to the SPPTS discharge gallery continue to be detected, prompting RFLMA consultation (see CR 2007-02).
June/July 2007	EPA certifies completion of cleanup and closure of the former RFP in accordance with the Rocky Flats National Wildlife Refuge Act of 2001. DOE transfers jurisdiction and control of the majority of POU lands to the U.S. Department of Interior, U.S. Fish and Wildlife Service.
July 2007	CDPHE approves a three-phase work plan for the OLF to address slumping and erosion issues identified during routine inspections. Phase 1 near-term repairs are completed by the end of 2007.
September 2007	Second FYR report is issued. The remedy remains protective.
January 2008	The PLF Monitoring and Maintenance Plan, which is adopted by reference in the RFLMA, is updated to incorporate changes in inspection frequencies, completion of certain monitoring requirements, and clarification of vegetation inspection schedules and completion criteria (see CR 2007-08).
April 2008	Phase 2 investigation fieldwork at OLF is completed. This work included a geophysical survey and excavation of test pits and boreholes (see CR 2008-07).
November 2008	Repairs and design changes at OLF are completed. This work included berm maintenance and repair, installation of inclinometers, regrade of the west perimeter channel, and modifications to some drains (see CR 2008-07).
September 2009	The OLF Monitoring and Maintenance Plan, which is adopted by reference in the RFLMA, is updated (see CR 2008-07).
January 2010	Changes to the Colorado Water Quality Control Commission Regulation No. 38 take effect, redefining Segment 5 of Walnut Creek as the portion of Walnut Creek between the western and eastern boundaries of the COU. Segment 4b is redefined as that portion of Walnut Creek between the eastern boundary of the COU and Indiana St. The Recreational Use Classification of N (no primary contact use) for Segment 5 is retained.
July 2010	Following a 30-day public review and comment period, RFLMA Attachment 2 is modified to revise several monitoring locations (see CR 2010-04).
March 2011	A small-scale air stripper is installed at MSPTS to evaluate use of air stripping at this location. This spray-type air stripper is in the effluent manhole and is designed to treat groundwater for volatile organic compounds (VOCs) following passive zero-valent iron (ZVI) treatment in underground tanks. The air stripper is powered entirely by batteries, which are recharged using solar energy.
September 2011	Operation of new surface water points of compliance (POCs) at Woman Creek (WOMPOC) and Walnut Creek (WALPOC) commences at the boundary of the COU. These POCs replace former POCs at locations GS08, GS11, and GS31. Monitoring at GS08, GS11, and GS31 continues under the Adaptive Management Plan. A CAD/ROD amendment for the COU is signed. The primary purpose of the amendment is to clarify the description of the institutional controls pertaining to excavation, soil disturbance, and changes to engineered components.
November 2011	DOE and CDPHE revise the 2006 Environmental Covenant restricting use and access to the COU. The Covenant may be viewed on the LM website.
September 2012	Third FYR report is issued. The remedy remains protective.
December 2012	Minor modifications are made to RFLMA Attachment 2 to reflect establishment of new POCs, WALPOC and WOMPOC, and incorporate changes to Colorado surface water standards, among other things (see CR 2012-03).
February 2013	A small-scale air stripper is installed at ETPTS to evaluate use of this technology at this location. This spray-type air stripper is in the influent manhole and is designed to treat groundwater for VOCs before passive ZVI treatment in underground tanks. The air stripper is powered entirely by batteries, which are recharged using solar energy.

Date	Event
September 2013	The two surface water POCs at Indiana Street, GS01 and GS03, are no longer monitored under the RFLMA. This change reflects the deletion of the POU from the NPL and establishment as a National Wildlife Refuge and realignment of POCs to the COU boundary. Monitoring at GS01 and GS03 continued until 2015 under the Adaptive Management Plan. Record-setting precipitation and flooding on the Front Range of Colorado.
October 2013	As a result of the September 2013 flooding, slumping at the OLF results in a reportable condition (see CR 2013-02). Minor slumping had also occurred in 2007 and 2010.
December 2013	As a result of the September 2013 flooding, a reportable condition for the 30-day average for uranium at WALPOC is documented and persists through May 2014 (see CR 2014-05).
October 2014	As a result of the September 2013 flooding, a reportable condition for the 12-month rolling average for uranium at WALPOC is documented (see CR 2015-01).
December 2014	Minor modifications are made to the PLF Monitoring and Maintenance Plan (see CR 2014-03).
January 2015	A commercial air stripper is installed and begins operation at the ETPTS, replacing the ZVI treatment media (see CR 2014-04). This technology improvement achieves a greater reduction of VOCs in groundwater than the previous ZVI-based technology.
May–September 2015	Extended heavy precipitation over several months in the spring causes significant cracking, slumping, and movement on northwestern and eastern sides of the OLF. Immediate response actions include installing overland drainpipes and developing small drainage channels to conduct water off the cover (see CR 2015-03). Subsequent interim actions include regrading the affected areas and closing cracks (see CR 2015-06). The heavy precipitation also causes significant slumping in the North Walnut Creek basin east of the SPPTS.
September 2015	An extensive evaluation of water quality is finalized. *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site* discusses geochemical conditions resulting in mobilization of uranium in the Walnut Creek drainage.
June 2016	An Explanation of Significant Differences is issued to document a significant change to the CAD/ROD approved in 2006. The change consists of removing groundwater treatment components from the MSPTS and pumping the Mound Site Plume groundwater to the ETPTS air stripper for treatment. This improved the removal of VOCs in groundwater, eliminated the use of ZVI treatment media, and reduced the number of groundwater treatment systems in the COU from four to three.
July 2016	SPPTS conversion from organic media/ZVI to full-scale, interim design lagoon treatment for nitrate is completed and testing is ongoing. Evaluation of treatment technologies for uranium continues.
September 2016	The reconfiguration of the MSPTS is complete; combined groundwater from MSPTS (now referred to as the Mound Site Plume Collection System [MSPCS]) and ETPTS is now treated for VOCs at the commercial air stripper at the ETPTS. Wells/piezometers are installed upgradient of the OLF to allow for long-term monitoring of groundwater levels.
December 2016	Repair and upgrade of the ESSD at OLF begin. The ESSD was constructed in 2005 and comprised a subsurface rock drain designed to divert groundwater away from the landfill. This feature is no longer functioning and is partially replaced with drain piping that allowed for more effective groundwater collection and would be less likely to clog (see CR 2016-04). The project is completed in January 2017.
January 2017	The *Original Landfill Path Forward* document is published. This document evaluates long-term solutions for reducing the instability of the slopes surrounding the OLF. Two key OLF technical evaluations are included as attachments to this document: *OLF Options Report* and *OLF Geotechnical Engineering Review.*
January 2017	A temporary ground water intercept system is installed on the pediment north of the OLF.
March 2017	A Restrictive Notice replaces the 2011 Environmental Covenant. The Notice may be viewed on the LM website.
May 2017	North Walnut Creek hillside is regraded after slumping in 2015 and 2017 (see CR 2017-03).

Date	Event
August 2017	Fourth FYR report is issued. The remedy remains protective.
November 2017	An additional slope stability analysis is completed for the OLF. Analysis recommends actions for controlling infiltration, stabilizing the toe, diverting groundwater from the landfill, and collecting additional geotechnical data to confirm the subsurface stratigraphy.
December 2017	Geotechnical borings and inclinometers are installed on the North Walnut Creek hillside. Resulting data are to be used to support development of a conceptual design for stabilization of the hillside (see CR 2017-03 and Field Change Concurrence 121917).
February 2018	North Walnut Creek Slump (NWCS) scarp line is regraded. Monitoring of groundwater levels and hillside movement continues.
April 2018	An alternatives evaluation is completed for uranium treatment at the SPPTS, based on literature and technology review and laboratory and field testing. The results are to be used to prepare statements of work and related procurement and contractual products.
June 2018	Additional geotechnical data are obtained at OLF to address the data needs identified in November 2017 slope stability analysis (see CR 2018-01).
October 2018	An engineering analysis of the NWCS is completed. The analysis includes a slope stability evaluation and preliminary cost estimate for hillside stabilization. The collection of additional data is recommended to finalize recommendations.
August 2018	NWCS scarp line is regraded. Monitoring of groundwater levels and hillside movement continues.
November 2018	Following successful testing, the full-scale test component at the SPPTS receives upgrades suitable for long-term use, becoming the formal SPPTS nitrate treatment component. System flows resume in early December.
December 2018	RFLMA Attachment 2 minor modification is approved (see CR 2018-05). Modification incorporates previously approved modifications; revises Table 1, “Surface Water Standards,” and Table 2, “Water Monitoring Locations and Sampling Criteria Water”; and updates the Environmental Covenant description.
February 2019	OLF stabilization project engineering design work begins.
July 2019	The 2015 *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site* is updated.
August 2019	OLF stabilization project commences (see CR 2019-02).
October 2019	A swale is installed, and modifications to rock crossings are made upgradient of the NWCS area to divert stormwater from the slump (see CR 2019-03).
August 2020	OLF stabilization project is completed.

Appendix B

Rocky Flats Legacy Management Agreement Attachment 2

Document History

Rocky Flats Legacy Management Agreement
Attachment 2, Legacy Management Requirements

<table>
<tr><th>Date</th><th>Description of Changes</th></tr>
<tr><td>December 2012</td><td>Modification per RFLMA Contact Record 2012-03. For simplicity, Document History table was revised to remove the detailed list of changes made in modifications through the last modification in September 2011. All prior modifications are documented in the Rocky Flats post-closure administrative record.</td></tr>
<tr><td>December 2012</td><td>Section 5.1 updated to note the date WALPOC and WOMPOC became Points of Compliance (POCs), replacing former POCs GS08, GS11, and GS31.</td></tr>
<tr><td>December 2012</td><td>Section 5.3.7 and Table 5 related to additional ecological sampling deleted for simplicity. The additional ecological sampling was completed and approved in 2008.</td></tr>
<tr><td>December 2012</td><td>Section 7.3 was based on the schedule for the second 5-year review report in 2007. The third 5-year review was completed in 2012. Section was modified to address the scheduling for completion of future reports.</td></tr>
<tr><td>December 2012</td><td>Table 1 modified to make standards consistent with changes promulgated by the Colorado Water Quality Control Commission (WQCC) with an effective date of January 31, 2013, as follows:
<table>
<tr><th>Analyte</th><th>Previous Standard (mg/L)</th><th>New Standard (mg/L)</th></tr>
<tr><td>Acrylamide</td><td>7.80E-6</td><td>2.20E-5</td></tr>
<tr><td>Carbon tetrachloride</td><td>2.30E-4</td><td>4.30E-4</td></tr>
<tr><td>1,2-Dichloroethene (cis)</td><td>7.00E-2</td><td>1.40E-2 to 7.00E-2</td></tr>
<tr><td>1,4-Dioxane</td><td>3.20E-3</td><td>3.50E-4</td></tr>
<tr><td>Hexachloroethane</td><td>4.00E-4</td><td>5.00E-4</td></tr>
<tr><td>Nitrobenzene</td><td>3.50E-3</td><td>1.40E-2</td></tr>
<tr><td>Pentachlorophenol</td><td>2.70E-4</td><td>8.00E-5</td></tr>
<tr><td>Tetrachloroethene</td><td>6.90E-4</td><td>5.00E-3</td></tr>
</table>
Table 1 footnotes modified as follows:

[c] and [h]: Deleted because footnotes referenced Temporary Modifications that expired at the end of 2009. Both footnotes marked as “Reserved.”

[e]: Revised to clarify that the WQCC promulgated standard for un-ionized ammonia applies to Segment 4a only.

[i]: Clarified that nitrate and nitrite standards are “as nitrogen.”

[m]: Deleted because footnote referred to the March 22, 2012, effective date for the 1,4-Dioxane standard (3.20E-3 mg/L). Footnote marked as “Reserved.”

[n]: Added 1,2-Dichloroethene (cis) to this footnote, to note that the higher number in the range is to be used as the applicable or corresponding Table 1 standard in the flowcharts in Figures 7 through 11. Prior to this change, arsenic was the only Table 1 analyte noted in footnote [n] based on the WQCC promulgated standard that is a range of values.</td></tr>
<tr><td>December 2012</td><td>Table 2 modified to remove former POCs GS08, GS11 and GS31, which have been replaced as POCs by WALPOC and WOMPOC as described in Section 5.1.</td></tr>
<tr><td>December 2012</td><td>Table 3 modified to remove landfill-specific vegetation and inspection requirements as recommended in the third 5-year review report.
Table 3 was also modified to change Present Landfill reference from “pond” to “downstream” monitoring because the Present Landfill Pond dam was breached in 2012.</td></tr>
</table>

<table>
<tr><th>Date</th><th>Description of Changes</th></tr>
<tr><td>December 2012</td><td>Figure 1 modified to remove former POCs GS08, GS11, and GS31 and to change note regarding GS01 and GS03 consistent with change to Section 5.1. The footprint of the Present Landfill Pond and Pond A-3 changed to reflect dam breach and the map feature for these ponds changed to “wetland/marsh.” The note regarding dam breach changed to delete reference to Present Landfill Pond and Pond A-3. Surface water sampling locations “Pond A4”, Pond B5” and “Pond C2” changed to “A4 Pond”, “B5 Pond” and “C2 Pond” consistent with Table 2 location codes.</td></tr>
<tr><td>December 2012</td><td>Figure 3 modified to correct typo for former sewage treatment plant Building 988, previously labeled 998.</td></tr>
<tr><td>December 2012</td><td>Figure 4 modified to show the location of the Original Landfill and the Present Landfill and to change the figure title accordingly. Figure 4 also modified to reflect Present Landfill Pond and Pond A-3 dam breach.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>December 2018</td><td>Minor modification per RFLMA Contact Record 2018-05.</td></tr>
<tr><td>December 2018</td><td>Incorporate minor modifications approved by CR 2014-02, CR 2014-07, and CR 2015-04. The changes include removal of GS01 and GS03 from text, tables and figures; removal of Sentinel well 88104 from tables and figures; and modification of monitoring locations and names associated with the MSPTS reconfiguration project.

The MSPTS reconfiguration project was considered a significant change to the CAD/ROD and an Explanation of Significant Differences (ESD) was issued (in conjunction with CR 2016-02) to document the change.</td></tr>
<tr><td>December 2018</td><td>Remove references to “environmental covenant” throughout Attachment 2. The 2011 environmental covenant was superseded in April 2017 by a restrictive notice (also referred to as Environmental Use Restrictions) issued under Colorado Revised Statutes §25-15-318.5.</td></tr>
<tr><td>December 2018</td><td>Delete references to ponds other than terminal ponds A-4, B-5 and C-2 in text and Figure 13.</td></tr>
<tr><td>December 2018</td><td>Modify Table 1, “Surface Water Standards” list of analytes based on closure decisions and post-closure analytical data; update select metals standards and practical quantitation limits (PQLs); revise and renumber footnotes as necessary to reflect changes.

Revise the following Table 1 analyte standards:

<table>
<tr><th>Analyte</th><th>Previous Standard (mg/L)</th><th>New Standard (mg/L)</th></tr>
<tr><td>Cadmium, dissolved</td><td>1.50E-03</td><td>5.60E-04</td></tr>
<tr><td>Copper, dissolved</td><td>1.60E-02</td><td>1.20E-02</td></tr>
<tr><td>Lead, dissolved</td><td>6.50E-03</td><td>3.70E-03</td></tr>
<tr><td>Nickel, dissolved</td><td>1.23E-01</td><td>7.00E-02</td></tr>
<tr><td>Zinc, dissolved</td><td>1.41E-01</td><td>1.68E-01</td></tr>
</table>

Revise practical quantitation limits (PQLs).</td></tr>
<tr><td>December 2018</td><td>Add “Analyte Category” column to Table 1 that assigns each Table 1 analyte a category (metals, volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], or other) that can be directly tied to the required monitoring listed for each location in Table 2, “Water Monitoring Locations and Sampling Criteria”.</td></tr>
<tr><td>December 2018</td><td>Modify Table 2, “Water Monitoring Locations and Sampling Criteria” to delete obsolete monitoring locations and update monitoring location nomenclature.</td></tr>
<tr><td>December 2018</td><td>Update Figure 1 to remove monitoring locations 88104, GS01, GS03, Mound R2-E, and rename monitoring locations associated with MSPTS and ETPTS reconfiguration.</td></tr>
</table>

Date	Description of Changes
December 2018	Update Figure 2 to reflect changes to ponds as a result of previous dam breaches and update treatment system nomenclature.
December 2018	Revise Notes in Figure 11, “Groundwater Treatment Systems” to reflect MSPTS and ETPTS reconfiguration.
December 2018	Revise Figure 13, “Pre-Discharge Pond Sampling” to delete “(or other ponds upstream of POC serving as a terminal pond)” at beginning of flowchart.

Table of Contents

Tables

Figures

1.0 PURPOSE AND BACKGROUND

The purpose of this attachment to the Rocky Flats Legacy Management Agreement (RFLMA) is to specify the legacy management requirements that will ensure the response action selected and approved in the final Corrective Action Decision and Record of Decision (CAD/ROD) for the Central Operable Unit (OU) remains protective of human health and the environment. The remedy specified in the final CAD/ROD is supported by a Comprehensive Risk Assessment, which is based on a specific land use. The remedy, therefore, relies on certain physical and institutional controls, which must be maintained to ensure long-term protectiveness. The remedy also includes engineered features—landfills and water treatment systems—which must be maintained to remain protective. Reduced levels of residual soil contamination remain at the site and may continue to affect surface water. Contaminated groundwater also exists at the site and may impact surface water quality. Continued routine monitoring for groundwater and surface water is therefore required. Air, soil, and ecological receptors have been extensively monitored for many years and routine monitoring is no longer required.

Legacy management requirements described in this attachment are intended to address the requirements of the following statutes:

- Resource Conservation and Recovery Act (RCRA);
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) including applicable or relevant and appropriate requirements (ARARs); and
- Colorado Hazardous Waste Act (CHWA).

Modifications to this attachment will occur in accordance with the provisions of Part 10 of RFLMA.

2.0 REMEDY PERFORMANCE STANDARDS AND REQUIREMENTS

Remedy performance standards and requirements are enforceable numerical values or narrative descriptions of conditions or restrictions, designed to protect existing or potential uses, against which remedy performance can be measured. These standards and requirements are derived from state surface water standards and from requirements established in the final CAD/ROD.

2.1 Surface Water Standards

Protection of surface water was a basis for making soil and groundwater response action decisions during the cleanup period so that surface water on site and leaving the site would be of sufficient quality to support all uses. The applicable surface water uses are consistent with the following Colorado Water Quality Control Commission (WQCC) surface water use classifications:

- Water Supply,
- Aquatic Life – Warm 2,
- Agriculture,
- Recreation N (North Walnut Creek, South Walnut Creek, and Pond C-2), and
- Recreation E (Woman Creek).

The remedy performance standards for surface water at the Rocky Flats Site are found in Table 1 and are based on the tables found in the WQCC Regulation No. 31: Basic Standards and Methodologies for Surface Water (5 CCR 1002-31) and on the site-specific standards in the WQCC Regulations No. 38 (5 CCR 1002-38). The Table 1 standards are tailored to the conditions at the Rocky Flats Site and their use is limited to the evaluation of environmental monitoring data required by this agreement. The Table 1 standards do not supplant state of Colorado water quality standards applicable to surface waters at the site, which are named in the CAD/ROD. If the numeric values from the basic standards and the site-specific standards differ, the site-specific standard applies. Revisions to the practical quantitation limits (PQLs) in Table 1 may be proposed to Colorado Department of Public Health and Environment (CDPHE) for approval. The RFLMA parties should consider PQL guidance, applicable regulations, site-specific conditions, and other relevant information in establishing PQL values. Any changes to the standards will be discussed in the annual legacy management report.

The WQCC-designated groundwater use classification at the site is surface water protection. The numeric values for measuring potential effects of contaminated groundwater on surface water quality are the surface water standards in Table 1. Exceedances of water quality standards at a surface water POC may be subject to civil penalties under Sections 109 and 310(c) of CERCLA.

Criteria and strategies for comparing analytical results to these numeric values are established in Section 5 and in attached flowcharts.

2.2 Requirements of the Final CAD/ROD

Some response actions taken under Rocky Flats Cleanup Agreement decision documents specified conditions or restrictions that extend into the legacy management period. These requirements are captured in the final CAD/ROD and are specified in this attachment.

3.0 PHYSICAL CONTROLS

3.1 Engineered Remedies

DOE will maintain physical controls as necessary to protect engineered elements of the remedy, such as landfill covers, groundwater treatment systems, and monitoring equipment.

3.2 Signs

DOE will post signs legible from at least 25 feet at intervals around the perimeter of the Central OU, sufficient to notify persons that they are at the boundary of the Central OU. These signs will measure at least 11 inches by 14 inches and will include the following language: "U.S. Department of Energy – No Trespassing". In addition, signs listing use restrictions and providing contact information will be posted at access points to the Central OU.

4.0 INSTITUTIONAL CONTROLS

Institutional controls in the form of use restrictions are established in the CAD/ROD. These controls are embodied in a restrictive notice issued by CDPHE and are listed in Table 4. Prior to the restrictive notice, an environmental covenant was in place for the Central OU. The environmental covenant was superseded by the restrictive notice in April 2017 when the restrictive notice was recorded in the land records in Jefferson County, Colorado. DOE will annually verify the restrictive notice is on file in accordance with Section 5.3.6.

The use restrictions shall be implemented to meet the objective and rationale of the institutional control as provided in the CAD/ROD. DOE shall follow the RFLMA consultative process pursuant to Part 5 of RFLMA for any regulatory determination required regarding activities subject to the institutional control.

Results of consultation will be documented in contact records or written correspondence. Except for situations where immediate action is warranted, DOE will not implement the activity for which the regulatory determination is required until 10 calendar days after the contact record or written correspondence approving the activity is posted on the Rocky Flats website and notification of the posting is made to stakeholders in accordance with the RFLMA Public Involvement Plan.

DOE will employ administrative procedures to control all site modification, maintenance, or other activities requiring excavation within the Central OU in accordance with the institutional controls to prevent violation of the restrictions listed in Table 4. DOE shall ensure that all such site activities will not compromise the integrity or function of the remedy or result in uncontrolled releases of or exposures to subsurface contamination, in accordance with the land use restrictions in Table 4.

DOE will utilize work control procedures to help maintain the use restrictions and ensure protection of the integrity of the institutional controls. These procedures derive from U.S. Environmental Protection Agency (EPA) and State of Colorado regulation and guidance and DOE Orders and guidance. The DOE Integrated Safety Management System (ISMS) utilizes processes such as the job hazard analysis (JHA) to identify and mediate environmental, health and safety risks to ensure all work is done in a safe and environmentally protective manner.

4.1 Soil Disturbance Review Plan

Activities in the Central OU subject to Institutional Control 2 or 3, listed in Table 4, that are subject to regulatory review and approval will be reviewed and approved in accordance with this Soil Disturbance Review Plan.

4.1.1 Information in Soil Disturbance Review Plan

Prior to conducting any activity that is subject to this plan, DOE will submit the following information to CDPHE and EPA:

- A description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.
- Information about any remaining subsurface structures in the vicinity of the proposed project (or state that there are none if that is the case).
- Information about any former Individual Hazardous Substance Sites, Potential Areas of Concern, or other known or potential soil or groundwater contamination in the vicinity of the proposed project (or state that there is no known contamination).

In consultation with EPA, CDPHE will review the information described above. CDPHE will approve the proposed activity only if it determines that the proposed activity will not result in an unacceptable release or exposure to residual subsurface contamination, and will not damage any component of the remedy. In making such determinations, CDPHE will ensure that the proposed project meets the rationale and objectives of the institutional controls.

Subsurface soils disturbed by activities implemented in areas that, based on the results of the Remedial Investigation/Feasibility Study, are or may be contaminated must be characterized. Characterization may rely on existing data, and be sufficient to implement the DOE work control procedures to establish controls for worker health and safety, potential migration of contamination and other project specific items identified through the evaluation of information in the Soil Disturbance Review Plan. Contaminated soils may be returned to the excavation, provided the rationale and objectives of the institutional controls are still met. Contaminated soils not returned to the excavation must be managed in accordance with regulatory requirements.

If an onsite or offsite borrow source is needed to fill an excavation, the source must be identified. This Soil Disturbance Review Plan also applies to any onsite borrow source.

DOE will document the elevation created by any soil-disturbing activity that does not return the soil surface to preexisting grade or higher, in order to ensure that the minimum 3-foot cover thickness above any contaminated subsurface feature in Figures 3 or 4 is maintained.

5.0 MONITORING REQUIREMENTS

Monitoring will provide measurements for remedy performance, safety, compliance with standards, and effectiveness of physical and institutional controls. Monitoring requirements are designed to provide data that meet designated monitoring objectives (as outlined in Table 2 and in attached flowcharts) and that support operational and regulatory decision making. Legacy Management operational documents relating to the monitoring and maintenance performed by DOE will be provided to CDPHE and EPA and will be available to the public.

Environmental sampling, analysis, and data management required by this attachment will conform to the Legacy Management CERCLA Sites Quality Assurance Project Plan (QAPP) and meet the quality assurance and quality control requirements in current EPA guidance. DOE submitted the QAPP to CDPHE and EPA within two months of execution of the RFLMA. DOE will ensure that laboratories generating data have procedures for assuring that the precision, accuracy, representativeness, completeness, and comparability (and sensitivity in the case of radiological analyses) of data are known and documented. DOE will also perform periodic assessments of analytical data, including laboratory audits. Upon request, all analytical data including QA/QC procedures, audits, and reports will be provided to CDPHE and/or EPA.

Standard EPA analytical methods will be used with the intent that detection limits will be less than the respective standards. If standard analytical methods cannot attain the standard, then alternative methods or PQLs will be proposed to CDPHE. The currently accepted PQLs are listed in Table 1.

5.1 Monitoring Surface Water

Compliance with the surface-water standards in Table 1 will be measured at the Points of Compliance (POCs) and consider groundwater in alluvium. Points of Evaluation (POEs) and additional performance monitoring locations serve to monitor the quality of surface water in the Central OU. The data evaluation methods described in the attached flowcharts will be used to evaluate sampling data collected at these locations. POCs, POEs and performance monitoring locations are shown in Figure 1; the monitoring location identification, description and sampling criteria are identified in Table 2.

- Points of Compliance (POCs): Located in Woman and Walnut Creeks. These locations are used to demonstrate compliance with the surface-water standards in Table 1 and are identified as WOMPOC and WALPOC, respectively.
- Points of Evaluation (POEs): Located in the Central OU upstream of the POCs. These locations are used to evaluate water-quality in comparison to the surface-water standards in Table 1.
- Performance monitoring locations: Located downstream of specific remedies to determine the short and long-term effectiveness of these remedies where known contaminants may affect surface water.

5.2 Monitoring Groundwater

Groundwater is monitored in or near areas of groundwater contamination that might adversely affect surface water quality (Figure 2). Contaminated groundwater emerges to surface water before leaving the Central OU. DOE will maintain a network of groundwater monitoring wells to assess the potential effects of contaminated groundwater on surface water quality. These wells and sampling criteria are identified in Table 2 and shown in Figure 1 with the following well classifications:

- Area of Concern (AOC) Wells: Located within a drainage and downgradient of a contaminant plume or group of contaminant plumes. These wells are monitored to determine whether the plume(s) may be discharging to surface water.
- Sentinel Wells: Typically located near downgradient edges of contaminant plumes, in drainages, and downgradient of groundwater treatment systems. These wells are monitored to determine whether concentrations of contaminants are increasing, which could indicate plume migration or treatment system problems.

- Evaluation Wells: Typically located within plumes and near plume source areas, or in the interior of the Central OU. Data from these wells will help determine when monitoring of an area or plume can cease. A subset of these wells is located in areas that may experience significant changes in groundwater conditions as a result of closure activities.
- RCRA Wells: Dedicated to monitoring the Present Landfill and Original Landfill.

5.3 Remedy Monitoring and Maintenance

5.3.1 Original Landfill

Groundwater and surface water monitoring details, including criteria and analytes, are listed in Table 2. Table 3 summarizes the inspection and maintenance requirements contained in the approved *Original Landfill Monitoring and Maintenance Plan,* which is incorporated by reference as an enforceable requirement of the RFLMA.

5.3.2 Present Landfill

Groundwater and surface water monitoring details, including criteria and analytes, are listed in Table 2. Table 3 summarizes the inspection and maintenance requirements contained in the approved *Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan,* which is incorporated by reference as an enforceable requirement of the RFLMA.

5.3.3 Groundwater Treatment Systems

Each system will be monitored, at a minimum, for untreated influent and treated effluent, and for impacts to surface water downstream of the effluent discharge point according to the sampling criteria in Table 2 and the decision rules in the attached flowcharts. The systems will be maintained to ensure the effluent meets Table 1 standards.

5.3.4 Residual Subsurface Contamination

The Central OU will be monitored for significant erosion annually and following major precipitation events. DOE will evaluate whether the erosion is in proximity to the subsurface features shown in Figures 3 and 4. Monitoring will include visual observation (and measurements, if necessary) of precursor evidence of significant erosion (cracks, rills, slumping, subsidence, sediment deposition, etc.).

5.3.5 Monitoring Physical Controls

The condition of signs and other physical controls maintained by DOE will be inspected on a quarterly basis.

5.3.6 Monitoring Institutional Controls

The effectiveness of the institutional controls described in Table 4 of this attachment and in the restrictive notice required by Section 4.0 will be determined by inspecting the Central OU at least annually for any evidence of violations of those controls. DOE will also annually verify that the restrictive notice for the Central OU remains in the Administrative Record and is recorded in Jefferson County.

5.4 Operational Monitoring

Operational monitoring is not a requirement of the CAD/ROD, but is a requirement of this Attachment. Operational monitoring provides information that will supplement CAD/ROD required monitoring.

5.4.1 Duplicate or Split Sampling

CDPHE and EPA will be allowed the opportunity to collect duplicate or split samples for any monitoring. This opportunity shall be coordinated in accordance with the consultative process and right of entry provisions in RFLMA.

5.4.2 Pre-discharge Pond Sampling

DOE will collect pre-discharge samples from Pond A-4, Pond B-5, or Pond C-2 when operated in batch and release mode. DOE will notify appropriate parties in accordance with Figure 13 in advance of pre-discharge pond sampling. Samples will be analyzed for POC constituents far enough in advance of a routine discharge to allow action to be taken if exceedances are suggested, but near enough to the time of discharge to be representative of the discharge composition. Figure 13 shows how actions are determined based on the results of pre-discharge samples. Ponds will be operated to maintain dam safety regardless of the status or results of pond sampling.

5.4.3 Adverse Biological Conditions

DOE will note evidence of adverse biological conditions (e.g., unexpected mortality or morbidity) observed during other monitoring and maintenance activities described above.

6.0 ACTION DETERMINATIONS

Whenever any of the following reportable conditions are observed, DOE shall follow the appropriate procedures in this section. Reportable conditions include:

- Exceedances of surface water standards at surface water and groundwater monitoring locations consistent with the attached flowcharts;
- Evidence of significant erosion in areas of residual subsurface contamination;
- Evidence of adverse biological conditions;
- Conditions affecting the effectiveness of the landfill covers;
- Evidence of violation of the institutional controls;
- Physical control failure that adversely affects the remedy; or
- Other abnormal conditions that adversely affect the remedy.

When reportable conditions occur (except in the case of evidence of violation of institutional controls as described below), DOE will inform CDPHE and EPA within 15 days of receiving the inspection reports or validated data. Within 30 days of receiving inspection reports or validated analytical data documenting a reportable condition, DOE will submit a plan and a schedule for an evaluation to address the condition. DOE will consult as described in RFLMA Paragraph 11 to determine if mitigating actions are necessary. Final plans and schedules for mitigating actions, if any, will be approved by CDPHE in consultation with EPA. DOE is not, however, precluded from undertaking timely mitigation once a reportable condition has been identified.

In the case of evidence of violation of institutional controls, DOE will notify EPA and CDPHE within 2 days of discovering any evidence of such a violation, and at that time will initiate the consultative process to address the situation. In no case will DOE notify EPA and CDPHE more than 10 days after the discovery of a situation that may interfere with the effectiveness of the institutional controls. DOE will notify EPA and CDPHE of the actions it is taking within 10 days after beginning the process to address the situation.

The RFLMA Parties will consult whenever reportable conditions are observed or at the request of one of the Parties when routine communication processes are not sufficient or appropriate. The objective of the consultation will be to determine a course of action to address the reportable condition and to ensure the remedy remains protective. Results of consultation will be documented in contact records and/or written correspondence.

Surface water and groundwater monitoring results will be evaluated as described in the following flowcharts:

- Figure 5 Flowchart—Points of Compliance
- Figure 6 Flowchart—Points of Evaluation
- Figure 7 Flowchart—Area of Concern Wells and SW018
- Figure 8 Flowchart—Sentinel Wells
- Figure 9 Flowchart—Evaluation Wells
- Figure 10 Flowchart—RCRA Wells
- Figure 11 Flowchart—Groundwater Treatment Systems
- Figure 12 Flowchart—Original Landfill Surface Water
- Figure 13 Flowchart—Pre-discharge Pond Sampling

Exceedances of water quality standards at a POC may be subject to civil penalties under Sections 109 and 310(c) of CERCLA. In addition, failure of DOE to notify the State and EPA of such exceedances or other reportable occurrences, or failure to undertake source evaluations or mitigating actions as described above, will be enforceable consistent with the terms of Part 8 of the RFLMA.

7.0 PERIODIC REPORTING REQUIREMENTS

In addition to notifications of reportable conditions described in Section 6, periodic reporting will provide CDPHE, EPA, and the public with updated information pertaining to the surveillance and maintenance of the remedy prescribed in the final CAD/ROD. Analytical data and other information will be clearly presented along with summaries and evaluations to help interpret the data. Reports will be posted on the LM website and available for regulatory and public review in accordance with the following schedule:

- Quarter ending March 31 will be posted by July 15
- Quarter ending June 30 will be posted by October 15
- Quarter ending September 30 will be posted by January 15
- Year and quarter ending December 31 will be posted by April 30

7.1 Quarterly Legacy Management Reports

The various reporting requirements may be combined into a summary report of surveillance and maintenance activities that occurred during the applicable quarter. The following topics will be included in quarterly reports:

- Surface water monitoring data;
- Groundwater monitoring data;
- Groundwater treatment system monitoring data;
- Adverse biological conditions;
- Inspection reports; and
- Summary of maintenance and repairs.

7.2 Annual Legacy Management Reports

The various reporting requirements may be combined into a comprehensive report of all surveillance and maintenance activities that occurred during the applicable calendar year. Annual reports may include a summary for the previous quarter. The following will be included in annual reports:

- Discussion of surface water monitoring data;
- Discussion of groundwater monitoring data;
- Discussion of groundwater treatment system monitoring data;
- Adverse biological conditions;
- Summary of actions taken in response to reportable conditions;
- Summary of maintenance and repairs;
- Inspection reports;

- Verification of the restrictive notice and evaluation of the effectiveness of institutional controls;
- Original Landfill Monitoring Report (see Table 3 and Section 6.1 of the *Original Landfill Monitoring and Maintenance Plan*, as approved);
- Present Landfill Monitoring Report (see Table 3 and Section 6.1 of the *Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan,* as approved);
- Assessments of analytical data, including laboratory audits; and
- Other conditions or actions taken that are pertinent to the continued effectiveness of the remedy.

7.3 CERCLA 5-Year Review

A statutory 5-year review is required under CERCLA for the Central OU because the selected remedy will result in hazardous substances, pollutants or contaminants remaining above levels that allow for unrestricted use and unlimited exposure. DOE will prepare the 5-year review report consistent with EPA-OSWER Directive 9355.7-03B-P (or subsequent EPA directives), as applicable to Rocky Flats. DOE will submit the 5-year review report to EPA upon a mutually agreeable schedule determined by the RFLMA Project Coordinators in accordance with the consultative process in RFLMA paragraph 11, so as to allow for EPA concurrence within 5 years of the preceding 5-year review report. DOE will conduct 5-year reviews in accordance with RFLMA Part 11, Periodic Reviews, until such time as EPA determines that CERCLA periodic reviews are no longer required. The 5-year review will evaluate site conditions and determine whether the selected remedy remains protective of human health and the environment. In doing so, the 5-year review will evaluate the components of the remedy (including, but not limited to, requirements for monitoring, maintenance and inspections, institutional controls, and reporting.) The 5-year review will determine whether such remedy components will be continued, modified, or discontinued. The public will be notified when the review will be conducted. Results of 5-year reviews will be made available to the public.

Table 1. Surface Water Standards

Analyte	CAS Reference Number	Standards [a] (mg/L)	Basis [a, b]	PQLs [c] (mg/L)	Analyte Category [d]
Acenaphthene	83-32-9	4.20E-01	W+F, WS		SVOCs
Anthracene	120-12-7	2.10E+00	W+F, WS		SVOCs
Arsenic, total recoverable [e]	7440-38-2	2.00E-05 to 1.00E-02 [f]	SS		Metals
Benzene	71-43-2	2.20E-03	W+F		VOCs
Benzo(a)pyrene	50-32-8	3.80E-06	W+F	1.00E-04	SVOCs
Benzo(g,h,i)perylene	191-24-2	3.80E-06	W+F	1.00E-04	SVOCs
Beryllium [e]	7440-41-7	4.00E-03	SS		Metals
Boron, total [e]	7440-42-8	7.50E-01	AG, SS		Metals
Bromoform [Tribromomethane]	75-25-2	4.30E-03	W+F [g]		VOCs
Cadmium, dissolved	7440-43-9	5.60E-04	TVS [h]		Metals

Table 1. Surface Water Standards (continued)

Analyte	CAS Reference Number	Standards [a] (mg/L)	Basis [a, b]	PQLs [c] (mg/L)	Analyte Category [d]
Carbon tetrachloride	56-23-5	4.30E-04	W+F	1.00E-03	VOCs
Chlorobenzene	108-90-7	1.00E-01	W+F, WS		VOCs
Chloroform [Trichloromethane]	67-66-3	3.40E-03	W+F [g]		VOCs
bis(2-Chloroisopropyl)ether	108-60-1	2.80E-01	W+F, WS		SVOCs
Chloromethane [Methyl chloride]	74-87-3	5.60E-03	W+F		VOCs
Chloronaphthalene	91-58-7	5.60E-01	W+F, WS		SVOCs
Chromium, Total Recoverable [e, i]	16065-83-1	5.00E-02	SS		Metals
Chrysene	218-01-9	3.80E-06	W+F	1.00E-04	SVOCs
Copper, dissolved	7440-50-8	1.20E-02	TVS [h]	1.50E-02	Metals
Dibenzo(a,h)anthracene	53-70-3	3.80E-06	W+F	1.00E-04	SVOCs
Di-n-butylphthalate	84-74-2	7.00E-01	W+F, WS		SVOCs
1,2-Dichlorobenzene	95-50-1	4.20E-01	W+F		VOCs
1,3-Dichlorobenzene	541-73-1	9.40E-02	W+F, WS		VOCs
1,4-Dichlorobenzene	106-46-7	6.30E-02	W+F		VOCs
1,2-Dichloroethane	107-06-2	3.80E-04	W+F	6.50E-04	VOCs
1,1-Dichloroethene	75-35-4	7.00E-03	W+F, WS		VOCs
1,2-Dichloroethene (cis)	156-59-2	1.40E-02 to 7.00E-02 [f]	WS		VOCs
1,2-Dichloroethene (trans)	156-60-5	1.00E-01	W+F, WS		VOCs
1,2-Dichloropropane	78-87-5	5.00E-04	W+F	9.00E-04	VOCs
Diethylphthalate	84-66-2	5.60E+00	W+F, WS		SVOCs
Dimethylphthalate	131-11-3	7.00E+01	W+F, WS		SVOCs
Dioxin (2,3,7,8 TCDD)	1746-01-6	5.00E-12	W+F	1.00E-03	Other
Ethylbenzene	100-41-4	5.30E-01	W+F		VOCs
bis(2-Ethylhexyl)phthalate	117-81-7	1.20E-03	W+F	3.00E-03	SVOCs
Fluoranthene	206-44-0	1.30E-01	W+F		SVOCs
Fluorene	86-73-7	2.80E-01	WS		SVOCs
Hexachlorobutadiene	87-68-3	4.40E-04	W+F	1.80E-03	VOCs
Hexachloroethane	67-72-1	5.00E-04	W+F	1.00E-02	SVOCs
Isophorone	78-59-1	1.30E-01	W+F		SVOCs
Lead, dissolved	7439-92-1	3.70E-03	TVS [h]		Metals
Mercury, total [e]	7439-97-6	1.00E-05	SS	2.00E-04	Metals
Methylene chloride [Dichloromethane]	75-09-2	4.60E-03	W+F		VOCs
Naphthalene	91-20-3	1.40E-01	W+F, WS		VOCs
Nickel, dissolved	7440-02-0	7.00E-02	TVS [h]		Metals
Nitrate [j]	14797-55-8	1.00E+01	AG, SS		Other
PCBs	1336-36-3	6.40E-08	W+F [k]	2.00E-03	Other

Table 1. Surface Water Standards (continued)

Analyte	CAS Reference Number	Standards [a] (mg/L)	Basis [a, b]	PQLs [c] (mg/L)	Analyte Category [d]
Pyrene	129-00-0	2.10E-01	W+F, WS		SVOCs
Selenium [e]	7782-49-2	4.60E-03	AL		Metals
Silver, dissolved	7440-22-4	6.00E-04	TVS [h]	5.00E-03	Metals
Styrene	100-42-5	1.00E-01	WS		VOCs
1,1,2,2-Tetrachloroethane	79-34-5	1.70E-04	W+F	2.00E-03	VOCs
Tetrachloroethene	127-18-4	5.00E-03	W+F, WS		VOCs
Toluene	108-88-3	1.00E+00	W+F, WS		VOCs
1,2,4-Trichlorobenzene	120-82-1	3.50E-02	W+F		VOCs
1,1,1-Trichloroethane	71-55-6	2.00E-01	WS		VOCs
1,1,2-Trichloroethane	79-00-5	2.70E-03	W+F		VOCs
Trichloroethene	79-01-6	2.50E-03	W+F		VOCs
Vinyl chloride	75-01-4	2.30E-05	W+F	5.00E-04	VOCs
Xylene (total)	1330-20-7	1.00E+01	WS		VOCs
Zinc, dissolved	7440-66-6	1.68E-01	TVS [h]		Metals
RADIONUCLIDES [l]					
Americium 241 [e]	14596-10-2	0.15 (pCi/L)	BS		Other
Plutonium 239/240 [e]	10-12-8	0.15 (pCi/L)	BS		Other
Uranium, total [e]	7440-61-1	16.8 (µg/L)	SS		Other

Notes:

[a] The values in these columns reflect the promulgated Colorado WQCC classifications and standards.

[b] Acronyms: AG = Agriculture; AL = Aquatic Life; BS = Basic Standard; SS = Site Specific Standard; TVS = Table Value Standard; WS = Water Supply; W+F = Water plus Fish

[c] Whenever the practical quantitation limit (PQL) for a pollutant is higher (less stringent) than a standard or temporary modification, "less than" the PQL will be used as the compliance threshold.

[d] Specific analyte categories are referenced in Table 2 for the RFLMA monitoring locations. Analytes categorized as 'other' are specified individually in Table 2, if targeted for that location.

[e] Groundwater samples collected from monitoring wells for analysis of metals, Pu, Am, and U will be field-filtered. Analytical results will be evaluated against the corresponding Table 1 value whether the standard is listed as dissolved or total.

[f] The second number in the range for arsenic and 1,2-Dichloroethene (cis) is applied as the corresponding or applicable Table 1 standard in the flowcharts in Figures 7 through 11.

[g] Per the Basic Standards, the Total Trihalomethane (TTHM) standard applies to the sum of the four TTHM compounds. For dibromochloromethane the TTHM value for water supply, 80 parts per billion, was applied.

[h] Table value standards for metals are based on a toxicity equation which uses a hardness value of 143 mg/L.

[i] Chromium analyses for RFLMA monitoring locations are reported as the total concentration of chromium, which includes both trivalent (Cr-III) and hexavalent (Cr-VI) forms. These data are evaluated against the chromium water supply standard of 50 µg/L established for those waters classified for domestic water use. [5 Colorado Code of Regulations 1002-38.6(3), table footnote 5]

[j] Nitrate analyses are reported as nitrate + nitrite (as Nitrogen) and are evaluated against the nitrate standard.

[k] The total PCB standard in the Basic Standards is based on the sum of the Aroclor analytes.

Table 1. Surface Water Standards (continued)

[l] Radionuclides are measured in activity per volume units except for uranium, which is measured as a metal parameter in mass per volume units.

The scientific notation used in this table indicates the power of ten by which the two-decimal-place number is multiplied (e.g., 2.52E-02 = 2.52 X 10-2 = 0.0252).

Table 2. Water Monitoring Locations and Sampling Criteria

General Objective	Classification	Media	Location ID (1)	Location Description	Frequency	Analytes (2,3,4)
Points of Compliance (POCs)						
	POC (5)	SW	WALPOC	Walnut Creek near COU Boundary	Flow-paced (varies)	Pu, Am, U, nitrate, flow rate
	POC (5)	SW	WOMPOC	Woman Creek near COU Boundary	Flow-paced (varies)	Pu, Am, U, flow rate
Points of Evaluation (POEs)						
	POE (6)	SW	GS10	S. Walnut Creek at B-Series Bypass	Flow-paced (varies)	Pu, Am, U, dissolved Ag and Cd, total Be and Cr, flow rate
	POE (6)	SW	SW027	SID at Pond C-2	Flow-paced (varies)	Pu, Am, U, dissolved Ag and Cd, total Be and Cr, flow rate
	POE (6)	SW	SW093	N. Walnut Creek at end of FC-3	Flow-paced (varies)	Pu, Am, U, dissolved Ag and Cd, total Be and Cr, flow rate
Present Landfill (PLF) Area						
	RCRA (10)	GW	70193	Upgradient	Quarterly	VOCs, metals
	RCRA (10)	GW	70393	Upgradient	Quarterly	VOCs, metals
	RCRA (10)	GW	70693	Upgradient	Quarterly	VOCs, metals
	RCRA (10)	GW	73005	Downgradient	Quarterly	VOCs, metals
	RCRA (10)	GW	73105	Downgradient	Quarterly	VOCs, metals
	RCRA (10)	GW	73205	Downgradient	Quarterly	VOCs, metals
	AOC (7)	GW	4087	East of PLF	Semiannual	VOCs, U, nitrate
	AOC (7)	GW	B206989	East of PLF	Semiannual	VOCs, U, nitrate
	Treatment System (11)	GW	PLFSEEPINF	Seep influent to treatment system	Quarterly	VOCs, U, metals, instantaneous flow rate
	Treatment System (11)	SW	PLFSYSEFF	Treatment system effluent	Quarterly; Monthly (if required by decision)	VOCs, SVOCs, U, metals
	Treatment System (11)	SW	NNG01	East of PLFSYSEFF	As required by decision rule	As required by decision rule
Original Landfill (OLF) Area						
	RCRA (10)	GW	P416589	Upgradient	Quarterly	VOCs, metals, SVOCs
	RCRA (10)	GW	80005	Downgradient	Quarterly	VOCs, metals, SVOCs
	RCRA (10)	GW	80105	Downgradient	Quarterly	VOCs, metals, SVOCs
	RCRA (10)	GW	80205	Downgradient	Quarterly	VOCs, metals, SVOCs
	AOC (7)	GW	11104	Downgradient, downstream	Semiannual	VOCs, U
	OLF SW (12)	SW	GS05	Woman Creek at west property line (upstream)	Quarterly; Monthly (if required by decision)	VOCs, U, metals
	OLF SW (12)	SW	GS59	Woman Creek 700 feet east of OLF (downstream)	Quarterly; Monthly (if required by decision)	VOCs, U, metals

Table 2. Water Monitoring Locations and Sampling Criteria (continued)

General Objective	Classification	Media	Location ID (1)	Location Description	Frequency	Analytes (2,3,4)
Mound Site Plume and Collection System (MSPCS)						
	Evaluation (9)	GW	00897	Source area	Biennial	VOCs
	Sentinel (8)	GW	15699	Downgradient of intercept trench	Semiannual	VOCs
	Treatment System (11)	GW	MOUND R1-0	Treatment system influent	Semiannual	VOCs
	Treatment System (11)	GW	MSETEF	Treatment system effluent	Semiannual	VOCs
	Treatment System (11)	SW	POM2	S. Walnut Creek downstream of treatment system	Semiannual	VOCs
East Trenches Plume and Treatment System (ETPTS)						
	Evaluation (9)	GW	3687	Source area	Biennial	VOCs
	Evaluation (9)	GW	05691	Source area	Biennial	VOCs
	Evaluation (9)	GW	03991	East of source area	Biennial	VOCs
	Sentinel (8)	GW	04091	East of source area	Semiannual	VOCs
	Sentinel (8)	GW	95299	Downgradient of intercept trench	Semiannual	VOCs
	Sentinel (8)	GW	95199	Downgradient of intercept trench	Semiannual	VOCs
	Sentinel (8)	GW	95099	Downgradient of intercept trench	Semiannual	VOCs
	Sentinel (8)	GW	23296	Downgradient of intercept trench	Semiannual	VOCs, U
	Treatment System (11)	GW	MSETINF	Treatment system influent	Semiannual	VOCs
	Treatment System (11)	GW	MSETEF	Treatment system effluent	Semiannual	VOCs
	Treatment System (11)	SW	POM2	S. Walnut Creek downstream of treatment system	Semiannual	VOCs
Solar Ponds Plume and Treatment System (SPPTS)						
	Evaluation (9)	GW	P210189	VOC plume source area	Biennial	VOCs, U, nitrate
	Evaluation (9)	GW	79102	SPP source area - north	Biennial	VOCs, U, nitrate
	Evaluation (9)	GW	79202	SPP source area - north	Biennial	VOCs, U, nitrate
	Evaluation (9)	GW	P208989	SPP source area - north	Biennial	VOCs, U, nitrate
	Evaluation (9)	GW	79302	SPP source area - northeast	Biennial	U, nitrate
	Evaluation (9)	GW	79402	SPP source area - northeast	Biennial	U, nitrate
	Evaluation (9)	GW	79502	SPP source area - east	Biennial	U, nitrate
	Evaluation (9)	GW	79605	SPP source area - east	Biennial	U, nitrate
	Evaluation (9)	GW	00203	SPP source area - south	Biennial	VOCs, U, nitrate
	Evaluation (9)	GW	22205	SPP downgradient plume - north	Biennial	VOCs, U, nitrate
	Sentinel (8)	GW	P210089	SPP downgradient plume - north	Semiannual	VOCs, U, nitrate
	Sentinel (8)	GW	70099	Northwest of treatment system	Semiannual	U, nitrate
	Treatment System (11)	GW	SPIN	Treatment system influent	Semiannual	U, nitrate
	Treatment System (11)	GW	SPOUT	Treatment system effluent	Semiannual	U, nitrate

Table 2. Water Monitoring Locations and Sampling Criteria (continued)

General Objective	Classification	Media	Location ID (1)	Location Description	Frequency	Analytes (2,3,4)
Solar Ponds Plume and Treatment System (SPPTS) (continued)						
	Treatment System (11)	SW	GS13	N. Walnut Creek at A-Series Bypass	Semiannual	U, nitrate
	Evaluation (9)	GW	B210489	Downgradient of treatment system	Biennial	U, nitrate
	Evaluation (9)	GW	51605	Downgradient, adjacent to GS13	Biennial	U, nitrate
Other Areas of Interest						
Drainages Below Impacted Areas	AOC (7)	GW	10594	N. Walnut Creek downstream of GS13	Semiannual	VOCs, U, nitrate
	AOC (7)	GW	00997	S. Walnut Creek upstream of Pond B-5	Semiannual	VOCs, U, nitrate
	AOC (7)	GW	00193	Woman Creek upstream of Pond C-2	Semiannual	VOCs, U
Former Building 371/374	Sentinel (8)	GW	37505	North part of former B371 area	Semiannual	VOCs, U, nitrate
	Sentinel (8)	GW	37405	North/northeast part of former B371/374 area	Semiannual	VOCs, U, nitrate, Pu, Am
	Sentinel (8)	GW	37705	East/southeast of former B371/374 area at foundation drain confluence	Semiannual	VOCs, U, nitrate, Pu, Am
Former Building 771/774	Sentinel (8)	GW	20705	North/northwest of former B771 area	Semiannual	VOCs, U, nitrate, Pu, Am
	Sentinel (8)	GW	20505	North of former B771/774 area	Semiannual	VOCs, U, Pu, Am
	Sentinel (8)	GW	20205	North/northeast of former B771/774 area	Semiannual	VOCs, U, Pu, Am
Former North-Central IA	Evaluation (9)	GW	P114689	Southwest of former B559 area	Biennial	VOCs
	Evaluation (9)	GW	P115589	West part of former B551 Warehouse area	Biennial	VOCs
	Evaluation (9)	GW	70705	East part of former B707 area	Biennial	VOCs, U
	Evaluation (9)	GW	33905	North of former 231 Tanks area	Biennial	VOCs
	Evaluation (9)	GW	21505	West of former B776/777 area	Biennial	VOCs
	Sentinel (8)	GW	52505	West of former IHSS 118.1 area	Semiannual	VOCs
	Evaluation (9)	GW	20902	Northwest of former IHSS 118.1	Biennial	VOCs
	AOC (7)	GW	42505	Terminus of FC-2	Semiannual	VOCs
Former Building 559	Evaluation (9)	GW	55905	North part of former B559 area	Biennial	VOCs, U, nitrate
	Evaluation (9)	GW	56305	West part of former B559 area	Biennial	VOCs, U, nitrate
Former IHSS 118.1	Evaluation (9)	GW	18199	North of former IHSS 118.1 area	Biennial	VOCs
	SW Performance [SW018] (7)	SW	SW018	Upstream of FC-2 wetland	Semiannual	VOCs
Former Building 444 Complex	Evaluation (9)	GW	40005	West part of former B444 area	Biennial	VOCs, U
	Evaluation (9)	GW	40205	South part of former B444 end	Biennial	VOCs, U
	Evaluation (9)	GW	P419689	Southeast of former B444 area	Biennial	VOCs, U
	Sentinel (8)	GW	40305	East part of former B444 area	Semiannual	VOCs, U
	Evaluation (9)	GW	P416889	Southeast of former B444 area	Biennial	VOCs, U
	Sentinel (8)	GW	11502	Southeast of former B444 area	Semiannual	VOCs, U
Former Building 881	Evaluation (9)	GW	88205	South part of former B881 area	Biennial	VOCs, U
	Sentinel (8)	GW	00797	South of former B881 area	Semiannual	VOCs, U

Table 2. Water Monitoring Locations and Sampling Criteria (continued)

General Objective	Classification	Media	Location ID (1)	Location Description	Frequency	Analytes (2,3,4)
Other Areas of Interest (continued)						
Former Building 886	Evaluation (9)	GW	22996	East/northeast part of former B886 area	Biennial	VOCs, U
Former Building 991	Sentinel (8)	GW	99305	East part of former B991 area	Semiannual	VOCs, U, nitrate
	Sentinel (8)	GW	99405	Southeast part of former B991 area	Semiannual	VOCs, U, nitrate
	Sentinel (8)	GW	91305	South of confluence of FC-4 and FC-5	Semiannual	VOCs, U, nitrate
Former Oil Burn Pit No. 1	Evaluation (9)	GW	33502	Source area	Biennial	VOCs
	Evaluation (9)	GW	33604	Source area	Biennial	VOCs
	Sentinel (8)	GW	33711	Downgradient of source area	Semiannual	VOCs
Former Oil Burn Pit No. 2	Evaluation (9)	GW	91105	Source area	Biennial	VOCs
	Sentinel (8)	GW	91203	Downgradient of source area	Semiannual	VOCs
Former SW056	Sentinel (8)	GW	45608	Adjacent to French drain remnants and drain interruption	Semiannual	VOCs
OU1 Plume	Evaluation (9)	GW	891WEL	Source area	Biennial	VOCs
	AOC (7)	GW	89104	Downgradient at Woman Creek	Semiannual	VOCs
903 Pad/Ryan's Pit Plume	Evaluation (9)	GW	00191	East of former 903 Pad area	Biennial	VOCs
	Evaluation (9)	GW	50299	East of former 903 Pad area	Biennial	VOCs
	Evaluation (9)	GW	90402	Southeast of former 903 Pad area	Biennial	VOCs
	Evaluation (9)	GW	00491	Southeast of former 903 Pad area	Biennial	VOCs
	Evaluation (9)	GW	07391	Ryan's Pit source area	Biennial	VOCs, U
	Evaluation (9)	GW	90804	Southeast part of 903 Pad/Ryan's Pit Plume	Biennial	VOCs
	Sentinel (8)	GW	90399	Southeast part of 903 Pad/Ryan's Pit Plume at SID	Semiannual	VOCs
	Sentinel (8)	GW	90299	Southeast part of 903 Pad/Ryan's Pit Plume at SID	Semiannual	VOCs
	AOC (7)	GW	10304	Southeast of 903 Pad/Ryan's Pit Plume at Woman Creek	Semiannual	VOCs, U, nitrate
PU&D Yard Plume	Evaluation (9)	GW	30900	Source area	Biennial	VOCs
	Sentinel (8)	GW	30002	Downgradient at N. Walnut Creek	Semiannual	VOCs
Pre-discharge						
	Pre-discharge (13)	SW	Pond A-4	A-Series terminal pond on N. Walnut Creek	Prior to routine discharge	Pu, Am, U, nitrate
	Pre-discharge (13)	SW	Pond B-5	B-Series terminal pond on S. Walnut Creek	Prior to routine discharge	Pu, Am, U, nitrate
	Pre-discharge (13)	SW	Pond C-2	C-Series terminal pond in Woman Creek	Prior to routine discharge	Pu, Am, U

Table 2. Water Monitoring Locations and Sampling Criteria (continued)

Notes
(1) See Figure 1 for monitoring locations.
(2) Where noted for surface water samples, flow rate is required to pace the automatic samplers.
(3) Groundwater samples collected from monitoring wells for analysis of metals, Pu, Am, and U will be field-filtered.
(4) Analysis and evaluation for metals, VOCs, and SVOCs will be performed for the analytes within the corresponding Analyte Category listed in Table 1.
(5) Results for POCs are evaluated using Figure 5.
(6) Results from POEs are evaluated using Figure 6.
(7) Results from AOC wells and SW018 are evaluated using Figure 7.
(8) Results from Sentinel wells are evaluated using Figure 8.
(9) Results from Evaluation wells are evaluated using Figure 9.
(10) Results from RCRA wells are evaluated using Figure 10.
(11) Results from Treatment System locations are evaluated using Figure 11.
(12) Results from OLF SW locations are evaluated using Figure 12.
(13) Results from Pre-discharge locations are evaluated using Figure 13.

Abbreviations
Ag: silver
Am: americium-241
AOC: Area of Concern
B (followed by numerals): Building (e.g., B371)
Be: beryllium
Cd: cadmium
Cr: chromium
FC: Functional Channel (e.g., FC-2)
GW: ground water
IA: Industrial Area
N/A: not applicable
OLF: Original Landfill
OU1: Operable Unit 1
PLF: Present Landfill
POC: Point of Compliance
POE: Point of Evaluation
PU&D: Property Utilization and Disposal
Pu: plutonium-239,240
RCRA: Resource Conservation and Recovery Act
SID: South Interceptor Ditch
SPP: Solar Ponds Plume
SVOCs: semi-volatile organic compounds
SW: surface water
U: uranium
VOCs: volatile organic compounds

Table 3. Present and Original Landfill Inspection and Maintenance Requirements

Present Landfill

Requirement	Description of activity	Frequency	Documentation/Reporting	Exit strategy
Final cover inspection and monitoring	- inspect/monitor slope stability, soil cover - visually inspect surface of landfill cover for cracks, depressions, heaving, and sinkholes - monitor settlement monuments and side slope stability monuments	- quarterly (settlement and stability monuments annually); evaluate frequency during CERCLA periodic review - additional weather-related inspections within 2 days after storm event of one inch or more of rain in a 24-hour period or significant melt of 10-inch or more snowstorm	- conditions affecting effectiveness of landfill cover to be reported per note 1 below - document on inspection checklist; submit to parties within one month of inspection; include in quarterly and annual reports	Consultative process or periodic CERCLA review
Inspection and monitoring of stormwater management system and erosion control features	- Visually inspect stormwater management structures (channels/lining, culverts, and outfalls); erosion control features (perimeter channels and natural drainages); and seep treatment system	- monthly for first year; evaluate frequency during CERCLA periodic review - additional weather-related inspections within 2 days after a storm event of one inch or more of rain in a 24-hour period or significant melt of a 10-inch or more snowstorm	- conditions affecting effectiveness of landfill cover to be reported per note 1 below - document on inspection checklist; submit to parties within one month of inspection; include in quarterly and annual reports	Consultative process or periodic CERCLA review
GW monitoring	Included in Table 2, Figure 1, and Figure 10	Included in Table 2, Figure 1, and Figure 10	Included in Table 2, Figure 1, and Figure 10	Included in Table 2, Figure 1, and Figure 10
Landfill seep and downstream monitoring	Included in Table 2, Figure 1, and Figure 11	Included in Table 2, Figure 1, and Figure 11	Included in Table 2, Figure 1, and Figure 11	Included in Table 2, Figure 1, and Figure 11
Maintenance and repairs	Perform minor or major repairs as needed; for major damage or repairs, consult with parties and develop appropriate actions for approval by CDPHE	- as needed	- minor/routine repairs and maintenance report on inspection form - conditions affecting effectiveness of landfill cover to be reported per note 1 below	Consultative process or periodic CERCLA review
Institutional and physical controls	Fence around perimeter of Central OU, signs at entry points to Central OU, warning signs in accordance with 6 CCR 1007-3 Part 265.14		- failure of physical controls to be reported per note 1 below - failure of institutional controls to be per note 2 below	Consultative process or periodic CERCLA review

Table 3. Present and Original Landfill Inspection and Maintenance Requirements (continued)

Original Landfill

Requirement	Description of activity	Frequency	Documentation/Reporting	Exit strategy
Final cover inspection and monitoring	- inspect/monitor slope stability and soil cover - visually inspect surface of landfill cover for cracks, depressions, heaving, sinkholes; visually inspect diversion berms; measure height and gradient if indicated (employ topographic surveys as described in OLF M&M Plan.) - monitor settlement monuments	- Monthly, until CDPHE approves Quarterly frequency; topographic survey every other year; evaluate frequency during CERCLA periodic review. - Additional weather-related monitoring within 2 days after a storm event of one inch or more or rain in a 24-hour period or significant melt of a 10-inch or more snowstorm - Quarterly until CDPHE approves annual frequency.	- conditions affecting effectiveness of landfill cover to be reported per note 1 below - document on inspection checklist; submit to parties within one month of inspection; include in quarterly and annual reports	Consultative process or periodic CERCLA review
Inspection and monitoring of stormwater management system, seeps, and erosion controls	- Visually inspect/monitor stormwater management structures, seeps, and erosion controls	- Monthly, until CDPHE approves Quarterly, Semi-annual or Annual frequency; evaluate frequency during CERCLA periodic review - Additional weather-related inspections within 2 days after a storm event of one inch or more of rain in a 24-hour period or significant melt of a 10-inch or more snowstorm	- conditions affecting effectiveness of landfill cover to be reported per note 1 below - document on inspection checklist; submit to parties within one month of inspection; include in quarterly and annual reports	Consultative process or periodic CERCLA review
GW monitoring	Included in Table 2, Figure 1, and Figure 10	Included in Table 2, Figure 1, and Figure 10	Included in Table 2, Figure 1, and Figure 10	Included in Table 2, Figure 1, and Figure 10
SW monitoring	Included in Table 2, Figure 1, and Figure 12	Included in Table 2, Figure 1, and Figure 12	Included in Table 2, Figure 1, and Figure 12	Included in Table 2, Figure 1, and Figure 12
Maintenance and repairs	- Perform minor or major repairs and maintenance - For major damage or repairs, consult with parties and develop appropriate actions for approval by CDPHE	- as needed	- minor/routine repairs and maintenance, report on inspection form - conditions affecting effectiveness of landfill cover to be reported per note 1 below	Consultative process or periodic CERCLA review
Institutional and physical controls	- inspection for evidence that institutional controls were violated or physical controls damaged	- document on inspection forms	- failure of physical controls to be reported per note 1 below - failure of institutional controls to be reported per note 2 below	Consultative process or periodic CERCLA review

Table 3. Present and Original Landfill Inspection and Maintenance Requirements (continued)

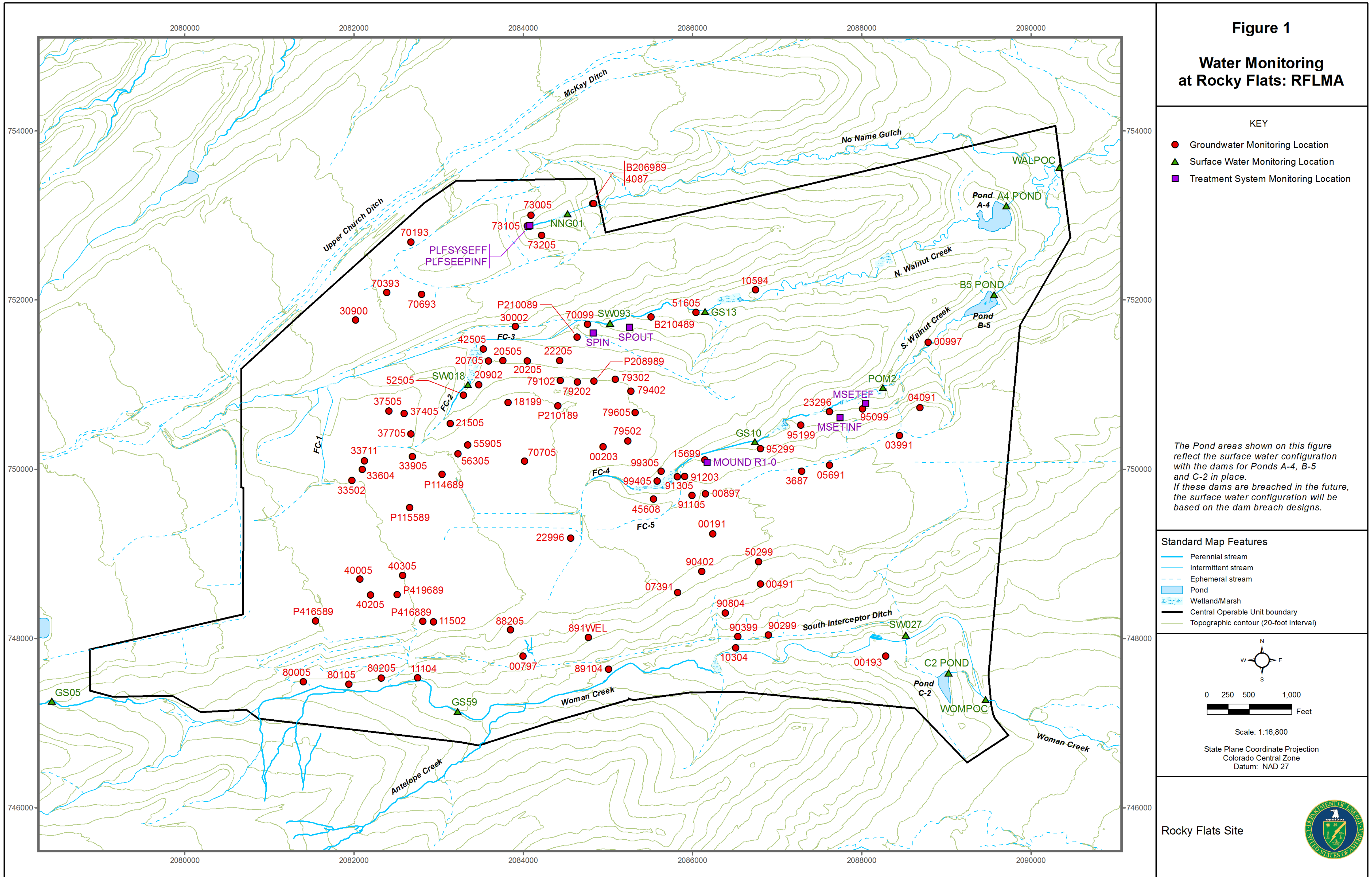
Note 1: For reportable conditions as defined in RFLMA Attachment 2, Section 6.0 (except in the case of failure of institutional controls), DOE will inform CDPHE and EPA within 15 days of receiving the inspection reports or validated data. Evaluation and planning for mitigating actions, if any, will be prepared and submitted as defined in RFLMA, Attachment 2, Section 6.0.

Note 2: In case of failure of institutional controls, DOE will notify EPA and CDPHE within 2 days of discovering evidence and will perform evaluation, consultation, and actions as defined in RFLMA, Attachment 2, Section 6.0.

Table 4. Institutional Controls for the Central Operable Unit

Controls	Use Restrictions
1	The construction and use of buildings that will be occupied on a permanent or temporary basis (such as for residences or offices) is prohibited. The construction and use of storage sheds or other, non-occupied structures is permitted, consistent with the restrictions contained in controls 2 and 3 below, and provided such use does not impair any aspect of the response action at Rocky Flats.
	Objective: Prevent unacceptable exposures via the indoor air pathway. **Rationale:** The analysis of the indoor air pathway in the Comprehensive Risk Assessment indicated that subsurface volatile organic compounds were at levels in certain portions of the Central OU that could pose a risk of unacceptable exposure to the WRW if occupied structures were built in these areas.
2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central OU, and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.
3	No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan (including Surface Water Protection Plans submitted to EPA under the Clean Water Act) approved by CDPHE or EPA. Soil disturbance that will not restore the soil surface to preexisting grade or higher may not be performed without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent migration of residual surface soil contamination to surface water. **Rationale:** Certain surface soil contaminants, notably plutonium-239/240, were identified in the fate and transport evaluation in the Remedial Investigation as having complete pathways to surface water if disturbed. This restriction minimizes the possibility of such disturbance and resultant impacts to surface water. Restoring the soil surface to preexisting grade maintains the current depth to subsurface contamination or contaminated structures.
4	Surface water may not be used for drinking water or agricultural purposes.
	Objective: Prevent unacceptable exposure to local surface water contamination above the terminal ponds. **Rationale:** While the Comprehensive Risk Assessment did not evaluate the risks posed by the use of surface water for drinking or agricultural purposes, the nature and extent of contamination evaluation in the Remedial Investigation showed that certain contaminants were found at levels exceeding standards above the terminal ponds. This restriction reduces the possibility of unacceptable exposures to future users from this source.
5	The construction or operation of groundwater wells is prohibited, except for remedy-related purposes.
	Objective: Prevent unacceptable exposure to contaminated groundwater. **Rationale:** While the Comprehensive Risk Assessment did not evaluate the risks posed by the use of groundwater for drinking or agricultural purposes, the nature and extent of contamination evaluation in the Remedial Investigation identified areas in the Central OU where groundwater contaminants exceeded water quality standards or MCLs. This restriction reduces the possibility of unacceptable exposures to future users from this source. Additionally, it prevents the disruption of groundwater flow paths so as to avoid impacts on groundwater collection and treatment systems.
6	Digging, drilling, tilling, grading, excavation, construction of any sort (including construction of any structures, paths, trails or roads), and vehicular traffic are prohibited on the covers of the Present Landfill and the Original Landfill, except for authorized response actions.
	Objective: Ensure the continued proper functioning of the landfill covers. **Rationale:** This restriction helps ensure the integrity of the landfill covers.
7	Activities that may damage or impair the proper functioning of any engineered component of the response action, including but not limited to any treatment system, monitoring well, landfill cap, or surveyed benchmark, are prohibited. The preceding sentence shall not be construed to prohibit the modification, removal, replacement, or relocation of any engineered component of the response action in accordance with the action determinations in RFLMA Attachment 2.
	Objective: Ensure the continued proper functioning of engineered portions of the remedy. **Rationale:** This restriction helps ensure the integrity of other engineered components of the remedy, including monitoring and survey points.

WRW = Wildlife Refuge Worker.
MCL = maximum contaminant level.



M:\LTS\111\0056\36\000\S09443\S0944300.mxd coatesc 12/03/2018 5:01:00 PM

Figure 1. Water Monitoring at Rocky Flats

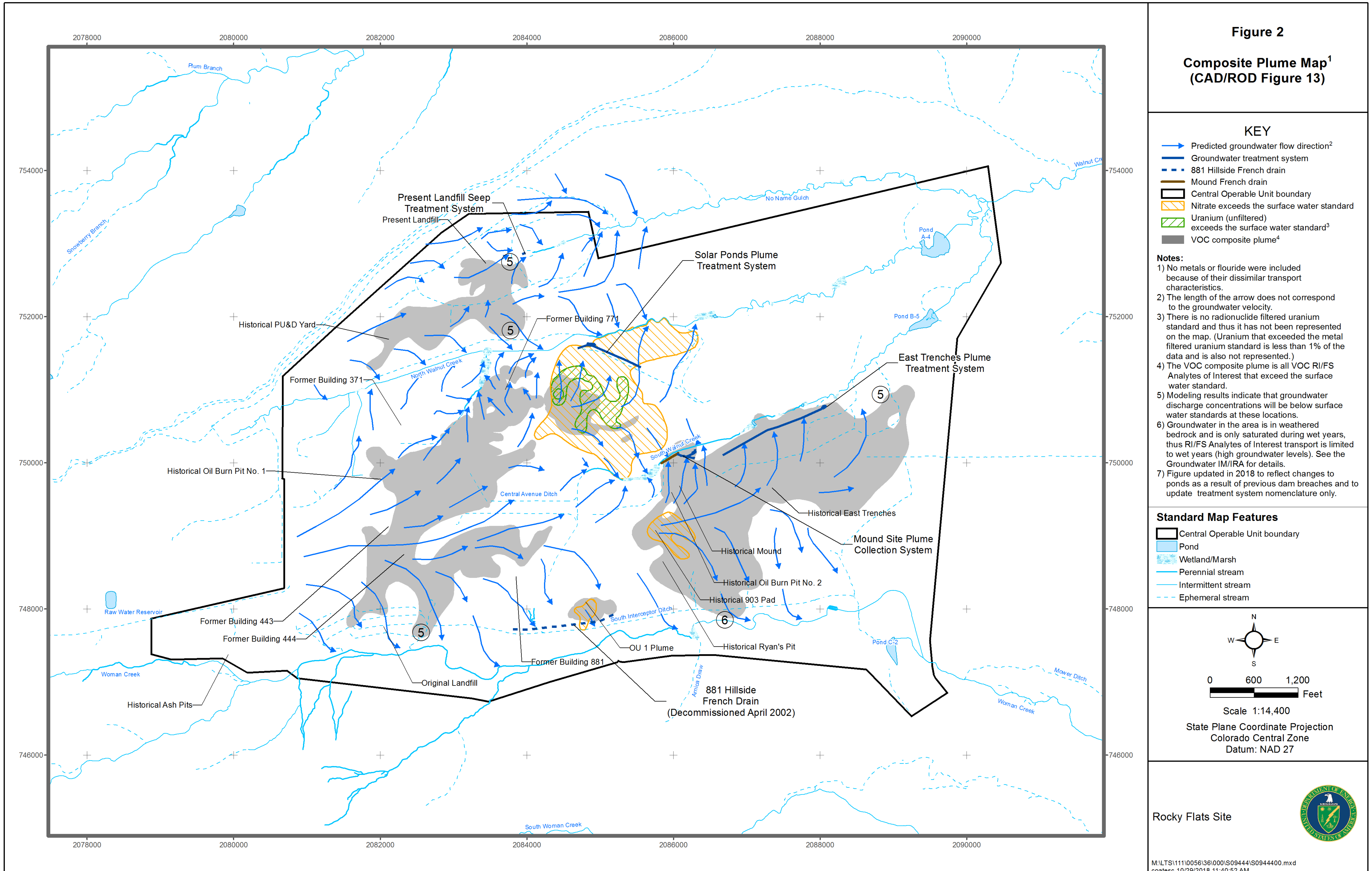


Figure 2. Composite Plume Map

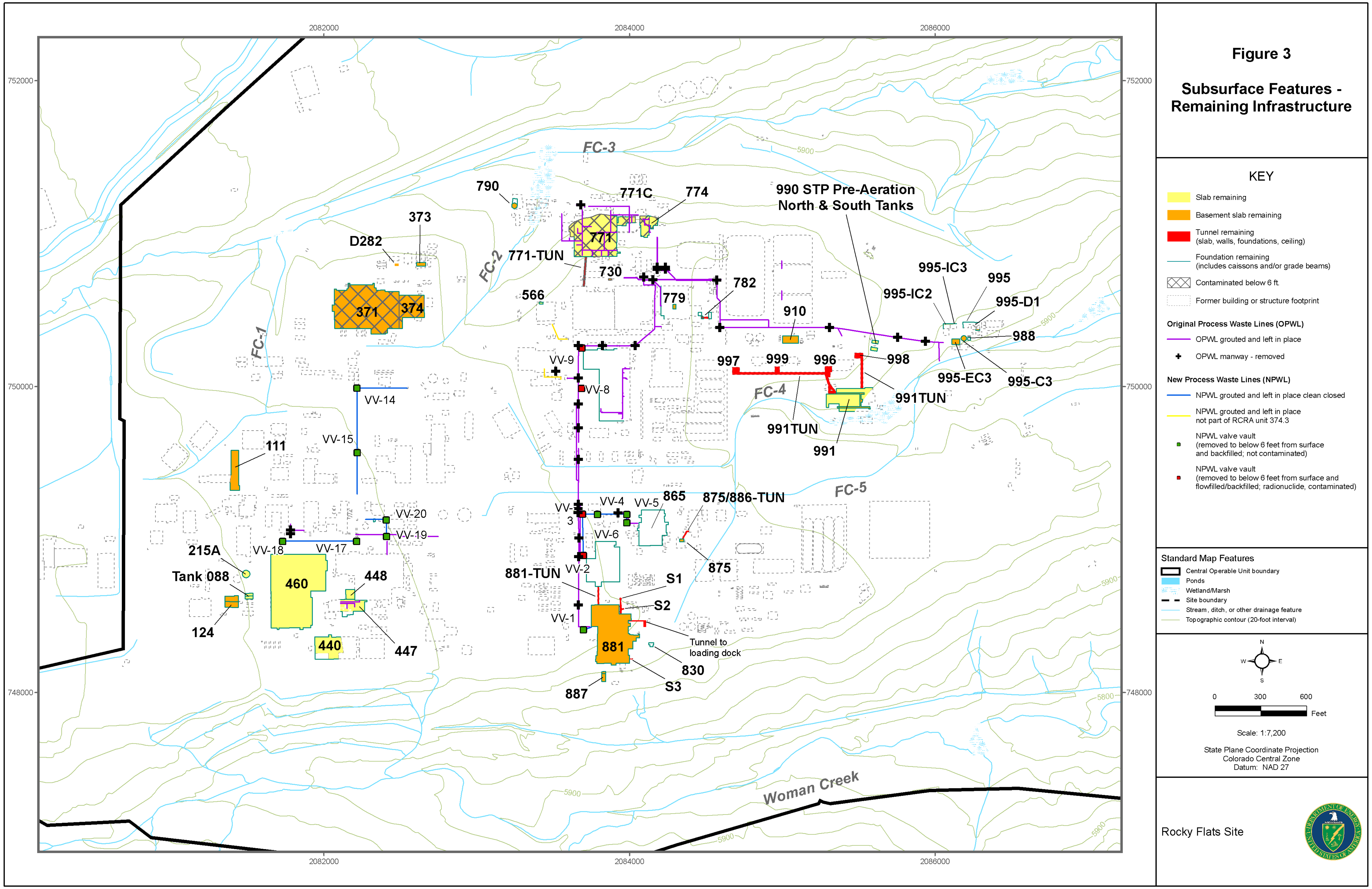
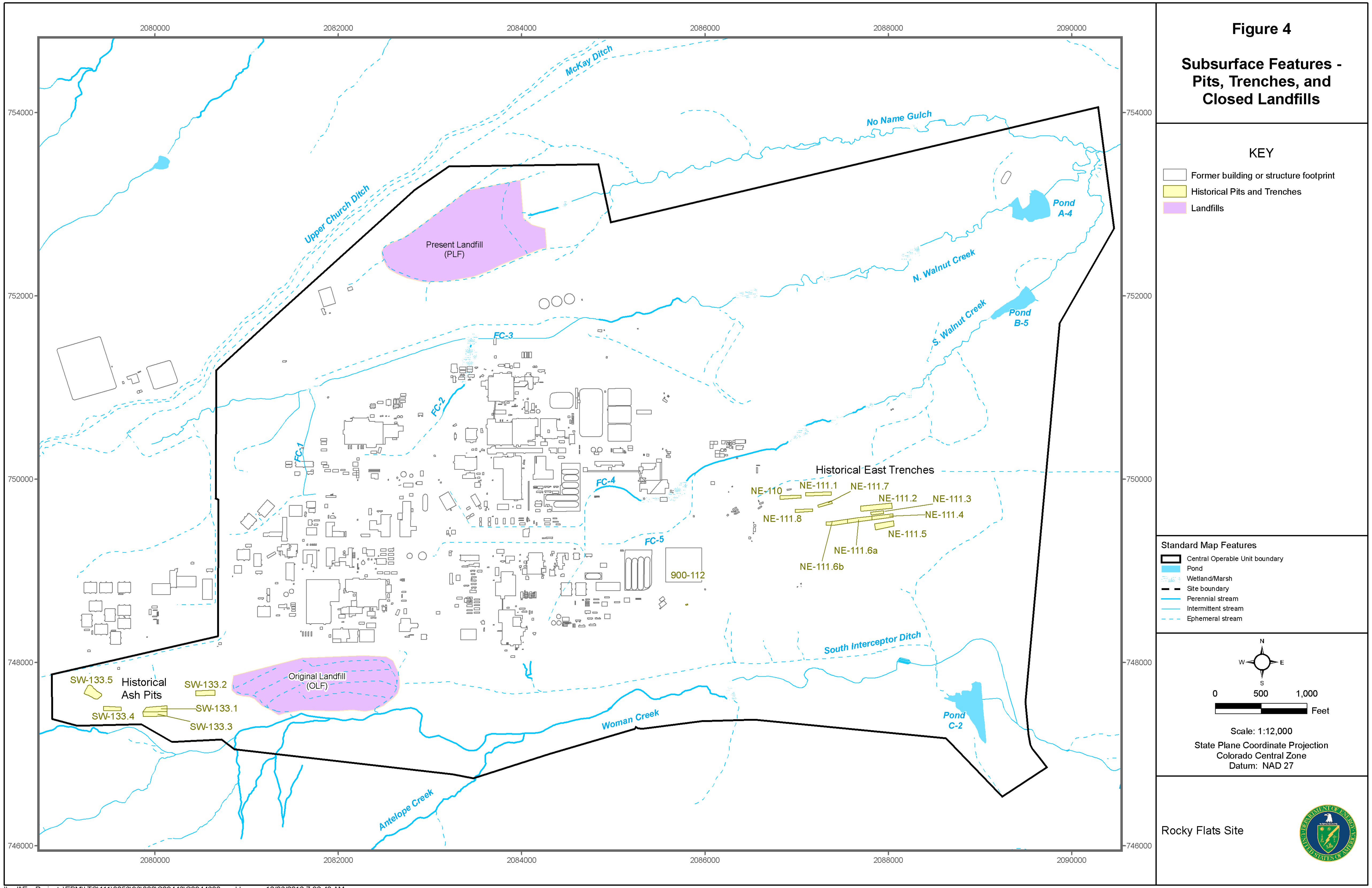
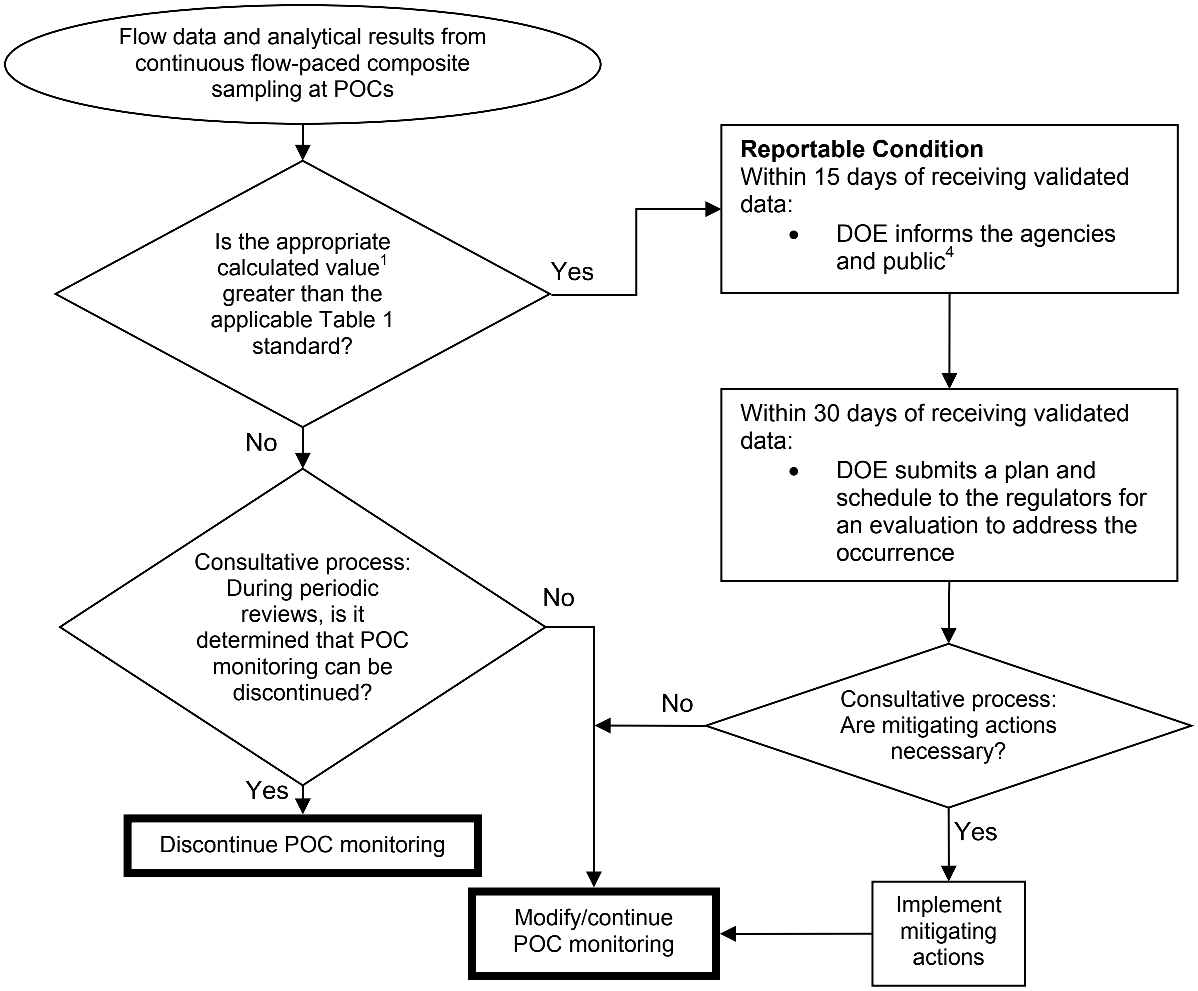


Figure 3. Subsurface Features—Remaining Infrastructure



\\gull\EnvProjects\EBM\LTS\111\0056\36\000\S09446\S0944600.mxd brownc 12/06/2012 7:32:40 AM

Figure 4. Subsurface Features—Pits, Trenches, and Closed Landfills



Notes: see Fig. 1 and Tables 1 and 2 for locations, standards, and sampling criteria.

[1]Calculated values for determining Reportable Condition and exceedances of remedy performance standards at POCs.

- Reportable conditions (according to Section 6.0):
  - **plutonium, americium, uranium, nitrate** → 30-day average[2]

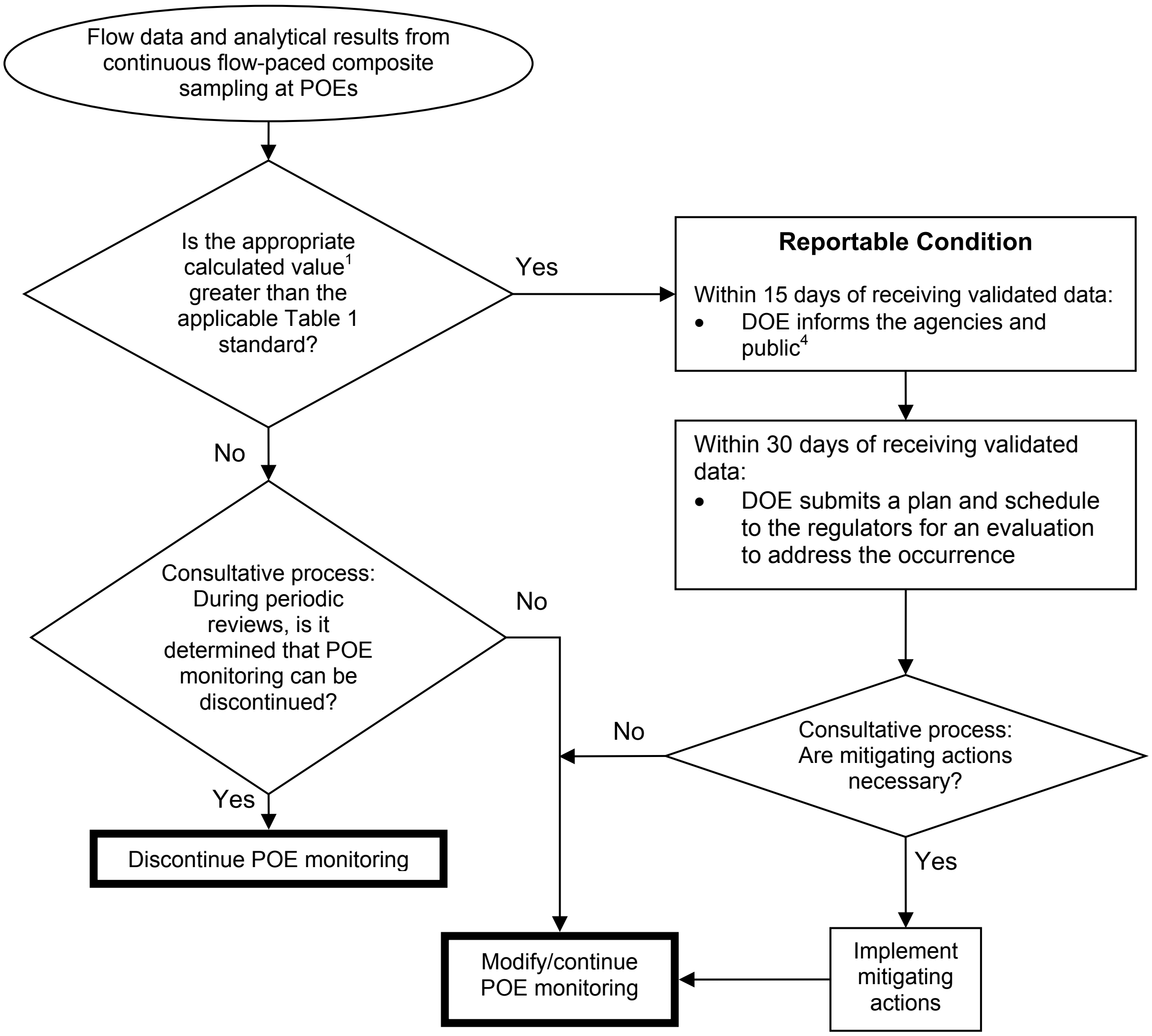
- Reportable Conditions and evaluation of compliance with remedy performance standards in Table 1:
  - **plutonium, americium, uranium, nitrate** → 12-month rolling average[3]

[2] The 30-day average for a particular day is calculated as a volume-weighted average of a "window" of time containing the previous 30 days with measurable flow. Each day has its own discharge volume (measured with a flow meter) and activity/concentration (from the sample carboy in place at the end of that day). Therefore, there are 365 30-day moving averages for a location that flows all year. At locations that have intermittent flows, 30-day averages are reported as averages of the previous 30 days of greater than zero flow. For days where no analytical result is available, either due to failed laboratory analysis or non-sufficient quantity (NSQ) for analysis, no 30-day average is reported.

[3] The 12-month rolling average for the last day of a particular month is calculated as a volume-weighted average of a "window" of time containing the previous 12 months. Each 12-month "window" includes daily discharge volumes (measured with a flow meter) and daily activities/concentrations (from the sample carboy in place at the end of that day). Therefore, there are twelve 12-month rolling averages for a given calendar year. Days with no flow or no analytical result, either due to failed laboratory analysis or NSQ for analysis, are not included in the average. When no flow has occurred in the previous 12 months, no 12-month rolling average is reported.

[4] Agencies: EPA, CDPHE, and USFWS
Public: Cities of Broomfield, Northglenn, Thornton, and Westminster; Rocky Flats Stewardship Council (RFSC)

Figure 5. Points of Compliance



Notes: see Fig. 1 and Tables 1 and 2 for locations, standards, and sampling criteria.

[1] Calculated Values by analytes (see Table 2 for reference)

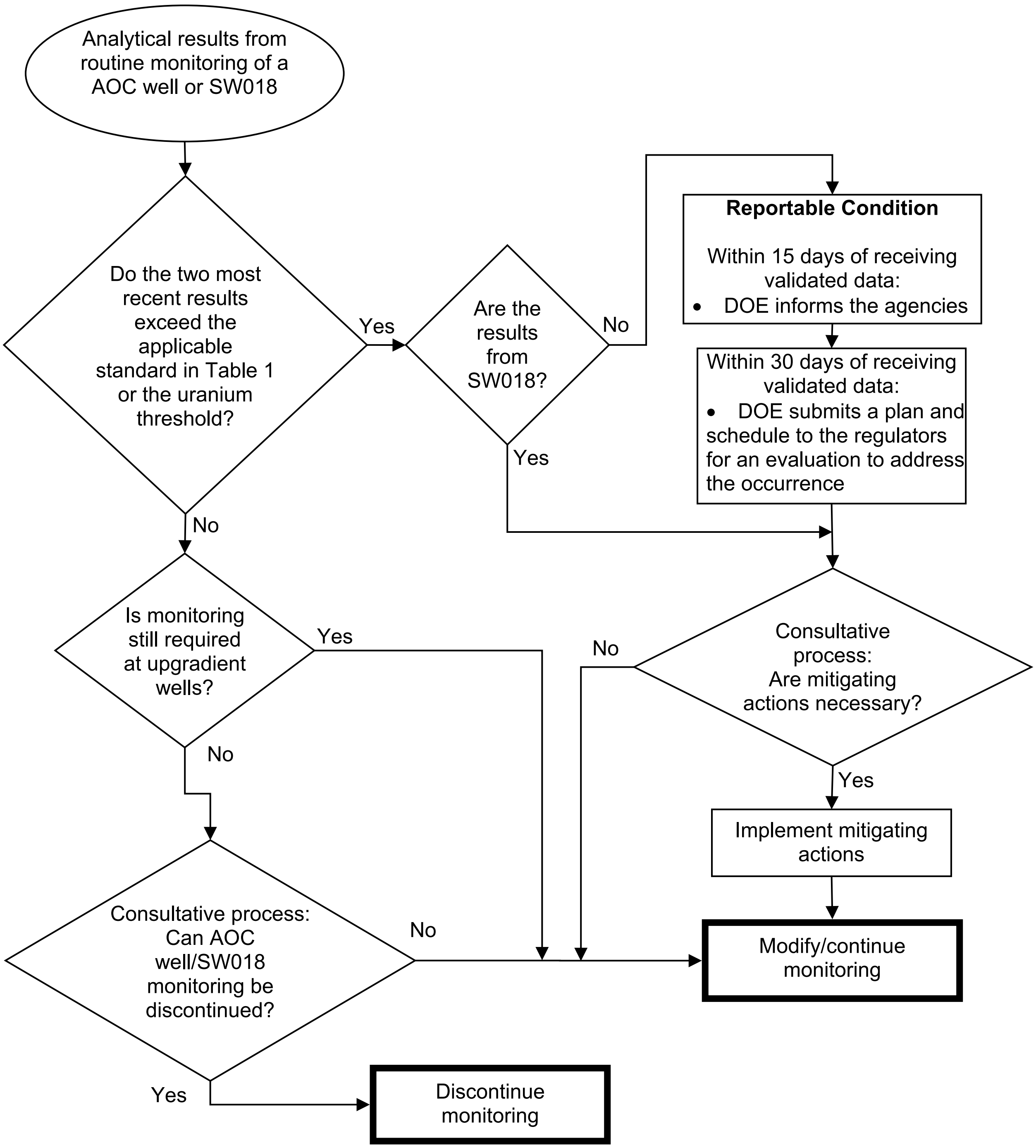
- plutonium, americium, uranium → 12-month rolling average[2]
- dissolved Cd and Ag, total Be and Cr → 85th percentile of 30-day averages[3] for previous calendar year

[2] The 12-month rolling average for the last day of a particular month is calculated as a volume-weighted average of a "window" of time containing the previous 12 months. Each 12-month "window" includes daily discharge volumes (measured with a flow meter) and daily activities/concentrations (from the sample carboy in place at the end of that day). Therefore, there are twelve 12-month rolling averages for a given calendar year. Days with no flow or no analytical result, either due to failed laboratory analysis or NSQ for analysis, are not included in the average. When no flow has occurred in the previous 12 months, no 12-month rolling average is reported.

[3] The 30-day average for a particular day is calculated as a volume-weighted average of a "window" of time containing the previous 30 days with measurable flow. Each day has its own discharge volume (measured with a flow meter) and activity/concentration (from the sample carboy in place at the end of that day). Therefore, there are 365 30 day moving averages for a location that flows all year. At locations that have intermittent flows, 30-day averages are reported as averages of the previous 30 days of greater than zero flow. For days where no analytical result is available, either due to failed laboratory analysis or NSQ for analysis, no 30-day average is reported.

[4] Agencies: EPA, CDPHE, and USFWS
Public: Cities of Broomfield, Northglenn, Thornton, and Westminster; Rocky Flats Stewardship Council (RFSC)

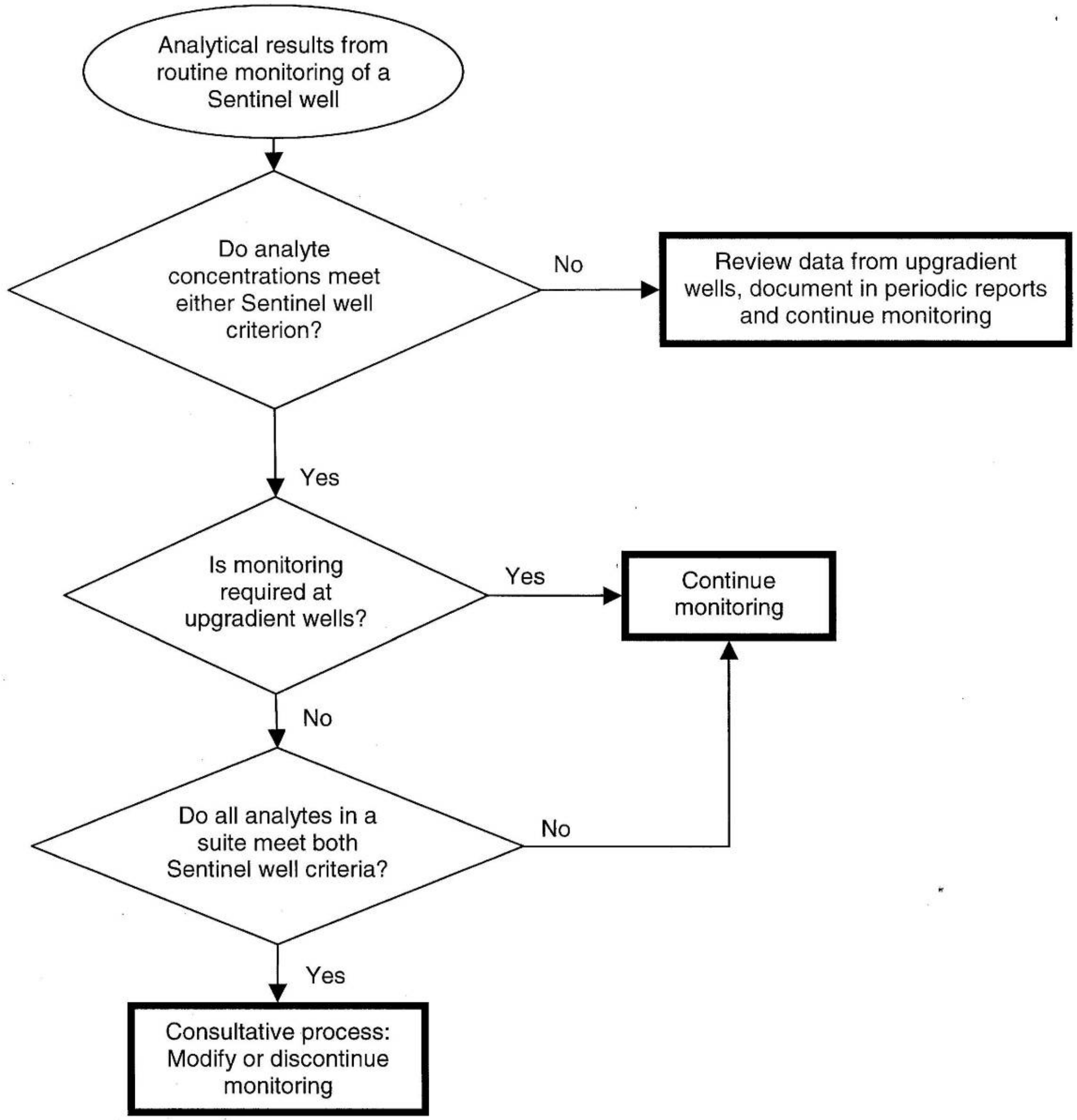
Figure 6. Points of Evaluation



Notes: see Fig. 1 and Tables 1 and 2 for locations, standards, and sampling criteria.

- AOC wells and location SW018 are sampled twice each year; see Table 2.
- Decisions related to uranium in groundwater are based upon a 120 ug/L threshold for AOC wells (basis: a grand mean of results from Site-wide high-resolution uranium analyses performed in the late 1990s through mid-2000s), rather than the standard in Table 1.

Figure 7. Area of Concern Wells and SW018



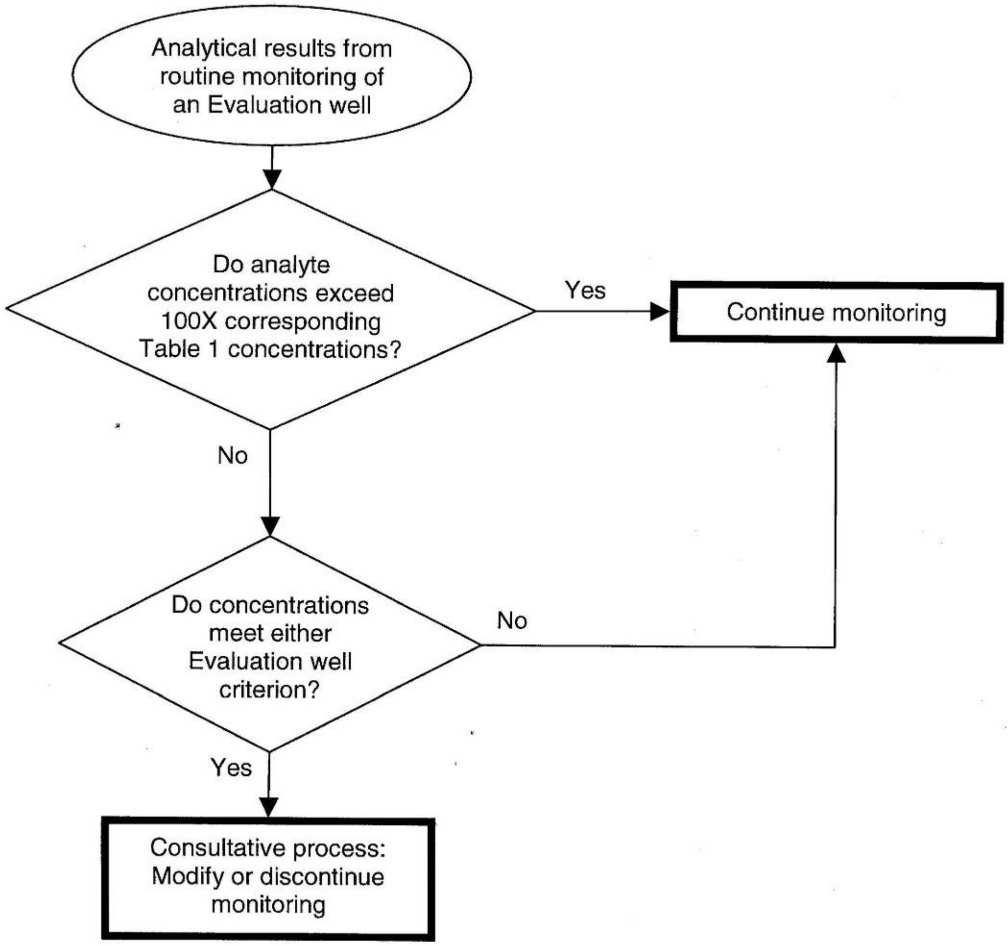
Notes: see Fig. 1 and Tables 1 and 2 for locations, standards, and sampling criteria.

- Sentinel wells are sampled twice each year; see Table 2.
- Decisions related to uranium are based upon a 120 ug/L threshold for AOC wells (basis: a grand mean of results from Site-wide high-resolution uranium analyses performed in the late 1990s through mid-2000s), rather than the standard in Table 1.

Sentinel Well Criteria

1. The 85th percentile concentration of an analyte *is less than or equal to* the corresponding concentration in Table 1 or, for uranium, the 85th percentile concentration does not exceed 2x120 ug/L or the highest calendar year 2005 concentration, whichever is higher.
2. Analyte concentrations exhibit an indeterminate or statistically-significant *decreasing* trend at the 95% confidence level.

Figure 8. Sentinel Wells



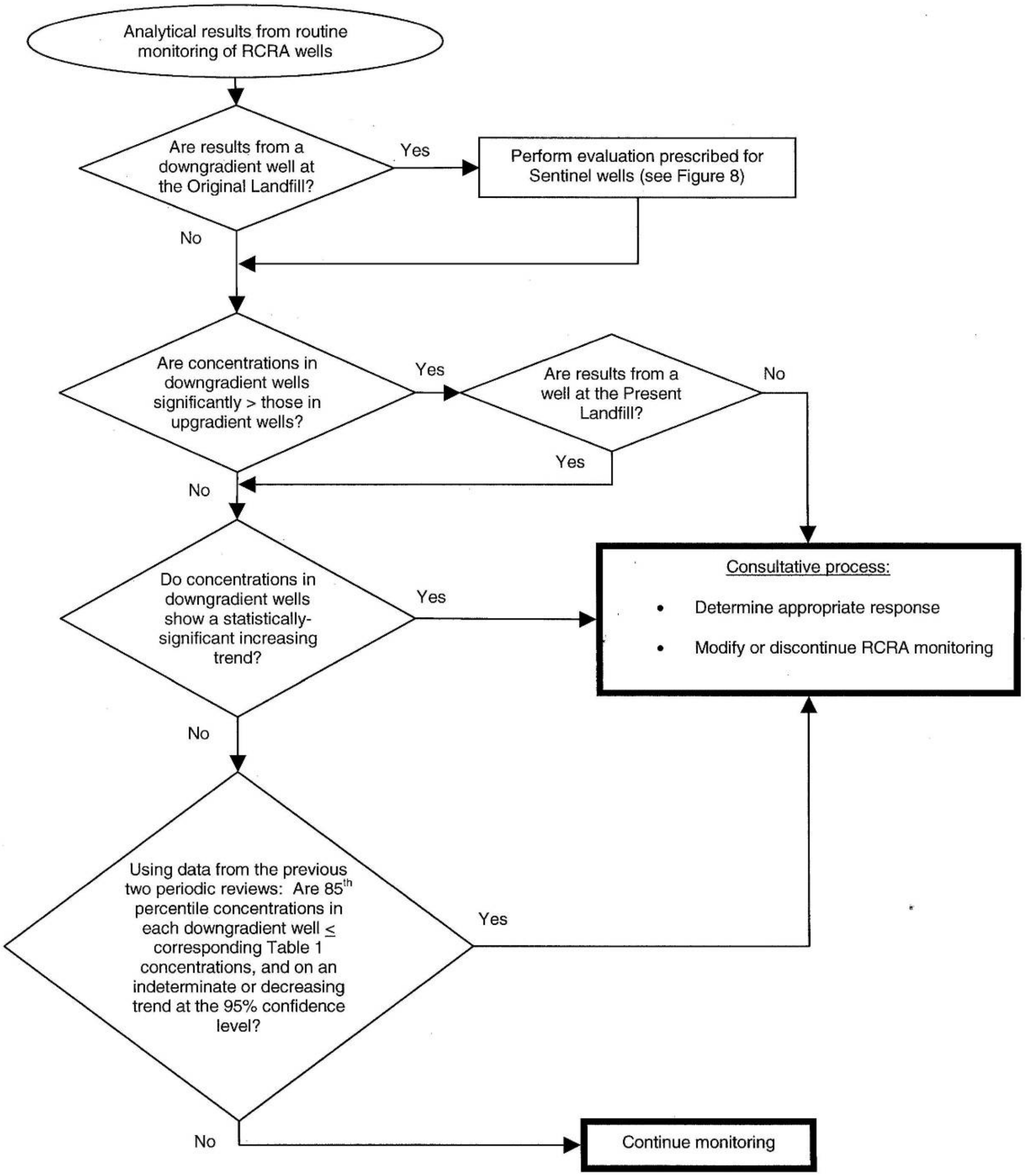
Notes: see Fig. 1 and Tables 1 and 2 for locations, standards, and sampling criteria.

- Evaluation wells are listed in Table 2.

Evaluation Well Criteria:

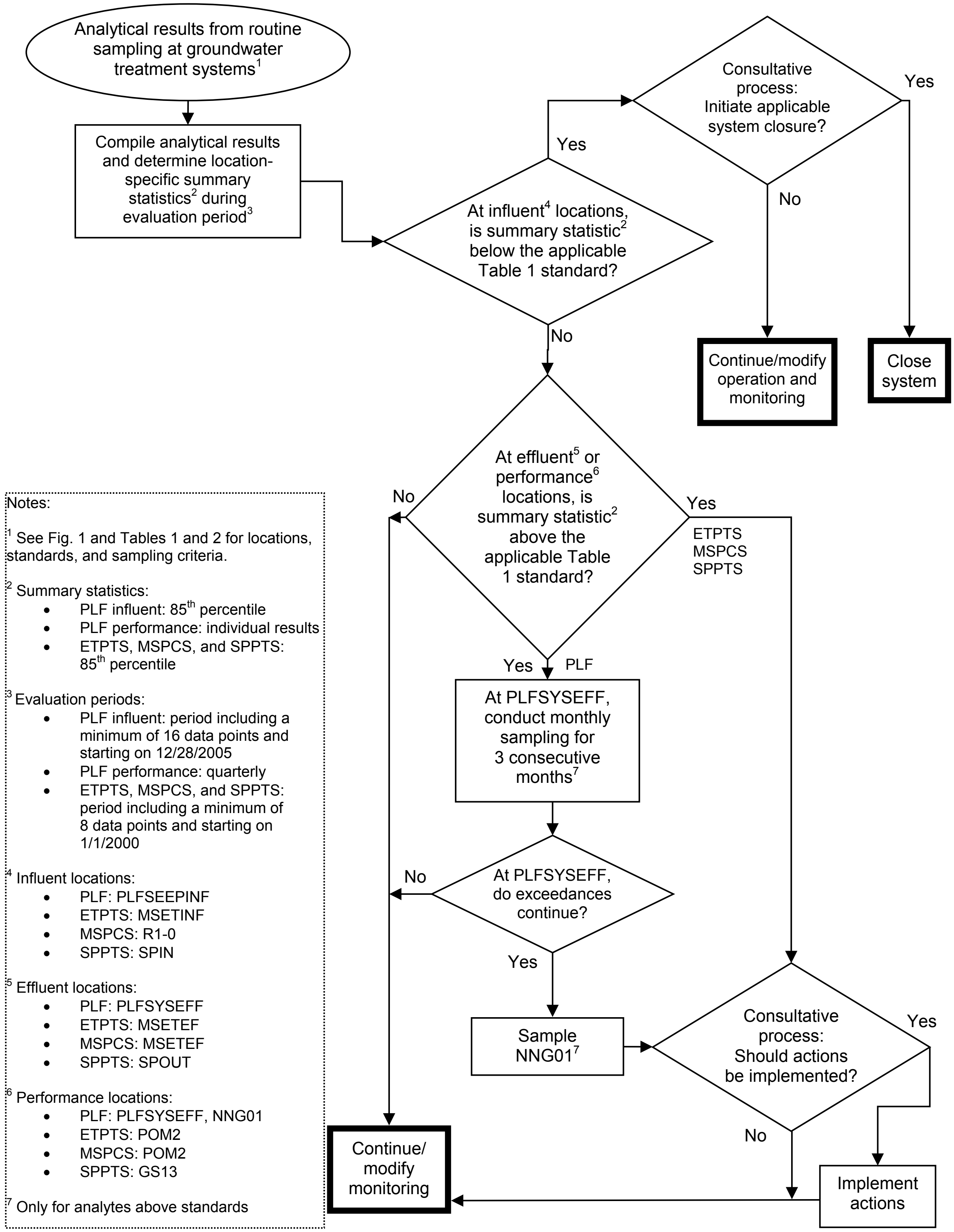
1. The 85th percentile concentration of an analyte *is less than or equal to* the corresponding concentration in Table 1, or, for uranium, 240 ug/L or highest pre-CY05 concentration, whichever is higher.
2. Analyte concentrations exhibit an indeterminate or statistically-significant *decreasing* trend at the 95% confidence level.

Figure 9. Evaluation Wells



Notes: see Fig. 1 and Tables 1 and 2 for locations, standards, and sampling criteria.
RCRA wells are sampled quarterly; see Table 2.

Figure 10. RCRA Wells



Notes:

[1] See Fig. 1 and Tables 1 and 2 for locations, standards, and sampling criteria.

[2] Summary statistics:
- PLF influent: 85th percentile
- PLF performance: individual results
- ETPTS, MSPCS, and SPPTS: 85th percentile

[3] Evaluation periods:
- PLF influent: period including a minimum of 16 data points and starting on 12/28/2005
- PLF performance: quarterly
- ETPTS, MSPCS, and SPPTS: period including a minimum of 8 data points and starting on 1/1/2000

[4] Influent locations:
- PLF: PLFSEEPINF
- ETPTS: MSETINF
- MSPCS: R1-0
- SPPTS: SPIN

[5] Effluent locations:
- PLF: PLFSYSEFF
- ETPTS: MSETEF
- MSPCS: MSETEF
- SPPTS: SPOUT

[6] Performance locations:
- PLF: PLFSYSEFF, NNG01
- ETPTS: POM2
- MSPCS: POM2
- SPPTS: GS13

[7] Only for analytes above standards

Figure 11. Groundwater Treatment Systems

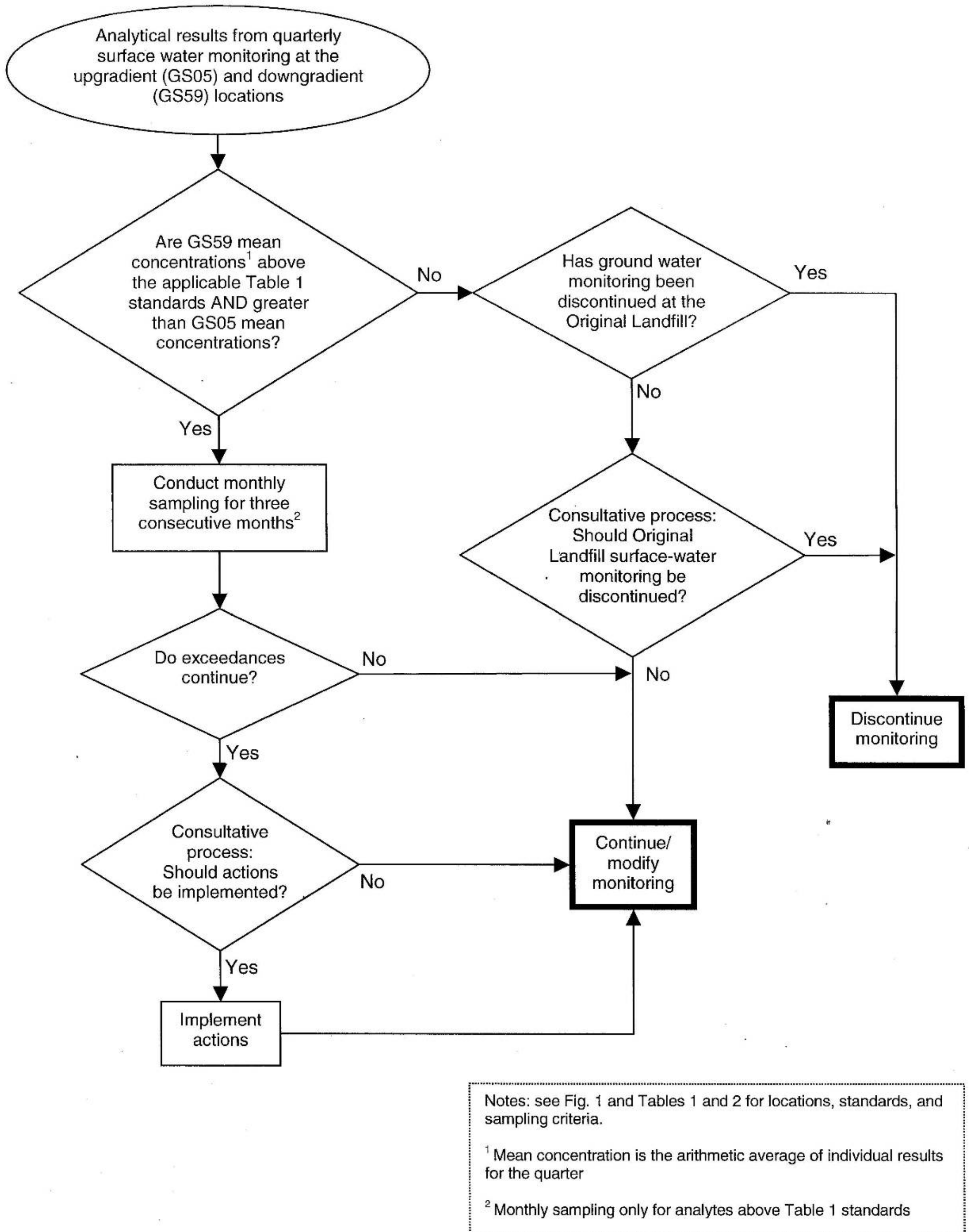


Figure 12. Original Landfill Surface Water

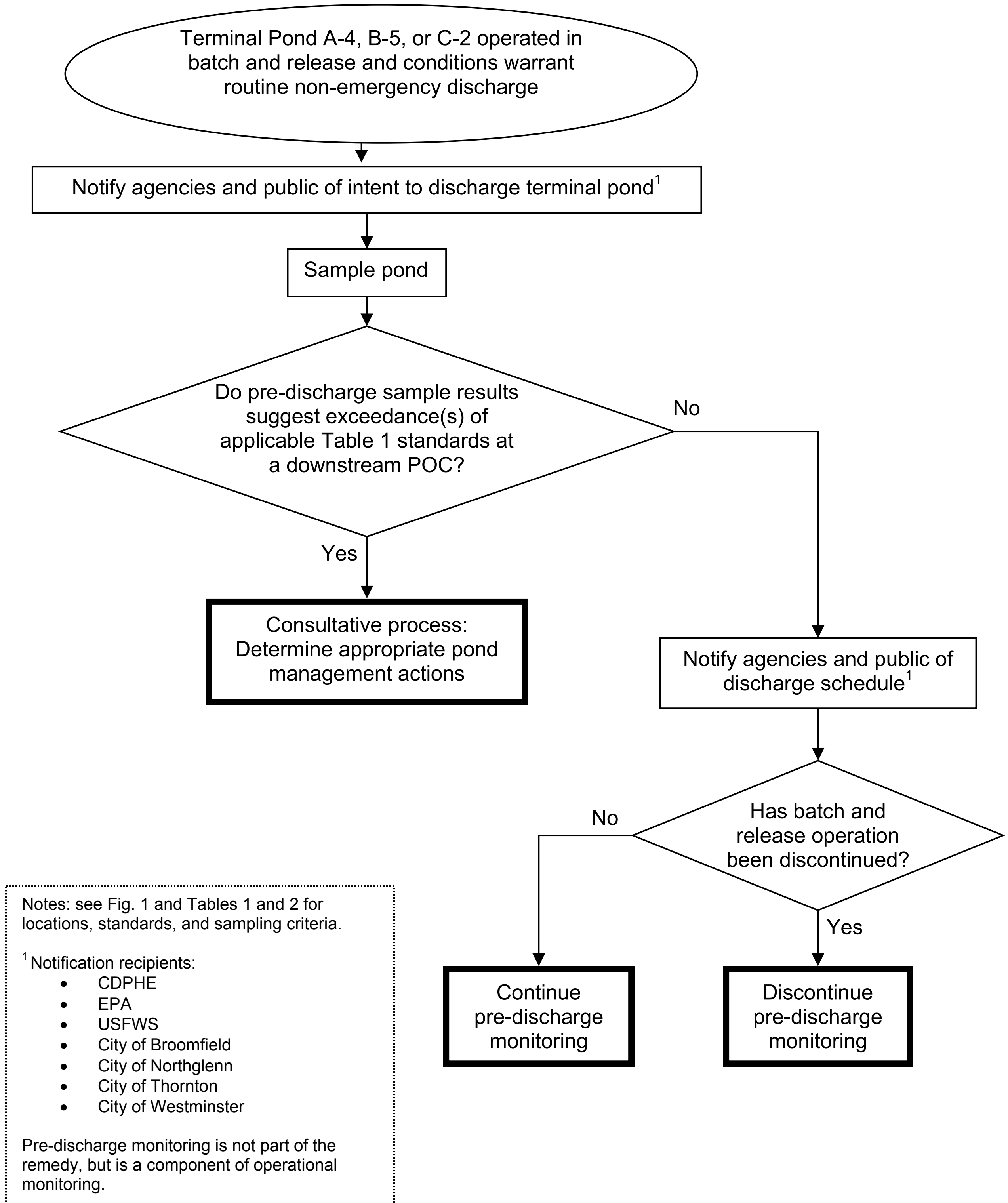


Figure 13. Pre-discharge Pond Sampling

Appendix C

Risk Assessment Review for COU, POU, and OU-3

Contents

Figures

Tables

Attachments

C1.0 Introduction

In accordance with CERCLA guidance, this FYR must provide an evaluation of changes to risk assessment factors to determine if these changes impact the risks presented by residual contamination within the COU. This appendix presents the methodology for reviewing and evaluating the changes to chemical and radiological risk assessment parameters that took effect during this FYR period and details the results of the risk evaluation. The methodology used in this FYR evaluation is based on the methodology used for the 2006 CRA and the 2017 FYR report (DOE 2017). In the 2017 FYR report, RSLs for industrial soil established by EPA in 2016 were used as a conservative proxy for the WRW PRGs developed for the CRA. The chemical risk review for the COU in this FYR used updated RSLs for industrial soil established by EPA in 2021. For the radiological risk review, the 2017 FYR report and this FYR used the EPA online "Preliminary Remediation Goals for Radionuclides" (i.e., PRG calculator) to calculate updated PRGs (EPA 2021a).

Although this FYR risk evaluation is limited to risks posed by residual contamination within the COU, a separate review of the impacts of changes to risk assessment factors was conducted for the POU and OU-3. This separate review used residential RSLs and PRGs to determine if the UU/UE designations are still valid at these OUs. The POU and OU-3 were both deleted from the NPL in 2007 because they posed no significant threat to public health or the environment (Volume 72 *Federal Register* page 29276 [72 FR 29276]).

C2.0 Central Operable Unit

In the RI/FS Report (DOE 2006), the nature and extent of residual contamination in soil and sediment were evaluated after completion of accelerated actions at the site. This evaluation identified analytes of interest (AOIs), which are chemicals that have been detected at concentrations that may contribute to the risk to future receptors. The soil AOIs identified in the RI/FS Report are presented in Table C-1.

In 2006, the CRA was completed for the COU and POU to quantify the risk of residual contamination remaining after accelerated cleanup actions (DOE 2006). The CRA was conducted in accordance with the *Final Comprehensive Risk Assessment Work Plan and Methodology* (DOE 2005), approved by EPA and CDPHE. The CRA was completed after all accelerated actions were finished. To facilitate the CRA, the lands that comprise the COU and POU were divided into the 12 EUs shown in Figure C-1. Risk for each EU was calculated individually and reported in a separate volume of the CRA. The basic methodology for conducting human health risk assessments, as described in the *Risk Assessment Guidance for Superfund* (EPA 1989), has not changed since the CRA was completed.

Table C-1. Soil AOIs Identified in the RI/FS Report

Surface Soil (0–0.5 ft)	Subsurface Soil (0.5–8 ft)	Subsurface Soil (>8 ft)
Radionuclides		
Americium-241 Plutonium-239/240 Uranium-233/234 Uranium-235 Uranium-238	Americium-241 Plutonium-239/240 Uranium-235 Uranium-238	Plutonium-239/240
Metals		
Aluminum Arsenic Chromium (total) Vanadium	Chromium (total) Lead	None
VOCs		
None	Tetrachloroethene	1,1,2,2-Tetrachloroethane Carbon tetrachloride Chloroform Methylene chloride Tetrachloroethene Trichloroethene
SVOCs		
Benzo[*a*]pyrene Dibenz[*a,h*]anthracene	Benzo[*a*]pyrene	Benzo[*a*]pyrene
Polychlorinated Biphenyls		
Aroclor-1254 Aroclor-1260 2,3,7,8-Tetrachlorodibenzo-p-dioxin	None	Aroclor-1260

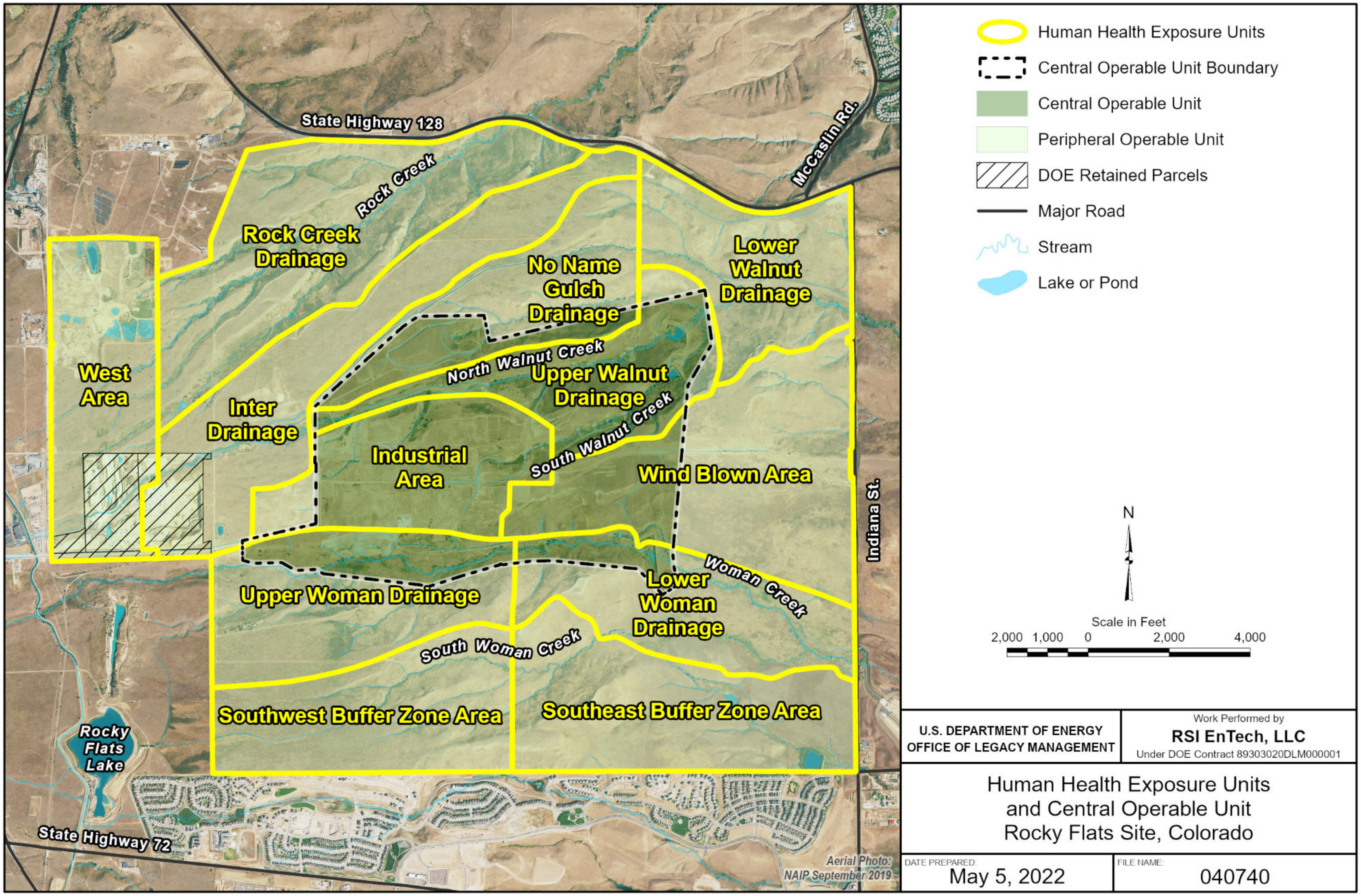


Figure C-1. Human Health EUs

C2.1 Risk Definitions

This section presents the definitions of key risk terms used throughout this appendix.

95% upper confidence limit of the arithmetic mean (95UCL). The statistical 95% upper confidence limit estimate of the mean concentration for a set of sample analytical results. As a general rule, EPA recommends use of the 95UCL concentrations as the exposure point concentration for soils at a site, which is regarded as a conservative estimate of the average concentration that a receptor may encounter (EPA 1989).

cancer risk. The added probability of an individual or population of developing cancer during a lifetime as a result of exposure to site contaminants. The acceptable risk range for CERCLA sites is an added risk of less than 1 in 1,000,000 (1×10^{-6}) to a maximum of 1 in 10,000 (1×10^{-4}).

Hazard Quotient (HQ). The ratio of the exposure level of a single substance to an acceptable noncancer toxicity value (e.g., reference dose). If multiple substances are present, hazard quotients are summed to derive a hazard index. For CERCLA sites, the maximum acceptable hazard index is 1.0.

maximum detected concentration (MDC). The maximum concentration detected in any soil sample for a given constituent and EU.

preliminary remediation goals (PRGs). PRGs are screening values used to identify potential chemicals of concern. The presence of an analyte in site soil at a concentration greater than its PRG does not necessarily indicate the presence of an unacceptable risk or hazard. Noncancer-based PRGs are derived based on a noncancer HQ of 0.1, and cancer-based PRGs are based on a cancer risk of 1×10^{-6}.

slope factor. An estimate of the risk of developing cancer associated with exposure to a carcinogenic or potentially carcinogenic substance (i.e., risk per dose).

C2.2 CRA Review Methodology

As one of the initial steps in the CRA process (Figure C-2), residual concentrations of constituents in soil for each EU were compared to PRGs developed for a WRW, which would also be protective of a WRV. The PRGs represent concentrations for individual chemicals that would equate to a cancer risk of 1×10^{-6} or a noncancer HQ of 0.1 based on the exposure assumptions for the WRW. The 2006 CRA used an HQ value of 0.1 as an initial, conservative screening level; an HQ value greater than 1.0 indicates an exposure that exceeds a reference dose. The PRGs were developed using toxicity data that were current at the time of the CRA. Separate sets of PRGs were developed for exposures to surface soils and subsurface soils. PRGs for subsurface soils are the WRW surface soil PRGs, multiplied by a factor of 11.5, as it was assumed that the exposure frequency to subsurface soil would be much lower (20 days per year compared to 230 days per year). The MDC for each detected constituent at each EU was compared to its respective PRG. If the MDC was less than the PRG, the constituent was eliminated from further consideration. If the MDC exceeded the PRG, the 95UCL for that constituent was compared to the PRG. If the 95UCL was less than the PRG, the constituent was eliminated from further consideration. If the 95UCL exceeded the PRG, the constituent was further evaluated based on frequency of detection, comparison to background concentrations, and professional judgement. Constituents passing through these remaining screening criteria were identified as COCs for each EU (Table C-2) and were further evaluated in the CRA. (Note that the AOI screening process and CRA EU-specific COC screening process were somewhat different and produced different results.) In the 2006 CRA, COCs were only identified for surface soils. The screening process for constituents in subsurface soils did not result in the identification of any subsurface soil COCs.

C2.3 2017 FYR Methodology for Chemical Risk Evaluation

This section summarizes the methodology used in the 2017 FYR to perform the chemical risk evaluation for the COU. A description of the 2017 FYR methodology for the evaluation of chemical risks is provided in this FYR because that methodology presents the framework upon which this fifth FYR evaluation is built.

Because the first two steps of the COC screening process in the CRA relied on a comparison of residual soil concentrations with the WRW PRGs, any subsequent changes to exposure assumptions or toxicity values used to calculate the PRGs could change the outcome of the screening process. For the 2017 FYR risk evaluation, a methodology similar to that described for the CRA was applied to determine the impact of changes to risk assessment parameters for soils. Figure C-3 presents the 2017 FYR screening methodology. In lieu of recalculating over 200 site-specific PRGs for a WRW, the 2017 FYR risk evaluation review used the EPA RSLs for industrial soil (EPA 2016) as a proxy for revised WRW PRGs. The industrial soil RSLs incorporated the then-current toxicity values and methodologies for the same exposure pathways of concern as for the WRW. The default exposure assumptions for the industrial soil scenario are very similar to those used for the WRW for surface soils. Table C-3 compares the key assumptions that were used in calculating the industrial RSLs and the site-specific PRGs. The set of exposure factors used in the derivation of the industrial RSLs are more conservative than those used to derive the WRW PRGs. Therefore, it was established in the 2017 FYR report that the EPA industrial soil RSLs are an acceptable screening tool to represent updated surface soil WRW PRGs.

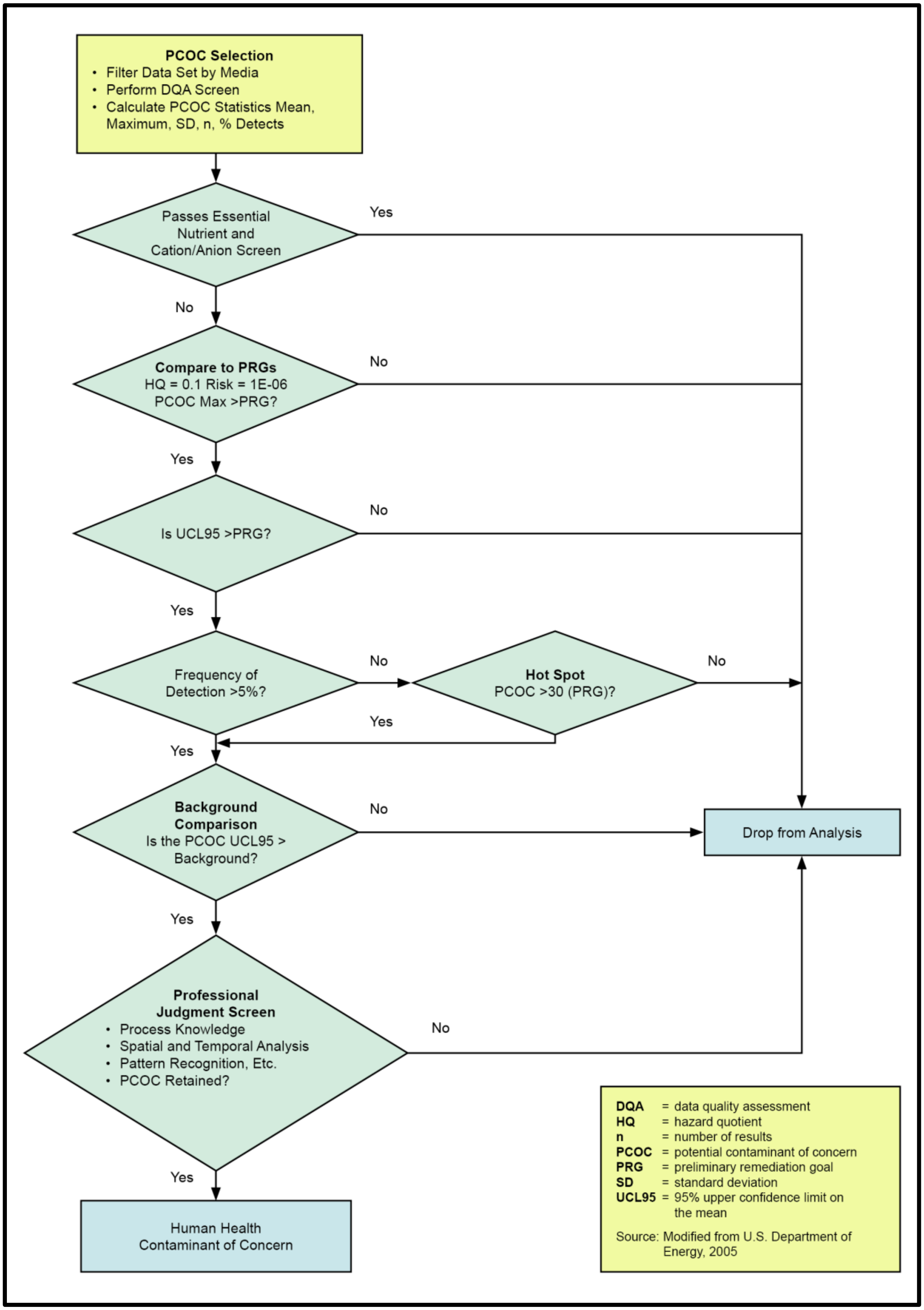


Figure C-2. 2006 CRA Constituent Review Process

Table C-2. Surface Soil COCs Identified for Each EU in the CRA

Constituent	Exposure Unit											
	Industrial Area EU	**Upper Woman Drainage EU**	**Wind Blown EU**	**No Name Gulch EU**	**Upper Walnut Drainage EU**	**Lower Woman Drainage EU**	**Rock Creek EU**	**Lower Walnut Drainage EU**	**Inter Drainage EU**	**West Area EU**	**Southwest Buffer Zone Area EU**	**Southeast Buffer Zone Area EU**
Part of COU	●	●	●	●	●	●						
Part of POU	●	●	●	●	●	●	●	●	●	●	●	●
Arsenic	X	-	X	-	-	-	-	-	-	-	-	-
Vanadium	-	-	-	X	-	-	-	-	-	-	-	-
2,3,7,8-TCDD	-	X	-	-	-	-	-	-	-	-	-	-
Benzo[*a*]pyrene	X	X	-	-	X	-	-	-	-	-	-	-
Plutonium-239/240	-	-	X	-	-	-	-	-	-	-	-	-

Abbreviations:
2,3,7,8-TCDD = 2,3,7,8-tetrachlorodibenzo-*p*-dioxin
X = constituent was designated a COC in the 2006 CRA
- = constituent was not designated a COC in the 2006 CRA

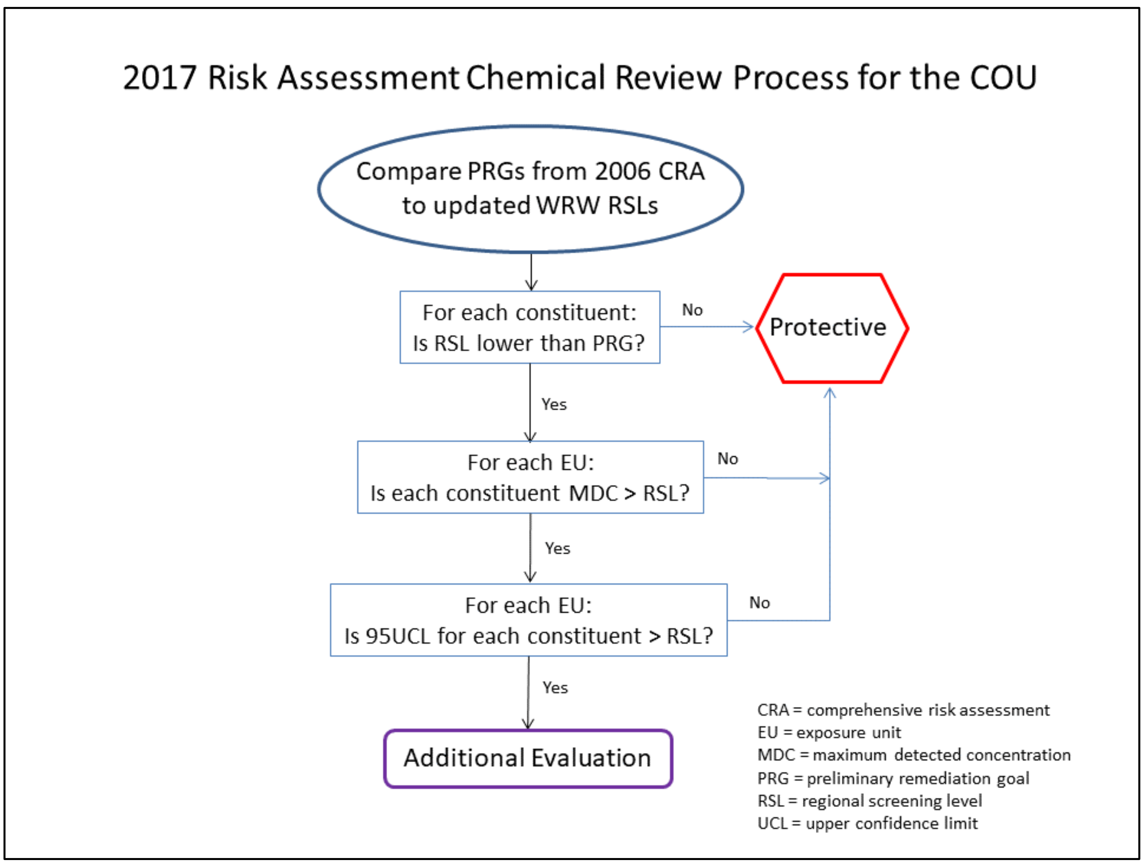


Figure C-3. 2017 FYR Risk Assessment Chemical Review Process

The complete list of surface soil PRGs developed for the CRA was compared to the 2016 industrial RSLs list (EPA 2016). When PRGs were lower than the 2016 RSLs, it was assumed that results of the original screening process were still valid for non-COCs. Statistical data for COCs were screened against the higher RSLs to determine if they would still be considered COCs based on the updated values. When industrial RSLs were lower than PRGs, a rescreening of the EU statistical data was also performed. EPA RSLs were compared to data presented in the CRA for each EU. The analytical data (MDCs and 95UCL values) used were the same data used in the 2006 CRA. The MDCs and 95UCLs used in the surface soil screening were compared to the industrial RSLs. If MDCs or 95UCLs were lower than the 2016 industrial RSLs, constituents were eliminated from further consideration. All other constituents were retained for further evaluation.

Table C-3. Comparison of Key Exposure Assumptions for RSLs and PRGs

Exposure Factor (units)	EPA RSL Default Value	WRW PRG Assumption
Frequency of exposure (days/year)	250	Surface soils, 230 Subsurface soils, 20
Exposure duration (years)	25	18.7
Exposure time (hours/day)	8	8
Soil ingestion rate (milligrams/day)	100	100
Adult body weight (kilograms)	80	70
Skin surface area (square centimeters)	3527	3300

C2.4 2022 Risk Evaluation

The following sections present the 2022 FYR risk evaluation methodology and results for the chemical and radiological risk review for the COU. The exposure pathways and receptors assumed in the CRA remain current for the COU. The evaluations for chemical and radionuclide constituents are presented separately in the following sections because the methodologies for these evaluations used somewhat different approaches.

C2.4.1 Chemical Constituent Review Methodology

The 2022 FYR risk evaluation methodology is built on the framework of the 2017 FYR chemical risk evaluation, which is summarized in Section C2.3. The 2017 FYR established the use of EPA industrial RSLs to serve as conservative screening levels to evaluate protectiveness for a WRW in the COU. The RSLs are regularly updated by EPA; this FYR evaluation used RSLs for industrial soil published in 2021 (EPA 2021b). This FYR evaluation used the 2016 RSLs, included in the last FYR evaluation, as a baseline to evaluate changes in toxicity values over the past 5 years. The exposure assessment methods and default input values in the 2021 soil RSLs for an industrial worker have not changed since the last FYR evaluation (EPA 2021b). Any changes to toxicity values since the last FYR are included in the 2021 RSLs.

The process used in this FYR to evaluate chemical constituents in the COU is shown in Figure C-4; this process is consistent with the screening process used in the 2006 CRA and the 2017 FYR.

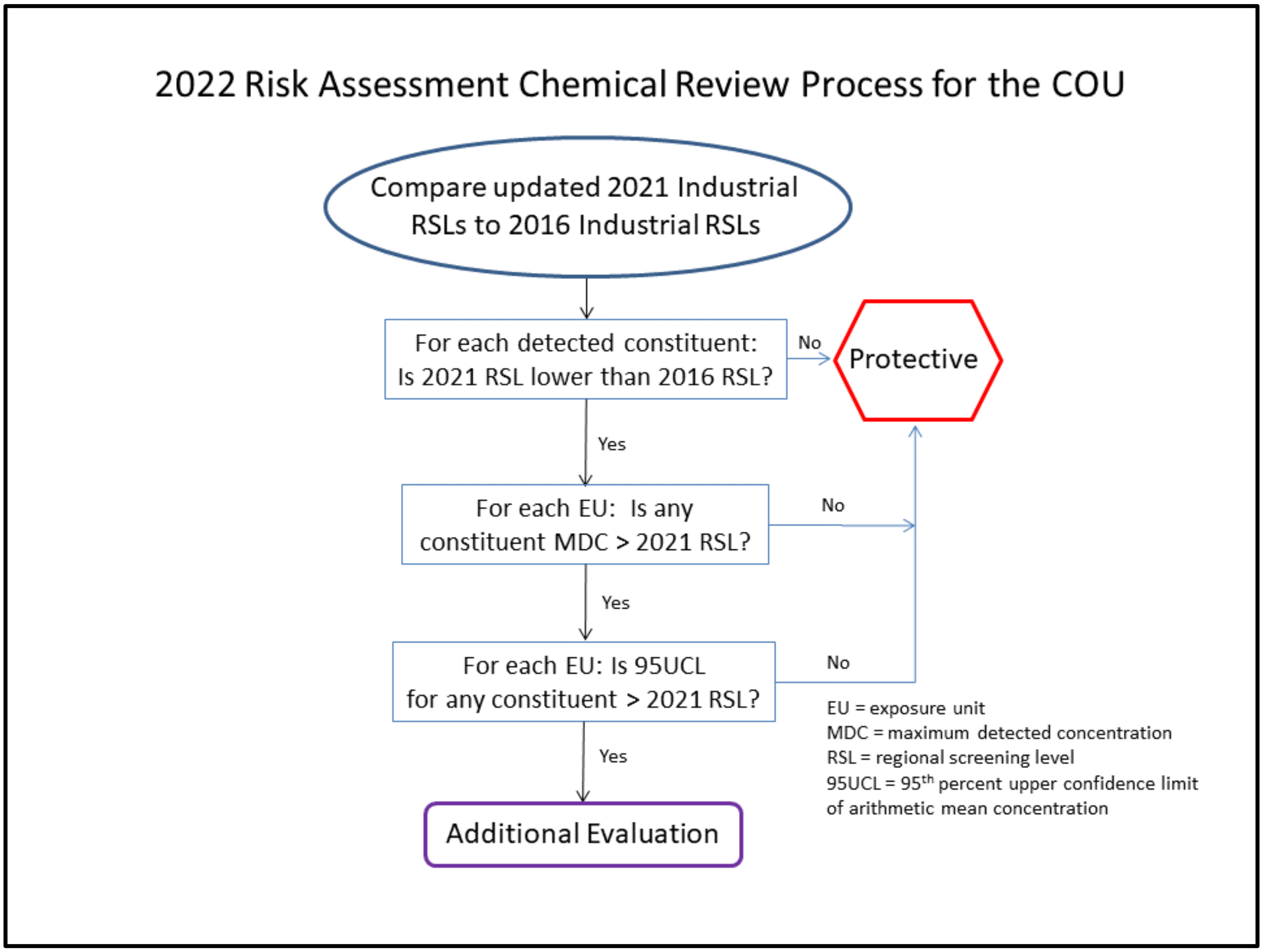


Figure C-4. 2022 FYR Risk Assessment Chemical Review Process

C2.4.2 Chemical Constituent Review Results

Based on the review described below, the COU remedy continues to be protective with respect to chemical constituents.

The first step in the risk evaluation process is a comparison of the 2021 RSLs to the 2016 RSLs. Because no RSL exposure parameter values have changed since the last FYR, the vast majority of the 2021 RSLs are unchanged. The 2021 RSL values that are greater than the 2016 RSLs or remain unchanged are identified as still protective for screening at an HQ of 0.1 and a cancer risk of 1×10^{-6}. Of the chemicals with 2021 RSLs that are less than the 2016 RSLs, the following three were detected in COU surface soil: DDD, Aroclor 1248, and naphthalene. The 2021 DDD RSL is based on a screening-level reference dose (0.00003 mg/kg/d) that is described as being "of limited use to risk assessors" and not of sufficient quality for quantitative risk assessment (EPA 2017). The 2016 DDD RSL was based on carcinogenic effects associated with the still-current cancer slope factor and unit risk. There was a negligible change in the Aroclor 1248 RSL, which is because of a decrease in the volatilization factor from 6.3 m^3/kg in the 2016 RSL to 5.1 m^3/kg in the 2021 RSL. The 2021 RSL for naphthalene is based on the addition of a California EPA cancer slope factor of 0.12 $(mg/kg/d)^{-1}$ (EPA 2021b). Previously, no oral slope factor was used in the RSL derivation for naphthalene.

The analytical data (MDCs and 95UCL values) used in the next two steps of the process (Figure C-4) are the same data used in the 2006 CRA; no new soil sample analytical data were collected for this FYR risk evaluation. The MDC of each of the three analytes in soil/sediment in each EU were compared to the 2021 RSL (Table C-4). Of these analytes, only naphthalene had an MDC in surface soil that exceeded the current RSL value. The maximum MDC for naphthalene was 41 mg/kg in the UWOEU. The UWOEU is the only EU in which the MDC of naphthalene exceeds the 2021 RSL. The next step in the evaluation was to compare the 95UCL concentration of naphthalene in the UWOEU to the 2021 (Table C-4). The 95UCL concentration is a conservative estimate of the average constituent concentration to which the WRW might be exposed. The maximum 95UCL value for naphthalene was 1.4 mg/kg in the UWOEU. This 95UCL value is less than the current RSL; therefore, Rocky Flats surface soil is still protective for the WRW, and no new potential soil or sediment COCs are identified.

Table C-4. RSL Comparison for Chemicals in COU Surface Soil

Analyte[a]	**2016 Surface Soil RSL**[b] **(mg/kg)**	**2021 Surface Soil RSL**[c] **(mg/kg)**	**MDC - All EUs**[d] **(mg/kg)**	**MDC Exceeds 2021 RSL?**	**Maximum 95UCL – All EUs**[e] **(mg/kg)**	**95UCL Exceeds 2021 RSL?**	**Identified as COC?**
DDD	9.6	2.5	0.01	No	NA	No	No
Aroclor 1248	0.95	0.94	0.84	No	NA	No	No
Naphthalene[f]	17	8.6	41	Yes	1.4	No	No

Notes:
All MDCs and 95UCLs are from the 2006 CRA.
[a] Includes only those analytes detected in COU surface soil or sediment with 2021 RSL values that are less than the corresponding 2016 RSL values.
[b] 2016 RSL table values for an industrial worker at a cancer risk of 1×10^{-6} and an HQ of 0.1 (EPA 2016).
[c] 2021 RSL table values for an industrial worker at a cancer risk of 1×10^{-6} and an HQ of 0.1 (EPA 2021b).
[d] MDC among all EUs (DOE, EPA, and CDPHE 2006).
[e] Maximum 95UCL among all EUs (DOE, EPA, and CDPHE 2006).
[f] The MDC among all EUs and the maximum 95UCL occurred at the UWOEU. The MDC for naphthalene in surface soil was exceeded only at the UWOEU, where it was detected in 11 of 113 surface soil samples.

Abbreviation:
NA = not applicable

Chemical constituents in subsurface soil were evaluated similarly to those in surface soil for this FYR. The three chemicals detected in surface soil for which the 2021 RSLs are less than the 2016 RSLs were also detected in subsurface soil. Additionally, the 2021 RSL for *trans*-1,2-dichloroethene (*trans*-1,2-DCE) was less than the 2016 RSL, and *trans*-1,2-DCE was also detected the Industrial Area EU subsurface soil. It is noted that *trans*-1,2-DCE was not detected in surface soil, thus it is not included in Table C-4. As described in Section C2.2, the WRW PRGs used for subsurface soil are the surface soil WRW PRGs multiplied by a factor of 11.5 because the exposure frequency for surface soil exposure (230 days per year) is 11.5 times greater than the exposure frequency for subsurface soil (20 days per year). Therefore, consistent with the 2017 FYR, the subsurface soil RSLs were derived by multiplying the surface soil RSLs by a factor of 11.5.

As presented in Table C-5, naphthalene is the only chemical with an MDC greater than the 2021 subsurface soil RSL. None of the chemicals detected in COU subsurface soil had a 95UCL that exceeded the 2021 subsurface soil RSL. Therefore, no potential COCs for COU subsurface soil were identified. This is consistent with the CRA and the 2017 FYR.

Table C-5. RSL Comparison for Chemicals in COU Subsurface Soil

Analyte[a]	2016 Subsurface Soil RSL[b] (mg/kg)	2021 Subsurface Soil RSL[c] (mg/kg)	MDC - All EUs[d] (mg/kg)	MDC Exceeds 2021 RSL?	Maximum 95UCL – All EUs[e] (mg/kg)	95UCL Exceeds 2021 RSL?	Identified as COC?
DDD	110	29	0.0076	No	NA	No	No
Aroclor 1248	10.9	10.8	7.2	No	NA	No	No
Naphthalene	196	99	350	Yes	0.42	No	No
trans-1,2-DCE	26500	345	0.09	No	NA	No	No

Notes:

[a] Includes only those analytes detected in COU subsurface soil with 2021 RSL values that are less than the corresponding 2016 RSL values.

[b] 2016 RSL table values for an industrial worker at a cancer risk of 1×10^{-6} and HQ of 0.1 (EPA 2016) multiplied by a factor of 11.5 to account for the difference in WRW exposure frequency between subsurface (20 days/year) and surface soil (230 days/year).

[c] MDC among all EUs (DOE, EPA, and CDPHE 2006).

[d] 2021 RSL table values for an industrial worker at a cancer risk of 1×10^{-6} and HQ of 0.1 (EPA 2021b) multiplied by a factor of 11.5 to account for the difference in WRW exposure frequency between subsurface (20 days/year) and surface soil (230 days/year).

[e] Maximum 95UCL among all EUs (DOE, EPA, and CDPHE 2006). The MDC for naphthalene in subsurface soil was exceeded only at the UWOEU, where it was detected in 9 of 111 subsurface soil samples.

Abbreviation:
NA = not applicable

C2.4.3 Radiological Constituent Review Methodology

This 2022 FYR risk evaluation for radiological constituents followed the same approach to evaluating radiological risk as the 2017 FYR evaluation. Both evaluations used the EPA online PRG calculator to calculate updated radiological PRGs (EPA 2021a). The input parameters used in the 2006 CRA for the WRW were entered into the online EPA PRG calculator to obtain updated PRG values that correspond to a risk level of 1×10^{-6}, which is the lower bound of the EPA acceptable risk range. Although there were some changes to the PRG calculator since the last FYR, there have not been any changes to the slope factors for the radionuclides evaluated in this FYR (Table C-6).

The PRGs calculated by the online calculator are conservative screening values used in this FYR to identify individual contaminants that may require further evaluation. The methodology used for this FYR evaluation does not require input of site-specific analytical data because PRGs represent concentrations based on a target risk level rather than a risk level calculated from measured concentrations. As such, no new soil analytical data were collected for this FYR risk review. For completeness, this FYR considered $^{239/240}$Pu (the only radionuclide COC identified in the 2006 CRA), ^{241}Am, ^{234}U, ^{235}U, and ^{238}U. The Am and U isotopes represent the other primary radionuclides associated with RFP historical operations.

Table C-6. Comparison of Slope Factors for Various Pathways

Isotope	1994[a]	2006[b]	2017/2022[c]
	Adult Ingestion		
^{241}Am	2.40×10^{-10}	9.1×10^{-11}	9.1×10^{-11}
^{239}Pu	2.30×10^{-10}	1.21×10^{-10}	1.21×10^{-10}
^{234}U	1.60×10^{-11}	5.11×10^{-11}	5.11×10^{-11}
^{235}U	1.60×10^{-11}	4.92×10^{-11}	4.92×10^{-11}
^{238}U	1.60×10^{-11}	4.66×10^{-11}	4.66×10^{-11}
	Adult Inhalation		
^{241}Am	3.20×10^{-8}	2.81×10^{-8}	3.77×10^{-8}
^{239}Pu	3.80×10^{-8}	3.33×10^{-8}	5.55×10^{-8}
^{234}U	2.60×10^{-8}	1.14×10^{-8}	2.78×10^{-8}
^{235}U	2.50×10^{-8}	1.01×10^{-8}	2.50×10^{-8}
^{238}U	2.40×10^{-8}	9.32×10^{-9}	2.36×10^{-8}
	Adult External Exposure		
^{241}Am	4.90×10^{-9}	2.76×10^{-8}	2.77×10^{-8}
^{239}Pu	1.70×10^{-11}	2.00×10^{-10}	2.09×10^{-10}
^{234}U	3.00×10^{-11}	2.52×10^{-10}	2.53×10^{-10}
^{235}U	2.40×10^{-7}	5.18×10^{-7}	5.51×10^{-7}
^{238}U	2.10×10^{-11}	4.99×10^{-11}	1.24×10^{-10}

Notes:
[a] From the *Programmatic Risk-Based Preliminary Remediation Goals* (DOE 1994).
[b] From the *Final Comprehensive Risk Assessment Work Plan and Methodology* (DOE 2005).
[c] From the *Fourth Five-Year Review Report for the Rocky Flats Site* (DOE 2017).

The differences between the PRG values calculated for this FYR and the 2017 FYR PRGs are largely attributable to the application of a more conservative soil ACF in this FYR. A database of isotope-specific ACF values (ORNL 2014) is included in the PRG calculator, with the actual ACF values dependent on the area (in m^2) of the site. For this FYR, the largest site area listed in the PRG calculator of 1,000,000 m^2 (247 acres) was selected in the calculation of the 2022 PRGs, which resulted in an ACF value of 1.0 for all isotopes. A smaller site area that is less representative of the area of the COU was selected to calculate the 2017 PRGs, which resulted in correspondingly less-conservative ACF and PRG values. An ACF of 0.9 was used in the 2006 PRGs[1] based on guidance that was current at the time.

The CRA describes the WRW as spending 50% of the workday outdoors and 50% indoors. The PRG calculator includes both an indoor worker and an outdoor worker receptor but does not include a receptor who works both indoors and outdoors. The 2006 and 2017 PRGs were based on the outdoor WRW scenario, which is more conservative than the indoor scenario. To more accurately represent the WRW as defined in the CRA, a combined indoor/outdoor worker was assessed in this FYR. This was accomplished by using the PRG calculator to calculate separate PRGs for an indoor worker and an outdoor worker. It is noted that the CRA input parameters

[1] The PRGs used in the 2006 CRA were calculated in 2005 and presented in the *Final Comprehensive Risk Assessment Work Plan and Methodology* (DOE 2005). Throughout this report, the term “2006 CRA” refers to these PRGs calculated in 2005 and used in the 2006 CRA.

included a 0.7 dilution factor for the inhalation of indoor dust. Although the PRG calculator does not include an indoor air dilution factor, this value was incorporated into the indoor receptor PRG output spreadsheet. The PRG results for these two worker scenarios were then averaged in a separate spreadsheet to represent an individual who spends 50% of the workday indoors and 50% outdoors, consistent with the CRA. PRG calculator input and output for the WRW are included in Attachment 1 to this appendix.

C2.4.4 Radiological Constituent Evaluation Results

Based on the review described in this section, the COU remedy continues to be protective with respect to radiological constituents.

The PRGs for the WRW are summarized in Table C-7. Although the PRG output is based on a cancer risk of 1×10^{-6}, PRG values at 1×10^{-5} and at 1×10^{-4} were derived by multiplying by factors of 10 and 100, respectively.

As shown in Table C-7, the 2022 PRGs for all isotopes at the 1×10^{-6} risk level are less than the PRGs calculated in 2006 and 2017 at the same risk level. As discussed in the fourth FYR report, the 2017 PRGs at the 1×10^{-6} risk level decreased for all radionuclides except ^{241}Am and ^{235}U, which increased. Because of the differences in how the 2017 and 2022 PRGs were calculated (see Section C2.4.3) and because the 2022 PRGs are all less than the 2006 PRGs, this FYR focused on a comparison of the 2022 PRGs against the 2006 PRGs as a conservative measure. At a cancer risk level of 1×10^{-6}, the 2022 PRGs are 1.5 to 2.3 times lower than the 2006 PRGs. In terms of risk, this means that if the 2006 PRGs were used in a COC screening process today, the associated risk would be greater than 1×10^{-6} by a factor of 1.5 to 2.3, depending on the isotope. For example, the 2006 PRG for ^{239}Pu was 9.8 pCi/g, which at the time equated to a risk of 1×10^{-6}. Based on the 2022 PRGs, the risk associated with ^{239}Pu at this concentration would be greater than 1×10^{-6} (i.e., 1.9×10^{-6}; [9.8pCi/g ÷ 5.2 pCi/g] × [1×10^{-6}]), but still at the lower end of the acceptable risk range (i.e., between 1×10^{-6} and 1×10^{-5}).

Table C-7. Radionuclide PRG Comparison for WRW

Isotope	2006 PRG[a] (pCi/g)	2017 PRG[b] (pCi/g)	2022 PRG (pCi/g)		
Risk Level	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-5}**	**1×10^{-4}**
^{241}Am	7.7	11.5	5.1	51	510
^{239}Pu	9.8	9.3	5.2	52	520
^{240}Pu	9.8	9.3	5.2	52	520
^{234}U	25.3	20.0	10.9	109	1090
^{235}U	1.1	4.5	0.75	7.5	75
^{238}U	29.3	22.9	12.6	126	1260

Notes:
The calculated risk to a WRV in the COU is less than the calculated risk to a WRW, primarily due to the difference in exposure frequency. The WRW scenario exposure frequency is 1840 hours/year; the WRV scenario exposure frequency is 250 hours/year.
Each of the PRG values in the table was calculated with the assumption of decay as appropriate, but without the contribution of progeny and without the assumption of secular equilibrium.
[a] From the *Final Comprehensive Risk Assessment Work Plan and Methodology* (DOE 2005). Values have been rounded to the first decimal place.
[b] From the *Fourth Five-Year Review Report for the Rocky Flats Site* (DOE 2017).

This FYR evaluation also included a comparison of the MDCs and 95UCLs used in the 2006 CRA to the 2022 PRGs for each of the isotopes in this review. No new soil sample analytical data were collected for this FYR risk evaluation. As shown in Table C-8, $^{239/240}$Pu in the WBEU is the only analyte with a 95UCL (12.1 pCi/g) that exceeds its 2022 PRG (5.2 pCi/g) at the 1×10^{-6} risk level. However, the calculated risk associated with the $^{239/240}$Pu 95UCL of 12.1 pCi/g is still within the acceptable risk range (i.e., between 1×10^{-6} and 1×10^{-5}) and is near the lower bound of the range.

The only radiological COC identified in the 2006 CRA was $^{239/240}$Pu in the WBEU. If the 2022 PRGs had been used in the CRA, the selection of COCs would have been unaffected, and $^{239/240}$Pu would still be identified as a COC in the WBEU. A comparison of radiological data from the 2006 CRA to the 2022 PRGs at the 1×10^{-6} risk level results in no additional radiological COCs identified for the COU, indicating the CRA outcome would be the same whether the 2006 or 2022 PRGs were used for screening. Therefore, $^{239/240}$Pu in surface soil at the WBEU remains the only radiological COC for the COU.

In summary, although the calculated PRGs for the isotopes in this evaluation have decreased, the calculated risk to a WRW in the COU remains at the lower (i.e., more protective) end of the acceptable risk range considered by EPA to be protective of human health; therefore, the remedy in the COU remains protective. A comparison of radiological data from the 2006 CRA to the 2022 PRGs at the 1×10^{-6} risk level results in no additional radiological COCs identified for the COU, which indicates that the CRA outcome would be the same whether the 2006 or 2022 PRGs had been used for screening. Therefore, $^{239/240}$Pu in surface soil at the WBEU remains the only radiological COC for the COU.

Table C-8. PRG Comparison for Radionuclides in COU

Isotope	2022 PRGs[a]	Industrial Area EU		Upper Woman Drainage EU		Wind Blown Area EU		No Name Gulch EU		Upper Walnut Drainage EU		Lower Woman Drainage EU	
		MDC	95UCL	MDC	95UCL	MDC	95UCL	MDC	95UCL	MDC	95UCL	MDC	95UCL
^{241}Am	5.1	**51.2**	0.8	0.802	NA	**15.6**	2.4	1.15	NA	**6.89**	0.81[b]	1.66	NA
$^{239/240}$Pu	5.2	**183**	2.0	**17.1**	0.15	**49**	**12.1**	2.31	NA	**22.4**	2.0	**12.2**	1.3
^{234}U	10.9	**34.5**	1.4	**47.5**	2.6	7.96	NA	1.79	NA	3.7	NA	3.19	NA
^{235}U	0.75	**1.69**	0.08	**2.24**	0.16	0.68	NA	0.276	NA	0.285	NA	0.405	NA
^{238}U	12.6	**59**	1.9	**209**	8.3	3.78	NA	1.75	NA	6.1	NA	3.39	NA

Notes:
All values are in pCi/g. **Bolded** values exceed the PRG. All values are from the 2006 CRA.
[a] Calculated at a cancer risk level of 1×10^{-6} using the CRA default dust loading factor.
[b] Value is conservatively estimated based on 2 times the arithmetic mean concentration of 0.405 listed in the 2006 CRA for the Upper Walnut Drainage EU surface soil and sediment. The standard deviation of ^{241}Am is 0.805, for a coefficient of variation of 1.99, which is virtually the same as that of $^{239/240}$Pu (1.98, based on a mean of 1.22 and a standard deviation of 2.42). The 95UCL value for $^{239/240}$Pu is 1.99, which is a factor of 1.63 times the arithmetic mean. Also, both datasets are a similar size (n=171 and n=188 for ^{241}Am and $^{239/240}$Pu, respectively). Therefore, basing the estimated 95UCL on 2 times the arithmetic mean for ^{241}Am is likely conservative. Note that all mean and standard deviation values in this note are from the 2006 CRA and are in pCi/g.

Abbreviation:
NA = MDC is less than the 2022 PRG

C2.4.5 Alternative PRGs Based on Rocky Flats-Specific Dust Concentrations

In performing this FYR evaluation, the airborne dust concentration—referred to as the dust-loading factor (DLF)—used in the CRA (67 micrograms per cubic meter [μg/m^3]) and in the PRG calculations described in the preceding paragraphs was identified as being notably high. The high DLF used in the CRA results in unrealistically high exposure rates to dust-borne radiological constituents. For isotopes in which the inhalation pathway is significant, the use of the CRA default DLF may result in unrealistically conservative (i.e., low) PRG values. A review of the PRG output of the values described above reveals that the inhalation pathway is the dominant exposure pathway for each isotope except for ^{235}U. The DLFs are based on particulates of 10 micrometers or less (PM10). The 67 μg/m^3 value has been described as a 95th percentile of maximum daily air concentrations across more than 20 Colorado counties (DOE, EPA, and CDPHE 2002). This value exceeded the then-current PM10 National Ambient Air Quality Standard (NAAQS) of 50 μg/m^3 for annual PM10 concentration. EPA subsequently discontinued use of the annual PM10 NAAQS in December 2006, and this parameter is not included in the current NAAQS.

From 1995 through June 2001, air monitoring was conducted at five locations within the plant area to determine compliance with environmental standards, including the annual average PM10 NAAQS. The monitoring was discontinued in 2001 because it was determined that pollutant concentrations in air were low (CDPHE 2001). Various remediation activities were ongoing during this period, which would have tended to increase dust concentrations. The maximum annual monitoring concentration among all five stations was 16.6 μg/m^3 at station X-3 in 1995 (DOE, EPA, and CDPHE 2002), which was east-southeast of the RFP and west of Indiana Street. Station X-3 also had the highest mean annual dust concentration (12.8 μg/m^3) and a 95UCL of 14.5 μg/m^3 during this monitoring period. All these values were well within the 50 μg/m^3 former NAAQS PM10 value in effect at the time.

It is standard risk assessment practice to use an average-based concentration, such as a 95UCL concentration, for exposure to air and other media (EPA 1989). As an additional evaluation in this FYR, alternative PRGs were calculated using the 95UCL dust concentration based on Rocky Flats-specific data at station X-3 of 14.5 μg/m^3 in lieu of the 67 μg/m^3 value described above; all other input values for these alternative PRGs were the same as those used for the PRGs described in Section C2.4.3. This 14.5 μg/m^3 value is referred to hereafter as the Rocky Flats-specific DLF and the 67 μg/m^3 is referred to as the CRA default DLF. PRG output for using the Rocky Flats-specific DLF is included in Attachment 2.

The PRG calculator uses the reciprocal of the DLF to calculate the particulate emission factor (PEF) in units of m^3/kg. Therefore, the Rocky Flats-specific DLF is converted to 1.45×10^{-8} kg/m^3 to calculate the Rocky Flats-specific PEF of 6.90×10^{7} m^3/kg as follows:

$$PEF = \frac{1}{1.45 \times 10^{-8}\ \mathrm{kg/m^3}} = 6.90 \times 10^{7}\ \mathrm{m^3/kg}$$

Using the same equation, a CRA default PEF of 1.49×10^{7} m^3/kg was derived using the CRA default DLF. A lower PEF value (higher DLF) tends to result in a lower PRG. Table C-9 compares the 2006 PRGs to the 2022 PRGs based on the CRA default DLF and 2022 PRGs based on the Rocky Flats-specific DLF. The PRGs using the Rocky Flats-specific DLF value are all greater than the corresponding 2006 PRGs except for ^{235}U. Thus, if soil concentrations equal to the 2006 PRG values were screened against the 2022 PRGs calculated using the Rocky Flats-specific DLF, the associated risk of each isotope is would still be equivalent to the 1×10^{-6} cancer risk level (rounded to one significant figure).

The 2022 PRGs that are based on the Rocky Flats-specific DLF value are regarded as a conservative yet more realistic estimate of actual PM10 concentrations in air at the site than are the PRGs based on the CRA default DLF discussed in Section C2.4.4. Current dust concentrations in air would likely be lower than in 1995–2000 because there are currently no dust-generating remediation activities. Also, a higher percentage of the ground is vegetated than in 1995–2000 when the dust concentrations were measured; this vegetative cover would reduce airborne dust. Therefore, the 2022 PRGs in Table C-9 that are based on the Rocky Flats-specific DLF are recommended to be considered for the development of PRGs in future FYRs.

In conclusion, the DLF used in the CRA overestimated exposure via the inhalation of dust-borne radionuclides. As a result of this overestimate of inhalation exposure, the PRGs calculated at a given risk level are likely biased low when using the CRA default DLF. The 2022 PRGs calculated using the Rocky Flats-specific DLF provide more realistic, yet still conservative, screening values. As shown in Table C-9, if the Rocky Flats-specific DLF is used, the 2022 PRGs would all be above the 2006 PRGs, except for ^{235}U, which is near the lower bound of the acceptable risk range considered by EPA to be protective of human health. This alternative evaluation confirms that the use of a less conservative, more realistic DLF in calculating PRGs would result in the conclusion that the remedy in the COU remains protective.

Table C-9. PRG Comparison for WRW Based on CRA Default and Rocky Flats-Specific DLFs

Isotope	2006 PRG[a] (pCi/g)	2022 PRG Calculated Value with CRA Default DLF[b] (pCi/g)	2022 PRG Calculated Value with Rocky Flats-Specific DLF[c] (pCi/g)
^{241}Am	7.7	**5.1**	8.0
^{239}Pu	9.8	**5.2**	12.1
^{240}Pu	9.8	**5.2**	12.1
^{234}U	25.3	**10.9**	26.5
^{235}U	1.1	**0.8**	**0.8**
^{238}U	29.3	**12.6**	30.1

Notes:
Bold indicates that the value is less than the 2006 PRG value.
[a] From the *Final Comprehensive Risk Assessment Work Plan and Methodology* (DOE 2005). Values have been rounded to the first decimal place.
[b] Calculated using the default CRA DLF of 67 μg/m^3 (DOE 2005).
[c] Calculated using the derived Rocky Flats-specific DLF of 14.5 μg/m^3.

C2.5 PFAS Risk to Human and Ecological Receptors

This FYR included a limited screening of the potential risk of PFAS to human and ecological receptors at the site. Available PFAS data from surface water and groundwater samples collected at the site were compared to non-promulgated human health and ecological screening values. Because only water sample data were available, the screening was limited to potential exposure pathways involving surface water and groundwater. Other media (e.g., soil) and associated potential exposure pathways that may be present at the site were not considered, and, therefore, the potential risk of PFAS to human and ecological receptors in the COU has not been fully evaluated.

The limited screening of the potential risk of PFOA and PFOS to human receptors was completed by comparing available water data to the EPA lifetime drinking water HAL for PFOA and PFOS of 70 ng/L (parts per trillion). The HAL is the concentration of PFOA and PFOS in drinking water at or below which adverse human health effects are not anticipated to occur over a lifetime of exposure (Grevatt 2016). The HAL is applicable to PFOA and PFOS individually or combined when both are present. The HAL is based on the ingestion of drinking water and does not account for other potentially applicable exposure pathways (e.g., skin contact) that would be evaluated in a CERCLA risk assessment. The EPA HAL and Rocky Flats PFOA and PFOS data are included in Table C-10. The HAL was exceeded in groundwater samples collected from two monitoring wells and in surface water/seep samples collected at the PLFTS influent location. PFOA and PFOS were not detected, individually or combined, above the HAL in samples from the POCs that monitor surface water exiting the COU. This limited assessment is discussed further in Section 6.2.3.1.

The limited screening of the potential risk of PFAS to ecological receptors was completed by comparing Rocky Flats groundwater and surface water data to PFAS surface water ESVs published by Argonne National Laboratory in the fall of 2021 (ANL 2021). ESVs for eight PFAS were developed by ANL, in cooperation with U.S. Department of Defense and EPA subject matter experts, to support SLERAs at U.S. Department of Defense sites. The surface water ESVs[2] represent PFAS concentrations in surface water at or below which ecological receptors are not expected to be adversely affected and ecological risks are unlikely. For this FYR comparison, surface water ESVs for aquatic life, aquatic-dependent mammals, and aquatic-dependent birds were compared to PFAS water data collected in 2019 and 2021 at Rocky Flats. Of the eight PFAS for which ESVs were published, only the surface water PFOS ESV for aquatic-dependent mammals (0.117 µg/L) was exceeded and only in groundwater samples. All surface water sampled to date has had PFAS concentrations below the most stringent ESVs for the protection of wildlife and aquatic receptors. The ESVs and Rocky Flats PFAS data are included in Table C-11. This limited assessment is discussed further in Section 6.2.3.2.

[2] ESVs for soil are also presented in ANL 2021.

Table C-10. PFOA and PFOS HAL Comparison (ng/L)

Location	Location Description	Sample Date	PFOA	PFOS	PFOA + PFOS (combined)	HAL
			ng/L			
WELL 33502	Fire Dept/Oil Burn Pit #1	6/25/2019	**120**	**310**	**430**	70
		10/9/2019	70	**240**	**310**	70
		8/24/2021	66	**250**	**316**	70
WELL 91105	Oil Burn Pit #2	6/25/2019	0.9	0.99	1.89	70
		10/9/2019	0.55	1.1	1.65	70
		8/24/2021	1.3	1	2.3	70
WELL 40005	B444	6/25/2019	21	24	45	70
		10/9/2019	19	24	43	70
		8/24/2021	16	22	38	70
MSETINF	ETPTS Influent	6/25/2019	2	1	3	70
		10/9/2019	1.1	1	2.1	70
		8/3/2021	1.3	1	2.3	70
PLFSEEPINF	PLFTS Influent	6/25/2019	69	23	**92**	70
		10/9/2019	59	20	**79**	70
		8/3/2021	55	21	**76**	70
OLFSEEP8	OLF Seep	6/25/2019	7.4	3.4	10.8	70
		10/9/2019	7.3	3.3	10.6	70
		8/3/2021	12	4.3	16.3	70
PLFSYSEFF	PLFTS Effluent	8/3/2021	40	17	57	70
WELL 33604	Fire Dept/Oil Burn Pit #1	8/24/2021	38	8.1	46.1	70
WELL 33711	Fire Dept/Oil Burn Pit #1	8/24/2021	13	7	20	70
WELL 33905	Fire Dept/Oil Burn Pit #1	8/24/2021	32	**140**	**172**	70
WOMPOC	Woman Creek POC	6/25/2019	1.6	1.2	2.8	70
		10/23/2019	1.1	1.5	2.6	70
WALPOC	Walnut Creek POC	5/14/2019	13	18	31	70
		12/23/2019	1.3	2.3	3.6	70

Note:
Bolded numbers are above the HAL, individually or combined.

Table C-11. PFAS ESVs Comparison (µg/L)

Surface Water Ecological Screening Values (ESVs)			PFAS							
			PFOA	PFOS	PFHxA	PFDA	PFHxS	PFBA	PFBS	PFNA
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
		Aquatic Life	307	22.6	28.8	2.94	65.3	64.6	400	16.4
		Aquatic-Dependent Mammals	1580	0.117	2210	0.66	5.5	8370	5710	2.08
		Aquatic-Dependent Birds	None	2.57	None	None	None	None	88600	None
Location	**Location Description**	**Sample Date**	**PFOA**	**PFOS**	**PFHxA**	**PFDA**	**PFHxS**	**PFBA**	**PFBS**	**PFNA**
WELL 33502	Fire Dept/Oil Burn Pit #1	06/25/2019	0.12	**0.310**	--	--	--	--	--	--
		10/09/2019	0.07	**0.240**	--	--	--	--	--	--
		08/24/2021	0.066	**0.250**	0.071	0.045	0.14	0.055	0.043	0.049
WELL 91105	Oil Burn Pit #2	06/25/2019	0.0009	0.001	--	--	--	--	--	--
		10/09/2019	0.0006	0.0011	--	--	--	--	--	--
		08/24/2021	0.0013	0.001	0.0024	0.00046	0.00066	0.012	0.0046	0.0005
WELL 40005	B444	06/25/2019	0.021	0.024	--	--	--	--	--	--
		10/09/2019	0.019	0.024	--	--	--	--	--	--
		08/24/2021	0.016	0.022	0.012	0.0004	0.0095	0.0067	0.003	0.0013
MSETINF	ETPTS Influent	06/25/2019	0.002	0.001	--	--	--	--	--	--
		10/09/2019	0.0011	0.001	--	--	--	--	--	--
		08/03/2021	0.0013	0.001	0.00083	0.00044	0.00052	0.012	0.00046	0.00048
PLFSEEPINF	PLFTS Influent	06/25/2019	0.069	0.023	--	--	--	--	--	--
		10/09/2019	0.059	0.020	--	--	--	--	--	--
		08/03/2021	0.055	0.021	0.034	0.001	0.013	0.11	0.004	0.001
OLFSEEP8	OLF Seep	06/25/2019	0.0074	0.0034	--	--	--	--	--	--
		10/09/2019	0.0073	0.0033	--	--	--	--	--	--
		08/03/2021	0.012	0.0043	0.023	0.00046	0.015	0.03	0.0094	0.00072
PLFSYSEFF	PLFTS Effluent	08/03/2021	0.040	0.017	0.022	0.00044	0.011	0.068	0.0015	0.00048
WELL 33604	Fire Dept/Oil Burn Pit #1	08/24/2021	0.038	0.0081	0.069	0.00046	0.057	0.055	0.012	0.0005
WELL 33711	Fire Dept/Oil Burn Pit #1	08/24/2021	0.013	0.007	0.017	0.00042	0.01	0.042	0.0084	0.0035
WELL 33905	Fire Dept/Oil Burn Pit #1	08/24/2021	0.035	**0.150**	0.058	0.00043	0.14	0.038	0.017	0.0038

Table C-11. PFAS ESVs Comparison (µg/L) (continued)

Surface Water Ecological Screening Values (ESVs)			PFAS							
			PFOA	**PFOS**	**PFHxA**	**PFDA**	**PFHxS**	**PFBA**	**PFBS**	**PFNA**
			µg/L	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**	**µg/L**
Aquatic Life			307	22.6	28.8	2.94	65.3	64.6	400	16.4
Aquatic-Dependent Mammals			1580	0.117	2210	0.66	5.5	8370	5710	2.08
Aquatic-Dependent Birds			None	2.57	None	None	None	None	88600	None
Location	**Location Description**	**Sample Date**	**PFOA**	**PFOS**	**PFHxA**	**PFDA**	**PFHxS**	**PFBA**	**PFBS**	**PFNA**
WOMPOC	Woman Creek POC	06/25/2019	0.0016	0.0012	--	--	--	--	--	--
		10/23/2019	0.0011	0.0015	--	--	--	--	--	--
WALPOC	Walnut Creek POC	05/14/2019	0.013	0.018	--	--	--	--	--	--
		12/23/2019	0.0013	0.0023	--	--	--	--	--	--

Notes:
Bolded numbers are above the ESV.

Abbreviations:
"--" = not analyzed.
None = ESV not provided in ANL 2021.
PFBA = perfluorobutanoic acid,
PFBS = perfluorobutane sulfonic acid
PFDA = perfluorodecanoic acid
PFNA = perfluorononanoic acid
PFHxA = perfluorohexanoic acid
PFHxS = perfluorohexane sulphonic acid

C3.0 POU UU/UE Review

The POU was determined to be suitable for UU/UE and was deleted from the NPL in 2007 (72 FR 29276). As a result, an FYR of this OU is not required. However, the continued applicability of UU/UE to the POU has been reviewed as part of this FYR in light of potential changes to toxicity factors and other risk-related information since the original UU/UE determinations were made. Residential PRG values from the *Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium* (DOE, EPA, and CDPHE 2002), hereafter referred to as the Task 3 Radionuclide Soil Action Level (RSAL) Report, were used in the evaluation of the POU. The location of the POU in relation to the COU and OU-3 is shown in Figure C-5.

C3.1 Chemical Constituents Evaluation

The 2022 UU/UE evaluation for the POU was built upon the chemical evaluation approach used in the 2017 review in which the Rocky Flats-specific rural resident soil action levels calculated in 2002 were compared to the EPA 2016 residential RSL table values. The 2002 values were used because rural resident screening values were not included in the 2006 CRA. All 2016 RSLs that were lower than the 2002 values (i.e., were more conservative) were retained in the 2017 UU/UE review for comparison against residual POU surface soil concentrations from the 2006 CRA dataset. All residual surface soil concentrations from the 2006 dataset were found to correspond to levels within or below the EPA acceptable risk range (1×10^{-4} to 1×10^{-6}) based on the 2016 residential RSLs, indicating that the POU was still suitable for UU/UE.

The 2022 UU/UE review process began by comparing the 2021 residential RSLs to the 2016 residential RSLs for POU soil analytes. This is analogous to the process described in Section C2.4.1 for the COU. Because none of the exposure parameters changed for the resident, the overwhelming majority of the residential RSLs remain unchanged from 2016 to 2021. All chemicals with 2021 residential RSLs that are equal to or greater than the corresponding 2017 RSL are regarded as protective. Of the chemicals with 2021 RSLs that are less than the 2016 RSLs and the chemicals added in 2021 that were not listed in the 2016 RSL table, none were detected in any of the POU surface or subsurface soil samples.

In summary, POU surface soil and subsurface soils remain suitable for UU/UE for known chemical contaminants based on the following:

- The 2017 UU/UE review found that residual concentrations of chemical constituents in POU soils correspond to levels within or below the CERCLA acceptable risk range (1×10^{-4} to 1×10^{-6}) based on the 2016 residential RSLs. The 2021 RSLs for these detected constituents remain unchanged, so the associated risk levels remain within the CERCLA acceptable range.
- None of the chemical constituents with 2021 RSLs that are lower than 2016 RSL were detected in POU surface or subsurface soil. Neither were any chemicals that are newly listed on the RSL table since 2016 detected in POU soils. Therefore, these chemicals do not represent a human health threat associated with POU surface or subsurface soil.

Although the POU remains UU/UE for known chemical contaminants, it is recognized that the potential risk of PFAS to human and ecological receptors is unknown.

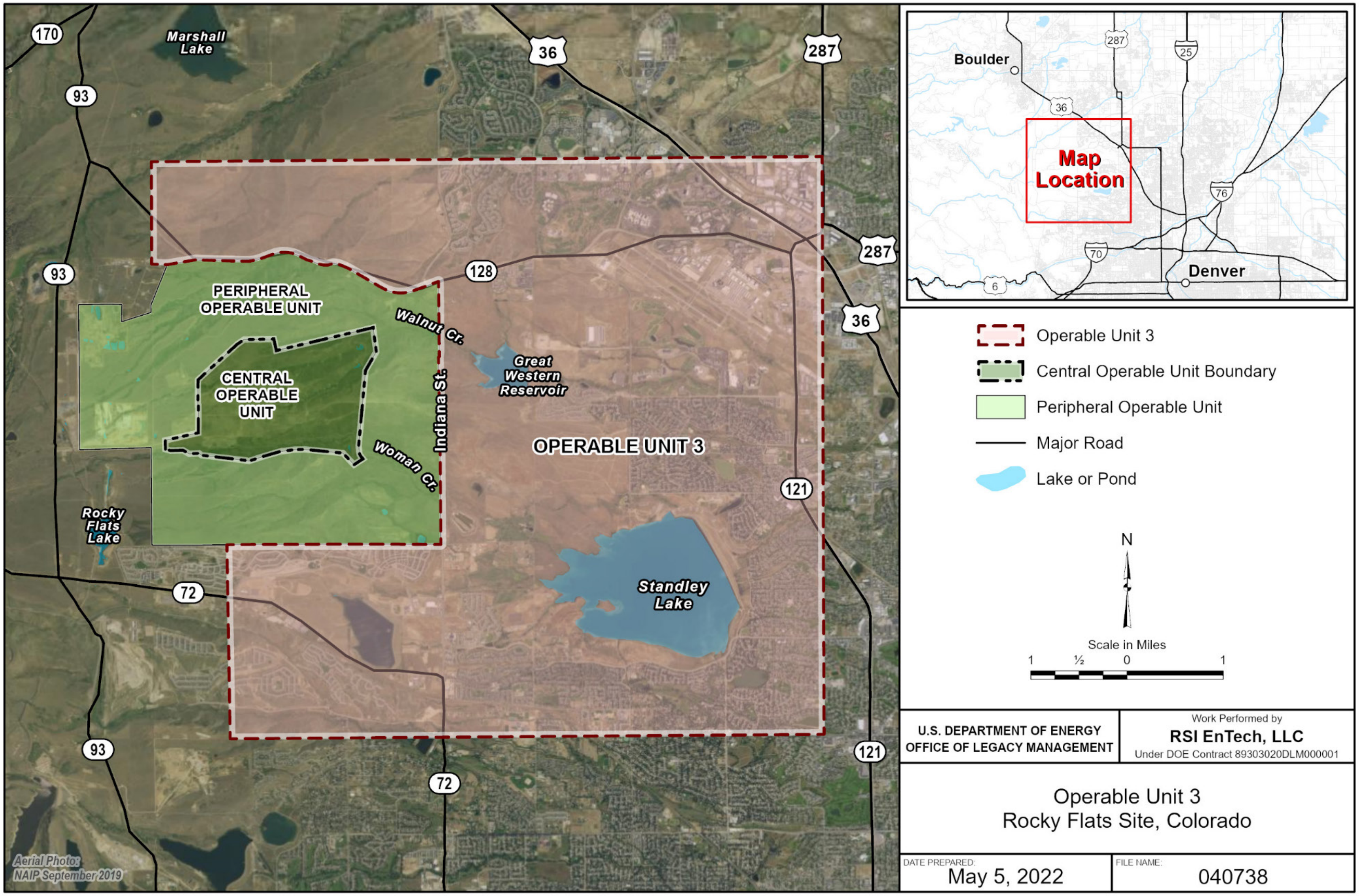


Figure C-5. Location of COU, POU, and OU-3

C3.2 Radiological Constituents Evaluation

The radiological review of the UU/UE criteria for the POU used the same approach as the COU radiological risk evaluation. The EPA online PRG calculator was used to generate 2022 PRGs for radionuclides in the POU based on the rural residential scenario referenced in the 2006 CAD/ROD (DOE, EPA, and CDPHE 2006). The rural residential scenario used to evaluate the POU for this UU/UE review is described in the Task 3 RSAL Report (DOE, EPA, and CDPHE 2002). The Task 3 RSAL Report was one of five tasks prepared to support the development of RSALs to replace the dose-based RSALs included in the 1996 *Rocky Flats Cleanup Agreement* (DOE, EPA, and CDPHE 1996). Four exposure scenarios were addressed: WRW, rural resident, open space user, and office worker. A residential scenario was not assessed in the CRA because it was not considered a reasonably anticipated land use. The risk calculations for a rural resident included in the Task 3 RSAL Report were the latest estimates of residential risk available until PRGs for a rural resident were recalculated in 2017 as part of the last FYR (DOE 2017). The site-specific RSAL exposure parameters from the Task 3 RSAL Report were used in the 2022 PRG calculations.

This UU/UE review and the 2017 review used the PRG calculator to calculate updated PRGs. As with the COU evaluation, some input parameters to the PRG calculator used in this 2022 review were different than those used in the 2017 UU/UE review. As described in Section C2.4.2 regarding the COU, the PRG calculator includes a database of isotope-specific ACF values (ORNL 2014) with the actual ACF values dependent on the area of the site. For this review, an area of 20,000 m^2 (approximately 5 acres) was selected in the calculation of the 2022 PRGs, consistent with the Task 3 RSAL Report for a rural resident scenario. A smaller site area that is less representative of the area for a POU residential scenario was selected to calculate the PRG in the 2017 UU/UE review. An ACF of 0.9 was used to derive the 2002 screening values based on guidance that was current at the time. In addition, the 2002 PRGs and this UU/UE review used the Task 3 RSAL Report ingestion rates for homegrown produce, whereas the 2017 review used a set of alternative produce ingestion rates that likely overestimated the ingestion rate of homegrown produce. The 2022 PRG calculator input and output for the rural resident are included in Attachment 3 to this appendix.

The 2022 PRGs were then compared to the rural resident PRGs calculated in 2002. Additionally, analytical data from the 2006 CRA were compared to the 2022 PRGs. As with each of the risk reviews completed for this FYR report, no new soil analytical data were collected for this review.

Table C-12 presents the 2002 and 2017 PRGs at the 1×10^{-6} risk level and the 2022 PRGs at multiple risk levels. Although the only radiological COC identified in the CRA was $^{239/240}Pu$, ^{241}Am and the U isotopes were also included in this review, consistent with the COU and OU-3 reviews. As shown in Table C-12, the 2022 PRGs are identical to the 2017 PRGs, except for ^{234}U and ^{238}U. The 2022 PRGs for these two isotopes are higher than the corresponding 2017 PRGs and slightly lower than the 2002 PRGs. Because of the differences in how the 2017 and 2022 radiological PRGs were calculated (see Section C2.4.3), this FYR focuses on a comparison of the 2022 PRGs against the 2002 PRGs as a conservative measure. The 2022 PRGs for ^{241}Am, ^{239}Pu, ^{234}U, and ^{238}U at a risk level of 1×10^{-6} are lower than the 2002 PRGs. However, these differences are minor, with only the 2002 PRG for ^{239}Pu exceeding the 2022 PRG by more than a factor of 0.4. The 2002 and 2022 PRGs for ^{235}U are identical. The minor decreases in the PRGs from 2002 to 2022 may be attributed to increases in the inhalation slope factors and various soil-to-plant transfer factors used in the produce ingestion pathway.

This UU/UE review also included a comparison of the analytical data (MDCs and 95UCLs) from the 2006 CRA to the 2022 PRGs (DOE, EPA, and CDPHE 2006). As shown in Table C-12, the MDC of $^{239/240}$Pu in POU surface soil is 20.3 pCi/g and the 95UCL concentration is 1.81 pCi/g (Attachment 4 to this appendix). The 95UCL value is used as the exposure point concentration for soil in risk assessment. The risk level for a rural resident scenario at the 95UCL is 4×10^{-6} when compared to the 2022 PRG values, which is near the low end of the CERCLA acceptable risk range considered by EPA to be protective of human health. The 95UCL values for ^{234}U and ^{238}U are each slightly above the 1×10^{-6} risk level but near the lower bound of the acceptable risk range with an associated cancer risk of 2×10^{-6} for each isotope. The 95UCL values for ^{241}Am and ^{235}U are each less than the 2022 PRG at the 1×10^{-6} risk level, indicating negligible risk for these isotopes. In summary, the overall risk to a rural resident from radionuclides in POU soil would be within the acceptable risk range at less than 1×10^{-5}. Therefore, based on this UU/UE evaluation, the POU continues to meet the criteria for UU/UE for radiological contaminants. Although this UU/UE evaluation is based on rural residential PRGs, residential use of this land is not anticipated, as it is currently part of the Rocky Flats National Wildlife Refuge and is expected to remain a refuge for the foreseeable future.

Table C-12. PRG Comparison for POU Rural Resident Exposure Scenario

Isotope	POU MDC[a] (pCi/g)	POU 95UCL[a] (pCi/g)	2002 Residential PRGs[b] (pCi/g)	2017 Residential PRGs[c] (pCi/g)	2022 Residential PRGs (pCi/g)		
Risk Level	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-5}**	**1×10^{-4}**
^{241}Am	3.5	0.3	0.7	0.5	0.5	4.8	48.2
$^{239/240}$Pu[d]	20.3	1.8	1.3[e]	0.4	0.4	4.3	42.8
^{234}U	4.3	1.2	0.4	0.1	0.3	2.5	25.4
^{235}U	0.47	0.09	0.1	0.1	0.1	1.1	10.6
^{238}U	4.5	1.2	0.4	0.1	0.3	2.8	28.1

Notes:

[a] From the CRA (DOE 2006). In the CRA, Pu in soil was analyzed as $^{239/240}$Pu.

[b] From the *Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium* (DOE, EPA, and CDPHE 2002). Values have been rounded to the first decimal place.

[c] From the *Fourth Five-Year Review Report for the Rocky Flats Site* (DOE 2017).

[d] The 2017 and 2022 residential PRGs for ^{239}Pu and ^{240}Pu are the same and are represented as $^{239/240}$Pu.

[e] The source document for the 2002 PRGs only included a PRG for ^{239}Pu.

C3.3 Sampling on the Refuge and Adjacent Transportation Corridor

In 2019, a number of soil sampling events were conducted at select locations within the Refuge and the Jefferson Parkway transportation corridor. These locations are in areas that were formerly part of the POU.

Sampling in the Refuge was conducted by USFWS in support of the construction of new trails. The results of this sampling event are found in the *Rocky Flats National Wildlife Refuge Proposed Trail Soil Sampling Results Report* (USFWS 2019). The sampling report concluded that USFWS sample results were "consistent with, if not generally lower than" the data used in the 2006 CRA for Rocky Flats (USFWS 2019). In addition, the report concluded that the sample results did not indicate a higher risk than that presented in the CRA, which was within the EPA acceptable excess cancer risk range of 1×10^{-4} to 1×10^{-6}.

Sampling in the Jefferson Parkway transportation corridor was conducted by the Jefferson Public Parkway Highway Authority and private parties. These sampling events are discussed in the CDPHE report "Review of Potential Radiation Doses During Construction of the Jefferson Parkway," published in June 2020 (CDPHE 2020; CDPHE 2021). The CDPHE report includes a review of the analytical data from the Jefferson Parkway sampling events, a radiological dose assessment, and a literature review. The review of the sampling events confirmed that (1) the majority of Pu is within the top 2 inches of soil (i.e., surface soil) and (2) with the exception of a single Jefferson Parkway transportation corridor Pu result of 264 pCi/g, no other reported soil samples exceeded the 50 pCi/g cleanup level established during closure of the RFS. The dose assessment was conducted by the CDPHE radiation program using the RESRAD model. The model calculated the potential radiation dose from residual Pu to a construction worker and a nearby resident. Using conservative assumptions, the highest calculated dose was to a construction worker at 11.52 mrem/yr; the highest calculated dose to a nearby resident was about 2.6 mrem/yr. The CDPHE dose assessment concluded that "remaining Rocky Flats plutonium in the Jefferson Parkway transportation corridor and offsite poses a small risk, well within regulatory limits for radiation. This conclusion is consistent with previous findings and the cleanup process."

While these sampling efforts were limited in nature, the data collected in these efforts and the conclusions in the USFWS report and CDPHE dose assessment are consistent with the UU/UE determination for the former POU.

C4.0 OU-3 UU/UE Review

An RCRA Facility Investigation/Remedial Investigation report and baseline risk assessment were completed for OU-3 in June 1996 (DOE 1996). This report identified the COCs in OU-3 as $^{239/240}$Pu and ^{241}Am in surface soils and $^{239/240}$Pu in surface sediments within the Great Western Reservoir. Although COCs were only identified for surface soil and sediment in OU-3, the RCRA Facility Investigation/Remedial Investigation gathered and considered a substantial amount of surface water, groundwater, and air data. The baseline risk assessment included evaluation of residential and recreational exposure scenarios and concluded that conditions in OU-3 were within the acceptable risk range for protection of human health under these scenarios. The CAD/ROD for OU-3 was published in June 1997 and selected no action as the remedy (DOE, EPA, and CDPHE 1997).

OU-3 was determined to be suitable for UU/UE and was deleted from the NPL in 2007 (72 FR 29276). As a result, an FYR of this OU is not required. However, the continued applicability of UU/UE at OU-3 has been reviewed as part of this FYR in light of potential changes to toxicity factors and other risk-related information since the original UU/UE determination was made. Residential PRGs from the Task 3 RSAL Report (DOE, EPA, and CDPHE 2002) were used in this 2022 UU/UE review of OU-3. The location of OU-3 in relation to the COU and POU is shown in Figure C-5.

C4.1 Radiological Constituents Evaluation

The 2022 PRGs calculated for the POU rural resident in Table C-12 were compared to the residential PRGs that were calculated for OU-3 in 2017 and 1994 (DOE 1994). The same 2022 PRGs were used for the OU-3 UU/UE review because the 2022 PRGs were calculated using both the Task 3 RSAL Report inputs and current input parameters for a rural residential scenario that includes a resident who ingests homegrown produce. Additionally, the MDCs of isotopes in OU-3 soils were compared to the 2022 PRGs. As with the COU and POU risk reviews, no new data were collected for the UU/UE review for OU-3.

Table C-13 presents the 1994 residential PRGs and the 2017 and 2022 PRGs calculated for the rural resident. As shown in the table, the 2022 PRGs are identical to the 2017 PRGs, except for ^{234}U and ^{238}U. The 2022 PRGs for these two isotopes are higher than the corresponding 2017 PRGs and much lower than the 1994 PRGs. Because of the differences in how the 2017 and 2022 PRGs were calculated (see Section C2.4.3), this FYR focused on a comparison of the 2022 PRGs against the 1994 PRGs as a conservative measure. The calculated 2022 PRGs at the 1×10^{-6} risk level for ^{241}Am, ^{239}Pu, ^{240}Pu, ^{234}U, and ^{238}U are much lower than those calculated in 1994 at the same risk level. There are multiple differences in the calculation of the 1994 values versus the 2022 values, but the two primary differences reflected in the disparity of the PRGs are: (1) the 1994 residential PRGs did not include the consumption of homegrown produce, which is the risk-driving exposure pathway for all isotopes except ^{235}U, and (2) the PEF value used in the 1994 PRGs is 300 times less conservative than the CRA default PEF value (Section C2.4.5) used to calculate the 2022 PRGs. The PEF is related to the inhalation pathway, which for all isotopes except ^{235}U, is the second most dominant exposure pathway for the residential receptor. Another significant difference that was also recognized in the fourth FYR, is the order-of-magnitude increase in the external radiation slope factors for ^{234}U and ^{238}U (Table C-6). As stated in the 1996 RCRA Facility Investigation/Remedial Investigation for OU-3, U isotopes were not considered to be above background concentrations and were not identified as COCs.

As stated in the 1997 OU-3 CAD/ROD, the only COCs identified for OU-3 were ^{239}Pu, ^{240}Pu, and ^{241}Am (DOE, EPA, and CDPHE 1997). The OU-3 surface soil MDC for $^{239/240}$Pu was 6.47 pCi/g and for ^{241}Am was 0.52 pCi/g (DOE, EPA, and CDPHE 1997). A comparison of these data with the 2022 PRGs calculated for the rural resident demonstrates that the $^{239/240}$Pu level measured at OU-3 approximates the midpoint of the EPA acceptable risk range (1×10^{-5}) and the risk associated with the ^{241}Am MDC is at the lower bound of the EPA acceptable risk range (1×10^{-6}). Soil concentrations of U were identified in the OU-3 risk assessment as consistent with background levels. Even so, the MDCs for ^{234}U, ^{235}U, and ^{238}U are each less than the 2022 PRG at the 1×10^{-5} risk level, which is within the acceptable risk range. It is noted that MDC values are overestimates of exposure point concentrations, which are typically based on 95UCL values for soil exposure; 95UCL values were not used in the OU-3 human health risk assessment to evaluate exposure to the OU-3 resident (DOE 1996). Because exposure to these radiological constituents results in estimated cancer risks for the rural resident that would be well within the EPA acceptable risk range, OU-3 continues to meet the conditions for UU/UE for radiological contaminants. However, the potential risk of PFAS (a group of chemical substances) to human and ecological receptors in OU-3 is unknown.

Table C-13. PRG Comparison for OU 3 Residential Exposure Scenario

Isotope	OU-3 MDC[a] (pCi/g)	1994 Residential PRGs[b] (pCi/g)	2017 Residential PRGs[c]	2022 Residential PRGs (pCi/g)		
Risk Level	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-6}**	**1×10^{-5}**	**1×10^{-4}**
^{241}Am	0.52	2.4	0.5	0.5	4.8	48.2
$^{239/240}Pu$[d]	6.47	3.4	0.4	0.4	4.3	42.8
^{234}U	2.02	45.3	0.1	0.3	2.5	25.4
^{235}U	0.36	0.2	0.1	0.1	1.1	10.6
^{238}U	2.15	46.0	0.1	0.3	2.8	28.1

Notes:

[a] From the *Resource Conservation and Recovery Act Facility Investigation/Remedial Investigation Report, Operable Unit 3 (Offsite Areas)* (DOE 1996). Pu was analyzed as $^{239/240}Pu$ in OU-3 soils.

[b] From the *Programmatic Risk-Based Preliminary Remediation Goals* (DOE 1994). Values have been rounded to the first decimal place.

[c] From the *Fourth Five-Year Review Report for the Rocky Flats Site* (DOE 2017).

[d] The 1994, 2017, and 2022 residential PRGs for ^{239}Pu and ^{240}Pu are the same and are represented as $^{239/240}Pu$.

C5.0 References

72 FR 29276. "Notice of Partial Deletion of the Rocky Flats Plant from the National Priorities List," *Federal Register*, May 25, 2007, available at https://www.federalregister.gov/documents/2007/05/25/E7-10055/national-oil-and-hazardous-substances-pollution-contingency-plan-national-priorities-list.

ANL (Argonne National Laboratory), 2021. *Derivation of PFAS Ecological Screening Values*, completed under an Interagency Agreement between DOE, ANL, and the Air Force Civil Engineer Center, September.

CDPHE (Colorado Department of Public Health and Environment), 2001. *Air Monitoring Data Report on the Rocky Flats Monitoring Network—2001*, APCD-TS-B1, Air Pollution Control Division.

CDPHE (Colorado Department of Public Health and Environment), 2020. "Review of Potential Radiation Doses During Construction of the Jefferson Parkway," June.

CDPHE (Colorado Department of Public Health and Environment), 2021. CDPHE, letter ("RE: Minor correction to CDPHE's 2020 Jefferson Parkway Analysis") to Rocky Flats Stewardship Council, March 3.

DOE (U.S. Department of Energy), 1994. *Programmatic Risk-Based Preliminary Remediation Goals*, U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado, October.

DOE (U.S. Department of Energy), 1996. *Resource Conservation and Recovery Act Facility Investigation/Remedial Investigation Report, Operable Unit 3 (Offsite Areas)*, RF/ER-96-0029.UN, June.

DOE (U.S. Department of Energy), 2005. *Final Comprehensive Risk Assessment Work Plan and Methodology*, Revision 1, prepared by the Kaiser-Hill Company, LLC for the U.S. Department of Energy, September.

DOE (U.S. Department of Energy), 2006. *RCRA Facility Investigation – Remedial Investigation/Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site,* (Comprehensive Risk Assessment [CRA] is included as Appendix A in 15 volumes), June.

DOE (U.S. Department of Energy), 2017. *Fourth Five-Year Review Report for the Rocky Flats Site, Jefferson County, Colorado*, LMS/RFS/S15528, Office of Legacy Management, June.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 1996. *Rocky Flats Cleanup Agreement* (RFCA), 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, July 19.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 1997. *Corrective Action Decision/Record of Decision, Operable Unit 3, the Offsite Areas, Rocky Flats Environmental Technology Site, Golden, Colorado*, April.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2002. *Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium*, September.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2006. *Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit*, *Jefferson and Boulder Counties, Colorado*, September.

EPA (U.S. Environmental Protection Agency), 1989. *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)*, Interim Final, EPA/540/1-89-002, December.

EPA (U.S. Environmental Protection Agency), 2016. "Regional Screening Levels (RSLs)," https://www.epa.gov/risk/regional-screening-levels-rsls, accessed November 23, 2021.

EPA (U.S. Environmental Protection Agency), 2017. *Provisional Peer-Reviewed Toxicity Values for p,p'-Dichlorodiphenyldichloroethane (p,p'-DDD) (CASRN 72-54-8)*, EPA/690/R-17/006, Superfund Health Risk Technical Support Center, National Center for Environmental Assessment. Cincinnati, Ohio, September.

EPA (U.S. Environmental Protection Agency), 2021a. “Preliminary Remediation Goals for Radionuclides (PRG),” online calculator, https://epa-prgs.ornl.gov/cgi-bin/radionuclides/rprg_search, accessed November 16, 2021.

EPA (U.S. Environmental Protection Agency), 2021b. “Regional Screening Levels (RSLs) – Generic Tables”, https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables, accessed November 16, 2021.

Grevatt, 2016. Peter C. Grevatt, Director, Office of Ground Water and Drinking Water, U.S. Environmental Protection Agency, letter (“Clarification about the Appropriate Application of the PFOA and PFOS Drinking Water Health Advisories”) to Water Division Directors, Regions I-X, U.S. Environmental Protection Agency, November 15.

ORNL (Oak Ridge National Laboratory), 2014. *Area Correction Factors for Contaminated Soil for Use in Risk and Dose Assessment Models*, ORNL/TM-2013/00, Office of Science and Technical Information, September.

USFWS (U.S. Fish and Wildlife Service), 2019. *Rocky Flats National Wildlife Refuge Proposed Trail Soil Sampling Results Report*, August.

Attachment C-1

PRG Calculator Input/Output for Wildlife Refuge Worker Using the CRA Default Dust-Loading Factor

Calculation of Wildlife Refuge Worker (WRW) Preliminary Remediation Goals (PRGs) Based on PRG Calculator Output for Indoor and Outdoor Activities Using the Default Dust-Loading Factor[a]

Isotope	Calculated WRW Outdoor PRGs[b] (pCi/g)	Calculated WRW Indoor PRGs[b] (pCi/g)	2022 WRW PRGs[c] (pCi/g)
Am-241	3.89	6.26	**5.1**
Pu-239	4.56	5.91	**5.2**
Pu-240	4.57	5.93	**5.2**
U-234	9.39	12.4	**10.9**
U-235	0.442	1.06	**0.8**
U-238	10.9	14.3	**12.6**

Notes:

[a] All values are based on 1 x 10^{-6} excess lifetime cancer risk, using the default Comprehensive Risk Assessment (CRA) dust loading factor (DLF) of 67 micrograms per cubic meter. This DLF equates to a particulate emission factor (PEF) of 1.49 x 10^{-7} m^3 per kilogram which was used as input for the PRG calculator.

[b] PRG Calculator Input and Output are provided in this attachment.

[c] Assumes 50 percent of workday is spent indoors and 50 percent outdoors, consistent with the CRA and the RSAL document (EPA, DOE, CDPHE 2002).

References:

DOE (U.S. Department of Energy), 2006. RCRA Facility Investigation – Remedial Investigation/Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site, (Comprehensive Risk Assessment [CRA] is included as Appendix A in 15 volumes), June.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2002. *Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium* , September.

PRG Calculator Input/Output for Wildlife Refuge Worker - Indoor Portion

Using the CRA Default Dust-Loading Factor

PRGs for Radionuclides Calculator Input Values - Using the CRA Default Dust-Loading Factor

Wildlife Refuge Worker - Indoor Portion, COU

Variable	Indoor Worker Soil Default Value	Form-Input Value[a]	Source
A (PEF Dispersion Constant)	16.2302	16.2302	Calculator data based on City selection[b]
B (PEF Dispersion Constant)	18.7762	18.7762	Calculator data based on City selection[b]
City (Climate Zone)	Default	Denver, CO (4)	Selected from Calculator[c]
C (PEF Dispersion Constant)	216.108	216.108	Calculator data based on City selection[b]
Cover thickness for GSF_b (gamma shielding factor) cm	0 cm	0 cm	
F(x) (function dependent on U_m/U_t) unitless	0.194	0.0827	Calculated from windspeed
PEF (particulate emission factor) m^3/kg	1359344438	14900000	2002 RSAL default[d,e]
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	33.68438944	Calculated from City selection[b]
A_s (acres)	0.5	500	Largest size selected
Site area for ACF (area correction factor) m^2	1000000 m^2	1000000 m^2	Largest size selected[f]
ED_{iw} (exposure duration - indoor worker) yr	25	18.7	2002 RSAL[e]
EF_{iw} (exposure frequency - indoor worker) day/yr	250	230	2002 RSAL[e]
ET_{iw} (exposure time - indoor worker) hr/day	8	8	2002 RSAL[e]
GSF_i (indoor gamma shielding factor) unitless	0.4	0.4	2002 RSAL[e]
Indoor Air dilution factor	na	0.7[g]	2002 RSAL[e]
IRA_{iw} (inhalation rate - indoor worker) m^3/day	60	31.2	2002 RSAL[e]
IRS_{iw} (soil intake rate - indoor worker) mg/day	50	100	2002 RSAL[e]
t_{iw} (time - indoor worker) yr	25	18.7	2002 RSAL[e]
TR (target cancer risk) unitless	0.000001	0.000001	2002 RSAL[e]
U_m (mean annual wind speed) m/s	4.69	4.2	2002 RSAL[e]
U_t (equivalent threshold value)	11.32	11.32	
V (fraction of vegetative cover) unitless	0.5	0.5	

Notes:

[a] Non-highlighted values are PRG calculator default values.
[b] See footnote c.
[c] Selected based on geographic area.
[d] Value is calculated from the CRA default dust-loading factor of 67 ug/m^3, as described in Section C2.4 of Appendix C.
[e] "2002 RSAL" refers to: DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2002. Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium, September. (Note that the 2002 RSAL values were used in the Comprehensive Risk Assessment [DOE 2006] and are referred to as "CRA default" values.)
[f] Converts to 247 acres, which is smaller than the COU.
[g] Value is used to calculate adjusted inhalation exposure pathway PRG and adjusted total PRG on the attached PRG output spreadsheet.

Abbreviation:

CRA = Comprehensive Risk Assessment (DOE 2006)

PRGs for Radionuclides Calculator Output - Using the CRA Default Dust-Loading Factor

Wildlife Refuge Worker - Indoor Portion, COU

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Halflife (yr)	1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor
Am-241	F	3.77E-08	2.77E-08	9.10E-11	1.60E-03	4.32E+02	1.00E+00	1.00E+00
Pu-239	F	5.55E-08	2.09E-10	1.21E-10	2.87E-05	2.41E+04	1.00E+00	1.00E+00
Pu-240	F	5.55E-08	7.12E-11	1.21E-10	1.06E-04	6.56E+03	1.00E+00	1.00E+00
U-234	S	2.78E-08	2.53E-10	5.11E-11	2.82E-06	2.46E+05	1.00E+00	1.00E+00
U-235	S	2.50E-08	5.51E-07	4.92E-11	9.84E-10	7.04E+08	1.00E+00	1.00E+00
U-238	S	2.36E-08	1.24E-10	4.66E-11	1.55E-10	4.47E+09	1.00E+00	1.00E+00

Total Indoor GSF Soil Volume	Particulate Emission Factor (m^3/kg)	RF-Specific Indoor Dust Inhalation Factor	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG (no adjustment) TR=1.0E-06 (pCi/g)	Indoor Inhalation-adjusted PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Total PRG (no indoor inhalation adjustment) TR=1.0E-06 (pCi/g)	Indoor Inhalation-adjusted Total PRG TR=1.0E-06 (pCi/g)
4.00E-01	1.49E+07	7.00E-01	2.59E+01	8.96E+00	1.28E+01	2.33E+01	**5.18E+00**	**6.26E+00**
4.00E-01	1.49E+07	7.00E-01	1.92E+01	6.00E+00	8.57E+00	3.05E+03	**4.57E+00**	**5.91E+00**
4.00E-01	1.49E+07	7.00E-01	1.92E+01	6.01E+00	8.59E+00	8.94E+03	**4.58E+00**	**5.93E+00**
4.00E-01	1.49E+07	7.00E-01	4.55E+01	1.20E+01	1.71E+01	2.51E+03	**9.44E+00**	**1.24E+01**
4.00E-01	1.49E+07	7.00E-01	4.72E+01	1.33E+01	1.90E+01	1.15E+00	**1.04E+00**	**1.06E+00**
4.00E-01	1.49E+07	7.00E-01	4.99E+01	1.41E+01	2.01E+01	5.14E+03	**1.10E+01**	**1.43E+01**

Notes: The indoor-adjusted PRG reflects an adjustment for indoor air inhalation of 0.7 to account for lower dust levels indoors, consistent with the 2002 RSAL and the CRA (see notes on accompanying input page in this attachment). The indoor inhalation-adjusted Total PRG (last column) was calculated using the Indoor Inhalation-adjusted PRG instead of the unadjusted inhalation PRG value using the standard Total PRG equation described in the online PRG user's guide.

PRG Calculator Input/Output for Wildlife Refuge Worker - Outdoor Portion

Using the CRA Default Dust-Loading Factor

PRGs for Radionuclides Calculator Input Values - Using the CRA Default Dust-Loading Factor

Wildlife Refuge Worker - Outdoor Portion, COU

Variable	Outdoor Worker Soil Default Value	Form-Input Value[a]	Source
A (PEF Dispersion Constant)	16.2302	16.2302	Calculator data based on City selection[b]
B (PEF Dispersion Constant)	18.7762	18.7762	Calculator data based on City selection[b]
City (Climate Zone)	Default	Denver, CO (4)	Selected from Calculator[c]
C (PEF Dispersion Constant)	216.108	216.108	Calculator data based on City selection[b]
Cover layer thickness for GSF (gamma shielding factor) cm	0 cm	0 cm	
F(x) (function dependent on U_m/U_t) unitless	0.194	0.082666567	Calculated from City selection[b]
PEF (particulate emission factor) m^3/kg	1359344438	14900000	2002 RSAL default[d,e]
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	33.68438944	Calculated from Selection[c]
A_s (acres)	0.5	500	Largest size selected
Slab size for ACF (area correction factor) m^2	1000000 m^2	1000000 m^2	Largest size selected[f]
ED_{ow} (exposure duration - outdoor worker) yr	25	18.7	2002 RSAL[d]
EF_{ow} (exposure frequency - outdoor worker) day/yr	225	230	2002 RSAL[d]
ET_{ow} (exposure time - outdoor worker) hr/day	8	8	2002 RSAL[d]
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60	31.2	2002 RSAL[d]
IRS_{ow} (soil intake rate - outdoor worker) mg/day	100	100	2002 RSAL[d]
t_{ow} (time - outdoor worker) yr	25	18.7	2002 RSAL[d]
TR (target cancer risk) unitless	0.000001	0.000001	2002 RSAL[d]
U_m (mean annual wind speed) m/s	4.69	4.2	2002 RSAL[d]
U_t (equivalent threshold value)	11.32	11.32	
V (fraction of vegetative cover) unitless	0.5	0.5	

Notes:

[a] Non-highlighted values are PRG calculator default values.

[b] See footnote c.

[c] Selected based on geographic area.

[d] "2002 RSAL" refers to: DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2002. Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium, September. (Note that the 2002 RSAL values were also used in the Comprehensive Risk Assessment [DOE 2006] and are referred to as the "CRA default" values.)

[e] Value is calculated from the CRA default dust-loading factor of 67 ug/m^3, as described in Section C2.4 of Appendix C.

[f] Converts to 247 acres, which is smaller than the COU.

CRA = Comprehensive Risk Assessment (DOE 2006)

PRGs for Radionuclides Calculator Output - Using the CRA Default Dust-Loading Factor
Wildlife Refuge Worker - Outdoor Portion, COU

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Halflife (yr)	1000000 m^2 Soil Volume Area Correction Factor
Am-241	F	3.77E-08	2.77E-08	9.10E-11	1.60E-03	4.32E+02	1.00E+00
Pu-239	F	5.55E-08	2.09E-10	1.21E-10	2.87E-05	2.41E+04	1.00E+00
Pu-240	F	5.55E-08	7.12E-11	1.21E-10	1.06E-04	6.56E+03	1.00E+00
U-234	S	2.78E-08	2.53E-10	5.11E-11	2.82E-06	2.46E+05	1.00E+00
U-235	S	2.50E-08	5.51E-07	4.92E-11	9.84E-10	7.04E+08	1.00E+00
U-238	S	2.36E-08	1.24E-10	4.66E-11	1.55E-10	4.47E+09	1.00E+00

0 cm Soil Volume Gamma Shielding Factor	Particulate Emission Factor (m^3/kg)	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (mg/kg)
1.00E+00	1.49E+07	2.59E+01	8.96E+00	9.34E+00	**3.89E+00**	1.13E-06
1.00E+00	1.49E+07	1.92E+01	6.00E+00	1.22E+03	**4.56E+00**	7.35E-05
1.00E+00	1.49E+07	1.92E+01	6.01E+00	3.58E+03	**4.57E+00**	2.02E-05
1.00E+00	1.49E+07	4.55E+01	1.20E+01	1.00E+03	**9.39E+00**	1.51E-03
1.00E+00	1.49E+07	4.72E+01	1.33E+01	4.62E-01	**4.42E-01**	2.05E-01
1.00E+00	1.49E+07	4.99E+01	1.41E+01	2.06E+03	**1.09E+01**	3.25E+01

CRA = Comprehensive Risk Assessment (DOE 2006)

Attachment C-2

Surface Soil PRG Calculator Input/Output for Wildlife Refuge Worker Using the Rocky Flats-Specific Dust-Loading Factor

Calculation of Wildlife Refuge Worker (WRW) Surface Soil Preliminary Remediation Goals (PRGs) Based on PRG Calculator Output for Indoor and Outdoor Activities Using the Rocky Flats-Specific Dust-Loading Factor[a]

Isotope	Calculated WRW Outdoor PRGs (pCi/g)	Calculated WRW Indoor PRGs (pCi/g)	2022 WRW PRGs[b] (pCi/g)
Am-241	5.89	10.2	**8.0**
Pu-239	11.3	12.9	**12.1**
Pu-240	11.3	12.9	**12.1**
U-234	24.4	28.6	**26.5**
U-235	0.454	1.11	**0.8**
U-238	27.9	32.3	**30.1**

Notes:

[a] All values are based on 1 x 10^{-6} excess lifetime cancer risk, using the Rocky Flats-specific dust loading factor (DLF) of 14.5 micrograms per cubic meter. This DLF equates to a particulate emission factor (PEF) of 6.90 x 10^{7} m^3 per kilogram which was used as input for the PRG calculator. This DLF value is based on Rocky Flats-specific information from Table F-1 of the RSAL report.

[b] Assumes 50 percent of workday is spent indoors and 50 percent outdoors, consistent with the CRA and the RSAL document (EPA, DOE, CDPHE 2002).

References:

DOE (U.S. Department of Energy), 2006. RCRA Facility Investigation – Remedial Investigation/Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site, (Comprehensive Risk Assessment [CRA] is included as Appendix A in 15 volumes), June.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2002. *Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium* , September.

Surface Soil PRG Calculator Input/Output for Wildlife Refuge Worker
Indoor Portion
Using the Rocky Flats-Specific Dust-Loading Factor

Surface Soil PRGs for Radionuclides Calculator Input Values - Using the Rocky Flats-Specific Dust-Loading Factor
Wildlife Refuge Worker - Indoor Portion, COU

Variable	Indoor Worker Soil Default Value	Form-input Value[a]	Source
A (PEF Dispersion Constant)	16.2302	11.3612	Calculator data based on City selection[b]
B (PEF Dispersion Constant)	18.7762	19.3324	Calculator data based on City selection[b]
City (Climate Zone)	Default	Denver, CO (4)	Selected from Calculator[c]
C (PEF Dispersion Constant)	216.108	221.2167	Calculator data based on City selection[b]
Cover thickness for GSF_b (gamma shielding factor) cm	0 cm	0 cm	
F(x) (function dependent on U_m/U_t) unitless	0.194	0.082666567	Calculated from windspeed
PEF (particulate emission factor) m^3/kg	1359344438	69000000	2002 RSAL-based alternate[d]
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	24.73125549	Calculator data based on City selection[b]
A_s (acres)	0.5	500	Largest size selected
Site area for ACF (area correction factor) m^2	1000000 m^2	1000000 m^2	Largest size selected[e]
ED_{iw} (exposure duration - indoor worker) yr	25	18.7	2002 RSAL[f]
EF_{iw} (exposure frequency - indoor worker) day/yr	250	230	2002 RSAL[f]
ET_{iw} (exposure time - indoor worker) hr/day	8	8	2002 RSAL[f]
GSF_i (indoor gamma shielding factor) unitless	0.4	0.4	2002 RSAL[f]
Indoor Air dilution factor	na	0.7[g]	2002 RSAL[f]
IRA_{iw} (inhalation rate - indoor worker) m^3/day	60	31.2	2002 RSAL[f]
IRS_{iw} (soil intake rate - indoor worker) mg/day	50	100	2002 RSAL[f]
t_{iw} (time - indoor worker) yr	25	18.7	2002 RSAL[f]
TR (target cancer risk) unitless	0.000001	0.000001	2002 RSAL[f]
U_m (mean annual wind speed) m/s	4.69	4.2	2002 RSAL[f]
U_t (equivalent threshold value)	11.32	11.32	
V (fraction of vegetative cover) unitless	0.5	0.5	

[a] Non-highlighted values are PRG Calculator default values.
[b] See footnote c.
[c] Selected based on geographic area.
[d] Value is calculated from a dust-loading factor of 14.5 ug/m3, as described in Section C2.4 of Appendix C. This value is a 95 percent upper confidence of the annual mean concentration at the station with the highest dust concentration as described in Section C2.4 of the Appendix C text. This value is based on Rocky Flats-specific information from Table F-1 of the 2002 RSAL report (see footnote f).
[e] Converts to 247 acres, which is smaller than the COU.
[f] "2002 RSAL" refers to: DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2002. Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium, September. (Note that the RSAL default values were also used in the Comprehensive Risk Assessment [DOE 2006] and are referred to as "CRA default" values.)
[g] Value is used to calculate adjusted inhalation exposure pathway PRG and adjusted total PRG on the attached PRG output spreadsheet.

CRA = Comprehensive Risk Assessment (DOE 2006).

Surface Soil PRGs for Radionuclides Calculator Output - Using the Rocky Flats-Specific Default Dust-Loading Factor
Wildlife Refuge Worker - Indoor Portion, COU

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Halflife (yr)	1000000 m^2 Soil Volume Area Correction Factor	0 cm Soil Volume Gamma Shielding Factor
Am-241	F	3.77E-08	2.77E-08	9.10E-11	1.60E-03	4.32E+02	1.00E+00	1.00E+00
Pu-239	F	5.55E-08	2.09E-10	1.21E-10	2.87E-05	2.41E+04	1.00E+00	1.00E+00
Pu-240	F	5.55E-08	7.12E-11	1.21E-10	1.06E-04	6.56E+03	1.00E+00	1.00E+00
U-234	S	2.78E-08	2.53E-10	5.11E-11	2.82E-06	2.46E+05	1.00E+00	1.00E+00
U-235	S	2.50E-08	5.51E-07	4.92E-11	9.84E-10	7.04E+08	1.00E+00	1.00E+00
U-238	S	2.36E-08	1.24E-10	4.66E-11	1.55E-10	4.47E+09	1.00E+00	1.00E+00

Total Indoor GSF Soil Volume	Particulate Emission Factor (m^3/kg)	Indoor Dust Filtration Factor	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	Indoor Filtration Adjusted Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Total PRG (without indoor filtration factor) TR=1.0E-06 (pCi/g)	Indoor Filtration Adjusted Total PRG TR=1.0E-06 (pCi/g)	Isotope
4.00E-01	6.90E+07	7.00E-01	2.59E+01	4.15E+01	5.93E+01	2.33E+01	**9.48E+00**	**1.02E+01**	Am-241
4.00E-01	6.90E+07	7.00E-01	1.92E+01	2.78E+01	3.97E+01	3.05E+03	**1.13E+01**	**1.29E+01**	Pu-239
4.00E-01	6.90E+07	7.00E-01	1.92E+01	2.78E+01	3.97E+01	8.94E+03	**1.14E+01**	**1.29E+01**	Pu-240
4.00E-01	6.90E+07	7.00E-01	4.55E+01	5.54E+01	7.91E+01	2.51E+03	**2.48E+01**	**2.86E+01**	U-234
4.00E-01	6.90E+07	7.00E-01	4.72E+01	6.17E+01	8.81E+01	1.15E+00	**1.11E+00**	**1.11E+00**	U-235
4.00E-01	6.90E+07	7.00E-01	4.99E+01	6.52E+01	9.31E+01	5.14E+03	**2.81E+01**	**3.23E+01**	U-238

Note: The indoor-adjusted PRG reflects an adjustment for indoor air inhalation of 0.7 to account for lower dust levels indoors, consistent with the 2002 RSAL and the CRA (see notes on accompanying input page in this attachment). The indoor inhalation-adjusted Total PRG (last column) was calculated using the Indoor Inhalation-adjusted PRG instead of the unadjusted inahalation PRG value using the standard Total PRG equation described in the online PRG user's manual.

Output generated 06OCT2021:12:23:56

Surface Soil PRG Calculator Input/Output for Wildlife Refuge Worker
Outdoor Portion
Using the Rocky Flats-Specific Dust-Loading Factor

Surface Soil PRGs for Radionuclides Calculator Input Values - Using the Rocky-Flats-Specific Dust-Loading Factor
Wildlife Refuge Worker - Outdoor Portion, COU

Variable	Outdoor Worker Soil Default Value	Form-input Value[a]	Source
A (PEF Dispersion Constant)	16.2302	11.3612	Calculator data based on City selection[b]
B (PEF Dispersion Constant)	18.7762	19.3324	Calculator data based on City selection[b]
City (Climate Zone)	Default	Denver, CO (4)	Selected from Calculator[c]
C (PEF Dispersion Constant)	216.108	221.2167	Calculator data based on City selection[b]
Cover layer thickness for GSF (gamma shielding factor) cm	0 cm	0 cm	
F(x) (function dependent on U_m/U_t) unitless	0.194	0.082666567	Calculated from windspeed selection[c]
PEF (particulate emission factor) m^3/kg	1359344438	69000000	2002 RSAL-based alternate[d]
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	24.73125549	Calculated based on windspeed
A_s (acres)	0.5	500	Largest size selected
Slab size for ACF (area correction factor) m^2	1000000 m^2	1000000 m^2	Largest size selected[e]
ED_{ow} (exposure duration - outdoor worker) yr	25	18.7	2002 RSAL[f]
EF_{ow} (exposure frequency - outdoor worker) day/yr	225	230	2002 RSAL[f]
ET_{ow} (exposure time - outdoor worker) hr/day	8	8	2002 RSAL[f]
IRA_{ow} (inhalation rate - outdoor worker) m^3/day	60	31.2	2002 RSAL[f]
IRS_{ow} (soil intake rate - outdoor worker) mg/day	100	100	2002 RSAL[f]
t_{ow} (time - outdoor worker) yr	25	18.7	2002 RSAL[f]
TR (target cancer risk) unitless	0.000001	0.000001	2002 RSAL[f]
U_m (mean annual wind speed) m/s	4.69	4.2	2002 RSAL[f]
U_t (equivalent threshold value)	11.32	11.32	
V (fraction of vegetative cover) unitless	0.5	0.5	

[a] Non-highlighted values are PRG Calculator default values.
[b] See footnote c.
[c] Selected based on geographic area.
[d] Value is calculated from a dust-loading factor of 14.5 ug/m^3, as described in Section C2.4 of Appendix C. This value is a 95 percent upper confidence of the annual mean concentration at the station with the highest dust concentration as described in Section C2.4 of the Appendix C text. This value is based on Rocky Flats-specific information from Table F-1 of the 2002 RSAL report (see footnote f).
[e] Converts to 247 acres, which is smaller than the COU.
[f] "2002 RSAL" refers to: DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2002. Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium, September. (Note that the RSAL default values were also used in the Comprehensive Risk Assessment [DOE 2006] and are referred to as "CRA default" values.)

CRA = Comprehensive Risk Assessment (DOE 2006).

Surface Soil PRGs for Radionuclides Calculator Output - Using the Rocky Flats-Specific Dust-Loading Factor
Wildlife Refuge Worker - Outdoor Portion, COU

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Adult Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Halflife (yr)	1000000 m^2 Soil Volume Area Correction Factor
Am-241	F	3.77E-08	2.77E-08	9.10E-11	1.60E-03	4.32E+02	1.00E+00
Pu-239	F	5.55E-08	2.09E-10	1.21E-10	2.87E-05	2.41E+04	1.00E+00
Pu-240	F	5.55E-08	7.12E-11	1.21E-10	1.06E-04	6.56E+03	1.00E+00
U-234	S	2.78E-08	2.53E-10	5.11E-11	2.82E-06	2.46E+05	1.00E+00
U-235	S	2.50E-08	5.51E-07	4.92E-11	9.84E-10	7.04E+08	1.00E+00
U-238	S	2.36E-08	1.24E-10	4.66E-11	1.55E-10	4.47E+09	1.00E+00

0 cm Soil Volume Gamma Shielding Factor	Particulate Emission Factor (m^3/kg)	Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (mg/kg)	Isotope
1.00E+00	6.90E+07	2.59E+01	4.15E+01	9.34E+00	**5.89E+00**	1.72E-06	Am-241
1.00E+00	6.90E+07	1.92E+01	2.78E+01	1.22E+03	**1.13E+01**	1.82E-04	Pu-239
1.00E+00	6.90E+07	1.92E+01	2.78E+01	3.58E+03	**1.13E+01**	5.00E-05	Pu-240
1.00E+00	6.90E+07	4.55E+01	5.54E+01	1.00E+03	**2.44E+01**	3.92E-03	U-234
1.00E+00	6.90E+07	4.72E+01	6.17E+01	4.62E-01	**4.54E-01**	2.10E-01	U-235
1.00E+00	6.90E+07	4.99E+01	6.52E+01	2.06E+03	**2.79E+01**	8.30E+01	U-238

Output generated 06OCT2021:12:13:03

Attachment C-3

PRG Calculator Input/Output for Rural Resident

PRGs for Radionuclides Calculator Input Values

Rural Resident Scenario, Rocky Flats POU and OU3

Variable	Resident Soil Default Value	Form-Input Value[a]	Source
A (PEF Dispersion Constant)	16.2302	11.3612	Calculator data based on City selection[b]
B (PEF Dispersion Constant)	18.7762	19.3324	Calculator data based on City selection[b]
City (Climate Zone)	Default	Denver, CO (4)	Selected from Calculator[c]
C (PEF Dispersion Constant)	216.108	221.2167	Calculator data based on City selection[b]
Cover thickness for GSF_o (gamma shielding factor) cm	0 cm	0 cm	
Cover thickness for GSF_b (gamma shielding factor) cm	0 cm	0 cm	
$CF_{res\text{-}produce}$ (contaminated plant fraction) unitless	1	1	
$CF_{res\text{-}apple}$ (contaminated apple fraction) unitless	1	1	2002 RSAL[d]
$CF_{res\text{-}cereal\ grain}$ (contaminated cereal grain fraction) unitless	1	0.01	2002 RSAL[d]
$CF_{res\text{-}lettuce}$ (contaminated lettuce fraction) unitless	1	1	2002 RSAL[d]
$CF_{res\text{-}tomato}$ (contaminated tomato fraction) unitless	1	1	2002 RSAL[d]
$ED_{res\text{-}a}$ (produce exposure duration - resident adult) yr	20	20	EPA 2014[e]
$ED_{res\text{-}c}$ (produce exposure duration - resident child) yr	6	6	EPA 2014[e]
$EF_{res\text{-}a}$ (produce exposure frequency - resident adult) day/yr	350	350	EPA 2014[e]
$EF_{res\text{-}c}$ (produce exposure frequency - resident child) day/yr	350	350	EPA 2014[e]
$IFAP_{res\text{-}adj}$ (age-adjusted apple ingestion fraction) g	668500	1162140	Calculator generated from RSAL ingestion rate values
$IFCG_{res\text{-}adj}$ (age-adjusted cereal grain ingestion fraction) g	611800	2243080	Calculator generated from RSAL ingestion rate values
$IFLE_{res\text{-}adj}$ (age-adjusted lettuce ingestion fraction) g	264040	151830	Calculator generated from RSAL ingestion rate values
$IFTO_{res\text{-}adj}$ (age-adjusted tomato ingestion fraction) g	636300	870870	Calculator generated from RSAL ingestion rate values
$IRAP_{res\text{-}a}$ (apple ingestion rate - resident adult) g/day	73.9	156	2002 RSAL[d,f]
$IRAP_{res\text{-}c}$ (apple ingestion rate - resident child) g/day	72	33.4	2002 RSAL[d,g]
$IRCG_{res\text{-}a}$ (cereal grain ingestion rate - resident adult) g/day	70.2	301	2002 RSAL[d,h]
$IRCG_{res\text{-}c}$ (cereal grain ingestion rate - resident child) g/day	39.8	64.8	2002 RSAL[d,i]
$IRLE_{res\text{-}a}$ (lettuce ingestion rate - resident adult) g/day	36.7	20.4	2002 RSAL[d,j]
$IRLE_{res\text{-}c}$ (lettuce ingestion rate - resident child) g/day	3.4	4.3	2002 RSAL[d,k]
$IRTO_{res\text{-}a}$ (tomato ingestion rate - resident adult) g/day	80.1	117	2002 RSAL[d,l]
$IRTO_{res\text{-}c}$ (tomato ingestion rate - resident child) g/day	36	24.7	2002 RSAL[d,m]
MLF_{apple} (apple mass loading factor) unitless	0.00016	0.00016	
$MLF_{cereal\ grain}$ (cereal grain mass loading factor) unitless	0.25	0.25	
$MLF_{lettuce}$ (lettuce mass loading factor) unitless	0.0135	0.0135	
MLF_{tomato} (tomato mass loading factor) unitless	0.00177	0.00177	
TR (produce target cancer risk) unitless	0.000001	0.000001	
F(x) (function dependent on U_m/U_t) unitless	0.194	0.082666567	Calculated from windspeed
PEF (particulate emission factor) m^3/kg	1359344438	14900000	2002 RSAL default[d,n]
Q/C_{wind} (g/m^2-s per kg/m^3)	93.77	46.9974838	Calculator data based on City selection[b]
A_s (acres)	0.5	5	2002 RSAL[d]
Site area for ACF (area correction factor) m^2	1000000 m^2	20000 m^2	2002 RSAL[d,o]
ED_{res} (soil exposure duration - resident) yr	26	26	EPA 2014[e]
$ED_{res\text{-}a}$ (soil exposure duration - resident adult) yr	20	20	EPA 2014[e]
$ED_{res\text{-}c}$ (soil exposure duration - resident child) yr	6	6	EPA 2014[e]
EF_{res} (soil exposure frequency - resident) day/yr	350	350	EPA 2014[e]
$EF_{res\text{-}a}$ (soil exposure frequency - resident adult) day/yr	350	350	EPA 2014[e]
$EF_{res\text{-}c}$ (soil exposure frequency - resident child) day/yr	350	350	EPA 2014[e]
ET_{res} (soil exposure time - resident) hr/day	24	24	EPA 2014[e]
$ET_{res\text{-}a}$ (soil exposure time - resident adult) hr/day	24	24	EPA 2014[e]
$ET_{res\text{-}c}$ (soil exposure time - resident child) hr/day	24	24	EPA 2014[e]
$ET_{res\text{-}i}$ (soil exposure time - indoor resident) hr/day	16.416	20.6	2002 RSAL[d]
$ET_{res\text{-}o}$ (soil exposure time - outdoor resident) hr/day	1.752	3.4	2002 RSAL[d]
GSF_i (gamma shielding factor - indoor) unitless	0.4	0.4	2002 RSAL[d]
Indoor Air dilution factor	na	0.7[p]	2002 RSAL[d]
$IFA_{res\text{-}adj}$ (age-adjusted soil inhalation factor - resident) m^3	161000	157430	Calculator generated from RSAL inhalation rate values
$IFS_{res\text{-}adj}$ (age-adjusted soil ingestion factor - resident) mg	1120000	1120000	Calculator generated from RSAL ingestion rate values
$IRA_{res\text{-}a}$ (soil inhalation rate - resident adult) m^3/day	20	20	2002 RSAL[e]
$IRA_{res\text{-}c}$ (soil inhalation rate - resident child) m^3/day	10	8.3	Calculator generated from RSAL inhalation rate values
$IRS_{res\text{-}a}$ (soil intake rate - resident adult) mg/day	100	100	EPA 2014[e]
$IRS_{res\text{-}c}$ (soil intake rate - resident child) mg/day	200	200	EPA 2014[e]
t_{res} (time - resident) yr	26	26	EPA 2014[e]
TR (target cancer risk) unitless	0.000001	0.000001	2002 RSAL[d]
Soil type	Default	Loam	site-specific
U_m (mean annual wind speed) m/s	4.69	4.2	2002 RSAL[d]
U_t (equivalent threshold value)	11.32	11.32	
V (fraction of vegetative cover) unitless	0.5	0.5	

Notes:

[a] Non-highlighted values are PRG Calculator default values.

[b] See footnote c.

PRGs for Radionuclides Calculator Input Values

Rural Resident Scenario, Rocky Flats POU and OU3

Variable	Resident Soil Default Value	Form-Input Value[a]	Source

[c] Selected based on geographic area.

[d] "2002 RSAL" refers to: DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2002. Task 3 Report and Appendices: Calculation of Surface Radionuclide Soil Action Levels for Plutonium, Americium, and Uranium, September. (Note that the RSAL default values were also used in the Comprehensive Risk Assessment [DOE 2006] and are elsewhere referred to as the "CRA default" values.)

[e] EPA (U.S. Environmental Protection Agency (EPA), 2014. "Recommended Default Exposure Factors (2014), "Attachment 1 to *Human Health Evalaution Manual, Supplemental Guidance: Update of Default Exposure Factors* , Office of Solid Waste and Emergency Response, OSWER Directive 9200.1-120, 6 February.

[f] Converted from 2002 RSAL value of 57 kilograms per year (kg/yr).

[g] Converted from 2002 RSAL value of 12.2 kg/yr.

[h] Converted from 2002 RSAL value of 110 kg/yr.

[i] Converted from 2002 RSAL value of 23.65 kg/yr.

[j] Converted from 2002 RSAL value of 7.45 kg/yr.

[k] Converted from 2002 RSAL value of 1.57 kg/yr.

[l] Converted from 2002 RSAL value of 42.55 kg/yr.

[m] Converted from 2002 RSAL value of 9.00 kg/yr.

[n] Value is calculated from 2002 RSAL default dust-loading factor of 67 ug/m^3, as described in Section C2.4 of Appendix C.

[o] Converts to 247 acres, which is smaller than the COU.

[p] Value is used to calculate adjusted inhalation exposure pathway PRG and adjusted total PRG on the attached PRG output spreadsheet.

PRGs for Radionuclides Calculator Output
Rural Resident Scenario, Rocky Flats POU and OU3

Isotope	ICRP Lung Absorption Type	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Lambda (1/yr)	Halflife (yr)
Am-241	F	3.77E-08	2.77E-08	1.34E-10	1.84E-10	1.60E-03	4.32E+02
Pu-239	F	5.55E-08	2.09E-10	1.74E-10	2.28E-10	2.87E-05	2.41E+04
Pu-240	F	5.55E-08	7.12E-11	1.74E-10	2.28E-10	1.06E-04	6.56E+03
U-234	S	2.78E-08	2.53E-10	9.55E-11	1.48E-10	2.82E-06	2.46E+05
U-235	S	2.50E-08	5.51E-07	9.44E-11	1.48E-10	9.84E-10	7.04E+08
U-238	S	2.36E-08	1.24E-10	8.66E-11	1.34E-10	1.55E-10	4.47E+09

20000 m^2 Soil Volume Area Correction Factor	Wet Soil-to-Plant Transfer Factor Woody Tree (pCi/g-fresh plant per pCi/g-dry soil)	Wet Soil-to-Plant Transfer Factor Cereal Grain (pCi/g-fresh plant per pCi/g-dry soil)	Wet Soil-to-Plant Transfer Factor Leaf (pCi/g-fresh plant per pCi/g-dry soil)	Wet Soil-to-Plant Transfer Factor Non-Leafy Fruit (pCi/g-fresh plant per pCi/g-dry soil)	Particulate Emission Factor (m^3/kg)	Indoor Air Dilution Factor [a]
9.57E-01	8.00E-06	4.00E-04	1.60E-04	3.60E-04	1.49E+07	7.00E-01
1.00E+00	8.00E-06	4.90E-06	2.80E-04	6.20E-05	1.49E+07	7.00E-01
1.00E+00	8.00E-06	4.90E-06	2.80E-04	6.20E-05	1.49E+07	7.00E-01
1.00E+00	1.00E-03	7.70E-03	4.30E-02	2.30E-02	1.49E+07	7.00E-01
8.34E-01	1.00E-03	7.70E-03	4.30E-02	2.30E-02	1.49E+07	7.00E-01
1.00E+00	1.00E-03	7.70E-03	4.30E-02	2.30E-02	1.49E+07	7.00E-01

Ingestion PRG TR=1.0E-06 (pCi/g)	Inhalation PRG TR=1.0E-06 (pCi/g)	Indoor Filtration Adjusted Inhalation PRG [b] TR=1.0E-06 (pCi/g)	External Exposure PRG TR=1.0E-06 (pCi/g)	Produce Consumption PRG TR=1.0E-06 (pCi/g)	Total PRG TR=1.0E-06 (pCi/g)	Indoor Filtration Adjusted Total PRG [c] TR=1.0E-06 (pCi/g)
4.95E+00	2.56E+00	3.49E+00	3.19E+00	7.85E-01	**4.59E-01**	**4.82E-01**
3.92E+00	1.71E+00	2.33E+00	3.96E+02	6.05E-01	**4.00E-01**	**4.28E-01**
3.92E+00	1.71E+00	2.33E+00	1.16E+03	6.05E-01	**4.01E-01**	**4.28E-01**
6.02E+00	3.40E+00	4.64E+00	3.26E+02	2.81E-01	**2.49E-01**	**2.54E-01**
6.05E+00	3.78E+00	5.16E+00	1.80E-01	2.84E-01	**1.05E-01**	**1.06E-01**
6.65E+00	4.00E+00	5.46E+00	6.68E+02	3.10E-01	**2.76E-01**	**2.81E-01**

Notes:

[a] Indoor air dilution factor is from RSAL (DOE 2002)

[b] Indoor filtration adjusted inhalation PRG is calculated as: [(0.85 x inhalation PRG) + (0.15 x (inhalation PRG/indoor air dilution factor)]. Note that resident is assumed to spend 85% of their time indoors and 15% percent of their time outdoors (DOE 2002).

[c] Calculated using the Total PRG equation described in the Radionuclide PRG Calculator User's Guide, substituting the adjusted inhalation PRG for the (unadjusted) inhalation PRG.

Attachment C-4

ProUCL Input/Output for Radiological Concentrations in the POU

UCL Statistics for Uncensored Full Datasets			
User Selected Options			
Date/Time of Computation	ProUCL 5.112/1/2021 10:00:42 AM		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Am-241 POU			
General Statistics			
Total Number of Observations	501	Number of Distinct Observations	429
		Number of Missing Observations	0
Minimum	-0.082	Mean	0.221
Maximum	3.538	Median	0.0413
SD	0.457	Std. Error of Mean	0.0204
Coefficient of Variation	2.067	Skewness	3.867
Normal GOF Test			
Shapiro Wilk Test Statistic	0.534	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.29	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0399	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.255	95% Adjusted-CLT UCL (Chen-1995)	0.258
		95% Modified-t UCL (Johnson-1978)	0.255
Gamma Statistics Not Available			
Lognormal Statistics Not Available			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.255	95% Jackknife UCL	0.255
95% Standard Bootstrap UCL	0.255	95% Bootstrap-t UCL	0.259
95% Hall's Bootstrap UCL	0.261	95% Percentile Bootstrap UCL	0.258
95% BCA Bootstrap UCL	0.258		
90% Chebyshev(Mean, Sd) UCL	0.282	95% Chebyshev(Mean, Sd) UCL	0.31
97.5% Chebyshev(Mean, Sd) UCL	0.349	99% Chebyshev(Mean, Sd) UCL	0.424
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	0.31		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all real world datasets; for additional insight the user may want to consult a statistician.			

Americium-241 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00044WCU2	3.538	Americium-241		TR00127WCU2	0.0406	Americium-241
SS00035WCU2	3.361	Americium-241		SS03001WS	0.04046	Americium-241
SS00733STU2	3.135	Americium-241		04F0731-005	0.0403	Americium-241
SS00734STU2	2.924	Americium-241		04F0740-006	0.0402	Americium-241
SS00004WCU2	2.526	Americium-241		SS00038EG	0.04	Americium-241
SS00009WCU2	2.379	Americium-241		TR00126WCU2	0.0395	Americium-241
SS00744STU2	2.326	Americium-241		04F1866-002	0.0395	Americium-241
SS00732STU2	2.073	Americium-241		SS01109ST	0.03909	Americium-241
SS00041WCU2	1.773	Americium-241		SS00079EG	0.039	Americium-241
SS00038WCU2	1.703	Americium-241		04F0619-001	0.0386	Americium-241
TR00164WCU2	1.68	Americium-241		04F0779-008	0.0381	Americium-241
01S0056-003	1.61	Americium-241		SS00070EG	0.038	Americium-241
SS00742STU2	1.57	Americium-241		SS00071EG	0.038	Americium-241
01S0057-008	1.5	Americium-241		SS00066EG	0.038	Americium-241
SS00745STU2	1.457	Americium-241		SS00087EG	0.038	Americium-241
01S0057-002	1.42	Americium-241		SS00005JE	0.0379	Americium-241
TR00122WCU2	1.411	Americium-241		04F0814-002	0.0373	Americium-241
SS00030WCU2	1.324	Americium-241		SS00059EG	0.037	Americium-241
SS00002WCU2	1.301	Americium-241		SS00068EG	0.037	Americium-241
SS00743STU2	1.271	Americium-241		SS00085EG	0.037	Americium-241
SS60021WC	1.147	Americium-241		04F0707-010	0.037	Americium-241
SS00006WCU2	1.072	Americium-241		04F0614-002	0.0369	Americium-241
01S0057-007	1.07	Americium-241		98D1150-024	0.0367	Americium-241
01S0056-009	1.05	Americium-241		98D1150-010	0.0366	Americium-241
SS00016WCU2	0.9958	Americium-241		SS00080EG	0.036	Americium-241
SS01157ST	0.9913	Americium-241		SS02826EG	0.036	Americium-241
01S0056-012	0.987	Americium-241		SS20047WC	0.036	Americium-241
SS00052WCU2	0.973	Americium-241		04F1379-006	0.0358	Americium-241
SS00769STU2	0.968	Americium-241		04F0740-003	0.0355	Americium-241
01S0056-011	0.963	Americium-241		SS00042EG	0.035	Americium-241
04F0826-006	0.95	Americium-241		04F0707-002	0.035	Americium-241
SS00736STU2	0.9303	Americium-241		04F0779-005	0.0348	Americium-241
SS00740STU2	0.8996	Americium-241		SS60014WC	0.0344	Americium-241
98D1150-051	0.892	Americium-241		TR00125WCU2	0.0339	Americium-241
SS00061WCU2	0.877	Americium-241		SS01318ST	0.033	Americium-241
00R1027-001	0.875	Americium-241		98D1150-042	0.0324	Americium-241
SS00034WCU2	0.8739	Americium-241		SS00062EG	0.032	Americium-241
SS00765STU2	0.844	Americium-241		SS00034EG	0.032	Americium-241
SS00005WCU2	0.8226	Americium-241		SS01315ST	0.032	Americium-241
01S0057-005	0.819	Americium-241		04F0779-003	0.0319	Americium-241
01S0056-002	0.809	Americium-241		04F0779-007	0.0314	Americium-241
SS50075AS	0.802	Americium-241		04F1866-003	0.0313	Americium-241
SS01138ST	0.7478	Americium-241		04F0740-004	0.0311	Americium-241
98D1150-059	0.7353	Americium-241		04F0810-006	0.0311	Americium-241
01S0057-010	0.731	Americium-241		98D1150-047	0.0308	Americium-241

Americium-241 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
00R1027-007	0.7	Americium-241		SS60022WC	0.0305	Americium-241
TR00163WCU2	0.699	Americium-241		98D1150-065	0.0302	Americium-241
SS00043WCU2	0.6418	Americium-241		SS50076AS	0.03	Americium-241
01S0056-013	0.623	Americium-241		SS03006WS	0.0297	Americium-241
SS00039WCU2	0.6212	Americium-241		98D1150-027	0.0296	Americium-241
SS00003AS	0.6192	Americium-241		SS00063EG	0.029	Americium-241
SS00028WCU2	0.6133	Americium-241		SS01313ST	0.029	Americium-241
SS00747STU2	0.5877	Americium-241		SS50101AS	0.029	Americium-241
SS00004AS	0.5819	Americium-241		98D1150-046	0.0289	Americium-241
SS01159ST	0.5694	Americium-241		SS00019WCU2	0.02851	Americium-241
01S0056-007	0.564	Americium-241		SS60016WC	0.02773	Americium-241
00R1027-008	0.553	Americium-241		SS60006WC	0.02704	Americium-241
SS00023WCU2	0.5423	Americium-241		SS00046EG	0.027	Americium-241
01S0058-009	0.542	Americium-241		SS00061EG	0.027	Americium-241
SS00001WCU2	0.5409	Americium-241		98D1150-026	0.0266	Americium-241
SS00025WCU2	0.5346	Americium-241		SS00081EG	0.026	Americium-241
SS00024WCU2	0.5262	Americium-241		TR00074WCU2	0.026	Americium-241
SS01114ST	0.5259	Americium-241		04F0810-004	0.0258	Americium-241
01S0056-006	0.509	Americium-241		SS00001JE	0.02546	Americium-241
01S0057-009	0.503	Americium-241		04F8063-001	0.0252	Americium-241
SS00051WCU2	0.501	Americium-241		98D1150-022	0.0251	Americium-241
01S0058-002	0.501	Americium-241		SS00035EG	0.025	Americium-241
SS00031WCU2	0.4944	Americium-241		SS00040EG	0.025	Americium-241
SS00746STU2	0.492	Americium-241		SS50089AS	0.0249	Americium-241
01S0058-006	0.488	Americium-241		04F0731-004	0.0247	Americium-241
SS01165ST	0.4869	Americium-241		SS50077AS	0.0241	Americium-241
SS00003WCU2	0.4747	Americium-241		04F0732-006	0.0241	Americium-241
SS01142ST	0.474	Americium-241		SS03019WS	0.02404	Americium-241
SS01134ST	0.4717	Americium-241		02D0644-001	0.0236	Americium-241
00R1027-006	0.47	Americium-241		TR00024WCU2	0.0234	Americium-241
00R1027-010	0.469	Americium-241		SS00027WCU2	0.02322	Americium-241
SS00006AS	0.4564	Americium-241		SS60018WC	0.02316	Americium-241
00R1027-005	0.448	Americium-241		SS00043EG	0.023	Americium-241
01S0056-008	0.443	Americium-241		SS60191WC	0.0227	Americium-241
01S0058-005	0.436	Americium-241		04F0732-013	0.0226	Americium-241
SS00040WCU2	0.4346	Americium-241		98D1150-064	0.0225	Americium-241
SS00005AS	0.4318	Americium-241		SS50079AS	0.0225	Americium-241
SS00051EG	0.43	Americium-241		04F0731-001	0.0221	Americium-241
01S0058-003	0.429	Americium-241		SS60020WC	0.02203	Americium-241
TR00095WCU2	0.425	Americium-241		SS20040WC	0.022	Americium-241
01S0056-004	0.422	Americium-241		SS60023WC	0.02146	Americium-241
98D1150-004	0.4162	Americium-241		SS00039EG	0.021	Americium-241
SS01143ST	0.4092	Americium-241		SS60013WC	0.021	Americium-241
SS00748STU2	0.3948	Americium-241		SS20045WC	0.021	Americium-241
01S0058-008	0.393	Americium-241		SS03011WS	0.0208	Americium-241

Americium-241 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00037WCU2	0.3853	Americium-241		04F1379-008	0.0204	Americium-241
SS00012WCU2	0.3811	Americium-241		TR00123WCU2	0.0202	Americium-241
04F1269-007	0.381	Americium-241		SS60004WC	0.02012	Americium-241
SS00752STU2	0.379	Americium-241		SS00082EG	0.02	Americium-241
00R1027-011	0.378	Americium-241		04F0579-003	0.02	Americium-241
SS01116ST	0.3733	Americium-241		04F0779-001	0.02	Americium-241
00R1027-012	0.362	Americium-241		SS20046WC	0.02	Americium-241
01S0056-005	0.361	Americium-241		01S0055-005	0.02	Americium-241
SS00022WCU2	0.3588	Americium-241		SS50084AS	0.0199	Americium-241
04F0784-004	0.35	Americium-241		SS60009WC	0.0196	Americium-241
00R1027-002	0.35	Americium-241		98D1150-040	0.0194	Americium-241
01S0057-006	0.332	Americium-241		04F0814-006	0.0192	Americium-241
04F0814-003	0.329	Americium-241		SS60015WC	0.01914	Americium-241
SS01119ST	0.3166	Americium-241		SS00048EG	0.019	Americium-241
SS00755STU2	0.309	Americium-241		SS00077EG	0.019	Americium-241
SS00741STU2	0.3089	Americium-241		SS00084EG	0.019	Americium-241
SS01160ST	0.3051	Americium-241		SS20044WC	0.019	Americium-241
SS01139ST	0.3004	Americium-241		SS60024WC	0.01888	Americium-241
98D1150-005	0.2946	Americium-241		04F1866-001	0.0184	Americium-241
SS00062WCU2	0.283	Americium-241		SS00033EG	0.018	Americium-241
SS00767STU2	0.276	Americium-241		01S0055-009	0.018	Americium-241
SS00070WCU2	0.271	Americium-241		SS00756STU2	0.018	Americium-241
SS00036WCU2	0.264	Americium-241		SS50080AS	0.018	Americium-241
SS00011WCU2	0.2625	Americium-241		04F0579-005	0.0177	Americium-241
00R1027-009	0.248	Americium-241		04F1269-011	0.0177	Americium-241
SS01163ST	0.2454	Americium-241		04F1248-003	0.0169	Americium-241
SS00026WCU2	0.2409	Americium-241		98D1150-041	0.0168	Americium-241
SS01137ST	0.2401	Americium-241		SS60019WC	0.0168	Americium-241
00R1027-003	0.23	Americium-241		04F1269-005	0.0163	Americium-241
SS00009JE	0.226	Americium-241		98D1150-031	0.0161	Americium-241
01S0058-004	0.226	Americium-241		SS00053EG	0.016	Americium-241
SS01112ST	0.2255	Americium-241		SS70078ST	0.016	Americium-241
98D1150-006	0.2239	Americium-241		SS00033WCU2	0.01591	Americium-241
SS00057WCU2	0.22	Americium-241		TR00041WCU2	0.0159	Americium-241
01S0057-003	0.219	Americium-241		SS60025WC	0.0157	Americium-241
SS00017WCU2	0.2153	Americium-241		04F1269-009	0.0155	Americium-241
SS00013WCU2	0.2151	Americium-241		04F0764-001	0.0153	Americium-241
05F0604-009	0.204	Americium-241		SS00020WCU2	0.01524	Americium-241
00R1027-004	0.204	Americium-241		SS20043WC	0.015	Americium-241
SS00008WCU2	0.1936	Americium-241		SS50087AS	0.015	Americium-241
SS00042WCU2	0.1856	Americium-241		SS60007WC	0.0147	Americium-241
SS00760STU2	0.185	Americium-241		SS03018WS	0.01466	Americium-241
SS00001AS	0.1818	Americium-241		04F1269-001	0.0144	Americium-241
98D1150-013	0.1796	Americium-241		SS60011WC	0.0144	Americium-241
98D1150-061	0.1747	Americium-241		SS00054EG	0.014	Americium-241

Americium-241 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
98D1150-060	0.1683	Americium-241		SS00074EG	0.014	Americium-241
04F0784-002	0.168	Americium-241		SS20048WC	0.014	Americium-241
04F8067-004	0.165	Americium-241		04F0826-001	0.0136	Americium-241
SS01146ST	0.1647	Americium-241		SS50078AS	0.0136	Americium-241
SS00032WCU2	0.1594	Americium-241		04F8067-003	0.0132	Americium-241
SS01145ST	0.1545	Americium-241		04F1866-005	0.0129	Americium-241
SS50086AS	0.153	Americium-241		98D1150-038	0.0127	Americium-241
SS00059WCU2	0.15	Americium-241		SS50091AS	0.0125	Americium-241
TR00162WCU2	0.146	Americium-241		SS60012WC	0.0122	Americium-241
98D1150-007	0.1456	Americium-241		SS20041WC	0.012	Americium-241
SS00058WCU2	0.143	Americium-241		TR00044WCU2	0.0119	Americium-241
98D1150-012	0.141	Americium-241		SS50092AS	0.0119	Americium-241
SS00766STU2	0.14	Americium-241		SS50090AS	0.0117	Americium-241
04F1248-004	0.132	Americium-241		04F0826-002	0.0115	Americium-241
SS00010WCU2	0.1312	Americium-241		SS60026WC	0.0112	Americium-241
02D0644-002	0.122	Americium-241		SS00050EG	0.011	Americium-241
SS00065WCU2	0.122	Americium-241		SS50093AS	0.011	Americium-241
SS01111ST	0.1201	Americium-241		SS60005WC	0.01098	Americium-241
SS01144ST	0.1183	Americium-241		SS50074AS	0.0108	Americium-241
SS00758STU2	0.11	Americium-241		04F0740-001	0.0107	Americium-241
SS00753STU2	0.108	Americium-241		SS70077ST	0.01028	Americium-241
SS50085AS	0.104	Americium-241		TR00056WCU2	0.0096	Americium-241
SS01167ST	0.1035	Americium-241		SS03000WS	0.009461	Americium-241
TR00060WCU2	0.1001	Americium-241		04F0826-007	0.00941	Americium-241
01S0055-002	0.1	Americium-241		SS00031EG	0.009	Americium-241
04F1866-004	0.0998	Americium-241		SS00044EG	0.009	Americium-241
04F8067-001	0.0993	Americium-241		TR00159WCU2	0.009	Americium-241
SS00056WCU2	0.097	Americium-241		98D1150-028	0.0088	Americium-241
SS00078EG	0.096	Americium-241		TR00042WCU2	0.0086	Americium-241
TR00059WCU2	0.0957	Americium-241		SS50083AS	0.00849	Americium-241
04F0784-001	0.0951	Americium-241		98D1150-063	0.0083	Americium-241
04F8063-002	0.0935	Americium-241		04F0814-001	0.00803	Americium-241
SS00007WCU2	0.0926	Americium-241		04F0707-007	0.00797	Americium-241
SS00050WCU2	0.087	Americium-241		SS50081AS	0.00739	Americium-241
SS00071WCU2	0.087	Americium-241		98D1150-048	0.0072	Americium-241
SS00754STU2	0.08618	Americium-241		SS50097AS	0.007	Americium-241
SS00757STU2	0.085	Americium-241		04F0619-002	0.00671	Americium-241
TR00130WCU2	0.0827	Americium-241		TR00039WCU2	0.0067	Americium-241
98D1150-050	0.0815	Americium-241		04F0707-004	0.00646	Americium-241
SS50082AS	0.0807	Americium-241		SS03004WS	0.006385	Americium-241
04F0707-003	0.0804	Americium-241		04F0579-004	0.00617	Americium-241
04F0737-002	0.0741	Americium-241		TR00043WCU2	0.006	Americium-241
SS04020CH	0.074	Americium-241		TR00050WCU2	0.0059	Americium-241
SS00775STU2	0.074	Americium-241		TR00052WCU2	0.0053	Americium-241
SS01147ST	0.07332	Americium-241		SS00018WCU2	0.005282	Americium-241

Americium-241 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
04F0707-001	0.0729	Americium-241		04F1379-001	0.00511	Americium-241
SS00021WCU2	0.0714	Americium-241		SS60008WC	0.00457	Americium-241
SS00007AS	0.07111	Americium-241		04F0779-002	0.00452	Americium-241
SS00072WCU2	0.071	Americium-241		SS60010WC	0.0041	Americium-241
SS00075EG	0.07	Americium-241		TR00035WCU2	0.0041	Americium-241
98D1150-011	0.0694	Americium-241		TR00053WCU2	0.004	Americium-241
04F0826-004	0.0685	Americium-241		TR00023WCU2	0.0039	Americium-241
04F1379-004	0.0677	Americium-241		98D1150-043	0.0038	Americium-241
SS00251EG	0.067	Americium-241		04F0732-012	0.00349	Americium-241
SS00768STU2	0.067	Americium-241		TR00037WCU2	0.0034	Americium-241
TR00025WCU2	0.0667	Americium-241		TR00072WCU2	0.0034	Americium-241
SS02823EG	0.066	Americium-241		04F0707-009	0.00332	Americium-241
TR00124WCU2	0.0653	Americium-241		TR00016WCU2	0.0032	Americium-241
04F0814-004	0.0652	Americium-241		TR00051WCU2	0.0031	Americium-241
SS00047EG	0.065	Americium-241		04F1379-002	0.00298	Americium-241
01S0055-008	0.065	Americium-241		TR00054WCU2	0.0029	Americium-241
04F1269-006	0.064	Americium-241		TR00021WCU2	0.0029	Americium-241
04F1248-002	0.0623	Americium-241		TR00036WCU2	0.0028	Americium-241
98D1150-021	0.0614	Americium-241		04F0579-006	0.00247	Americium-241
TR00010WCU2	0.0611	Americium-241		TR00018WCU2	0.0024	Americium-241
01S0055-001	0.061	Americium-241		TR00038WCU2	0.0023	Americium-241
01S0055-011	0.061	Americium-241		TR00026WCU2	0.0023	Americium-241
98D1150-029	0.0579	Americium-241		TR00009WCU2	0.0022	Americium-241
01S0055-004	0.057	Americium-241		TR00006WCU2	0.0021	Americium-241
04F1269-004	0.0552	Americium-241		04F0732-002	0.00206	Americium-241
SS01118ST	0.0542	Americium-241		TR00002WCU2	0.0019	Americium-241
98D1150-025	0.0538	Americium-241		TR00003WCU2	0.0017	Americium-241
04F0579-002	0.0533	Americium-241		TR00022WCU2	0.0016	Americium-241
SS00008JE	0.0514	Americium-241		TR00019WCU2	0.0015	Americium-241
04F0688-001	0.0514	Americium-241		TR00007WCU2	0.0012	Americium-241
04F0737-003	0.0511	Americium-241		TR00001WCU2	0.0011	Americium-241
SS00037EG	0.051	Americium-241		TR00020WCU2	0.001	Americium-241
SS00052EG	0.05	Americium-241		TR00034WCU2	0.0009	Americium-241
TR00128WCU2	0.05	Americium-241		TR00055WCU2	0.0007	Americium-241
SS01312ST	0.05	Americium-241		TR00004WCU2	0.0005	Americium-241
98D1150-009	0.0499	Americium-241		TR00008WCU2	0.0005	Americium-241
SS70075ST	0.04942	Americium-241		TR00017WCU2	0.0004	Americium-241
TR00057WCU2	0.0492	Americium-241		04F0633-001	0	Americium-241
SS04021CH	0.049	Americium-241		TR00005WCU2	0	Americium-241
SS00056EG	0.048	Americium-241		98D1150-039	-0.0004	Americium-241
SS00014WCU2	0.04737	Americium-241		04F0764-003	-0.00184	Americium-241
SS00083EG	0.047	Americium-241		04F0810-001	-0.005	Americium-241
SS00058EG	0.047	Americium-241		04F0614-001	-0.0051	Americium-241
04F1269-002	0.0467	Americium-241		98D1150-008	-0.0058	Americium-241
SS01164ST	0.04659	Americium-241		04F1269-008	-0.006	Americium-241

Americium-241 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00036EG	0.046	Americium-241		04F0814-005	-0.00738	Americium-241
SS00069EG	0.046	Americium-241		04F0732-010	-0.0102	Americium-241
SS02824EG	0.046	Americium-241		04F0764-002	-0.0105	Americium-241
TR00058WCU2	0.0455	Americium-241		98D1150-030	-0.0106	Americium-241
04F1379-003	0.0453	Americium-241		01S0055-003	-0.012	Americium-241
SS00045EG	0.045	Americium-241		04F1379-005	-0.0128	Americium-241
SS00060EG	0.045	Americium-241		01S0055-007	-0.013	Americium-241
SS00086EG	0.045	Americium-241		04F0779-004	-0.0131	Americium-241
SS01110ST	0.04496	Americium-241		04F0732-001	-0.0142	Americium-241
SS00008AS	0.04491	Americium-241		04F0784-005	-0.0153	Americium-241
SS00006JE	0.0449	Americium-241		04F0732-005	-0.0163	Americium-241
04F0740-002	0.0444	Americium-241		98D1150-045	-0.018	Americium-241
SS00067EG	0.044	Americium-241		04F0731-002	-0.0209	Americium-241
SS00759STU2	0.044	Americium-241		04F0579-007	-0.0214	Americium-241
04F0737-001	0.0437	Americium-241		04F1379-007	-0.0218	Americium-241
SS00015WCU2	0.04353	Americium-241		04F0707-008	-0.0288	Americium-241
98D1150-023	0.0432	Americium-241		04F0633-007	-0.0296	Americium-241
01S0055-010	0.043	Americium-241		04F0826-003	-0.0301	Americium-241
SS60017WC	0.04224	Americium-241		04F0740-005	-0.0425	Americium-241
SS00049EG	0.042	Americium-241		04F0731-003	-0.0497	Americium-241
SS00064EG	0.042	Americium-241		04F0732-009	-0.0584	Americium-241
04F8067-002	0.042	Americium-241		04F0579-008	-0.0769	Americium-241
SS00002AS	0.04188	Americium-241		04F0732-011	-0.082	Americium-241
04F1269-010	0.0414	Americium-241				
98D1150-049	0.0414	Americium-241				
04F0732-007	0.0413	Americium-241				
SS00073EG	0.041	Americium-241				
98D1150-044	0.0408	Americium-241				

pCi/g = picocuries per gram

Plutonium POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00733STU2	20.344	Plutonium-239/240		SS00080EG	0.15	Plutonium-239/240
TR00164WCU2	18.9	Plutonium-239/240		SS00071EG	0.15	Plutonium-239/240
SS00044WCU2	18.51	Plutonium-239/240		SS00077EG	0.15	Plutonium-239/240
SS00035WCU2	17.18	Plutonium-239/240		SS00087EG	0.15	Plutonium-239/240
SS00734STU2	13.812	Plutonium-239/240		SS00086EG	0.15	Plutonium-239/240
SS00012WCU2	12.84	Plutonium-239/240		04F1379-006	0.149	Plutonium-239/240
SS00041WCU2	12.43	Plutonium-239/240		SS70075ST	0.1485	Plutonium-239/240
SS00769STU2	12.178	Plutonium-239/240		04F0732-009	0.148	Plutonium-239/240
SS00744STU2	11.701	Plutonium-239/240		04F0826-003	0.146	Plutonium-239/240
SS00009WCU2	11.5	Plutonium-239/240		98D1150-009	0.1425	Plutonium-239/240
SS00732STU2	10.295	Plutonium-239/240		SS10046ST	0.1404	Plutonium-239/240
SS00002WCU2	8.933	Plutonium-239/240		SS00037EG	0.14	Plutonium-239/240
SS01094ST	8.8	Plutonium-239/240		SS00047EG	0.14	Plutonium-239/240
SS00736STU2	8.743	Plutonium-239/240		SS00056EG	0.14	Plutonium-239/240
SS01116ST	8.448	Plutonium-239/240		SS00066EG	0.14	Plutonium-239/240
SS00030WCU2	8.429	Plutonium-239/240		SS00068EG	0.14	Plutonium-239/240
01S0057-008	8.29	Plutonium-239/240		SS00060EG	0.14	Plutonium-239/240
SS00052WCU2	7.871	Plutonium-239/240		04F1379-001	0.14	Plutonium-239/240
SS00016WCU2	7.281	Plutonium-239/240		SS00006JE	0.1388	Plutonium-239/240
04F0826-006	7.25	Plutonium-239/240		SS10043ST	0.1364	Plutonium-239/240
SS01157ST	7.198	Plutonium-239/240		04F1269-004	0.136	Plutonium-239/240
SS00038WCU2	7.15	Plutonium-239/240		SS10057ST	0.1348	Plutonium-239/240
01S0057-002	7	Plutonium-239/240		98D1150-065	0.1323	Plutonium-239/240
SS00743STU2	6.899	Plutonium-239/240		SS00032EG	0.13	Plutonium-239/240
SS00006WCU2	6.667	Plutonium-239/240		SS00070EG	0.13	Plutonium-239/240
TR00163WCU2	6.66	Plutonium-239/240		SS00073EG	0.13	Plutonium-239/240
SS00034WCU2	6.609	Plutonium-239/240		SS01082ST	0.13	Plutonium-239/240
01S0057-007	6.2	Plutonium-239/240		SS00036EG	0.13	Plutonium-239/240
SS00765STU2	5.996	Plutonium-239/240		SS00043EG	0.13	Plutonium-239/240
SS00028WCU2	5.887	Plutonium-239/240		SS01312ST	0.13	Plutonium-239/240
98D1150-051	5.8706	Plutonium-239/240		SS01089ST	0.13	Plutonium-239/240
SS00745STU2	5.797	Plutonium-239/240		SS01493ST	0.13	Plutonium-239/240
SS00043WCU2	5.555	Plutonium-239/240		SS60014WC	0.1292	Plutonium-239/240
SS01115ST	5.062	Plutonium-239/240		04F1269-005	0.128	Plutonium-239/240
SS00061WCU2	5.015	Plutonium-239/240		SS10045ST	0.1221	Plutonium-239/240
SS50075AS	5.01	Plutonium-239/240		SS10047ST	0.1214	Plutonium-239/240
SS01103ST	4.6	Plutonium-239/240		SS00045EG	0.12	Plutonium-239/240
01S0056-009	4.59	Plutonium-239/240		SS00058EG	0.12	Plutonium-239/240
SS10058ST	4.551	Plutonium-239/240		SS01078ST	0.12	Plutonium-239/240
SS01138ST	4.472	Plutonium-239/240		SS00033EG	0.12	Plutonium-239/240
SS00005WCU2	4.437	Plutonium-239/240		SS02824EG	0.12	Plutonium-239/240
SS01165ST	4.392	Plutonium-239/240		SS01077ST	0.12	Plutonium-239/240
01S0056-013	4.24	Plutonium-239/240		SS01313ST	0.12	Plutonium-239/240
01S0056-003	4.21	Plutonium-239/240		SS01500ST	0.12	Plutonium-239/240
SS00039WCU2	4.196	Plutonium-239/240		SS00015WCU2	0.1194	Plutonium-239/240
TR00148WCU2	3.952	Plutonium-239/240		98D1150-028	0.1151	Plutonium-239/240
01S0056-012	3.91	Plutonium-239/240		SS10023ST	0.1145	Plutonium-239/240
01S0057-010	3.86	Plutonium-239/240		SS60017WC	0.1125	Plutonium-239/240
01S0056-011	3.62	Plutonium-239/240		SS60023WC	0.1118	Plutonium-239/240
01S0058-009	3.54	Plutonium-239/240		SS50077AS	0.111	Plutonium-239/240
01S0056-002	3.52	Plutonium-239/240		SS00034EG	0.11	Plutonium-239/240
SS01508ST	3.5	Plutonium-239/240		SS00038EG	0.11	Plutonium-239/240
SS00001WCU2	3.485	Plutonium-239/240		SS00040EG	0.11	Plutonium-239/240
SS01142ST	3.484	Plutonium-239/240		SS00039EG	0.11	Plutonium-239/240
SS00740STU2	3.351	Plutonium-239/240		SS00049EG	0.11	Plutonium-239/240
98D1150-059	3.3095	Plutonium-239/240		SS00063EG	0.11	Plutonium-239/240

Plutonium POU Input Data for ProUCL

SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00004AS	3.253	Plutonium-239/240		SS00084EG	0.11	Plutonium-239/240
SS00003AS	3.252	Plutonium-239/240		SS01509ST	0.11	Plutonium-239/240
SS00051WCU2	3.22	Plutonium-239/240		SS01490ST	0.11	Plutonium-239/240
SS01114ST	3.138	Plutonium-239/240		SS01315ST	0.11	Plutonium-239/240
SS00031WCU2	3.121	Plutonium-239/240		SS01487ST	0.11	Plutonium-239/240
01S0057-005	3.11	Plutonium-239/240		SS01080ST	0.11	Plutonium-239/240
01S0056-008	2.95	Plutonium-239/240		SS10050ST	0.1086	Plutonium-239/240
TR00095WCU2	2.94	Plutonium-239/240		98D1150-040	0.108	Plutonium-239/240
SS01134ST	2.939	Plutonium-239/240		SS10021ST	0.1064	Plutonium-239/240
SS01102ST	2.9	Plutonium-239/240		98D1150-048	0.106	Plutonium-239/240
SS00025WCU2	2.832	Plutonium-239/240		04F0619-001	0.106	Plutonium-239/240
SS00752STU2	2.709	Plutonium-239/240		TR00127WCU2	0.1056	Plutonium-239/240
SS00747STU2	2.613	Plutonium-239/240		SS00001JE	0.1055	Plutonium-239/240
01S0058-005	2.6	Plutonium-239/240		04F0740-006	0.102	Plutonium-239/240
SS01113ST	2.507	Plutonium-239/240		SS00035EG	0.1	Plutonium-239/240
SS01143ST	2.461	Plutonium-239/240		SS00083EG	0.1	Plutonium-239/240
SS00006AS	2.452	Plutonium-239/240		SS20043WC	0.1	Plutonium-239/240
00R1027-011	2.4	Plutonium-239/240		SS00046EG	0.099	Plutonium-239/240
01S0058-002	2.39	Plutonium-239/240		SS50084AS	0.0989	Plutonium-239/240
00R1027-007	2.37	Plutonium-239/240		SS01495ST	0.097	Plutonium-239/240
SS00037WCU2	2.366	Plutonium-239/240		SS00042EG	0.096	Plutonium-239/240
SS00003WCU2	2.358	Plutonium-239/240		SS01472ST	0.096	Plutonium-239/240
01S0056-004	2.35	Plutonium-239/240		SS00757STU2	0.096	Plutonium-239/240
SS01159ST	2.315	Plutonium-239/240		SS60009WC	0.0954	Plutonium-239/240
SS00023WCU2	2.299	Plutonium-239/240		SS60022WC	0.0936	Plutonium-239/240
SS00748STU2	2.262	Plutonium-239/240		SS60004WC	0.09119	Plutonium-239/240
01S0058-003	2.26	Plutonium-239/240		98D1150-046	0.0911	Plutonium-239/240
SS00004WCU2	2.241	Plutonium-239/240		SS00050EG	0.091	Plutonium-239/240
00R1027-002	2.23	Plutonium-239/240		01S0055-007	0.091	Plutonium-239/240
SS00011WCU2	2.229	Plutonium-239/240		SS60007WC	0.08829	Plutonium-239/240
SS00051EG	2.2	Plutonium-239/240		SS01088ST	0.088	Plutonium-239/240
00R1027-008	2.2	Plutonium-239/240		SS60016WC	0.08664	Plutonium-239/240
SS00024WCU2	2.198	Plutonium-239/240		SS00052EG	0.086	Plutonium-239/240
SS00040WCU2	2.122	Plutonium-239/240		TR00042WCU2	0.0856	Plutonium-239/240
SS01160ST	2.121	Plutonium-239/240		SS00082EG	0.084	Plutonium-239/240
SS00005AS	2.119	Plutonium-239/240		98D1150-010	0.084	Plutonium-239/240
00R1027-001	2.09	Plutonium-239/240		SS20047WC	0.084	Plutonium-239/240
SS01119ST	2.081	Plutonium-239/240		SS00019WCU2	0.08329	Plutonium-239/240
01S0057-006	2	Plutonium-239/240		SS00054EG	0.082	Plutonium-239/240
SS00009JE	1.967	Plutonium-239/240		SS00085EG	0.08	Plutonium-239/240
01S0058-006	1.9	Plutonium-239/240		SS00061EG	0.08	Plutonium-239/240
01S0056-005	1.89	Plutonium-239/240		SS20040WC	0.08	Plutonium-239/240
01S0056-006	1.86	Plutonium-239/240		SS01494ST	0.079	Plutonium-239/240
SS60021WC	1.849	Plutonium-239/240		SS01084ST	0.078	Plutonium-239/240
SS01137ST	1.821	Plutonium-239/240		SS01496ST	0.077	Plutonium-239/240
00R1027-009	1.78	Plutonium-239/240		SS00033WCU2	0.07512	Plutonium-239/240
SS00022WCU2	1.745	Plutonium-239/240		SS00020WCU2	0.07505	Plutonium-239/240
SS01139ST	1.708	Plutonium-239/240		SS02826EG	0.075	Plutonium-239/240
00R1027-010	1.66	Plutonium-239/240		TR00159WCU2	0.075	Plutonium-239/240
SS00057WCU2	1.657	Plutonium-239/240		SS20045WC	0.073	Plutonium-239/240
SS00026WCU2	1.581	Plutonium-239/240		SS01497ST	0.072	Plutonium-239/240
SS00741STU2	1.579	Plutonium-239/240		SS01318ST	0.072	Plutonium-239/240
01S0057-009	1.57	Plutonium-239/240		SS50091AS	0.0714	Plutonium-239/240
SS00746STU2	1.542	Plutonium-239/240		04F1379-005	0.0707	Plutonium-239/240
04F0784-004	1.54	Plutonium-239/240		98D1150-064	0.0681	Plutonium-239/240
00R1027-005	1.54	Plutonium-239/240		TR00023WCU2	0.0671	Plutonium-239/240

Plutonium POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
01S0056-007	1.53	Plutonium-239/240		TR00043WCU2	0.0668	Plutonium-239/240
SS00036WCU2	1.521	Plutonium-239/240		SS10039ST	0.06653	Plutonium-239/240
SS00755STU2	1.502	Plutonium-239/240		98D1150-039	0.0661	Plutonium-239/240
SS01112ST	1.455	Plutonium-239/240		SS00081EG	0.066	Plutonium-239/240
00R1027-012	1.43	Plutonium-239/240		SS60005WC	0.066	Plutonium-239/240
SS00760STU2	1.427	Plutonium-239/240		TR00044WCU2	0.0655	Plutonium-239/240
04F0784-002	1.42	Plutonium-239/240		SS00008AS	0.06439	Plutonium-239/240
01S0058-008	1.42	Plutonium-239/240		SS01076ST	0.064	Plutonium-239/240
SS01163ST	1.416	Plutonium-239/240		SS50080AS	0.0637	Plutonium-239/240
SS10065ST	1.403	Plutonium-239/240		98D1150-030	0.0634	Plutonium-239/240
SS01146ST	1.399	Plutonium-239/240		SS60018WC	0.06319	Plutonium-239/240
98D1150-004	1.3937	Plutonium-239/240		SS01499ST	0.063	Plutonium-239/240
SS00062WCU2	1.391	Plutonium-239/240		SS00057EG	0.062	Plutonium-239/240
TR00147WCU2	1.379	Plutonium-239/240		SS01086ST	0.062	Plutonium-239/240
SS00017WCU2	1.369	Plutonium-239/240		98D1150-026	0.061	Plutonium-239/240
SS00070WCU2	1.259	Plutonium-239/240		SS03014WS	0.06093	Plutonium-239/240
SS00008WCU2	1.245	Plutonium-239/240		SS60015WC	0.06033	Plutonium-239/240
SS00065WCU2	1.237	Plutonium-239/240		98D1150-023	0.0603	Plutonium-239/240
01S0057-003	1.22	Plutonium-239/240		SS10038ST	0.06003	Plutonium-239/240
TR00010WCU2	1.2078	Plutonium-239/240		SS01489ST	0.06	Plutonium-239/240
TR00025WCU2	1.2034	Plutonium-239/240		SS60013WC	0.0592	Plutonium-239/240
TR00162WCU2	1.18	Plutonium-239/240		SS00053EG	0.059	Plutonium-239/240
SS00042WCU2	1.165	Plutonium-239/240		SS01083ST	0.059	Plutonium-239/240
01S0058-004	1.16	Plutonium-239/240		SS00044EG	0.058	Plutonium-239/240
SS00032WCU2	1.101	Plutonium-239/240		SS01314ST	0.058	Plutonium-239/240
SS01516ST	1.1	Plutonium-239/240		98D1150-027	0.0572	Plutonium-239/240
04F8067-004	1.07	Plutonium-239/240		SS60024WC	0.05718	Plutonium-239/240
SS00013WCU2	1.054	Plutonium-239/240		SS03011WS	0.05678	Plutonium-239/240
00R1027-003	1.03	Plutonium-239/240		TR00056WCU2	0.0552	Plutonium-239/240
98D1150-005	1.0248	Plutonium-239/240		98D1150-045	0.0551	Plutonium-239/240
98D1150-060	1.0245	Plutonium-239/240		TR00009WCU2	0.055	Plutonium-239/240
SS00767STU2	0.989	Plutonium-239/240		98D1150-047	0.0548	Plutonium-239/240
98D1150-006	0.9844	Plutonium-239/240		SS03019WS	0.05409	Plutonium-239/240
00R1027-004	0.942	Plutonium-239/240		SS01081ST	0.053	Plutonium-239/240
SS01111ST	0.9148	Plutonium-239/240		SS60025WC	0.0511	Plutonium-239/240
SS01145ST	0.8933	Plutonium-239/240		SS03015WS	0.05029	Plutonium-239/240
SS50086AS	0.889	Plutonium-239/240		SS60006WC	0.05024	Plutonium-239/240
SS00010WCU2	0.8546	Plutonium-239/240		SS10054ST	0.05012	Plutonium-239/240
00R1027-006	0.852	Plutonium-239/240		SS00031EG	0.05	Plutonium-239/240
05F0604-009	0.85	Plutonium-239/240		SS20044WC	0.05	Plutonium-239/240
SS00059WCU2	0.791	Plutonium-239/240		SS00018WCU2	0.04843	Plutonium-239/240
04F0737-002	0.781	Plutonium-239/240		98D1150-008	0.0484	Plutonium-239/240
SS00742STU2	0.776	Plutonium-239/240		SS10049ST	0.04833	Plutonium-239/240
SS00001AS	0.7709	Plutonium-239/240		TR00021WCU2	0.0477	Plutonium-239/240
98D1150-012	0.753	Plutonium-239/240		98D1150-044	0.0475	Plutonium-239/240
SS00058WCU2	0.748	Plutonium-239/240		SS03013WS	0.04747	Plutonium-239/240
98D1150-007	0.7338	Plutonium-239/240		SS60191WC	0.0473	Plutonium-239/240
TR00060WCU2	0.6975	Plutonium-239/240		SS70077ST	0.04673	Plutonium-239/240
SS01167ST	0.6869	Plutonium-239/240		TR00143WCU2	0.04552	Plutonium-239/240
SS01156ST	0.6567	Plutonium-239/240		SS01491ST	0.045	Plutonium-239/240
TR00146WCU2	0.6532	Plutonium-239/240		SS03006WS	0.04486	Plutonium-239/240
TR00059WCU2	0.6315	Plutonium-239/240		SS03000WS	0.04405	Plutonium-239/240
SS00754STU2	0.61	Plutonium-239/240		SS00756STU2	0.044	Plutonium-239/240
98D1150-013	0.6065	Plutonium-239/240		SS60020WC	0.0434	Plutonium-239/240
SS00050WCU2	0.587	Plutonium-239/240		SS03018WS	0.04335	Plutonium-239/240
SS00768STU2	0.578	Plutonium-239/240		SS10052ST	0.04315	Plutonium-239/240

Plutonium POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00007WCU2	0.5577	Plutonium-239/240		SS50092AS	0.0431	Plutonium-239/240
SS50090AS	0.551	Plutonium-239/240		98D1150-043	0.043	Plutonium-239/240
04F1248-004	0.513	Plutonium-239/240		SS03004WS	0.043	Plutonium-239/240
98D1150-050	0.512	Plutonium-239/240		SS20046WC	0.042	Plutonium-239/240
98D1150-049	0.4603	Plutonium-239/240		TR00022WCU2	0.04	Plutonium-239/240
SS00766STU2	0.452	Plutonium-239/240		SS00048EG	0.039	Plutonium-239/240
SS00021WCU2	0.4467	Plutonium-239/240		SS01504ST	0.039	Plutonium-239/240
SS50085AS	0.428	Plutonium-239/240		TR00039WCU2	0.038	Plutonium-239/240
SS01147ST	0.4237	Plutonium-239/240		SS60026WC	0.0378	Plutonium-239/240
SS01507ST	0.42	Plutonium-239/240		SS50074AS	0.0378	Plutonium-239/240
SS00056WCU2	0.412	Plutonium-239/240		SS60019WC	0.03766	Plutonium-239/240
SS50082AS	0.409	Plutonium-239/240		SS50081AS	0.0371	Plutonium-239/240
TR00130WCU2	0.4018	Plutonium-239/240		SS10041ST	0.03552	Plutonium-239/240
SS10059ST	0.4015	Plutonium-239/240		SS60011WC	0.0354	Plutonium-239/240
SS01095ST	0.4	Plutonium-239/240		SS03001WS	0.03249	Plutonium-239/240
SS00071WCU2	0.397	Plutonium-239/240		SS01501ST	0.032	Plutonium-239/240
SS01164ST	0.352	Plutonium-239/240		SS01087ST	0.032	Plutonium-239/240
SS00067EG	0.35	Plutonium-239/240		SS50097AS	0.032	Plutonium-239/240
98D1150-061	0.3476	Plutonium-239/240		SS50078AS	0.0318	Plutonium-239/240
SS00008JE	0.3421	Plutonium-239/240		SS03010WS	0.03176	Plutonium-239/240
04F0826-007	0.334	Plutonium-239/240		SS01085ST	0.031	Plutonium-239/240
TR00058WCU2	0.327	Plutonium-239/240		SS50101AS	0.031	Plutonium-239/240
04F8067-001	0.298	Plutonium-239/240		98D1150-029	0.0294	Plutonium-239/240
SS00072WCU2	0.29	Plutonium-239/240		SS01498ST	0.029	Plutonium-239/240
TR00145WCU2	0.2861	Plutonium-239/240		98D1150-063	0.0281	Plutonium-239/240
TR00024WCU2	0.2852	Plutonium-239/240		98D1150-038	0.0266	Plutonium-239/240
02D0644-001	0.285	Plutonium-239/240		SS20041WC	0.026	Plutonium-239/240
SS00753STU2	0.282	Plutonium-239/240		SS20048WC	0.026	Plutonium-239/240
SS01110ST	0.274	Plutonium-239/240		SS50093AS	0.0218	Plutonium-239/240
SS01096ST	0.27	Plutonium-239/240		TR00002WCU2	0.021	Plutonium-239/240
SS01118ST	0.2664	Plutonium-239/240		SS10056ST	0.01895	Plutonium-239/240
TR00057WCU2	0.2617	Plutonium-239/240		TR00020WCU2	0.0176	Plutonium-239/240
SS50076AS	0.257	Plutonium-239/240		TR00035WCU2	0.0172	Plutonium-239/240
SS01109ST	0.2504	Plutonium-239/240		SS01097ST	0.017	Plutonium-239/240
SS01502ST	0.25	Plutonium-239/240		SS00079EG	0.016	Plutonium-239/240
04F0707-001	0.25	Plutonium-239/240		SS00078EG	0.016	Plutonium-239/240
98D1150-011	0.2471	Plutonium-239/240		TR00052WCU2	0.0159	Plutonium-239/240
TR00074WCU2	0.246	Plutonium-239/240		SS60010WC	0.0154	Plutonium-239/240
SS00775STU2	0.243	Plutonium-239/240		98D1150-042	0.0148	Plutonium-239/240
04F8067-002	0.241	Plutonium-239/240		TR00006WCU2	0.0133	Plutonium-239/240
02D0644-002	0.239	Plutonium-239/240		TR00051WCU2	0.0127	Plutonium-239/240
SS00758STU2	0.231	Plutonium-239/240		TR00038WCU2	0.0116	Plutonium-239/240
SS01093ST	0.23	Plutonium-239/240		TR00123WCU2	0.0114	Plutonium-239/240
SS01506ST	0.23	Plutonium-239/240		SS01473ST	0.011	Plutonium-239/240
04F0784-005	0.226	Plutonium-239/240		TR00126WCU2	0.0107	Plutonium-239/240
SS04021CH	0.22	Plutonium-239/240		TR00034WCU2	0.0106	Plutonium-239/240
04F0633-007	0.213	Plutonium-239/240		TR00001WCU2	0.0103	Plutonium-239/240
SS10042ST	0.2119	Plutonium-239/240		SS60008WC	0.00934	Plutonium-239/240
SS00064EG	0.21	Plutonium-239/240		TR00125WCU2	0.0085	Plutonium-239/240
SS00002AS	0.2058	Plutonium-239/240		98D1150-024	0.0084	Plutonium-239/240
TR00041WCU2	0.2054	Plutonium-239/240		TR00004WCU2	0.0081	Plutonium-239/240
04F1379-004	0.2	Plutonium-239/240		SS50087AS	0.0079	Plutonium-239/240
SS10051ST	0.1994	Plutonium-239/240		TR00072WCU2	0.0078	Plutonium-239/240
SS00007AS	0.1987	Plutonium-239/240		TR00050WCU2	0.0077	Plutonium-239/240
SS00759STU2	0.198	Plutonium-239/240		TR00008WCU2	0.0073	Plutonium-239/240
SS10066ST	0.1945	Plutonium-239/240		TR00007WCU2	0.0071	Plutonium-239/240

Plutonium POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS50079AS	0.192	Plutonium-239/240		TR00005WCU2	0.0062	Plutonium-239/240
SS00069EG	0.19	Plutonium-239/240		TR00122WCU2	0.0061	Plutonium-239/240
SS04020CH	0.19	Plutonium-239/240		TR00141WCU2	0.005639	Plutonium-239/240
04F1269-010	0.188	Plutonium-239/240		98D1150-041	0.0056	Plutonium-239/240
04F0707-003	0.185	Plutonium-239/240		TR00026WCU2	0.0056	Plutonium-239/240
SS00027WCU2	0.1822	Plutonium-239/240		TR00036WCU2	0.0054	Plutonium-239/240
SS00014WCU2	0.1821	Plutonium-239/240		TR00037WCU2	0.0052	Plutonium-239/240
SS00062EG	0.18	Plutonium-239/240		TR00018WCU2	0.0052	Plutonium-239/240
SS01075ST	0.18	Plutonium-239/240		TR00016WCU2	0.0049	Plutonium-239/240
SS01503ST	0.18	Plutonium-239/240		TR00053WCU2	0.0048	Plutonium-239/240
TR00129WCU2	0.1777	Plutonium-239/240		TR00124WCU2	0.0047	Plutonium-239/240
SS10060ST	0.1775	Plutonium-239/240		98D1150-031	0.0047	Plutonium-239/240
SS00251EG	0.17	Plutonium-239/240		TR00019WCU2	0.0046	Plutonium-239/240
SS50089AS	0.17	Plutonium-239/240		TR00003WCU2	0.0033	Plutonium-239/240
98D1150-021	0.1638	Plutonium-239/240		TR00017WCU2	0.0028	Plutonium-239/240
04F0579-005	0.163	Plutonium-239/240		TR00142WCU2	0.001754	Plutonium-239/240
TR00128WCU2	0.1616	Plutonium-239/240		TR00055WCU2	0.0013	Plutonium-239/240
SS00059EG	0.16	Plutonium-239/240		TR00054WCU2	0.0003	Plutonium-239/240
SS00075EG	0.16	Plutonium-239/240		TR00140WCU2	0	Plutonium-239/240
SS02823EG	0.16	Plutonium-239/240		TR00139WCU2	-0.000876	Plutonium-239/240
SS10040ST	0.1595	Plutonium-239/240		98D1150-025	-0.0015	Plutonium-239/240
TR00144WCU2	0.1595	Plutonium-239/240		SS50083AS	-0.00192	Plutonium-239/240
04F0814-001	0.159	Plutonium-239/240		98D1150-022	-0.0108	Plutonium-239/240
04F0810-006	0.158	Plutonium-239/240				

pCi/g = picocuries per gram

UCL Statistics for Uncensored Full Datasets Plutonium Concentrations in the POU			
User Selected Options			
Date/Time of Computation	ProUCL 5.111/5/2021 4:08:37 PM		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Pu-239/240 POU			
General Statistics			
Total Number of Observations	495	Number of Distinct Observations	419
		Number of Missing Observations	0
Minimum	-0.0108	Mean	1.285
Maximum	20.34	Median	0.158
SD	2.68	Std. Error of Mean	0.12
Coefficient of Variation	2.085	Skewness	3.763
Normal GOF Test			
Shapiro Wilk Test Statistic	0.526	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.314	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0402	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.484	95% Adjusted-CLT UCL (Chen-1995)	1.505
		95% Modified-t UCL (Johnson-1978)	1.487
Gamma Statistics Not Available			
Lognormal Statistics Not Available			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.484	95% Jackknife UCL	1.484
95% Standard Bootstrap UCL	1.486	95% Bootstrap-t UCL	1.509
95% Hall's Bootstrap UCL	1.505	95% Percentile Bootstrap UCL	1.497
95% BCA Bootstrap UCL	1.509		
90% Chebyshev(Mean, Sd) UCL	1.647	95% Chebyshev(Mean, Sd) UCL	1.811
97.5% Chebyshev(Mean, Sd) UCL	2.038	99% Chebyshev(Mean, Sd) UCL	2.484
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	1.811		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all real world datasets; for additional insight the user may want to consult a statistician.

Uranium-234 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00075EG	4.3	Uranium-233/234		SS00016WCU2	1	Uranium-233/234
SS00032EG	3.3	Uranium-233/234		SS20047WC	1	Uranium-233/234
SS00058EG	3.2	Uranium-233/234		SS20040WC	1	Uranium-233/234
SS00043EG	2.8	Uranium-233/234		SS04021CH	1	Uranium-233/234
SS00060EG	2.8	Uranium-233/234		04F0779-007	1	Uranium-233/234
SS00057EG	2.7	Uranium-233/234		SS00023WCU2	0.9937	Uranium-233/234
SS00056EG	2.6	Uranium-233/234		04F0814-004	0.993	Uranium-233/234
SS00059EG	2.6	Uranium-233/234		04F0731-003	0.993	Uranium-233/234
SS00251EG	2.5	Uranium-233/234		00R1027-002	0.992	Uranium-233/234
SS00084EG	2.4	Uranium-233/234		SS00052WCU2	0.99	Uranium-233/234
SS50097AS	2.4	Uranium-233/234		SS00006JE	0.9819	Uranium-233/234
SS00063EG	2.2	Uranium-233/234		04F0732-007	0.981	Uranium-233/234
04F0814-003	2.17	Uranium-233/234		SS20043WC	0.98	Uranium-233/234
SS00037EG	2.1	Uranium-233/234		04F0731-001	0.98	Uranium-233/234
SS00035EG	2.1	Uranium-233/234		SS03011WS	0.9772	Uranium-233/234
SS00052EG	2.1	Uranium-233/234		04F0737-001	0.975	Uranium-233/234
SS00050EG	2.1	Uranium-233/234		04F1269-009	0.973	Uranium-233/234
04F1866-005	2.08	Uranium-233/234		SS00007WCU2	0.9724	Uranium-233/234
SS00078EG	2	Uranium-233/234		SS00024WCU2	0.9717	Uranium-233/234
SS00036EG	2	Uranium-233/234		04F8063-002	0.971	Uranium-233/234
SS00073EG	2	Uranium-233/234		SS50078AS	0.965	Uranium-233/234
SS00054EG	2	Uranium-233/234		00R1027-010	0.964	Uranium-233/234
SS00062EG	2	Uranium-233/234		04F1269-010	0.961	Uranium-233/234
SS00038EG	2	Uranium-233/234		SS04020CH	0.96	Uranium-233/234
SS00053EG	2	Uranium-233/234		TR00146WCU2	0.9553	Uranium-233/234
SS00048EG	2	Uranium-233/234		04F1866-004	0.955	Uranium-233/234
SS00083EG	2	Uranium-233/234		04F0707-008	0.954	Uranium-233/234
SS00087EG	2	Uranium-233/234		04F0619-002	0.952	Uranium-233/234
SS00051WCU2	2	Uranium-233/234		04F0707-002	0.941	Uranium-233/234
SS00051EG	1.9	Uranium-233/234		04F0826-004	0.94	Uranium-233/234
SS00044EG	1.9	Uranium-233/234		04F8063-001	0.936	Uranium-233/234
SS00085EG	1.9	Uranium-233/234		SS00013WCU2	0.9344	Uranium-233/234
04F0614-002	1.83	Uranium-233/234		05F0604-009	0.928	Uranium-233/234
SS00033EG	1.8	Uranium-233/234		04F0732-010	0.926	Uranium-233/234
SS00064EG	1.8	Uranium-233/234		SS50080AS	0.926	Uranium-233/234
SS00081EG	1.8	Uranium-233/234		SS00015WCU2	0.925	Uranium-233/234
SS00082EG	1.8	Uranium-233/234		SS00038WCU2	0.9243	Uranium-233/234
SS00074EG	1.8	Uranium-233/234		SS03010WS	0.9219	Uranium-233/234
SS60017WC	1.786	Uranium-233/234		SS02826EG	0.92	Uranium-233/234
SS00080EG	1.7	Uranium-233/234		TR00145WCU2	0.9139	Uranium-233/234
SS00046EG	1.7	Uranium-233/234		04F1269-004	0.912	Uranium-233/234
SS00049EG	1.7	Uranium-233/234		SS20045WC	0.91	Uranium-233/234
SS00077EG	1.7	Uranium-233/234		04F0732-013	0.903	Uranium-233/234

Uranium-234 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00031EG	1.7	Uranium-233/234		04F1379-001	0.902	Uranium-233/234
SS00061EG	1.7	Uranium-233/234		04F0740-002	0.9	Uranium-233/234
SS00071EG	1.7	Uranium-233/234		SS60013WC	0.892	Uranium-233/234
SS00086EG	1.7	Uranium-233/234		SS50079AS	0.892	Uranium-233/234
00R1027-004	1.64	Uranium-233/234		SS00033WCU2	0.8912	Uranium-233/234
04F1866-003	1.62	Uranium-233/234		SS01314ST	0.89	Uranium-233/234
00R1027-001	1.62	Uranium-233/234		04F1379-002	0.882	Uranium-233/234
SS00034EG	1.6	Uranium-233/234		04F0784-001	0.881	Uranium-233/234
SS00045EG	1.6	Uranium-233/234		SS00012WCU2	0.8758	Uranium-233/234
SS00067EG	1.6	Uranium-233/234		SS00008WCU2	0.8736	Uranium-233/234
SS00061WCU2	1.6	Uranium-233/234		SS60026WC	0.868	Uranium-233/234
SS60023WC	1.546	Uranium-233/234		04F0707-003	0.867	Uranium-233/234
SS60018WC	1.527	Uranium-233/234		04F0814-002	0.865	Uranium-233/234
SS00039EG	1.5	Uranium-233/234		SS01318ST	0.86	Uranium-233/234
SS00070EG	1.5	Uranium-233/234		00R1027-012	0.86	Uranium-233/234
SS00066EG	1.5	Uranium-233/234		SS00006WCU2	0.8586	Uranium-233/234
SS00068EG	1.5	Uranium-233/234		SS70077ST	0.8514	Uranium-233/234
SS00042EG	1.5	Uranium-233/234		00R1027-003	0.847	Uranium-233/234
SS00050WCU2	1.5	Uranium-233/234		04F0633-007	0.836	Uranium-233/234
SS50101AS	1.5	Uranium-233/234		SS50089AS	0.836	Uranium-233/234
SS03019WS	1.472	Uranium-233/234		02D0644-002	0.833	Uranium-233/234
SS60007WC	1.47	Uranium-233/234		04F0814-001	0.828	Uranium-233/234
SS00005JE	1.469	Uranium-233/234		04F1379-006	0.823	Uranium-233/234
04F8067-004	1.45	Uranium-233/234		SS00020WCU2	0.8166	Uranium-233/234
SS60020WC	1.431	Uranium-233/234		04F1379-008	0.813	Uranium-233/234
00R1027-011	1.42	Uranium-233/234		04F1248-003	0.806	Uranium-233/234
SS00026WCU2	1.417	Uranium-233/234		04F1269-006	0.804	Uranium-233/234
SS00047EG	1.4	Uranium-233/234		04F0826-003	0.801	Uranium-233/234
SS01312ST	1.4	Uranium-233/234		SS02823EG	0.8	Uranium-233/234
SS01315ST	1.4	Uranium-233/234		04F0619-001	0.798	Uranium-233/234
SS00058WCU2	1.4	Uranium-233/234		04F0579-006	0.795	Uranium-233/234
SS00044WCU2	1.4	Uranium-233/234		04F0737-002	0.795	Uranium-233/234
SS00004WCU2	1.399	Uranium-233/234		TR00147WCU2	0.7927	Uranium-233/234
SS60015WC	1.369	Uranium-233/234		04F0707-010	0.781	Uranium-233/234
SS60014WC	1.365	Uranium-233/234		SS50076AS	0.774	Uranium-233/234
04F0814-005	1.35	Uranium-233/234		SS60009WC	0.773	Uranium-233/234
SS00037WCU2	1.337	Uranium-233/234		04F0707-009	0.772	Uranium-233/234
SS00025WCU2	1.33	Uranium-233/234		04F0633-001	0.771	Uranium-233/234
SS03001WS	1.326	Uranium-233/234		04F0826-007	0.765	Uranium-233/234
04F8067-003	1.32	Uranium-233/234		04F0764-003	0.76	Uranium-233/234
SS00031WCU2	1.301	Uranium-233/234		04F8067-001	0.748	Uranium-233/234
SS00079EG	1.3	Uranium-233/234		SS50077AS	0.745	Uranium-233/234
SS00040EG	1.3	Uranium-233/234		04F1248-004	0.743	Uranium-233/234

Uranium-234 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00069EG	1.3	Uranium-233/234		04F0779-004	0.742	Uranium-233/234
SS00070WCU2	1.3	Uranium-233/234		SS60011WC	0.741	Uranium-233/234
SS00065WCU2	1.3	Uranium-233/234		04F0707-007	0.741	Uranium-233/234
SS00062WCU2	1.3	Uranium-233/234		SS60191WC	0.74	Uranium-233/234
SS00057WCU2	1.3	Uranium-233/234		04F1269-007	0.737	Uranium-233/234
SS00056WCU2	1.3	Uranium-233/234		04F0688-001	0.736	Uranium-233/234
SS01313ST	1.3	Uranium-233/234		SS00014WCU2	0.7295	Uranium-233/234
SS00059WCU2	1.3	Uranium-233/234		04F0732-006	0.726	Uranium-233/234
SS20046WC	1.3	Uranium-233/234		04F0732-005	0.725	Uranium-233/234
SS00036WCU2	1.294	Uranium-233/234		SS60012WC	0.721	Uranium-233/234
SS60006WC	1.281	Uranium-233/234		04F1379-004	0.717	Uranium-233/234
04F0764-002	1.28	Uranium-233/234		04F0579-007	0.71	Uranium-233/234
04F0707-001	1.27	Uranium-233/234		04F0732-002	0.71	Uranium-233/234
SS03013WS	1.266	Uranium-233/234		00R1027-006	0.708	Uranium-233/234
SS00042WCU2	1.261	Uranium-233/234		TR00143WCU2	0.7002	Uranium-233/234
SS03000WS	1.255	Uranium-233/234		SS50074AS	0.7	Uranium-233/234
SS00032WCU2	1.254	Uranium-233/234		SS60008WC	0.696	Uranium-233/234
SS00002WCU2	1.254	Uranium-233/234		00R1027-008	0.691	Uranium-233/234
SS00005WCU2	1.246	Uranium-233/234		SS60004WC	0.6849	Uranium-233/234
SS00001JE	1.242	Uranium-233/234		04F0826-001	0.672	Uranium-233/234
SS00041WCU2	1.241	Uranium-233/234		SS50086AS	0.653	Uranium-233/234
SS00030WCU2	1.238	Uranium-233/234		SS60010WC	0.65	Uranium-233/234
SS00008JE	1.228	Uranium-233/234		TR00141WCU2	0.6462	Uranium-233/234
SS60019WC	1.225	Uranium-233/234		02D0644-001	0.639	Uranium-233/234
SS00009WCU2	1.223	Uranium-233/234		04F0779-005	0.638	Uranium-233/234
SS03014WS	1.215	Uranium-233/234		00R1027-009	0.637	Uranium-233/234
04F0810-004	1.21	Uranium-233/234		04F0779-002	0.636	Uranium-233/234
SS00022WCU2	1.208	Uranium-233/234		04F1269-011	0.636	Uranium-233/234
SS20041WC	1.2	Uranium-233/234		04F0731-002	0.635	Uranium-233/234
SS20048WC	1.2	Uranium-233/234		SS50081AS	0.634	Uranium-233/234
04F0707-004	1.2	Uranium-233/234		TR00139WCU2	0.6317	Uranium-233/234
SS20044WC	1.2	Uranium-233/234		SS70075ST	0.6282	Uranium-233/234
SS00072WCU2	1.2	Uranium-233/234		04F0779-003	0.613	Uranium-233/234
SS00003WCU2	1.194	Uranium-233/234		04F8067-002	0.604	Uranium-233/234
04F0740-004	1.19	Uranium-233/234		TR00142WCU2	0.5879	Uranium-233/234
04F0740-001	1.19	Uranium-233/234		04F0779-001	0.586	Uranium-233/234
04F1248-002	1.18	Uranium-233/234		04F0740-003	0.585	Uranium-233/234
SS03006WS	1.18	Uranium-233/234		SS50091AS	0.584	Uranium-233/234
04F0732-001	1.18	Uranium-233/234		04F0732-009	0.581	Uranium-233/234
SS60024WC	1.169	Uranium-233/234		SS50093AS	0.578	Uranium-233/234
SS70078ST	1.168	Uranium-233/234		04F0826-002	0.57	Uranium-233/234
SS00009JE	1.1502	Uranium-233/234		SS50087AS	0.557	Uranium-233/234
04F1269-001	1.15	Uranium-233/234		04F0579-003	0.553	Uranium-233/234

Uranium-234 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00035WCU2	1.147	Uranium-233/234		04F0731-005	0.549	Uranium-233/234
SS00039WCU2	1.143	Uranium-233/234		04F1379-005	0.541	Uranium-233/234
04F0614-001	1.14	Uranium-233/234		04F0764-001	0.541	Uranium-233/234
SS60016WC	1.136	Uranium-233/234		04F1379-007	0.522	Uranium-233/234
SS00001WCU2	1.133	Uranium-233/234		SS50090AS	0.517	Uranium-233/234
SS60021WC	1.132	Uranium-233/234		TR00140WCU2	0.5121	Uranium-233/234
04F0732-012	1.12	Uranium-233/234		04F0579-005	0.51	Uranium-233/234
SS03004WS	1.111	Uranium-233/234		04F0784-005	0.508	Uranium-233/234
SS00043WCU2	1.103	Uranium-233/234		SS50075AS	0.504	Uranium-233/234
SS00027WCU2	1.101	Uranium-233/234		04F0579-004	0.503	Uranium-233/234
SS60025WC	1.1	Uranium-233/234		SS50082AS	0.502	Uranium-233/234
SS00071WCU2	1.1	Uranium-233/234		04F0826-006	0.491	Uranium-233/234
TR00148WCU2	1.1	Uranium-233/234		04F1269-005	0.473	Uranium-233/234
04F0784-002	1.09	Uranium-233/234		TR00144WCU2	0.4672	Uranium-233/234
04F0740-006	1.09	Uranium-233/234		SS50092AS	0.455	Uranium-233/234
04F1866-001	1.09	Uranium-233/234		04F0810-006	0.413	Uranium-233/234
SS00011WCU2	1.083	Uranium-233/234		04F0731-004	0.413	Uranium-233/234
SS00019WCU2	1.081	Uranium-233/234		04F0579-002	0.408	Uranium-233/234
SS00017WCU2	1.08	Uranium-233/234		SS50084AS	0.381	Uranium-233/234
04F0740-005	1.08	Uranium-233/234		04F1269-002	0.351	Uranium-233/234
SS00021WCU2	1.075	Uranium-233/234		04F0814-006	0.343	Uranium-233/234
04F0732-011	1.07	Uranium-233/234		SS50085AS	0.334	Uranium-233/234
SS50083AS	1.07	Uranium-233/234		TR00043WCU2	0.262	Uranium-233/234
SS60005WC	1.062	Uranium-233/234		TR00035WCU2	0.248	Uranium-233/234
SS00010WCU2	1.057	Uranium-233/234		04F0579-008	0.246	Uranium-233/234
SS00034WCU2	1.044	Uranium-233/234		04F0810-001	0.241	Uranium-233/234
04F0784-004	1.04	Uranium-233/234		TR00044WCU2	0.229	Uranium-233/234
SS00040WCU2	1.037	Uranium-233/234		TR00039WCU2	0.221	Uranium-233/234
SS00018WCU2	1.034	Uranium-233/234		TR00041WCU2	0.215	Uranium-233/234
00R1027-005	1.03	Uranium-233/234		TR00042WCU2	0.215	Uranium-233/234
SS60022WC	1.02	Uranium-233/234		TR00038WCU2	0.198	Uranium-233/234
00R1027-007	1.02	Uranium-233/234		TR00036WCU2	0.193	Uranium-233/234
04F1379-003	1.01	Uranium-233/234		04F0779-008	0.191	Uranium-233/234
04F0737-003	1.01	Uranium-233/234		TR00034WCU2	0.187	Uranium-233/234
04F1269-008	1.01	Uranium-233/234		TR00037WCU2	0.119	Uranium-233/234
04F1866-002	1.01	Uranium-233/234				
SS02824EG	1	Uranium-233/234				

pCi/g = picocuries per gram

UCL Statistics for Uncensored Full Datasets	
User Selected Options	
Date/Time of Computation	ProUCL 5.112/1/2021 10:08:14 AM
From File	WorkSheet.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

U-234 POU

General Statistics			
Total Number of Observations	330	Number of Distinct Observations	241
		Number of Missing Observations	0
Minimum	0.119	Mean	1.116
Maximum	4.3	Median	1.005
SD	0.552	Std. Error of Mean	0.0304
Coefficient of Variation	0.495	Skewness	1.445

Normal GOF Test			
Shapiro Wilk Test Statistic	0.917	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.117	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0492	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	1.166	95% Adjusted-CLT UCL (Chen-1995)	1.168
		95% Modified-t UCL (Johnson-1978)	1.166

Gamma GOF Test			
A-D Test Statistic	1.618	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.758	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0624	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.0502	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Gamma Statistics			
k hat (MLE)	4.207	k star (bias corrected MLE)	4.171
Theta hat (MLE)	0.265	Theta star (bias corrected MLE)	0.267
nu hat (MLE)	2777	nu star (bias corrected)	2753
MLE Mean (bias corrected)	1.116	MLE Sd (bias corrected)	0.546
		Approximate Chi Square Value (0.05)	2632
Adjusted Level of Significance	0.0493	Adjusted Chi Square Value	2632

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.167	95% Adjusted Gamma UCL (use when n<50)	1.167

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.954	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	1.842E-10	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.078	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0492	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-2.129	Mean of logged Data	-0.0141
Maximum of Logged Data	1.459	SD of logged Data	0.526
Assuming Lognormal Distribution			
95% H-UCL	1.193	90% Chebyshev (MVUE) UCL	1.236
95% Chebyshev (MVUE) UCL	1.284	97.5% Chebyshev (MVUE) UCL	1.349
99% Chebyshev (MVUE) UCL	1.479		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.166	95% Jackknife UCL	1.166
95% Standard Bootstrap UCL	1.165	95% Bootstrap-t UCL	1.166
95% Hall's Bootstrap UCL	1.169	95% Percentile Bootstrap UCL	1.168
95% BCA Bootstrap UCL	1.17		
90% Chebyshev(Mean, Sd) UCL	1.207	95% Chebyshev(Mean, Sd) UCL	1.248
97.5% Chebyshev(Mean, Sd) UCL	1.305	99% Chebyshev(Mean, Sd) UCL	1.418
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	1.248		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all real world datasets; for additional insight the user may want to consult a statistician.			

Uranium-235 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
04F1866-004	0.466	Uranium-235		04F0732-007	0.0455	Uranium-235
04F8067-003	0.465	Uranium-235		SS00078EG	0.045	Uranium-235
00R1027-004	0.413	Uranium-235		SS50101AS	0.045	Uranium-235
00R1027-002	0.387	Uranium-235		SS00002WCU2	0.04488	Uranium-235
SS00061WCU2	0.38	Uranium-235		04F0740-005	0.0447	Uranium-235
04F1866-001	0.371	Uranium-235		TR00142WCU2	0.0445	Uranium-235
04F1269-010	0.344	Uranium-235		04F0579-007	0.0441	Uranium-235
SS00038EG	0.3	Uranium-235		SS20048WC	0.044	Uranium-235
00R1027-008	0.274	Uranium-235		SS04021CH	0.044	Uranium-235
04F0826-004	0.267	Uranium-235		SS50097AS	0.044	Uranium-235
04F0614-002	0.265	Uranium-235		SS60024WC	0.04395	Uranium-235
04F1866-003	0.262	Uranium-235		TR00148WCU2	0.04364	Uranium-235
00R1027-001	0.246	Uranium-235		04F0764-001	0.0435	Uranium-235
SS00075EG	0.24	Uranium-235		SS00046EG	0.043	Uranium-235
00R1027-003	0.231	Uranium-235		SS00077EG	0.043	Uranium-235
SS00251EG	0.23	Uranium-235		SS01313ST	0.043	Uranium-235
04F1866-002	0.224	Uranium-235		SS01315ST	0.043	Uranium-235
04F0810-004	0.215	Uranium-235		SS60018WC	0.04292	Uranium-235
04F0779-007	0.214	Uranium-235		SS00085EG	0.042	Uranium-235
SS00058EG	0.21	Uranium-235		04F0579-006	0.0419	Uranium-235
04F0779-008	0.204	Uranium-235		SS00022WCU2	0.04081	Uranium-235
SS00065WCU2	0.2	Uranium-235		SS20041WC	0.04	Uranium-235
04F1269-004	0.196	Uranium-235		SS00041WCU2	0.03978	Uranium-235
04F0732-001	0.189	Uranium-235		04F0731-005	0.0395	Uranium-235
04F0732-002	0.184	Uranium-235		SS00039WCU2	0.03889	Uranium-235
SS00060EG	0.18	Uranium-235		SS00026WCU2	0.03839	Uranium-235
04F0707-001	0.179	Uranium-235		SS00010WCU2	0.03838	Uranium-235
00R1027-010	0.174	Uranium-235		SS00039EG	0.038	Uranium-235
04F1379-002	0.168	Uranium-235		04F0633-007	0.038	Uranium-235
04F0784-001	0.163	Uranium-235		SS20046WC	0.038	Uranium-235
00R1027-005	0.163	Uranium-235		04F0784-004	0.0377	Uranium-235
SS00068EG	0.16	Uranium-235		SS00040WCU2	0.03763	Uranium-235
SS00084EG	0.16	Uranium-235		SS60010WC	0.0374	Uranium-235
SS00050WCU2	0.16	Uranium-235		SS50091AS	0.0374	Uranium-235
00R1027-012	0.158	Uranium-235		SS03000WS	0.03671	Uranium-235
00R1027-007	0.154	Uranium-235		SS20044WC	0.036	Uranium-235
SS00057EG	0.15	Uranium-235		SS00006WCU2	0.03557	Uranium-235
04F0614-001	0.15	Uranium-235		SS50080AS	0.0355	Uranium-235
00R1027-009	0.15	Uranium-235		SS00036WCU2	0.03412	Uranium-235
04F1379-003	0.143	Uranium-235		SS00052WCU2	0.034	Uranium-235
04F1269-001	0.143	Uranium-235		04F0619-001	0.034	Uranium-235
SS00056EG	0.14	Uranium-235		04F0814-005	0.0336	Uranium-235
SS03004WS	0.1393	Uranium-235		SS50077AS	0.0334	Uranium-235

Uranium-235 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
04F0732-011	0.138	Uranium-235		SS50081AS	0.0325	Uranium-235
04F0740-004	0.138	Uranium-235		SS00030WCU2	0.0324	Uranium-235
04F1269-011	0.133	Uranium-235		SS00087EG	0.032	Uranium-235
04F0737-001	0.132	Uranium-235		SS00034WCU2	0.03175	Uranium-235
SS00032EG	0.13	Uranium-235		SS60191WC	0.0313	Uranium-235
04F1269-008	0.126	Uranium-235		SS00038WCU2	0.03126	Uranium-235
04F0764-002	0.125	Uranium-235		SS00059WCU2	0.031	Uranium-235
SS00011WCU2	0.1244	Uranium-235		SS00056WCU2	0.031	Uranium-235
TR00146WCU2	0.1225	Uranium-235		04F1379-001	0.0294	Uranium-235
04F0707-007	0.121	Uranium-235		SS50084AS	0.0291	Uranium-235
SS00080EG	0.12	Uranium-235		SS50087AS	0.0291	Uranium-235
SS00050EG	0.12	Uranium-235		SS50089AS	0.029	Uranium-235
SS02823EG	0.12	Uranium-235		SS00024WCU2	0.0287	Uranium-235
SS20045WC	0.12	Uranium-235		SS00012WCU2	0.02858	Uranium-235
04F0707-002	0.12	Uranium-235		SS02824EG	0.028	Uranium-235
SS60015WC	0.1141	Uranium-235		02D0644-001	0.028	Uranium-235
04F0784-005	0.114	Uranium-235		SS01314ST	0.028	Uranium-235
04F0740-003	0.112	Uranium-235		04F0732-012	0.0278	Uranium-235
04F0731-003	0.111	Uranium-235		SS00062WCU2	0.027	Uranium-235
SS00059EG	0.11	Uranium-235		SS60008WC	0.027	Uranium-235
04F0633-001	0.11	Uranium-235		04F0826-002	0.0268	Uranium-235
04F0619-002	0.106	Uranium-235		SS00044WCU2	0.02658	Uranium-235
SS60004WC	0.1033	Uranium-235		04F0737-003	0.0262	Uranium-235
04F8067-001	0.101	Uranium-235		SS00070WCU2	0.026	Uranium-235
SS00063EG	0.1	Uranium-235		SS20040WC	0.026	Uranium-235
SS00054EG	0.1	Uranium-235		SS00005JE	0.02519	Uranium-235
SS00062EG	0.1	Uranium-235		SS60019WC	0.02512	Uranium-235
SS00051WCU2	0.099	Uranium-235		SS00016WCU2	0.02466	Uranium-235
04F0732-010	0.0989	Uranium-235		SS60020WC	0.02339	Uranium-235
SS00061EG	0.098	Uranium-235		04F0732-005	0.0232	Uranium-235
SS60017WC	0.09743	Uranium-235		SS50090AS	0.0224	Uranium-235
TR00139WCU2	0.09641	Uranium-235		04F0826-001	0.0223	Uranium-235
04F0732-009	0.0952	Uranium-235		TR00039WCU2	0.0221	Uranium-235
00R1027-011	0.095	Uranium-235		SS00025WCU2	0.02183	Uranium-235
04F0779-003	0.0946	Uranium-235		SS00008JE	0.0217	Uranium-235
04F0826-007	0.0942	Uranium-235		SS00001WCU2	0.02064	Uranium-235
00R1027-006	0.094	Uranium-235		SS00013WCU2	0.01999	Uranium-235
04F0810-006	0.0925	Uranium-235		SS00009JE	0.0198	Uranium-235
SS00082EG	0.092	Uranium-235		SS00021WCU2	0.0196	Uranium-235
SS00071WCU2	0.092	Uranium-235		SS00069EG	0.019	Uranium-235
SS03006WS	0.09176	Uranium-235		04F1248-003	0.019	Uranium-235
04F0779-004	0.0915	Uranium-235		SS00070EG	0.019	Uranium-235
SS00058WCU2	0.091	Uranium-235		SS00015WCU2	0.01898	Uranium-235

Uranium-235 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00042WCU2	0.09089	Uranium-235		SS50085AS	0.0183	Uranium-235
SS00052EG	0.09	Uranium-235		TR00140WCU2	0.01823	Uranium-235
04F0779-005	0.0894	Uranium-235		SS50092AS	0.018	Uranium-235
SS00036EG	0.089	Uranium-235		SS60005WC	0.01773	Uranium-235
04F0707-010	0.0887	Uranium-235		SS00008WCU2	0.01766	Uranium-235
SS00037EG	0.088	Uranium-235		SS00027WCU2	0.01601	Uranium-235
04F0814-003	0.0871	Uranium-235		TR00145WCU2	0.01589	Uranium-235
SS00074EG	0.087	Uranium-235		SS00043WCU2	0.01561	Uranium-235
04F0740-001	0.0861	Uranium-235		SS50076AS	0.0154	Uranium-235
04F1379-007	0.0851	Uranium-235		SS60022WC	0.0153	Uranium-235
SS00033EG	0.085	Uranium-235		SS00073EG	0.015	Uranium-235
04F1866-005	0.0827	Uranium-235		SS00006JE	0.0149	Uranium-235
SS00066EG	0.082	Uranium-235		04F1248-004	0.0145	Uranium-235
SS01312ST	0.082	Uranium-235		SS60009WC	0.0142	Uranium-235
SS00043EG	0.081	Uranium-235		SS60026WC	0.014	Uranium-235
SS00049EG	0.081	Uranium-235		SS04020CH	0.014	Uranium-235
SS02826EG	0.079	Uranium-235		TR00036WCU2	0.0135	Uranium-235
SS00031WCU2	0.07899	Uranium-235		04F8063-002	0.0133	Uranium-235
SS00014WCU2	0.07888	Uranium-235		SS00048EG	0.013	Uranium-235
SS60012WC	0.0784	Uranium-235		SS20043WC	0.013	Uranium-235
SS00044EG	0.077	Uranium-235		04F0731-002	0.0129	Uranium-235
SS00053EG	0.077	Uranium-235		04F0826-003	0.0125	Uranium-235
SS20047WC	0.077	Uranium-235		04F0740-002	0.0123	Uranium-235
SS00037WCU2	0.07647	Uranium-235		SS00004WCU2	0.01229	Uranium-235
SS60021WC	0.07541	Uranium-235		SS03014WS	0.01087	Uranium-235
SS00051EG	0.075	Uranium-235		SS03010WS	0.01062	Uranium-235
SS00072WCU2	0.075	Uranium-235		SS00023WCU2	0.009858	Uranium-235
SS03013WS	0.07436	Uranium-235		TR00037WCU2	0.0092	Uranium-235
SS60023WC	0.07365	Uranium-235		SS50082AS	0.009	Uranium-235
TR00143WCU2	0.07306	Uranium-235		SS00033WCU2	0.008292	Uranium-235
SS00040EG	0.073	Uranium-235		SS70075ST	0.008266	Uranium-235
SS03001WS	0.07231	Uranium-235		TR00034WCU2	0.00812	Uranium-235
SS60006WC	0.07134	Uranium-235		SS00020WCU2	0.006447	Uranium-235
SS00019WCU2	0.07129	Uranium-235		04F0737-002	0.00583	Uranium-235
SS01318ST	0.07	Uranium-235		04F1379-006	0.00533	Uranium-235
04F0707-009	0.0687	Uranium-235		SS50086AS	0	Uranium-235
04F0579-003	0.0684	Uranium-235		SS60016WC	0	Uranium-235
04F1269-009	0.0675	Uranium-235		SS70077ST	0	Uranium-235
SS00034EG	0.067	Uranium-235		TR00035WCU2	0	Uranium-235
SS00035WCU2	0.06661	Uranium-235		TR00044WCU2	0	Uranium-235
04F1269-006	0.0664	Uranium-235		TR00042WCU2	0	Uranium-235
SS00079EG	0.066	Uranium-235		TR00038WCU2	0	Uranium-235
SS60025WC	0.0659	Uranium-235		TR00041WCU2	0	Uranium-235

Uranium-235 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
02D0644-002	0.065	Uranium-235		TR00043WCU2	0	Uranium-235
SS00035EG	0.064	Uranium-235		TR00144WCU2	0	Uranium-235
SS00042EG	0.064	Uranium-235		TR00141WCU2	-0.0015	Uranium-235
SS00032WCU2	0.0627	Uranium-235		04F0579-008	-0.00199	Uranium-235
SS70078ST	0.06263	Uranium-235		04F0740-006	-0.00199	Uranium-235
04F0779-001	0.0602	Uranium-235		SS00005WCU2	-0.00366	Uranium-235
SS00071EG	0.06	Uranium-235		04F0779-002	-0.00375	Uranium-235
SS60013WC	0.0586	Uranium-235		05F0604-009	-0.00393	Uranium-235
SS50078AS	0.0573	Uranium-235		04F0707-008	-0.00402	Uranium-235
SS00007WCU2	0.05692	Uranium-235		04F0707-003	-0.00601	Uranium-235
04F1269-005	0.0565	Uranium-235		04F0579-002	-0.007	Uranium-235
SS50079AS	0.0563	Uranium-235		04F0579-004	-0.00747	Uranium-235
SS00001JE	0.05616	Uranium-235		04F0731-001	-0.00929	Uranium-235
SS00009WCU2	0.05599	Uranium-235		04F0732-006	-0.00953	Uranium-235
SS60014WC	0.05582	Uranium-235		SS60007WC	-0.0103	Uranium-235
SS00067EG	0.055	Uranium-235		04F0688-001	-0.0105	Uranium-235
SS50093AS	0.0549	Uranium-235		04F8063-001	-0.0114	Uranium-235
04F0814-002	0.0545	Uranium-235		04F0764-003	-0.0125	Uranium-235
SS00031EG	0.054	Uranium-235		04F0732-013	-0.0126	Uranium-235
SS00057WCU2	0.054	Uranium-235		04F1379-004	-0.0212	Uranium-235
SS00003WCU2	0.05378	Uranium-235		04F1269-007	-0.0218	Uranium-235
SS00045EG	0.053	Uranium-235		04F0731-004	-0.0241	Uranium-235
SS03019WS	0.05298	Uranium-235		04F1379-005	-0.0426	Uranium-235
SS00064EG	0.051	Uranium-235		04F1248-002	-0.0435	Uranium-235
SS00047EG	0.051	Uranium-235		04F0784-002	-0.0562	Uranium-235
SS00086EG	0.05	Uranium-235		04F0810-001	-0.0564	Uranium-235
SS50083AS	0.0494	Uranium-235		04F0814-004	-0.068	Uranium-235
SS03011WS	0.04896	Uranium-235		04F1379-008	-0.074	Uranium-235
TR00147WCU2	0.04844	Uranium-235		04F0579-005	-0.0754	Uranium-235
SS60011WC	0.0478	Uranium-235		04F0814-006	-0.0787	Uranium-235
04F8067-004	0.0471	Uranium-235		04F0826-006	-0.0796	Uranium-235
SS00083EG	0.047	Uranium-235		04F0707-004	-0.0882	Uranium-235
SS00081EG	0.046	Uranium-235		04F1269-002	-0.0934	Uranium-235
SS50075AS	0.046	Uranium-235		04F0814-001	-0.109	Uranium-235
SS50074AS	0.046	Uranium-235				
SS00018WCU2	0.04583	Uranium-235				
SS00017WCU2	0.04572	Uranium-235				

pCi/g = picocuries per gram

UCL Statistics for Uncensored Full Datasets			
User Selected Options			
Date/Time of Computation	ProUCL 5.112/1/2021 10:15:47 AM		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
U-235 POU			
General Statistics			
Total Number of Observations	329	Number of Distinct Observations	274
		Number of Missing Observations	0
Minimum	-0.109	Mean	0.0671
Maximum	0.466	Median	0.0458
SD	0.0812	Std. Error of Mean	0.00448
Coefficient of Variation	1.211	Skewness	1.896
Normal GOF Test			
Shapiro Wilk Test Statistic	0.846	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.139	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.0492	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.0745	95% Adjusted-CLT UCL (Chen-1995)	0.0749
		95% Modified-t UCL (Johnson-1978)	0.0745
Gamma Statistics Not Available			
Lognormal Statistics Not Available			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	0.0744	95% Jackknife UCL	0.0745
95% Standard Bootstrap UCL	0.0747	95% Bootstrap-t UCL	0.0756
95% Hall's Bootstrap UCL	0.075	95% Percentile Bootstrap UCL	0.0743
95% BCA Bootstrap UCL	0.0752		
90% Chebyshev(Mean, Sd) UCL	0.0805	95% Chebyshev(Mean, Sd) UCL	0.0866
97.5% Chebyshev(Mean, Sd) UCL	0.095	99% Chebyshev(Mean, Sd) UCL	0.112
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL	0.0866		
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			

Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all real world datasets; for additional insight the user may want to consult a statistician.

Uranium-238 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00075EG	4.5	Uranium-238		04F0779-005	1.07	Uranium-238
SS00032EG	2.9	Uranium-238		SS00001WCU2	1.065	Uranium-238
SS00058EG	2.8	Uranium-238		04F0784-005	1.06	Uranium-238
SS00060EG	2.7	Uranium-238		SS00023WCU2	1.053	Uranium-238
SS00083EG	2.7	Uranium-238		04F1269-002	1.05	Uranium-238
SS00056EG	2.7	Uranium-238		SS00020WCU2	1.049	Uranium-238
SS00084EG	2.6	Uranium-238		SS00040WCU2	1.037	Uranium-238
SS00057EG	2.6	Uranium-238		04F0810-001	1.03	Uranium-238
SS00043EG	2.5	Uranium-238		SS50078AS	1.03	Uranium-238
SS50097AS	2.5	Uranium-238		SS03010WS	1.028	Uranium-238
SS00073EG	2.4	Uranium-238		SS00019WCU2	1.019	Uranium-238
SS00054EG	2.3	Uranium-238		SS00005WCU2	1.012	Uranium-238
SS00070EG	2.3	Uranium-238		SS00034WCU2	1.009	Uranium-238
SS00053EG	2.2	Uranium-238		SS60005WC	1.003	Uranium-238
SS00059EG	2.2	Uranium-238		SS20040WC	1	Uranium-238
SS00251EG	2.2	Uranium-238		SS60025WC	0.996	Uranium-238
SS00052WCU2	2.2	Uranium-238		04F0579-006	0.994	Uranium-238
SS50101AS	2.2	Uranium-238		SS00021WCU2	0.9922	Uranium-238
SS00062EG	2.1	Uranium-238		04F0740-006	0.991	Uranium-238
SS00037EG	2.1	Uranium-238		SS00050WCU2	0.99	Uranium-238
SS00035EG	2	Uranium-238		04F1269-007	0.99	Uranium-238
SS00082EG	2	Uranium-238		TR00146WCU2	0.9859	Uranium-238
SS00051EG	2	Uranium-238		SS00024WCU2	0.9831	Uranium-238
SS00036EG	1.9	Uranium-238		SS00003WCU2	0.9829	Uranium-238
SS00077EG	1.9	Uranium-238		04F1248-003	0.98	Uranium-238
SS00064EG	1.9	Uranium-238		04F0731-001	0.98	Uranium-238
SS00045EG	1.9	Uranium-238		SS00006JE	0.9795	Uranium-238
SS00066EG	1.9	Uranium-238		04F0737-003	0.979	Uranium-238
SS00071EG	1.9	Uranium-238		04F0732-010	0.977	Uranium-238
SS00081EG	1.9	Uranium-238		TR00147WCU2	0.9688	Uranium-238
SS00069EG	1.9	Uranium-238		04F0732-012	0.962	Uranium-238
SS00087EG	1.9	Uranium-238		SS70078ST	0.9557	Uranium-238
SS00047EG	1.9	Uranium-238		04F1379-006	0.942	Uranium-238
SS00050EG	1.9	Uranium-238		SS01318ST	0.94	Uranium-238
04F1866-003	1.83	Uranium-238		SS20045WC	0.94	Uranium-238
SS00079EG	1.8	Uranium-238		04F0810-006	0.926	Uranium-238
SS00038EG	1.8	Uranium-238		SS00007WCU2	0.9224	Uranium-238
SS00052EG	1.8	Uranium-238		04F0688-001	0.922	Uranium-238
SS00044EG	1.8	Uranium-238		SS00027WCU2	0.9214	Uranium-238
SS00046EG	1.8	Uranium-238		04F0732-009	0.919	Uranium-238
SS00063EG	1.8	Uranium-238		SS00006WCU2	0.9161	Uranium-238
SS60018WC	1.749	Uranium-238		04F0779-001	0.913	Uranium-238
SS00078EG	1.7	Uranium-238		SS50074AS	0.913	Uranium-238

Uranium-238 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS00080EG	1.7	Uranium-238		04F0826-004	0.911	Uranium-238
SS00034EG	1.7	Uranium-238		SS00014WCU2	0.9092	Uranium-238
SS00039EG	1.7	Uranium-238		SS60022WC	0.909	Uranium-238
SS00068EG	1.7	Uranium-238		04F1379-003	0.905	Uranium-238
SS00051WCU2	1.7	Uranium-238		04F0740-002	0.905	Uranium-238
04F0707-002	1.7	Uranium-238		04F0619-002	0.899	Uranium-238
04F0619-001	1.65	Uranium-238		SS03011WS	0.8989	Uranium-238
00R1027-004	1.65	Uranium-238		04F1866-004	0.896	Uranium-238
SS00037WCU2	1.611	Uranium-238		04F1379-002	0.892	Uranium-238
SS00033EG	1.6	Uranium-238		SS60013WC	0.892	Uranium-238
SS00040EG	1.6	Uranium-238		04F0740-005	0.892	Uranium-238
SS00031EG	1.6	Uranium-238		SS00008WCU2	0.8905	Uranium-238
SS00048EG	1.6	Uranium-238		SS50077AS	0.875	Uranium-238
SS00074EG	1.6	Uranium-238		04F0633-007	0.874	Uranium-238
SS00086EG	1.6	Uranium-238		SS50089AS	0.873	Uranium-238
SS00070WCU2	1.6	Uranium-238		SS60191WC	0.869	Uranium-238
04F0737-001	1.6	Uranium-238		SS50080AS	0.869	Uranium-238
04F0614-002	1.57	Uranium-238		SS70077ST	0.8664	Uranium-238
04F8063-001	1.54	Uranium-238		04F0707-007	0.863	Uranium-238
SS03000WS	1.521	Uranium-238		04F0826-003	0.861	Uranium-238
SS60007WC	1.51	Uranium-238		04F1269-006	0.86	Uranium-238
04F0814-003	1.51	Uranium-238		04F1269-010	0.858	Uranium-238
SS00049EG	1.5	Uranium-238		04F0814-001	0.85	Uranium-238
SS00061EG	1.5	Uranium-238		SS50076AS	0.842	Uranium-238
SS00067EG	1.5	Uranium-238		SS02826EG	0.84	Uranium-238
SS00085EG	1.5	Uranium-238		04F0814-006	0.838	Uranium-238
SS00065WCU2	1.5	Uranium-238		00R1027-003	0.838	Uranium-238
SS01315ST	1.5	Uranium-238		04F0732-011	0.836	Uranium-238
SS01313ST	1.5	Uranium-238		SS60011WC	0.836	Uranium-238
SS00059WCU2	1.5	Uranium-238		SS00016WCU2	0.8337	Uranium-238
00R1027-002	1.49	Uranium-238		04F1379-008	0.833	Uranium-238
SS60006WC	1.462	Uranium-238		04F0732-002	0.83	Uranium-238
SS00022WCU2	1.461	Uranium-238		SS50079AS	0.827	Uranium-238
SS60023WC	1.458	Uranium-238		04F1379-005	0.824	Uranium-238
04F1866-005	1.45	Uranium-238		SS60026WC	0.819	Uranium-238
SS60024WC	1.448	Uranium-238		04F0779-007	0.819	Uranium-238
SS03014WS	1.447	Uranium-238		04F0779-003	0.818	Uranium-238
04F0732-001	1.43	Uranium-238		04F0784-002	0.815	Uranium-238
SS60017WC	1.429	Uranium-238		TR00140WCU2	0.8089	Uranium-238
SS00036WCU2	1.421	Uranium-238		SS50081AS	0.807	Uranium-238
SS00042EG	1.4	Uranium-238		04F0732-006	0.806	Uranium-238
SS01312ST	1.4	Uranium-238		04F1269-005	0.805	Uranium-238
SS00072WCU2	1.4	Uranium-238		04F0764-002	0.791	Uranium-238

Uranium-238 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
SS03019WS	1.389	Uranium-238		SS60010WC	0.784	Uranium-238
SS00044WCU2	1.383	Uranium-238		05F0604-009	0.783	Uranium-238
SS00031WCU2	1.37	Uranium-238		SS02824EG	0.78	Uranium-238
SS00013WCU2	1.369	Uranium-238		04F0707-003	0.78	Uranium-238
SS03013WS	1.365	Uranium-238		04F0826-007	0.778	Uranium-238
SS60021WC	1.359	Uranium-238		04F0732-013	0.775	Uranium-238
SS00005JE	1.348	Uranium-238		04F1269-011	0.775	Uranium-238
TR00145WCU2	1.311	Uranium-238		04F8067-001	0.77	Uranium-238
00R1027-011	1.31	Uranium-238		04F0740-001	0.766	Uranium-238
SS00004WCU2	1.308	Uranium-238		04F0579-007	0.764	Uranium-238
SS03006WS	1.306	Uranium-238		00R1027-005	0.763	Uranium-238
SS00030WCU2	1.301	Uranium-238		04F0732-005	0.749	Uranium-238
SS00062WCU2	1.3	Uranium-238		SS60004WC	0.7462	Uranium-238
SS00061WCU2	1.3	Uranium-238		SS02823EG	0.74	Uranium-238
SS00057WCU2	1.3	Uranium-238		02D0644-002	0.739	Uranium-238
SS03004WS	1.296	Uranium-238		SS60009WC	0.738	Uranium-238
00R1027-001	1.28	Uranium-238		00R1027-006	0.73	Uranium-238
SS00026WCU2	1.277	Uranium-238		04F0764-001	0.727	Uranium-238
SS00001JE	1.277	Uranium-238		04F0614-001	0.723	Uranium-238
SS60014WC	1.267	Uranium-238		TR00142WCU2	0.7182	Uranium-238
04F0579-004	1.26	Uranium-238		04F0740-003	0.712	Uranium-238
00R1027-010	1.25	Uranium-238		04F0731-003	0.704	Uranium-238
04F8067-004	1.25	Uranium-238		04F0579-002	0.696	Uranium-238
00R1027-007	1.24	Uranium-238		04F1269-009	0.696	Uranium-238
SS00009WCU2	1.223	Uranium-238		TR00139WCU2	0.6911	Uranium-238
04F0784-004	1.22	Uranium-238		04F0707-004	0.69	Uranium-238
04F0740-004	1.22	Uranium-238		04F1248-004	0.687	Uranium-238
SS60016WC	1.216	Uranium-238		04F0707-001	0.678	Uranium-238
04F0779-002	1.21	Uranium-238		04F0826-006	0.656	Uranium-238
SS00025WCU2	1.21	Uranium-238		04F1866-001	0.653	Uranium-238
SS00033WCU2	1.209	Uranium-238		SS70075ST	0.6496	Uranium-238
SS00032WCU2	1.209	Uranium-238		SS50075AS	0.646	Uranium-238
SS00038WCU2	1.206	Uranium-238		SS60012WC	0.635	Uranium-238
SS20044WC	1.2	Uranium-238		04F0707-009	0.635	Uranium-238
SS20046WC	1.2	Uranium-238		00R1027-012	0.632	Uranium-238
SS20047WC	1.2	Uranium-238		SS60008WC	0.621	Uranium-238
SS00056WCU2	1.2	Uranium-238		SS50091AS	0.62	Uranium-238
SS04020CH	1.2	Uranium-238		04F0784-001	0.615	Uranium-238
SS20043WC	1.2	Uranium-238		04F1269-001	0.607	Uranium-238
SS00058WCU2	1.2	Uranium-238		TR00148WCU2	0.6064	Uranium-238
SS00071WCU2	1.2	Uranium-238		SS50090AS	0.602	Uranium-238
SS00010WCU2	1.197	Uranium-238		02D0644-001	0.6	Uranium-238
04F1379-007	1.19	Uranium-238		04F0731-004	0.599	Uranium-238

Uranium-238 POU Input Data for ProUCL						
SAMP_NUM	RESULT (pCi/g)	Analyte Name		SAMP_NUM	RESULT (pCi/g)	Analyte Name
04F1248-002	1.19	Uranium-238		04F0579-003	0.595	Uranium-238
04F0814-005	1.19	Uranium-238		04F0579-008	0.592	Uranium-238
04F0737-002	1.19	Uranium-238		04F0707-010	0.591	Uranium-238
00R1027-008	1.18	Uranium-238		04F0579-005	0.59	Uranium-238
SS00012WCU2	1.178	Uranium-238		04F0731-002	0.579	Uranium-238
SS00008JE	1.1737	Uranium-238		TR00141WCU2	0.5772	Uranium-238
SS60015WC	1.17	Uranium-238		SS50092AS	0.575	Uranium-238
04F8063-002	1.17	Uranium-238		04F0814-004	0.569	Uranium-238
SS00017WCU2	1.143	Uranium-238		TR00143WCU2	0.5687	Uranium-238
SS00011WCU2	1.142	Uranium-238		SS50086AS	0.559	Uranium-238
SS00039WCU2	1.141	Uranium-238		04F0779-004	0.559	Uranium-238
04F1269-004	1.14	Uranium-238		04F0633-001	0.551	Uranium-238
SS00035WCU2	1.137	Uranium-238		04F0707-008	0.551	Uranium-238
04F1269-008	1.13	Uranium-238		SS50093AS	0.542	Uranium-238
SS03001WS	1.128	Uranium-238		SS50084AS	0.53	Uranium-238
04F8067-003	1.12	Uranium-238		04F1379-001	0.517	Uranium-238
SS00002WCU2	1.12	Uranium-238		SS50082AS	0.515	Uranium-238
SS60019WC	1.119	Uranium-238		00R1027-009	0.509	Uranium-238
SS00042WCU2	1.117	Uranium-238		SS50087AS	0.481	Uranium-238
SS60020WC	1.117	Uranium-238		SS50085AS	0.477	Uranium-238
SS00043WCU2	1.116	Uranium-238		04F1379-004	0.455	Uranium-238
SS00041WCU2	1.108	Uranium-238		04F0826-002	0.431	Uranium-238
SS00009JE	1.1022	Uranium-238		04F1866-002	0.417	Uranium-238
SS20048WC	1.1	Uranium-238		04F0826-001	0.386	Uranium-238
SS20041WC	1.1	Uranium-238		TR00144WCU2	0.3728	Uranium-238
SS01314ST	1.1	Uranium-238		TR00041WCU2	0.348	Uranium-238
SS04021CH	1.1	Uranium-238		TR00042WCU2	0.242	Uranium-238
04F0810-004	1.1	Uranium-238		TR00035WCU2	0.224	Uranium-238
SS00015WCU2	1.093	Uranium-238		TR00043WCU2	0.22	Uranium-238
04F0731-005	1.09	Uranium-238		TR00036WCU2	0.202	Uranium-238
04F0732-007	1.09	Uranium-238		TR00044WCU2	0.195	Uranium-238
SS50083AS	1.08	Uranium-238		TR00038WCU2	0.192	Uranium-238
04F0779-008	1.08	Uranium-238		TR00034WCU2	0.175	Uranium-238
04F8067-002	1.08	Uranium-238		TR00037WCU2	0.165	Uranium-238
SS00018WCU2	1.073	Uranium-238		TR00039WCU2	0.162	Uranium-238
04F0814-002	1.07	Uranium-238				
04F0764-003	1.07	Uranium-238				

pCi/g = picocuries per gram

UCL Statistics for Uncensored Full Datasets			
User Selected Options			
Date/Time of Computation	ProUCL 5.112/1/2021 10:19:46 AM		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
U-238 POU			
General Statistics			
Total Number of Observations	330	Number of Distinct Observations	232
		Number of Missing Observations	0
Minimum	0.162	Mean	1.152
Maximum	4.5	Median	1.07
SD	0.54	Std. Error of Mean	0.0297
Coefficient of Variation	0.469	Skewness	1.421
Normal GOF Test			
Shapiro Wilk Test Statistic	0.925	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.115	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0492	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.201	95% Adjusted-CLT UCL (Chen-1995)	1.204
		95% Modified-t UCL (Johnson-1978)	1.202
Gamma GOF Test			
A-D Test Statistic	1.271	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.0548	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.0502	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			
Gamma Statistics			
k hat (MLE)	4.688	k star (bias corrected MLE)	4.647
Theta hat (MLE)	0.246	Theta star (bias corrected MLE)	0.248
nu hat (MLE)	3094	nu star (bias corrected)	3067
MLE Mean (bias corrected)	1.152	MLE Sd (bias corrected)	0.535
		Approximate Chi Square Value (0.05)	2940
Adjusted Level of Significance	0.0493	Adjusted Chi Square Value	2939
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.202	95% Adjusted Gamma UCL (use when n<50)	1.203

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.951	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk P Value	6.009E-12	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0687	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.0492	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	-1.82	Mean of logged Data	0.0313
Maximum of Logged Data	1.504	SD of logged Data	0.495
Assuming Lognormal Distribution			
95% H-UCL	1.225	90% Chebyshev (MVUE) UCL	1.267
95% Chebyshev (MVUE) UCL	1.312	97.5% Chebyshev (MVUE) UCL	1.376
99% Chebyshev (MVUE) UCL	1.5		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.201	95% Jackknife UCL	1.201
95% Standard Bootstrap UCL	1.201	95% Bootstrap-t UCL	1.204
95% Hall's Bootstrap UCL	1.204	95% Percentile Bootstrap UCL	1.201
95% BCA Bootstrap UCL	1.201		
90% Chebyshev(Mean, Sd) UCL	1.241	95% Chebyshev(Mean, Sd) UCL	1.282
97.5% Chebyshev(Mean, Sd) UCL	1.338	99% Chebyshev(Mean, Sd) UCL	1.448
Suggested UCL to Use			
95% Student's-t UCL	1.201	or 95% Modified-t UCL	1.202
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all real world datasets; for additional insight the user may want to consult a statistician.			

Appendix D

RFLMA Contact Records and Other Written Correspondence

Contact Records

CR 2011-03	Resource Conservation and Recovery Act (RCRA) Well Monitoring Results at Original Landfill (OLF) and Present Landfill (PLF)
CR 2015-05	Reportable condition for plutonium 12-month rolling average at Point of Evaluation (POE) SW027
CR 2015-06	Original Landfill (OLF) Implementation of Interim Action to Reestablish Surface Water Management on Portions of the OLF, with Soil Disturbance Review Plan
CR 2015-10	Area of Concern Well 10304 Reportable Condition
CR 2016-02	Mound Site Plume Treatment System reconfiguration project Soil Disturbance Review Report and Explanation of Significant Differences
CR 2017-02	Reportable condition for evaluation purposes for uranium at Walnut Creek Point of Compliance (WALPOC)
CR 2017-03	North Walnut Creek Slump 2017 Maintenance and Soil Disturbance Review Plan
CR 2017-04	OLF 2017 Interim Maintenance Work: Creating Positive Drainage and Minor Adjustments to Berm Heights, in accordance with Soil Disturbance Review Plan
CR 2018-01	Original Landfill (OLF) Geotechnical Investigation Work in accordance with attached Soil Disturbance Review Plan
CR 2018-04	Reportable condition for evaluation purposes for uranium at Walnut Creek Point of Compliance (WALPOC)
CR 2018-05	Minor Modification of Rocky Flats Legacy Management Agreement (RFLMA) Attachment 2, “Legacy Management Requirement
CR 2019-01	Reportable condition for plutonium 12-month rolling average at Point of Evaluation (POE) SW027
CR 2019-02	Original Landfill (OLF) Stabilization Project with Soil Disturbance Review Plan
CR 2019-03	North Walnut Creek Stormwater Diversion and Soil Disturbance Review Plan
CR 2021-02	Reportable conditions for uranium at Point of Evaluation (POE) GS10
CR 2021-04	East Trenches Plume Treatment System (ETPTS) discharge line replacement
CR 2021-05	East Trenches Plume Treatment System (ETPTS) Discharge Gallery Replacement

Other Written Correspondence

Consultation Posting 010819	Reportable condition for TCE at AOC well 10304
Notification 020818	Notification of Maintenance Activities at OLF Berms 6 and 7

RFLMA Contact Records

ROCKY FLATS SITE
REGULATORY CONTACT RECORD

Purpose: Resource Conservation and Recovery Act (RCRA) Well Monitoring Results at Original Landfill (OLF) and Present Landfill (PLF)

Contact Record Approval Date: April 25, 2011

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); John Boylan, S.M. Stoller Corporation (Stoller); Rick DiSalvo, Stoller

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Discussion: Groundwater monitoring results were reviewed in accordance with Rocky Flats Legacy Management Agreement (RFLMA) requirements and for the preparation of the 2010 RFLMA Annual Report. The results of statistical evaluations of analytical data from the OLF and PLF RCRA wells required consultation among the RFLMA Parties. This contact record documents the specific results driving the need for consultation. More detailed information will be provided in the 2010 Annual Report.

The RFLMA decision flowchart for RCRA wells at the OLF and PLF is presented in Figure 10 of Attachment 2 to the RFLMA. The following summary describes conditions that require consultation to determine an appropriate response. These conditions were discussed in a consultation meeting on March 31, 2010.

<u>OLF</u>

1. Downgradient groundwater contains statistically significant higher concentrations of a constituent included in RFLMA Table 1 than are present in upgradient groundwater, *OR*
2. Trending calculations indicate a constituent in downgradient groundwater at the OLF is on a statistically significant increasing trend.

<u>PLF</u>

1. Downgradient groundwater contains statistically significant higher concentrations of a constituent included in RFLMA Table 1 than are present in upgradient groundwater, *AND* trending calculations indicate a constituent in downgradient groundwater at the PLF is on a statistically significant increasing trend.

Analytical data from the RCRA wells at each landfill was evaluated using the analysis of variance (ANOVA) approach to determine if downgradient concentrations significantly exceeded upgradient concentrations; and using the Seasonal Kendall trending method to assess whether any constituents are on a statistically significant increasing trend.

<u>OLF</u>

At the OLF, the result of corresponding evaluation condition number 1 above is true for 2010: the groundwater results for all three downgradient wells indicate a statistically significant higher concentration of boron (B) is present in downgradient than upgradient groundwater. The same applies to uranium (U) in downgradient groundwater monitored at well 80205, the easternmost of the three downgradient wells. The concentration of B is below the RFLMA Table 1 standard and the concentration of U is below the RFLMA groundwater threshold value. Furthermore, the U in this well has been characterized as 100% natural U by Los Alamos National Laboratory using Thermal Ionization Mass Spectrometry analysis.

The result for evaluation condition number 2 is not true for 2010.

The overall 2010 evaluation results for these analytes were no different than the 2009 results, which are summarized in contact record 2010-05 and the 2009 RFLMA Annual Report.

PLF

At the PLF, the result of the corresponding evaluation condition is true for 2010 for B in groundwater monitored at well 73105. The concentration of B is below the RFLMA Table 1 standard.

The overall 2010 evaluation results were no different than the 2009 results, which are summarized in contact record 2010-05 and the 2009 RFLMA Annual Report.

Resolution: The appropriate response is to continue monitoring RCRA wells in accordance with RFLMA.

The RFLMA Parties also agreed that no further contact record documentation for evaluation of these analytes at the PLF or OLF is required, and the evaluation is to be provided in subsequent RFLMA Annual Reports. After review of the RFLMA Annual Reports, the RFLMA Parties may decide that subsequent consultation regarding appropriate response is appropriate. Such consultation will be documented in a contact record.

Closeout of Contact Record: This contact record will be closed when it is posted to the Rocky Flats website.

Resolution: Carl Spreng, CDPHE, approved this contact record.

Contact Record Prepared By: John Boylan and Rick DiSalvo

Distribution:
Carl Spreng, CDPHE
Scott Surovchak, DOE
Linda Kaiser, Stoller
Rocky Flats Contact Record File

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2015-05

Purpose: Reportable condition for plutonium 12-month rolling average at Point of Evaluation (POE) SW027

Contact Record Approval Date: July 8, 2015

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); George Squibb, Kurt Franzen, Linda Kaiser, David Ward, Stoller Newport News Nuclear, Inc. (SN3), a wholly owned subsidiary of Huntington Ingalls Industries, Inc.

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: June 23, 2015

Consultation Meeting Participants: Carl Spreng, CDHPE; Vera Moritz, EPA; Scott Surovchak, DOE; Kurt Franzen, David Ward, John Boylan, Linda Kaiser, George Squibb, SN3; Michelle Hanson, Jody Nelson, J.G. Management Systems, Inc.

Discussion: This Contact Record documents DOE's consultation with CDPHE and EPA on June 23, 2015, regarding the evaluation of elevated concentrations of plutonium at POE SW027, which resulted in a reportable condition under RFLMA Attachment 2, "Legacy Management Requirements," Section 6.0, "Action Determinations."
.
A reportable condition was determined on June 11, 2015, based on evaluation of recently available validated analytical results for plutonium (Pu-239,240) from the composite samples collected during the period May 7, 2014–May 8, 2015. Americium (Am-241) is not reportable at this time. Following is a synopsis of the data:

No samples collected 5/7/14–3/8/15 due to lack of flow

Composite 3/9/15–3/11/15; Pu = 0.116 pCi/L, Am = 0.030 pCi/L

Composite 3/11/15–4/17/15; Pu = 0.139 pCi/L, Am = 0.030 pCi/L

Composite 4/17/15–5/6/15; Pu = 0.251 pCi/L, Am = 0.040 pCi/L

Composite 5/6/15–5/9/15; Pu = 1.02 (duplicate = 0.754) pCi/L, Am = 0.18 (duplicate = 0.157) pCi/L

The evaluation was performed in accordance with RFLMA Attachment 2, Figure 6, Points of Evaluation, which resulted in 12-month rolling average values of 0.037 pCi/L Am and 0.22 pCi/L Pu on April 30, 2015. The applicable RFLMA Table 1 standard for Am and Pu is 0.15 pCi/L.

Flow-through operations at Pond C-2 were initiated on November 7, 2011. The recent Pu and Am results from downstream location GS31 (Pond C-2 outlet) are higher than normal. Results from the downstream Point of Compliance WOMPOC (Woman Creek at COU boundary) have been received through May 17, 2015; all results were below the RFLMA Table 1 standard of 0.15 pCi/L and in fact below 0.09 pCi/L.

While the 12-month rolling average for Am is not reportable, the evaluation of the reportable Pu values will include consideration of the Am results.

Pursuant to RFLMA Attachment 2, Section 6.0, for a reportable condition:

- DOE must inform the RFLMA regulators and stakeholders identified in RFLMA Attachment 2, Figure 6 within 15 days of receipt of validated data for the reportable condition.
- DOE must submit a plan and schedule for an evaluation to address the condition within 30 days of receiving the validated data for the reportable condition.
- DOE will consult with CDPHE and EPA to determine if mitigating actions are necessary.
- The objective of consultation will be to determine a course of action (if determined necessary) to address the reportable condition and to ensure that the remedy remains protective.
- Results of consultation will be documented in Contact Records, written correspondence, or both.

The RFLMA parties have been kept informed of the elevated levels since the initial results were received, and a public-information e-mail was sent to the stakeholders on June 18, 2015.

This Contact Record describes the plan and schedule to address the reportable condition. The plan and schedule for evaluation and the status of actions related to the plan are described below:

- Evaluation of the steps taken in 2010 when it was anticipated the 12-month rolling average for plutonium would exceed the standard at SW027 as reported in CR 2010-06. This includes a review of "Report of Steps Taken Regarding Monitoring Results at Surface Water Point of Evaluation (POE) SW027," August 31, 2010, and "Calendar Year (CY) 2011 Status Report of Actions Taken in Point of Evaluation SW027 Drainage," January 2012.
- On June 17, 2015, Rocky Flats personnel walked the SID drainage area and identified opportunities to enhance the revegetation and erosion controls previously implemented in 2010 and 2011 (Figure 1). Also during the June 17 inspection, limited areas in the SID showed evidence of local erosion and/or sediment deposition. Based on these general observations, a geotechnical engineer was scheduled to inspect the areas and provide recommendations.
- During the June 17 inspection, locations were identified for immediate installation of new wattles (Figure 2); installation was completed on June 22, 2015.

- Additional erosion control methods will be installed in the SW027 drainage, predominantly on the hillside above GS51. These measures will include matting, wattles, GeoRidge berms, and organic mulch. Several areas in the SID will also receive erosion matting; other longer-term actions for the SID are dependent on recommendations from the geotechnical engineer. Figure 3 shows the planned locations for these measures; final locations will be documented after installation. This work is scheduled to be completed by August 2015.
- On June 29, 2015, geotechnical engineers, CDPHE, and Rocky Flats personnel walked down the SID to evaluate potential use of water and sediment management devices or structures. The geotechnical engineers will provide recommendations for water and sediment management in the SID. These recommendations will be implemented in the longer term as appropriate.
- Sampling will continue as currently scheduled when surface water runoff is available.
- Status of the above items will be reported in quarterly and annual reports or both, depending when the activities occur.

Resolution: Carl Spreng, CDPHE, will review the above plan and schedule to address this reportable condition and, after consulting with EPA, may approve, approve with modifications, or disapprove this Contact Record.

Closeout of Contact Record: This Contact Record will be closed when the proposed erosion and water management control methods have been implemented and revegetation is complete.

Contact Record Prepared by: Jody Nelson, J.G. Management Systems, Inc.; David Ward, George Squibb, Kurt Franzen, SN3

Distribution:
Carl Spreng, CDPHE
Scott Surovchak, DOE
Vera Moritz, EPA
Linda Kaiser, Stoller
Rocky Flats Contact Record File

Figure 1.

Figure 2. June 17, 2015

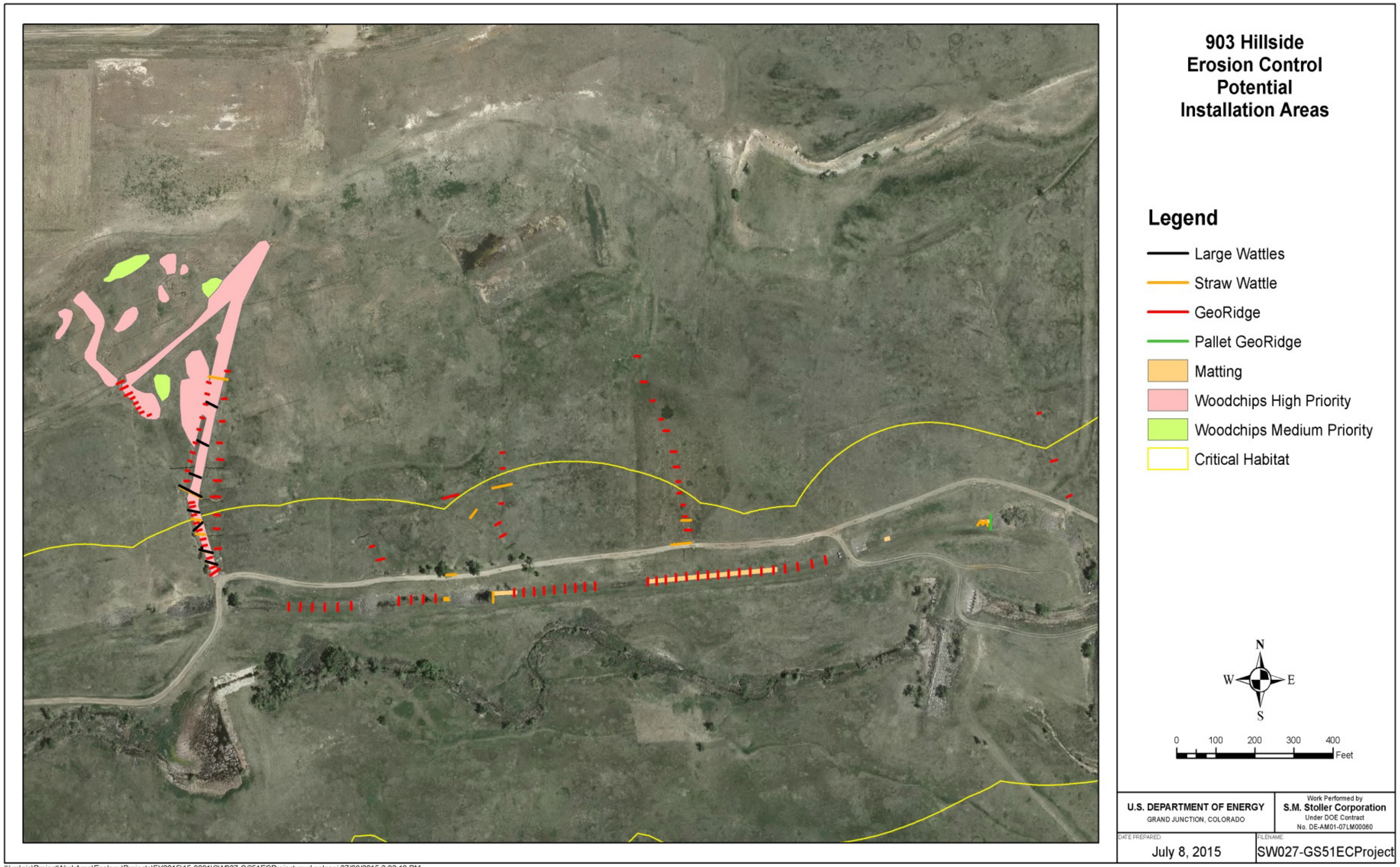


Figure 3. Planned Action Locations

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2015-06

Purpose: Original Landfill (OLF) Implementation of Interim Action to Reestablish Surface Water Management on Portions of the OLF, with Soil Disturbance Review Plan

Contact Record Approval Date: July 28, 2015

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); Kurt Franzen, Linda Kaiser, David Ward, John Boylan, George Squibb, Stoller Newport News Nuclear, Inc. (SN3), a wholly owned subsidiary of Huntington Ingalls Industries, Inc.

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: July 22, 2015

Consultation Meeting Participants: Carl Spreng, CDHPE; Scott Surovchak, DOE; Vera Moritz, EPA; Linda Kaiser, David Ward, George Squibb, John Boylan, SN3; Jody Nelson, Michelle Hansen, JG Management Systems, Inc.

Introduction: Contact Record (CR) 2015-03 approved immediate action to address areas of subsidence and the resulting standing water on portions of the OLF. This subsidence was caused by several weeks of precipitation in the spring of 2015. (May 2015 has been noted as the wettest May in Colorado's recorded history.) The immediate action has been successful in improving drainage of water on the surface of the OLF.

Localized instability of the East Perimeter Channel (EPC) of the OLF first occurred as the result of the rain event from September 9 through September 16, 2013, and was identified as a reportable condition in CR 2013-02, dated September 18, 2013. The efforts to repair, reconfigure, and stabilize the EPC that are listed in CR 2013-03 and modified in CR 2014-09 were postponed due to continuing moisture and weather conditions, and were ultimately completed in January 2015. Since that time, the site has received over 20 inches of precipitation. The subsidence has begun to slow in most areas and stopped in some areas.

Discussion: A qualified geotechnical engineer with prior experience at the OLF visited the OLF several times and made several recommendations to address the need to reestablish surface water flow off the OLF cover over the short term. Recommendations included "laying back" the ground at the top of the largest scarp to achieve a more gentle and uniform slope. This will require cutting up to 6 feet off the top of the scarp and placing the cut material at the base of the scarp, which will lessen the potential for excess erosion on the steep face and the resulting potential for deposits of eroded soil that could hamper the flow of water. To achieve this slope, a "field fit" approach will be used rather than detailed engineered designs. Re-grading this area would also reduce safety concerns presented by the steep scarp (see Figure 1).

Re-grading was also recommended to manage run on, requiring 3-foot cuts at the edge of the waste boundary and creating a series of smaller, but steeper than existing, berms as continuations of berms 4 through 7. Piping will also be added to convey water from the west end of the distressed area to the EPC. As part of the initial action (CR 2015-03), each of the berms was dammed and a pipe was installed to drain the water from the pools formed by the areas of subsidence off the landfill surface and down the slope. This existing piping can be repurposed to extend down the invert of the channels created by the new berms. The soil dams should remain to discourage water from bypassing the pipe. A series of rock dams can be placed over the pipe at intervals of 30 to 50 feet to ensure that piping remains in place until a longer-term solution is designed and implemented. The pipe and berms should slope approximately 10 percent or more to rapidly convey water across the distressed area to the EPC. In areas where relatively large flows have been observed following storm events, larger diameter pipe or multiple 4-inch diameter pipes could be used. Although these aboveground pipes will be subject to freezing for a short time during winter months, that risk should be offset by the ability to monitor pipe performance and correct issues over a comparatively long period of time during the remainder of the year. In addition, with the recommended slope there should be little water remaining in the pipes to freeze.

The area near the northeast edge of the OLF cover, where a rock drain was installed as a part of the OLF closure project, is very wet at the ground surface (see Figure 1). Observations by Rocky Flats staff and exploration using an excavator have shown that this drain appears to be at least partially blocked or clogged, hampering its effectiveness. The wet ground suggests the drain may be full of water that feeds permeable, low-strength lenses in the shallow soils. Excavation in the area to try to provide an outlet for water that may be collecting in the buried rock, thus providing a water source to the distressed areas, will be completed and will require an excavation of approximately 25 feet.

Cracks or voids observed at the ground surface will continue to be filled, tamped, or sealed off at the ground surface using heavy equipment or hand methods, as appropriate, to reduce infiltration of precipitation and snow melt. The ground surface will not be covered with an impermeable barrier, which would be subject to damage by high winds. Impermeable sheeting would also trap moisture and reduce evapotranspiration, potentially causing an increase in water content in the shallow subsurface.

Although distress has been less extensive on the western side of the OLF, local instabilities and distress have been noted (see Figure 1). These areas will be mitigated in a similar manner for the short term (but will not require intrusive work focusing on a subsurface drain, as planned on the eastern side). Scarps, hummocky surfaces, and other slope irregularities can be smoothed and drain pipes installed to more rapidly convey water across the distressed areas until the subsoils have dried and a longer-term solution has been designed.

Disturbed areas, both east and west, will be revegetated using a seed mixture that has proven successful in the area.

The important concept here is to not add any more weight to the OLF cover or water-management structures during this interim action. Therefore, the designed berm heights and cover thickness will not be maintained in these areas during this action. This is consistent with CR 2015-03, Original Landfill Immediate Response to Recent Precipitation, dated May 26, 2015.

DOE plans to start the work in August 2015 and complete it in September 2015. The longer-term approach to the stabilization of the OLF cover by a qualified geotechnical engineer is continuing.

Sampling of the Resource Conservation and Recovery Act wells that monitor the OLF is performed quarterly, and was most recently completed in May 2015. A composite sample at the surface water monitoring location downstream of the OLF in Woman Creek (GS59) was collected on May 18, 2015. This composite sample covers the period from May 9 to May 18. Results of the analysis of this sample will be available on GEMS (Geospatial Environmental Mapping System) after they are validated and will be reported in the corresponding quarterly report.

The soil disturbance, filling, and grading on the OLF cover are subject to the requirements of Rocky Flats Legacy Management Agreement (RFLMA) institutional controls (ICs) as discussed below. An approved Soil Disturbance Review Plan (SDRP) is required, and the RFLMA parties agree that the geotechnical engineer's recommendation provides sufficient information for the SDRP for the proposed work.

IC Evaluation: The soil disturbance work is subject to ICs 2, 3 and 6. Table 1 recaps these ICs.

Table 1. Institutional Controls

IC 2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central Operating Unit, and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.
IC 3	No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan (including Surface Water Protection Plans submitted to EPA under the Clean Water Act) approved by CDPHE or EPA. Soil disturbance that will not restore the soil surface to preexisting grade or higher may not be performed without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent migration of residual surface soil contamination to surface water. **Rationale:** Certain surface soil contaminants, notably plutonium-239/240, were identified in the fate and transport evaluation in the Remedial Investigation as having complete pathways to surface water if disturbed. This restriction minimizes the possibility of such disturbance and resultant impacts to surface water. Restoring the soil surface to preexisting grade maintains the current depth to subsurface contamination or contaminated structures.
IC 6	Digging, drilling, tilling, grading, excavation, construction of any sort (including construction of any structures, paths, trails, or roads), and vehicular traffic are prohibited on the covers of the Present Landfill and the Original Landfill, except for authorized response actions.
	Objective: Ensure the continued proper functioning of the landfill covers. **Rationale:** This restriction helps ensure the integrity of the landfill covers.

The required SDRP is in Attachment 1. The *Erosion Control Plan for Rocky Flats Property Central Operable Unit*, which has been approved by CDPHE and EPA, provides erosion control best-management practices that meet the IC 3 requirements.

Resolution: CDPHE, after reviewing information regarding the proposed soil disturbance and excavation and after consultation with EPA, will approve, approve with modification, or disapprove the proposed activity. CDPHE will determine whether the proposed activity: (1) will not compromise or impair the function of the remedy or (2) will result in an unacceptable release or exposure to residual subsurface contamination. CDPHE will also determine whether the proposed project meets the rationale and objectives of IC 2, 3 and 6.

CDPHE approved the proposed activity stated in this CR on July 28, 2015.

The work will be conducted after CDPHE's approval, but DOE will not conduct the approved soil disturbance until 10 calendar days after this Contact Record is posted on the Rocky Flats site's website and stakeholders are notified of the posting in accordance with the RFLMA Public Involvement Plan.

Progress and the completion of the work will be reported by DOE in RFLMA quarterly and annual reports of surveillance and maintenance activities for the period(s) in which these activities occur.

Closeout of Contact Record: This CR will be closed when the work is completed, post-construction reseeding has been performed, and post-construction erosion controls are in place.

Contact Record Prepared by: David Ward, John Boylan, and Kurt Franzen.

Distribution:
Carl Spreng, CDPHE
Vera Moritz, EPA
Scott Surovchak, DOE
Linda Kaiser, SN3
Rocky Flats Contact Record File

Attachment 1

Rocky Flats Legacy Management Agreement Soil Disturbance Review Plan

Proposed Project: Soil Disturbance Review Plan (SDRP) for Implementation of Interim Action to Reestablish Surface Water Management on Portions of the Original Landfill (OLF)

This SDRP provides information required by Rocky Flats Legacy Management Agreement (RFLMA) Attachment 2, "Legacy Management Requirements," Section 4.1, "Soil Disturbance Review Plan," regarding the work proposed by DOE.

<u>Description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.</u>

The purpose of the proposed project is to regrade portions of the OLF cover and East Perimeter Channel (EPC) and to reduce the slope grades in this area to improve slope stability and improve or reestablish drainage features to minimize the potential for infiltration of precipitation in the short term.

Contact Record (CR) 2015-06 Figure 1 shows the location and the lateral extent of the planned regrading, excavation, and soil disturbance. Laying back the largest scarp to achieve a shallower and more uniformly sloping configuration will require a cut of approximately 6 feet. Regrading the face of the cover as noted on CR 2015-06 Figure 1 will require a 3-foot cut at the edge of the waste footprint and in the EPC. The pothole indicated on CR 2015-06 Figure 1 will be approximately 25 feet deep.

<u>Information about any remaining subsurface structures in the vicinity of the proposed project (or state that there are none if that is the case).</u>

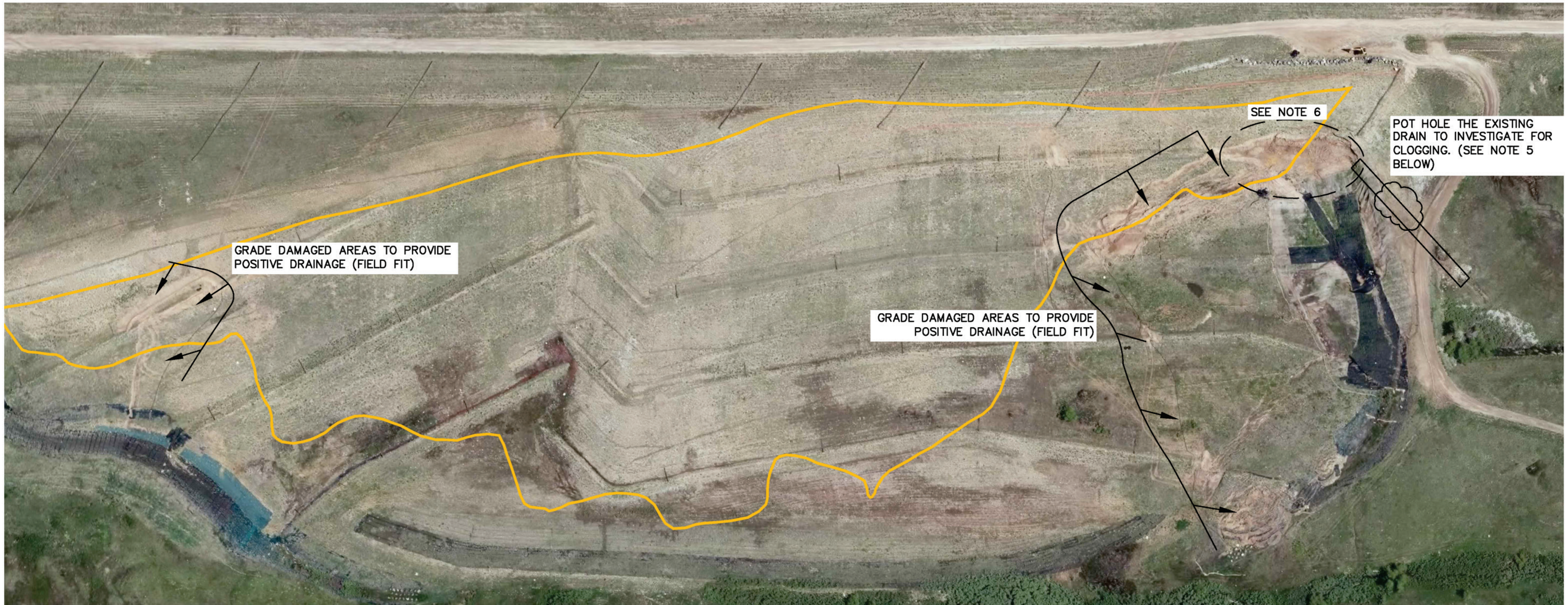
There are no remaining subsurface structures in the vicinity of the proposed project. An abandoned buried natural gas line operated by Xcel Energy is in the utility easement corridor north of the OLF. The location and alignment of this abandoned line is well known and marked with signs. It is well outside of the soil disturbance area.

<u>Information about any former Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern, or other known or potential soil or groundwater contamination in the vicinity of the proposed project.</u>

The OLF is former IHSS 115. The OLF design had a 2-foot-thick soil cover over the location of the disposed waste materials and clean Rocky Flats Alluvium fill surrounding the waste materials for the placement and configuration of storm water and seep water management features. Limits of the waste area are shown in Contact Record 2015-06 Figure 1.

The project area is in the Upper Woman Drainage Exposure Unit (EU) evaluated in the Comprehensive Risk Assessment, Appendix A, of the Remedial Investigation/Feasibility Study. The only contaminants of concern (COCs) identified for this EU are benzo[*a*]pyrene and dioxins/furans for surface soil/surface sediment.

Dioxin/furan concentrations were converted to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) toxicity equivalents (TEQs) for COC screening and risk characterization. Noncancer risks for benzo[a]pyrene and 2,3,7,8-TCDD TEQ were not evaluated because those COCs do not have noncancer toxicity values. Risks were calculated for benzo[a]pyrene and 2,3,7,8 TCDD TEQ. The estimated Tier 1 total excess lifetime cancer risk to the wildlife refuge worker at the EU is 8E-06, and the Tier 2 risk is 4E-06.



GENERAL NOTES:

1. EXISTING TRM AND COCONUT MAT IN THE EAST PERIMETER CHANNEL TO BE REMOVED AND DISPOSED AT A LOCAL LANDFILL. INSTALL NEW EROSION CONTROL AND SEED ON ALL DISTURBED AREA PER CONTRACTOR DIRECTION.
2. GRADE DAMAGED AREAS TO A UNIFORM SURFACE AND SLOPE FREE OF "DAMS" AND OBSTRUCTIONS.
3. ALL LOW SPOTS THAT RECEIVE NEW GRADING SHALL BE COMPACTED BY WHEEL ROLLING A MINIMUM OF ONE PASS.
4. THE EXISTING PIPING CAN BE RE-PURPOSED TO EXTEND DOWN THE INVERT OF THE CHANNELS CREATED BY THE NEW BERMS. THE SOIL DAMS SHOULD REMAIN TO DISCOURAGE WATER FROM BYPASSING THE PIPE AND FLOWING DIRECTLY ACROSS THE OLF SOILS. A SERIES OF ROCK DAMS COULD BE PLACED OVER THE PIPE AT INTERVALS OF 30-50 FEET TO ENSURE THAT PIPING REMAINS IN PLACE UNTIL A LONGER TERM SOLUTION IS DESIGNED AND IMPLEMENTED.
5. THE "DAMS" SHOULD CONSIST OF FREE DRAINING, WASHED ROCK 3" OR LESS IN NOMINAL DIAMETER WITH LESS THAN 5% PASSING THE NO. 8 SIEVE. THE PIPE AND BERMS SHOULD SLOPE ON THE ORDER OF 10 PERCENT OR MORE TO RAPIDLY CONVEY WATER ACROSS THE DISTRESSED AREA TO THE EPC.
6. EXCAVATE APPROXIMATELY PERPENDICULAR TO THE LONGITUDINAL AXIS OF THE DRAIN, WEST OF THE ROAD (SEE SKETCH). IF WATER IS FOUND IN THE POT HOLED AREA, THE EXCAVATION SHOULD BE GRADED TO DRAIN OR DRAIN PIPE SHOULD BE INSTALLED TO ALLOW ALL WATER TO DRAIN OUT.
7. SLOPE THE SCARP BY EXCAVATING UP TO 6' IN DEPTH AND 20' HORIZONTAL, PLACING THE EXCAVATED SPOILS AT THE TOE OF SCARP TO CREATE A CONTINUOUS SLOPE (FIELD FIT).
8. EXCAVATION INSIDE THE WASTE BOUNDARY SHALL NOT EXCEED 3FT BELOW EXISTING GRADE (EXCEPT FOR THE SCARP ABOVE THE EAST PERIMETER CHANNEL AND POT HOLING THE EAST SUBSURFACE DRAIN).

Figure 1

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2015-10

Purpose: Area of Concern Well 10304 Reportable Condition

Contact Record Approval Date: December 16, 2015

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); John Boylan, Linda Kaiser, David Ward, Navarro Research and Engineering, Inc. (Navarro)

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: December 1, 2015

Consultation Meeting Participants: Carl Spreng, CDPHE; Scott Surovchak, DOE

Background: The *Rocky Flats Legacy Management Agreement* (RFLMA) defines several categories of groundwater monitoring wells at the Rocky Flats Site. Of these, Area of Concern (AOC) wells have reportable conditions defined. AOC wells are located within a drainage and downgradient of one or more contaminant plumes and are monitored semiannually to determine whether the plume(s) may be impacting surface water quality. The primary objective of AOC well 10304 is to evaluate groundwater quality adjacent to Woman Creek, downgradient of the 903 Pad/Ryan's Pit Plume.

As discussed in the *Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2015* (DOE 2015), a groundwater sample collected on May 7, 2015, from well 10304 contained an elevated concentration of trichloroethene (TCE). The RFLMA water-quality standard, set forth in Attachment 2, Table 1 to the RFLMA, is 2.5 micrograms per liter (µg/L); the concentration in this sample was 15 µg/L. While TCE (and other volatile organic compounds [VOCs]) has been detected previously in samples from well 10304, it has not been reported in samples from this well at concentrations exceeding the RFLMA standard. A non-RFLMA confirmatory sample was collected on June 17 to assess whether this result might be erroneous; the TCE result in that second sample was 5.4 µg/L.

As outlined in RFLMA Attachment 2, Figure 7, a reportable condition for an AOC well exists when two consecutive, routine, semiannual samples contain the same analyte at concentrations exceeding the corresponding RFLMA standard. The fourth-quarter sample collected from well 10304 on October 29, 2015, contained a TCE concentration of 72 µg/L. This represents the second consecutive semiannual result above the RFLMA standard, and therefore, a reportable condition exists for AOC well 10304.

Per RFLMA, within 15 days of receiving validated data defining a reportable condition, DOE must notify the agencies. Within 30 days of that date, DOE will provide a plan and schedule to the regulators for an evaluation to address the occurrence. A consultation will follow and mitigating actions, if any, implemented thereafter.

Discussion: The potential for a reportable condition was noted in the above-referenced quarterly report for the second quarter of 2015. In fact, such a condition is anticipated during wet years, as described in the *Final Interim Measure/Interim Remedial Action for Groundwater at the Rocky Flats Environmental Technology Site* (Groundwater IM/IRA) (Kaiser-Hill 2005) and in the report on fate and transport modeling for VOCs (see *Fate and Transport Modeling of VOCs at the Rocky Flats Environmental Technology Site* [Kaiser-Hill 2004]). The Groundwater IM/IRA notes that "the downgradient portion of this plume only has the ability to impact surface water in wet years" (p. 6-31). The referenced modeling report concludes that groundwater from this plume may discharge to Woman Creek under conditions of higher-than-normal precipitation and notes that concentrations of TCE, in particular, in groundwater reaching Woman Creek may exceed standards. Therefore, given that 2015 has been an exceptionally wet year, the TCE results reported for AOC well 10304 are not unexpected. Installation of a groundwater treatment system downgradient of the 903 Pad/Ryan's Pit Plume was considered as part of site closure; however, due to the infrequency with which it would be needed (in the 10 years since site closure, this is the first year treatment might have been considered) and the costs and effort required to operate and maintain such a system, it was not required as part of the selected remedy/correction action to ensure that the site remain protective of human health and welfare and the environment.

DOE verbally informed CDPHE of the results from the fourth-quarter sample the same day validation was completed, on December 1, 2015. The plan for evaluating this occurrence was discussed at the same time. An email notification to EPA and CDPHE followed on December 3, 2015.

This Contact Record describes the plan and schedule to address the reportable condition.

- A grab sample will be collected from Woman Creek downgradient/downstream and in the vicinity of well 10304 to evaluate the potential for VOC-contaminated groundwater to adversely affect surface water quality in this reach of Woman Creek. The location of the sample will be determined based on a field walkdown and will be suitable and convenient for sample collection while still being downgradient of the plume and in the immediate vicinity of the well.
- When the results of the surface water sample are available, there will be further consultation.
- Grab samples will be collected from this Woman Creek surface water location each time AOC well 10304 is sampled, until water quality at the well is no longer reportable.

Analytical results from these samples will be included in the corresponding quarterly and annual reports.

Resolution: CDPHE, after consultation with EPA, will approve, approve with modification, or disapprove this contact record.

After completion of the approval process and incorporation of any required changes CDHPE approved this contact record.

Closeout of Contact Record: This contact record will be closed when the water quality at well 10304 is no longer reportable.

Contact Record Prepared by: John Boylan, David Ward, Navarro

Distribution:
Carl Spreng, CDPHE
Scott Surovchak, DOE
Vera Moritz, EPA
Linda Kaiser, Navarro
Rocky Flats Contact Record File

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2016-02

Purpose: Mound Site Plume Treatment System reconfiguration project Soil Disturbance Review Report and Explanation of Significant Differences

---

Contact Record Approval Date: June 15, 2016

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); Kurt Franzen, Linda Kaiser, and David Ward, Navarro Research and Engineering, Inc. (Navarro)

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: January 14, January 20, and February 18, 2016

Consultation Meeting Participants: Scott Surovchak, DOE; Carl Spreng, CDPHE; Vera Moritz, EPA; Linda Kaiser, John Boylan, George Squibb, Jody Nelson, Michelle Hanson, David Ward, Navarro

---

Introduction:
During the Rocky Flats Legacy Management Agreement (RFLMA) consultation on February 18, 2016, the Colorado Department of Public Health and Environment (CDPHE), the U.S. Environmental Protection Agency (EPA), and the U.S. Department of Energy (DOE) (jointly referred to as the RFLMA Parties) agreed the Mound Site Plume Treatment System reconfiguration project represents a significant change to the *Corrective Action Decision/Record of Decision for the Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit, Jefferson and Boulder Counties, Colorado* (CAD/ROD) signed September 29, 2006 (available at http://www.lm.doe.gov/Rocky_Flats/Regulations.aspx). It was also determined that the RFLMA process of documenting the RFLMA Parties' decisions as contact records in the Administrative Record, posting those contact records on the Rocky Flats public website, and notifying area stakeholders by email of the posting fulfills the process outlined in Title 40 *Code of Federal Regulations* Section (40 CFR) 300.435(c)(2)(i) for announcing an Explanation of Significant Differences (ESD) except for providing a notice of availability of the ESD in a local newspaper. Therefore, a notice of this contact record and ESD will be posted in the *Denver Post* to fulfill this ESD requirement.

Lead and Support Agencies: As outlined in the RFLMA the Parties follow a consultative process for implementing the agreement. As stated in the agreement:

> "Consultation" and "the consultative process" mean the responsibility of one Party to meet and confer with another Party and any appropriate contractors in order to reach agreement, to the extent possible, regarding a proposed course of action.

This contact record/ESD addresses the components of CAD/ROD as it concerns the contaminated groundwater collected and treated by the Mound Site Plume Treatment System (MSPTS). As agreed in the RFLMA and a Memorandum of Understanding between CDPHE and EPA, CDPHE is the lead agency with EPA as the support agency for this course of action.

This contact record/ESD documents a significant difference to the selected remedy in the CAD/ROD for the MSPTS and was prepared in accordance with Section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and with 40 CFR 300.435(c)(2)(i). The EPA Superfund Identification Number for Rocky Flats is CO7890010526.

This contact record/ESD will be available on the Rocky Flats public website at http://www.lm.doe.gov/Rocky_Flats/Sites.aspx. This contact record/ESD also will become part of the Rocky Flats site Administrative Record, which is available on the CERCLA Administrative Records search webpage at http://www.lm.doe.gov/CERCLA/SiteSelector.aspx 24 hours a day, 7 days a week. (On that webpage, select **Rocky Flats Site** from the drop-down list and then click the **Search the Administrative Record** button.) Also available on the Rocky Flats public website is a Rocky Flats Site Fact Sheet that provides a brief summary of contamination and site history.

Basis for the Document:
As discussed in RFLMA Contact Record (CR) 2015-04 dated July 8, 2015, the MSPTS described in the CAD/ROD includes a groundwater intercept trench, treatment components, and a subsurface discharge gallery. Groundwater collected in the trench flows by gravity through two plastic treatment cells (approximately 10 feet in diameter and 11.5 feet tall) filled with zero-valent iron (ZVI) treatment media. The ZVI is obtained from a source in Detroit, Michigan, and is trucked to the site for installation. Periodically, exhausted ZVI media must be removed and replaced, which is costly and labor intensive and requires the use of heavy construction equipment. The initial estimate of the frequency of media replacement was every 5–10 years. The most recent MSPTS media replacement was performed in 2010–2011. Based on historical operations of the MSPTS and analytical data from the water being treated, it may be more appropriate to perform routine media replacement every 4–5 years.

As stated in the CAD/ROD and the Final Mound Site Plume Decision Document (March 1994) the MSPTS was initially designed to simply reduce contaminant load to surface water. However, with the subsequent implementation of the RFLMA, effluent from the MSPTS was evaluated against the surface water quality standards listed in RFLMA Attachment 2, Table 1. Because the MSPTS system effluent typically contains one or more volatile organic compound (VOC) constituents at levels above RFLMA standards, the RFLMA Parties have consulted on ways to optimize treatment to further reduce the potential VOC contaminant load to surface water (RFLMA CR 2010-07 dated November 2, 2010). In 2011, a solar-powered pump was installed in the existing MSPTS effluent manhole to circulate water from the bottom of the manhole through a spray nozzle (also situated within the effluent manhole) to further treat the effluent using the air-stripping process (RFLMA CR 2011-01 dated January 14, 2011). This has been extremely effective, but significant maintenance is required to maintain high treatment effectiveness, and even then at least one VOC typically exceeds the corresponding RFLMA Table 1 standard. In addition, the presence of this air stripper does not substantially affect the requirement to replace the ZVI media periodically, since the upstream media removes most of the VOCs treated at the MSPTS.

The positive results of the MSPTS effluent manhole air stripper, together with additional testing at the MSPTS and East Trenches Plume Treatment System (ETPTS), eventually led DOE to install a commercial air stripper, adapted to the existing solar/battery power facility, at the ETPTS in 2014–2015. Like the MSPTS, the ETPTS was initially designed to reduce VOC load but was subsequently evaluated against the stricter requirements of the RFLMA standards. Even with fresh ZVI media, these targets were typically not met. A commercial air stripper at the ETPTS replaced the ZVI-based treatment, as documented in RFLMA CR 2012-02 dated October 25, 2012; RFLMA CR 2014-01 dated January 21, 2014; and RFLMA CR 2014-04 dated February 19, 2014. In contrast to the water quality of the ZVI-treated effluent, following completion of the air-stripper installation in January 2015, concentrations of VOCs in ETPTS effluent have met all corresponding RFLMA Table 1 standards (*Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2015* [April 2016]). The more effective contaminant treatment resulting from this change will better protect the water quality in South Walnut Creek, including when groundwater flows increase due to significant precipitation events like those in September 2013 and during the wet spring of 2015.

Information on the status of operation and performance of the MSPTS and ETPTS is provided in RFLMA quarterly and annual site surveillance and maintenance reports. RFLMA contact records and site surveillance and maintenance reports are available on the Rocky Flats public website at http://www.lm.doe.gov/rocky_flats/Sites.aspx.

Description of Significant Differences:
The significant difference is the change in the location of groundwater treatment of the Mound Site plume from the MSPTS to the ETPTS. The remedy selected in the CAD/ROD for Mound Site Plume VOC-contaminated groundwater was a passive system using a groundwater intercept trench and treatment for VOC removal at the intercept location. This approach was used at both the ETPTS and the MSPTS. This contact record/ESD changes the treatment of VOC contaminated groundwater collected at the MSPTS to the existing commercial air stripper located at the ETPTS. Therefore, this action will incorporate the water intercept components of two systems (the MSPTS and ETPTS) and treat the combined water with one, more effective treatment component (the air stripper at the ETPTS). This will require the construction of an approximately 1600-foot water transfer line from the MSPTS to the ETPTS influent manhole (see Figure 1), which will transport water collected at the MSPTS to the ETPTS for treatment.

Because the MSPTS itself will no longer perform water treatment but will still perform water collection, the associated MSPTS effluent monitoring location will no longer be applicable. Essentially, combining the two treatment systems into one will require a monitoring change in RFLMA, as identified in RFLMA CR 2015-04 dated July 8, 2015. The MSPTS effluent monitoring location will be changed from MOUND R2-E to the combined ETPTS and MSPTS effluent monitoring location, currently labeled ET EFFLUENT.

Based on DOE's evaluation of the combined ETPTS and MSPTS influent VOC concentrations and flow rates, the amounts and types of VOCs that the air stripper will volatilize to the air will remain below the requirements of an Air Pollutant Emission Notice (APEN) under the Colorado Air Quality Regulations. Therefore, an APEN will not be required.

Discussion:
The design of the infrastructure required to implement the MSPTS reconfiguration project is complete. The design routes the collected groundwater at the MSPTS to the ETPTS influent manhole (see Figure 1). The existing MSPTS ZVI-filled treatment cells will be emptied and modified for optional groundwater storage. The existing MSPTS effluent manhole will be replaced with a lift station and pump. Water intercepted by the MSPTS groundwater intercept trench will flow to this new lift station, and will then be pumped in batches to the ETPTS influent manhole through an approximately 1600-foot-long transfer line. The combined MSPTS and ETPTS influents will then flow to the ETPTS Influent Tank, from which the water will be pumped (in batches) to the ETPTS air stripper for treatment (as is currently the case with ETPTS influent).

Additional solar and battery power will be added to the existing ETPTS power facility to enable the air stripper to operate for longer periods, thereby treating the greater volume of water represented by the combined ETPTS and MSPTS influents. The additional batteries will be installed within the existing conex, which houses the existing batteries and acts as the platform for the main solar panel array. The additional solar resources will include two pole-mounted solar panel arrays. Each of these pole-mounted arrays will require a concrete foundation (see Figure 1) set in an excavation that will be approximately 4 feet by 4 feet and 9 feet deep. Piping, valves, instrumentation, and other necessary components will be installed at the existing MSPTS. These components will require an excavation approximately 6 to 10 feet deep, 10 feet wide, and 20 feet long. The MSPTS lift station installation will require an excavation approximately 10 feet by 10 feet and 10 feet deep. The existing MSPTS solar array will not be disturbed; however, the battery box and associated concrete pad will be removed (to make way for the planned excavations and other work) and replaced with new components. All of these excavations are in pre-disturbed areas.

The transfer line between the MSPTS lift station and the ETPTS influent manhole will require excavating a trench approximately 1600 feet long, 2 feet wide, and 4 to 6 feet deep. Other, less intrusive appropriate installation methods, such as horizontal directional drilling, may be used. This trench will be installed as near to the southern edge of the ETPTS access road as practicable. Depths will vary to ensure the proper gradient is maintained. Pipe cleanouts will be installed every 200 feet, and a bollard will be installed adjacent to the transfer line at each cleanout for protection.

As described above, this excavation work will exceed the 3-foot depth limit specified in RFLMA institutional control (IC) 2 (RFLMA, Attachment 2, Table 4, Control 2) as shown in Table 1 below, and so the required Soil Disturbance Review Plan is being submitted with this contact record for regulatory approval.

Table 1. IC 2 from RFLMA, Attachment 2, Table 4, "Institutional Controls for the Central Operable Unit"

Controls	Use Restrictions
IC 2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central OU [Operable Unit], and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.

The required Soil Disturbance Review Plan is in Attachment 1.

The MSPTS is expected to be shut down for several weeks to accomplish the work. Any water that interferes with the construction activities will need to be managed during the performance of the project. Treated water that is present within the treatment cells when the MSPTS is taken offline will be pumped out to the MSPTS effluent discharge gallery. Groundwater seeping into the excavation at the MSPTS will be pumped to the ground upgradient (generally south) of the MSPTS so that it may infiltrate and be recollected by the MSPTS groundwater intercept trench. If water that collects in the MSPTS intercept trench needs to be managed to reduce the water level in the trench, it will be transferred to the East Trenches Plume Treatment System as discussed in RFLMA CR 2011-01 or pumped upgradient of the MSPTS intercept trench. The ETPTS will also be shut down, for a shorter period, to complete electrical work and to connect the transfer line into the EPTTS influent manhole. The ETPTS groundwater intercept trench will store this water during that outage.

Rainfall and storm water run-on water that enters the trench excavated for the transfer line will be pumped to ground in a manner that is consistent with the site's approved erosion control plan. Groundwater seeping into that portion of the excavation that is generally upgradient (south) of the ETPTS intercept trench will be either (1) pumped to ground upgradient of the ETPTS intercept trench in a manner consistent with the site's approved erosion control plan or (2) containerized and decanted in the ETPTS Influent Tank for treatment.

Resolution: CDPHE has reviewed information regarding the proposed soil disturbance and excavation and, after consulting with EPA, has approved this proposed activity. CDPHE has determined that the proposed activity will not compromise or impair the function of the remedy or result in an unacceptable release or exposure to residual subsurface contamination. CDPHE has also determined that the proposed project meets the rationale and objectives of IC 2. EPA has determined the modified remedy continues to satisfy the requirements of CERCLA Section 121.

Considering the changes that have been made to the selected remedy, CDPHE and EPA have determined the remedy remains protective of human health and the environment, complies with federal and state requirements that were identified in the CAD/ROD as applicable or relevant and appropriate to the remedial action at the time the CAD/ROD was signed and is cost-effective. In addition, the revised remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable for the site.

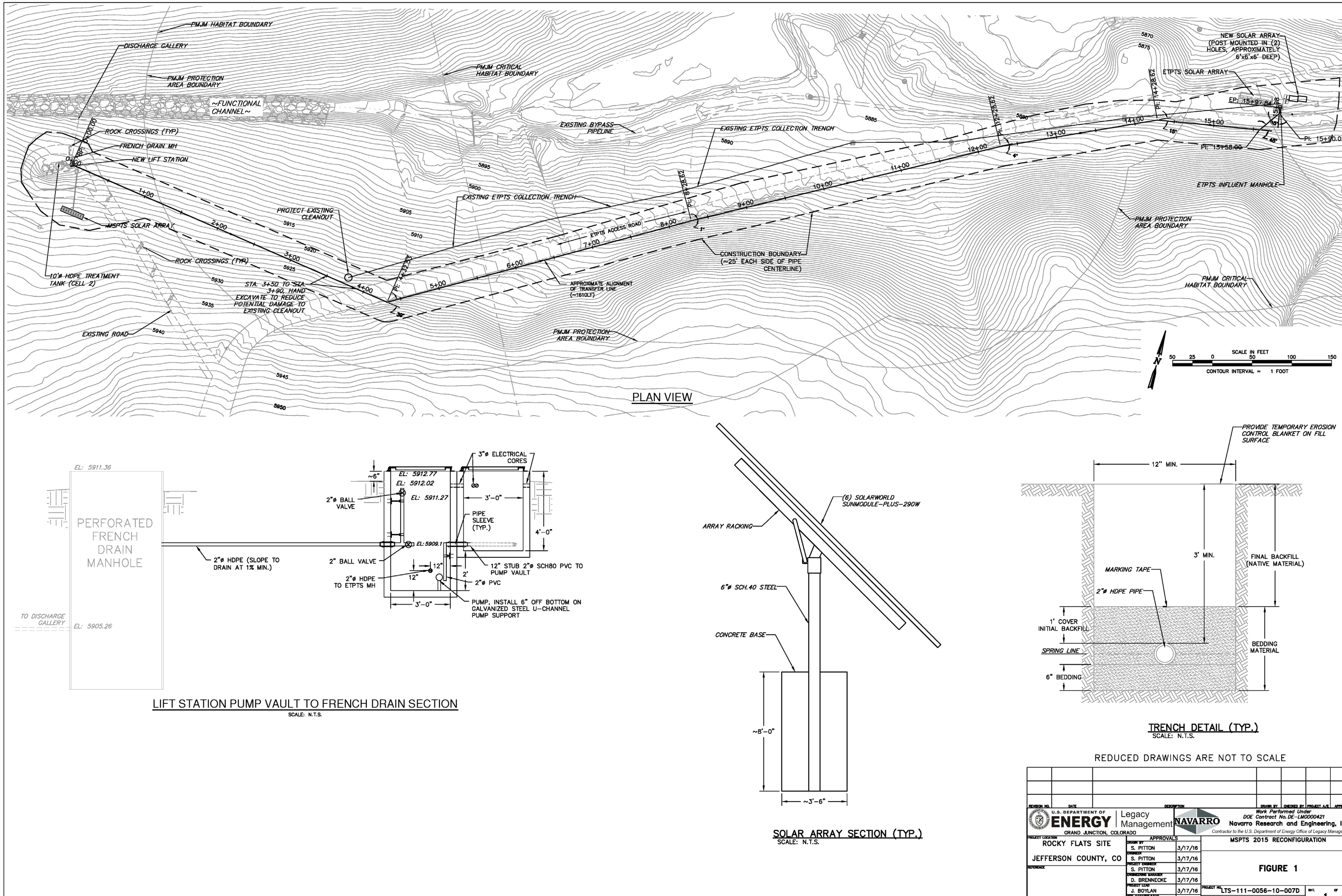
The work will not start until after CDPHE's approval, and in any case DOE will not begin the approved soil disturbance until 10 calendar days after this contact record is posted on the Rocky Flats site public website and stakeholders are notified of the posting in accordance with the RFLMA Public Involvement Plan.

Closeout of Contact Record: This contact record will be closed when the work is completed and post-construction revegetation and erosion controls are in place.

Contact Record Prepared by: David Ward and John Boylan, Navarro

---

Distribution:
Carl Spreng, CDPHE
Scott Surovchak, DOE
Vera Moritz, EPA
Linda Kaiser, Navarro
Rocky Flats Contact Record File
Rocky Flats Administrative Records


PMJM HABITAT BOUNDARY
DISCHARGE GALLERY
PMJM PROTECTION AREA BOUNDARY
~FUNCTIONAL CHANNEL~
PMJM CRITICAL HABITAT BOUNDARY
EXISTING BYPASS PIPELINE
EXISTING ETPTS COLLECTION TRENCH
ROCK CROSSINGS (TYP)
FRENCH DRAIN MH
NEW LIFT STATION
MSPTS SOLAR ARRAY
10'ø HDPE TREATMENT TANK (CELL 2)
ROCK CROSSINGS (TYP)
EXISTING ROAD
PROTECT EXISTING CLEANOUT
STA. 3+50 TO STA. 3+90, HAND EXCAVATE TO REDUCE POTENTIAL DAMAGE TO EXISTING CLEANOUT
ETPTS ACCESS ROAD
APPROXIMATE ALIGNMENT OF TRANSFER LINE (~1610LF)
CONSTRUCTION BOUNDARY (~25' EACH SIDE OF PIPE CENTERLINE)
PMJM PROTECTION AREA BOUNDARY
NEW SOLAR ARRAY (POST MOUNTED IN (2) HOLES, APPROXIMATELY 6'x6'x6' DEEP)
ETPTS SOLAR ARRAY
EP: 15+97.84
PI: 15+90.02
PI: 15+58.00
ETPTS INFLUENT MANHOLE
PMJM CRITICAL HABITAT BOUNDARY
SCALE IN FEET
CONTOUR INTERVAL = 1 FOOT
PLAN VIEW
EL: 5911.36
PERFORATED FRENCH DRAIN MANHOLE
TO DISCHARGE GALLERY
EL: 5905.26
2"ø HDPE (SLOPE TO DRAIN AT 1% MIN.)
2"ø BALL VALVE
EL: 5912.77
EL: 5912.02
EL: 5911.27
3"ø ELECTRICAL CORES
3'-0"
4'-0"
PIPE SLEEVE (TYP.)
EL:5909.1
2" BALL VALVE
2"ø HDPE TO ETPTS MH
12" STUB 2"ø SCH80 PVC TO PUMP VAULT
2"ø PVC
PUMP, INSTALL 6" OFF BOTTOM ON GALVANIZED STEEL U-CHANNEL PUMP SUPPORT
LIFT STATION PUMP VAULT TO FRENCH DRAIN SECTION
SCALE: N.T.S.
ARRAY RACKING
(6) SOLARWORLD SUNMODULE-PLUS-290W
6"ø SCH.40 STEEL
CONCRETE BASE
~8'-0"
~3'-6"
SOLAR ARRAY SECTION (TYP.)
SCALE: N.T.S.
PROVIDE TEMPORARY EROSION CONTROL BLANKET ON FILL SURFACE
12" MIN.
3' MIN.
FINAL BACKFILL (NATIVE MATERIAL)
MARKING TAPE
2"ø HDPE PIPE
1' COVER INITIAL BACKFILL
SPRING LINE
6" BEDDING
BEDDING MATERIAL
TRENCH DETAIL (TYP.)
SCALE: N.T.S.
REDUCED DRAWINGS ARE NOT TO SCALE
U.S. DEPARTMENT OF ENERGY
Legacy Management
GRAND JUNCTION, COLORADO
NAVARRO
Work Performed Under DOE Contract No. DE-LM0000421
Navarro Research and Engineering, Inc.
Contractor to the U.S. Department of Energy Office of Legacy Management
ROCKY FLATS SITE
JEFFERSON COUNTY, CO
APPROVALS
S. PITTON 3/17/16
S. PITTON 3/17/16
S. PITTON 3/17/16
D. BRENNECKE 3/17/16
J. BOYLAN 3/17/16
L. KAISER 3/17/16
MSPTS 2015 RECONFIGURATION
FIGURE 1
LTS-111-0056-10-007D
1 1

Attachment 1

Rocky Flats Legacy Management Agreement (RFLMA)
Soil Disturbance Review Plan (SDRP)

Proposed Project: Mound Site Plume Treatment System (MSPTS) reconfiguration project.

This SDRP provides information required by RFLMA Attachment 2, "Legacy Management Requirements," Section 4.1, "Soil Disturbance Review Plan," regarding the work proposed by DOE.

(1) Description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.

The MSPTS is being reconfigured such that intercepted groundwater will be transferred to the ETPTS for treatment, rather than being treated at the MSPTS. This is because the commercial air stripper installed in 2014–2015 at the ETPTS is much more effective at removing contaminants than is the ZVI originally used to treat the water (and still in use at the MSPTS). The reconfiguration project will require excavating around the MSPTS treatment cells and effluent manhole to make plumbing modifications and to replace the effluent manhole with a lift station; excavating and installing a water transfer line from this lift station to the ETPTS influent manhole; and excavating at the ETPTS solar/battery power facility to install two new pole-mounted solar arrays. Excavations will range from approximately 4 feet to 6 feet deep for lift station and pipe trench and 9 feet deep for the solar array foundations. See Figure 1, attached, for additional information.

(2) Information about any remaining subsurface structures in the vicinity of the proposed project.

Other than components of the MSPTS and ETPTS, there are no remaining subsurface structures in the vicinity, so cover assumptions will not be violated.

(3) Information about any former Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern, or other known or potential soil or groundwater contamination in the vicinity of the proposed project.

This construction area was not an IHSS. In the *Facility Investigation - Remedial Investigation/Corrective Measures Study - Feasibility Study Report for the Rocky Flats Environmental Technology Site* (June 2006), the figures in Section 3, "Nature and Extent of Soil Contamination," do not indicate soil contamination in this area. Groundwater in some (not all) of the areas involved in this construction work is impacted by the Mound Site and East Trenches plumes. Any groundwater that is encountered in an excavation will be managed as described in CR 2016-02.

(4) Resurvey any new surface established in subsurface soil, unless sufficient existing data is available to characterize the surface (or state that the excavated soil will be replaced and the original contours restored).

The lift station at the MSPTS will be installed in the approximately 10-foot × 10-foot × 10-foot deep excavation, and the surrounding area will be graded to approximately 6 inches below the top of the vault walls. The excavations for the new pole-mounted PV solar arrays at the ETPTS power facility will be filled with concrete and the surrounding surface will be returned to the existing grade or higher. All excavations for pipe and valve installations will be returned to grade. Therefore the area will be returned to its approximate original contours.

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2017-02

Purpose: Reportable condition for evaluation purposes for uranium at Walnut Creek Point of Compliance (WALPOC).

Contact Record Approval Date: March 6, 2017

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); George Squibb, Linda Kaiser, David Ward, Navarro Research and Engineering, Inc. (Navarro)

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: January 31 and February 28, 2017

Consultation Meeting Participants: Carl Spreng, CDPHE; Scott Surovchak, DOE

Discussion: A reportable condition occurred at surface water Point of Compliance (POC) WALPOC (sampling location identification) at the Rocky Flats Site, based on an evaluation of validated analytical results for uranium from the composite sample collected during the period of 9:29 a.m. on June 16, 2016, to 11:40 a.m. on January 3, 2017.

The evaluation was performed in accordance with *Rocky Flats Legacy Management Agreement* (RFLMA) Attachment 2, Figure 5, “Points of Compliance,” and resulted in a calculated 30-day average concentration for uranium of 16.9 micrograms per liter (µg/L) on December 8, 2016. This concentration exceeds the RFLMA-applicable Table 1 standard of 16.8 µg/L for uranium. Validated results were received on January 30, 2017.

Pursuant to RFLMA Attachment 2, Section 6.0, “Action Determinations,” a reportable condition necessitates the following actions:

- DOE must submit a plan and schedule for an evaluation to address the condition within 30 days of receiving the validated data for the reportable condition.
- DOE will consult with CDPHE and EPA to determine if mitigating actions are necessary.
- The objective of the consultation will be to determine a course of action (if necessary) to address the reportable condition and to ensure that the remedy remains protective.
- The results of the consultation will be documented in contact records, written correspondence, or both.

Representatives of CDPHE and DOE discussed this result on January 31, 2017, and February 28, 2017, and developed a path forward. Formal notification to the regulatory agencies and the public—in accordance with RFLMA Attachment 2, Figure 5—was made by email on February 3, 2017. This contact record documents DOE's consultation with CDPHE on January 31, 2017, and February 28, 2017.

The RFLMA Parties agreed on the evaluation steps described below and agreed that no mitigating actions are necessary at this time, for the following reasons:

- The remedy remains protective. The remedy standard for total uranium at the WALPOC sampling location is the calculated 12-month rolling average. Using the most recent validated data, the calculated 12-month rolling average at WALPOC for total uranium on December 31, 2016, is 11.5 µg/L and remains well below the 16.8 µg/L remedy performance standard.
- WALPOC has been a RFLMA monitoring location for roughly 5.5 years. During that period, the Site experienced one of its driest years (2012), its wettest month (September 2013), and one of its wettest springs (2015), according to precipitation data collected since 1990. Because uranium concentrations are influenced by changing environmental conditions, varying uranium concentrations at WALPOC are anticipated. While significant uranium concentration variability can be seen in both individual sample results and in the 30-day averages, the observed variability is not outside of anticipated ranges and remains well below 30 µg/L drinking water standard (i.e., the maximum contaminant level).
- Measured concentrations of total uranium at WALPOC include both naturally occurring and anthropogenic uranium. Previous high-resolution isotopic uranium analyses for WALPOC show signatures that are between 68−87 percent naturally occurring uranium.
- The variability of the uranium concentration influenced by environmental conditions was detailed in a study conducted by a qualified geochemistry subcontractor, the results of which were published in the *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site* (September 2015). This report can be found at https://www.lm.doe.gov/Rocky_Flats/Documents.aspx.
- Although the recent result was above the 16.8 µg/L Site standard, it remains well below the 30 µg/L drinking water standard for uranium. The 16.8 µg/L standard is a level at which there are no known or anticipated adverse effects on the health of a person, and is based on an adult weighing 70 kilograms consuming 2 liters of water per day for a lifetime. Because WALPOC has an intermittent flow of water and Walnut Creek is not a source of drinking water, there remains an adequate margin of safety. Therefore, the remedy remains protective of human health and the environment.

Plan and Schedule to Address the Reportable Condition: The RFLMA Parties agreed that steps described in this Contact Record shall serve as the plan and schedule for the evaluation.

The following steps have been or are being taken and will be utilized during the evaluation.

- Flow-paced composite samples routinely being collected at WALPOC will continue to be analyzed on a 2-week turnaround.
- High-resolution isotopic uranium analysis will be conducted on the most recent WALPOC samples to determine the percentages of natural and anthropogenic uranium for comparison to the historical data.
- DOE will provide CDPHE with a split sample from the next composite sample collected at WALPOC. That composite sample was started on January 30, 2017. This split sample will be analyzed for uranium by the State of Colorado.

DOE will report the results of continued monitoring, isotopic analysis, and of the subsequent evaluation in RFLMA quarterly and annual reports of surveillance and monitoring activities. This plan and schedule may be modified based on the outcome of RFLMA Party consultation related to the evaluation.

To keep the public informed, the outcome of continuing RFLMA Party consultation regarding the evaluation will be reported in RFLMA quarterly and annual reports of surveillance and monitoring activities or in subsequent contact records.

Resolution: CDPHE, after consultation with EPA, approves this contact record.

Closeout of Contact Record: This contact record will be closed when the results from the evaluation have been transmitted to CDPHE or as the RFLMA Party consultation related to this evaluation directs.

Contact Record Prepared by: George Squibb and David Ward, Navarro

---

Distribution:
Carl Spreng, CDPHE
Vera Moritz, EPA
Scott Surovchak, DOE
Linda Kaiser, Navarro
Documentation Determination
Records

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2017-03

Purpose: North Walnut Creek Slump 2017 Maintenance and Soil Disturbance Review Plan

Contact Record Approval Date: March 27, 2017

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); Jeremy Wehner, Linda Kaiser, and David Ward, Navarro Research and Engineering, Inc. (Navarro)

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: May 27, 2016; January 10, 2017; and February 6, 2017

Consultation Meeting Participants: Scott Surovchak and Jeff Murl, DOE; Carl Spreng and Lindsay Masters, CDPHE; Vera Moritz, EPA; Linda Kaiser, Jeremy Wehner, John Boylan, Michelle Hanson, George Squibb, Jody Nelson, Patty Gallo, and David Ward, Navarro

Related Contact Records: None

Introduction: The North Walnut Creek Slump (NWCS) was first observed as a surface crack prior to Rocky Flats Site (Site) closure. The hillside was identified as a "landslide deposit that consists of masses of earth and rock that have moved downslope as earthflows and slumps" in the Rocky Flats Solar Ponds Plume Treatment System (SPPTS) Geotechnical Investigation Report (Tetra Tech, October 2009). This feature is noted in *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2015* (2016) and is east of the SPPTS. The NWCS is threatening to damage some components of the SPPTS. The SPPTS collects and treats nitrate and uranium in contaminated groundwater from the former Solar Evaporation Ponds.

Slumps, such as the NWCS, are common on the hillsides at the Site and also along much of the Front Range of Colorado because of the local geology. The Rocky Flats Alluvium on the pediment surface typically overlays less permeable, low-strength claystone, and as water from precipitation infiltrates through the alluvium, it meets the claystone. Rather than continuing to move downward through the less permeable claystone material, this groundwater moves laterally on top of the claystone and often daylights as seeps on the hillsides. When above-average precipitation is received and the claystone beneath the steep hillsides adjacent to the pediment becomes saturated, slumping of the hillsides can occur.

The NWCS has existed for several years. Aerial photographs indicate it was present in the early 2000s, and anecdotal evidence suggests the slump crack was evident even prior to that time. This slump is of greater interest than most others on the Site because of its potential impact to subsurface and aboveground components of the SPPTS. Informal tracking of the slump movement began in the 2012 timeframe. In fall 2013 and again in spring 2015, the Site received above-average precipitation, after which substantial movement of the hillside at the NWCS was observed; that movement continued in 2016. The crack at the top of the slump, which until relatively recently showed only 1–2 feet of vertical displacement, now shows approximately 10 feet of vertical displacement in places (Figure 1), and lateral movement is also evident. As a result, several problem areas have been identified on the hillside.

- A critical component of the SPPTS is the subsurface groundwater collection trench (CT), which intercepts contaminated groundwater and routes it to the treatment components of the SPPTS. Most of this groundwater CT (the green line on Figure 1) is adjacent to the northern edge of the road to the SPPTS. The groundwater CT is approximately 1100 feet long and 20–30 feet deep; it consists of an impermeable barrier along its downgradient side, and along its length is a 4-inch-diameter perforated pipe bedded in sand above a bentonite layer on the upgradient side of the barrier. Small cracks have been observed as far south as the north edge of the road, potentially indicating movement in the vicinity of the groundwater CT. If the top of the slump is allowed to migrate southward, this could potentially damage the groundwater CT.
- Also present in the subsurface of this hillside is the preexisting and more extensive Interceptor Trench System (ITS) composed of 4-inch-diameter perforated pipes seated in gravel (the system of orange lines on Figure 1). This ITS also collects groundwater from the hillside. Part of the ITS is intercepted by the SPPTS groundwater collection trench, as described above and illustrated on Figure 1. The parts of the ITS that are beyond the SPPTS trench (to the northeast and downgradient) feed water to the Interceptor Trench System Sump (ITSS), which pumps collected water up the hill to the SPPTS treatment components. Given the location of the NWCS in relation to the ITS, it is possible that a portion of the ITS may be damaged or broken as a result of the movement on the hillside.
- Some cracking and uplifting of the soils are now observed directly adjacent to some of the ITSS components in the valley bottom (Area #5 on Figure 1), suggesting that parts of the ITSS may be at risk from further movement of the slump.
- The road used for access to the ITSS components of the SPPTS (in the valley bottom near the stream) has been destroyed by vertical and horizontal displacement, and it has been buried by part of the slump (Area #3 on Figure 1). As a result, vehicle access is no longer possible and maintenance must be conducted on foot. This creates potential health and safety issues and also limits possible activities to those that can be achieved by hand-carrying maintenance equipment into the area. At some point, heavy items that cannot be manually transported, such as the batteries that connect to the solar panels to power the ITSS pump, will need to be replaced. Vehicle access needs to be restored (Area #3 on Figure 1).
- A different slump (referred to as the Road Slump) near the intersection of the SPPTS and ITSS Roads is threatening the road and must be repaired and recontoured (Area #2 on Figure 1).
- At the toe of the main part of the NWCS, *Rocky Flats Legacy Management Agreement* (RFLMA) groundwater monitoring well B210489 is also threatened by the toe of the slump (Area #4 on Figure 1).

Discussion:
In order to prevent damage to the SPPTS and the other infrastructure, the NWCS area will be the subject of a series of activities, from investigation (such as evaluating groundwater distribution and characteristics and evaluating subsurface soil conditions) to repairs (such as regrading, adding or restoring groundwater collection components, and others as warranted). The initial action planned for early 2017 is intended to minimize further slumping resulting from precipitation and investigate soil and groundwater characteristics for a slope stabilization analysis. The slope stabilization analysis will be utilized to develop future projects in this area. The actions addressed in this contact record are the following:

- Use a Geoprobe at multiple locations upgradient of the slump and in the slump area to evaluate groundwater characteristics and bedrock depth. The expected average depth of the Geoprobe boreholes is approximately 20 feet. Temporary piezometers may be installed in these boreholes.
- Conduct geophysical testing of the slopes and slump area to attempt to identify depth to bedrock and attempt to locate ITS lines prior to construction activities (i.e., grading, excavating, or other intrusive activities near the ITS lines).
- Regrade the hillside and slump areas to fill cracks, regrade the scarps, and create positive drainage to reduce the potential for ponding of water on the hillslope. Cracks 4 inches wide and wider will be excavated to a depth of 4 feet and backfilled with native soil. This will help reduce the amount of water infiltrating to the subsurface and reduce the potential for further slumping. Area #1 on Figure 1 outlines the area of the hillside to receive this attention.
- Repair and recreate the two-track road, providing vehicle access to the ITSS area for maintenance activities (Area #3 on Figure 1).
- Regrade that part of the slump toe that threatens monitoring well B210489 in the valley bottom, moving slump material away from the well (Area #4 on Figure 1).
- Regrade and stabilize slopes near the SPPTS ITSS to protect this infrastructure from damage (Area #5 on Figure 1).
- Regrade the slump that threatens the upper east end of the A-Pond Road and repair this road as necessary (Area #2 on Figure 1).
- Possibly add seep drains to improve slope stability as the need is identified during regrading.
- Conduct a geotechnical drilling project that includes drilling up to 15 borings throughout the project area to evaluate geotechnical properties of soils and install piezometers for groundwater level monitoring and characteristics. Borings may be up to 14 inches in diameter and will penetrate unweathered bedrock up to 5 feet. The estimated total depth of each boring will be approximately 50 feet.

The regrade work for the hillside slump (Area 1 on Figure 1) will follow a “field fit” approach, cutting scarps and mid-slope elevated areas and using that soil to fill depressions to obtain a generally uniform slope of approximately 4 to 1 (horizontal to vertical). Excess material from the hillside slump area may also be used to repair the slump threatening the upper east end of the road to the ITSS Area 2 on Figure 1 to obtain a uniform slope of approximately 3 to 1. It is anticipated that to obtain a 4 to 1 slope for the hillside slump, the mid-slope bulge of the slump will be leveled and the crown of the scarp laid back. The mid-slope scarp is estimated to be approximately 15 feet in height. The existing trees on this hillside are providing some stability and will be kept, to the extent possible.

A portion of the proposed work is in the Preble's Mouse Critical Habitat and Protection Area (Figure 1). A Consultation Biological Assessment for this project has been submitted to U.S. Fish and Wildlife Service (USFWS) for approval. Intrusive work will not begin within these areas prior to receipt of this approval from USFWS.

Surface water runoff will be diverted around the construction area. Water (surface or ground) collected in the construction area during construction will be characterized using test strips for nitrate. The water will be dispositioned upgradient of SPPTS CT as previously approved in Contact Records 2008-06 and 2015-08.

IC Evaluation: This maintenance action will require excavating soil greater than 3 feet and will not return the surface to preexisting grade. Therefore, the soil disturbance work for this maintenance action is subject to Institutional Controls (ICs) 2 and 3, and requires approval of this contact record (2017-03). Table 1 recaps these ICs.

Table 1. Institutional Controls

IC 2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central OU (Central Operable Unit), and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.
IC 3	No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan (including Surface Water Protection Plans submitted to EPA under the Clean Water Act) approved by CDPHE or EPA. Soil disturbance that will not restore the soil surface to preexisting grade or higher may not be performed without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent migration of residual surface soil contamination to surface water. **Rationale:** Certain surface soil contaminants, notably plutonium-239/240, were identified in the fate and transport evaluation in the Remedial Investigation as having complete pathways to surface water if disturbed. This restriction minimizes the possibility of such disturbance and resultant impacts to surface water. Restoring the soil surface to preexisting grade maintains the current depth to subsurface contamination or contaminated structures.

The required Soil Disturbance Review Plan (SDRP) for IC 2 and IC 3 (for not restoring surface to preexisting grade) is in Attachment 1. The *Erosion Control Plan for Rocky Flats Property Central Operable Unit*, which has been approved by CDPHE and EPA, provides erosion control best-management practices that meet the requirements of IC 3.

Resolution: CDPHE, after reviewing information regarding the proposed soil disturbance and excavation and after consultation with EPA, will approve, approve with modification, or disapprove the proposed activity. CDPHE will determine whether the proposed activity (1) will not compromise or impair the function of the remedy or (2) will result in an unacceptable release or exposure to residual subsurface contamination. CDPHE will also determine whether the proposed project meets the rationale and objectives of IC 2 and IC 3.

The work will be conducted after CDPHE's approval, but DOE will not conduct the approved soil disturbance work until 10 calendar days after this Contact Record is posted on the Rocky Flats Site's website and stakeholders are notified of the posting in accordance with the RFLMA Public Involvement Plan. In addition, no intrusive work will be conducted within the Preble's Mouse Protected Area or Critical Habitat without USFWS approval to perform this work.

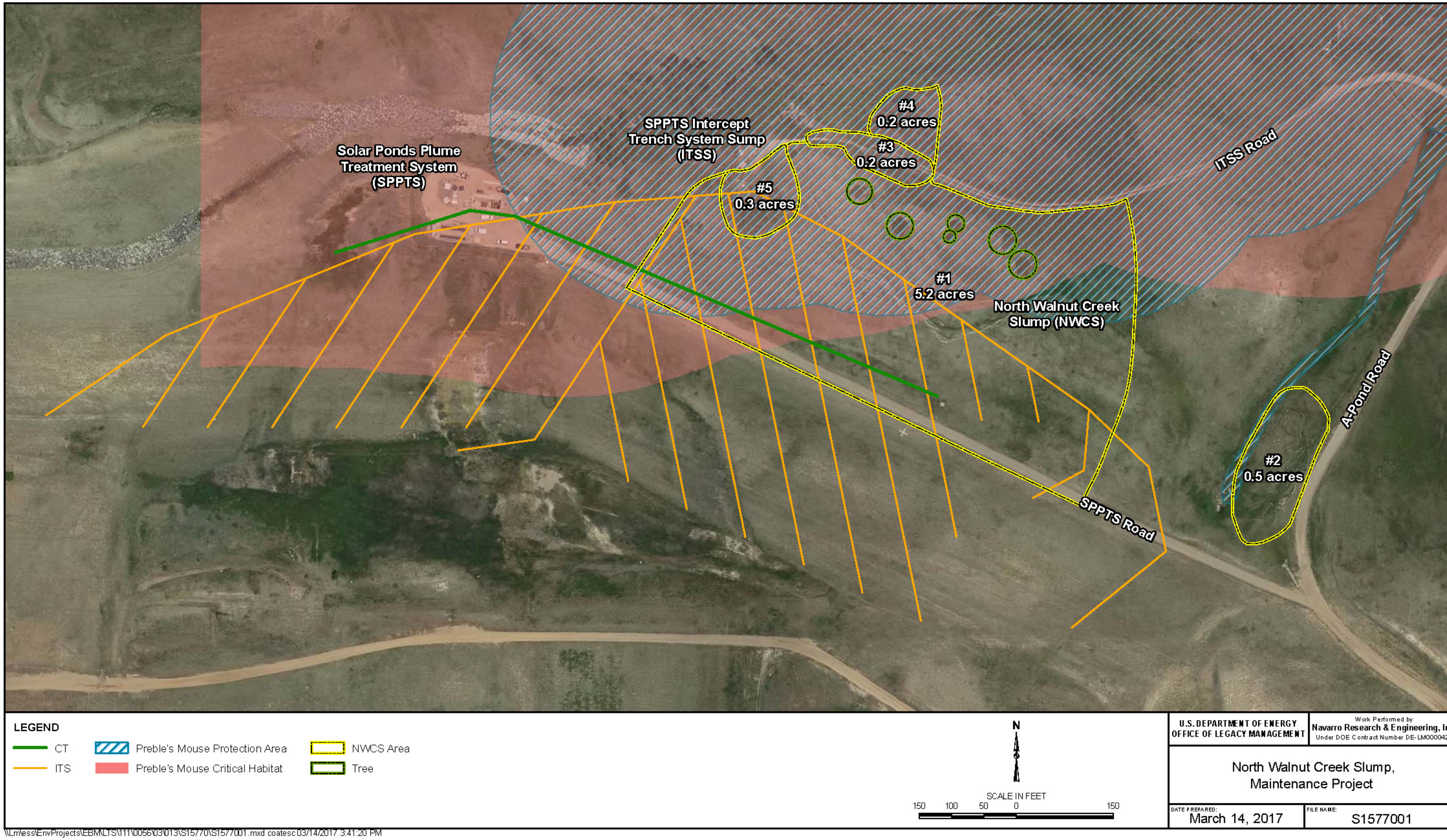
Progress and the completion of the work will be reported by DOE in RFLMA quarterly and annual reports of surveillance and maintenance activities for period(s) in which these activities occur.

Closeout of Contact Record: This contact record will be closed when the construction is completed, post-construction reseeding has been performed, and post-construction erosion controls are in place.

Contact Record Prepared by: David Ward and Jeremy Wehner, Navarro

---

Distribution:
Scott Surovchak, DOE
Carl Spreng, CDPHE
Vera Moritz, EPA
Linda Kaiser, Navarro
Document_Determination
Records
File: RFS 0025.02
RF Contact Record File



Solar Ponds Plume
Treatment System
(SPPTS)
SPPTS Intercept
Trench System Sump
(ITSS)
#4
0.2 acres
#3
0.2 acres
#5
0.3 acres
#1
5.2 acres
#2
0.5 acres
North Walnut Creek
Slump (NWCS)
ITSS Road
A-Pond Road
SPPTS Road
LEGEND
CT
ITS
Preble's Mouse Protection Area
Preble's Mouse Critical Habitat
NWCS Area
Tree
N
SCALE IN FEET
150 100 50 0 150
U.S. DEPARTMENT OF ENERGY
OFFICE OF LEGACY MANAGEMENT
Work Performed by
Navarro Research & Engineering, Inc.
Under DOE Contract Number DE-LM0000421
North Walnut Creek Slump,
Maintenance Project
DATE PREPARED:
March 14, 2017
FILE NAME:
S1577001
\\Lm\ess\EnvProjects\EBM\LTS\111\0056\03\013\S15770\S1577001.mxd coatesc 03/14/2017 3:41:20 PM

Figure 1

Attachment 1

Rocky Flats Legacy Management Agreement Soil Disturbance Review Plan

Proposed Project: Soil Disturbance Review Plan (SDRP) for the North Walnut Creek Slump Maintenance Activities

This SDRP provides information required by Rocky Flats Legacy Management Agreement (RFLMA) Attachment 2, "Legacy Management Requirements," Section 4.1, "Soil Disturbance Review Plan," regarding the work proposed by the U.S. Department of Energy.

Description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.

The North Walnut Creek Slump maintenance project for early 2017 includes investigating the groundwater and bedrock, regrading the hillside east of the Solar Ponds Plume Treatment System (SPPTS) and, as needed, installing seep drains. This effort is intended to improve hillslope drainage, minimize further slumping, and reduce the risk of damage to the SPPTS from further hillside movement. The total disturbed area is approximately 6 acres. The soil from the cut areas will be completely used in the fill areas and there will be no imported soils. The depths of cuts are expected to be less than 10 feet in most areas. Portions of the project will be within the Preble's Mouse Protection Area and Critical Habitat. Since portions of the area will not be returned to the preexisting grade the area will be surveyed after the regrading is complete to document the finish grade.

Information about any remaining subsurface structures in the vicinity of the proposed project (or state that there are none if that is the case).

The only remaining subsurface structures in the area are used in current operations and are not abandoned contaminated structures. They are the following:

- Interceptor Trench System (ITS) lines
- SPPTS collection trench (CT) and associated components (e.g., piezometers and cleanouts)
- Collection sump, transfer lines, and electrical lines associated with the Interceptor Trench System Sump (ITSS)
- Monitoring well B210489

Information about any former Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern, or other known or potential soil or groundwater contamination in the vicinity of the proposed project.

This area is IHSS 101, Solar Evaporation Ponds. In accordance with Environmental Restoration RSOP Notification #02-08 (DOE 2002), soil was removed from six hot spot locations. Confirmation sampling was conducted in the excavations to confirm that sufficient soil had been removed. All contaminant concentrations and activities were less than Rocky Flats Cleanup Agreement (RFCA) Tier II Soil Action Levels (SAL), except for one beryllium concentration, which was slightly greater than the RFCA Tier II SAL (1.10 milligrams per kilogram [mg/kg] vs 1.04 mg/kg). None of the results exceeded the wildlife refuge worker (WRW) SALs (DOE 2003).

After completion of accelerated actions, No Further Action was recommended for IHSS 101 based on the following:

- Contaminant concentrations and activities were less that RFCA Tier II SALs, with minor exceptions. No Tier I SALs were exceeded
- Results of an evaluation indicated additional action was not necessary

After reviewing the Closeout Report for IHSS Group 000-1, CDPHE approved the Solar Evaporation Pond Area of Concern (IHSS 101) for No Further Accelerated Action on July 25, 2003.

Any water encountered will be dispositioned upgradient of SPPTS CT.

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2017-04

Purpose: OLF 2017 Interim Maintenance Work: Creating Positive Drainage and Minor Adjustments to Berm Heights, in accordance with Soil Disturbance Review Plan

---

Contact Record Approval Date: October 6, 2017

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); Jeremy Wehner, Linda Kaiser, David Ward (Navarro)

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA); Lindsay Masters (CDPHE)

Date of Consultation Meeting: September 21, 2017

Consultation Meeting Participants: Scott Surovchak, Carl Spreng, Vera Moritz, Lindsay Masters, Linda Kaiser, Jeremy Wehner, David Ward, John Boylan, George Squibb, Michelle Hanson

Related Contact Records: CR 2013-02, CR 2013-03, CR 2014-09, CR 2015-03, CR 2015-06, CR 2016-03, CR 2016-04, CR 2017-01

Discussion:

Original Landfill 2017 Maintenance Work to Create Positive Drainage

Maintenance activities at the Original Landfill (OLF) are planned and expected to be performed in October 2017. The planned 2017 maintenance activities are consistent with activities outlined the *Original Landfill Monitoring and Maintenance Plan*. A geotechnical evaluation (Contact Record 2015-06 *Implementation of Interim Action to Reestablish Surface Water Management on Portions of the OLF*) is in progress; it is evaluating the effects of 2015-2017 events on slope stability. At the completion of the evaluation, additional actions may be selected for implementation at the OLF to increase slope stability. Field implementation of these additional actions is expected to begin in summer 2018.

The OLF 2017 maintenance work will include:

(1) regrading the lower portion of the slump to (a) eliminate cracks and pooling areas and (b) create positive drainage,

(2) conducting minor regrading of the upper portion of the slump for positive drainage, and

(3) conducting surface compaction of the entire slump area to minimize infiltration.

Erosion controls and revegetation will be installed in accordance with the approved *Erosion Control Plan for Rocky Flats Property Central Operable Unit* (2007).

The East Perimeter Channel (EPC) outlet is blocked by the slump below Berm 7 (as described in the May to current monthly inspection reports). The slump completely blocks flow in the EPC, forcing channelized flow in the EPC to overflow its east (lower) bank, and then flow downgradient through the well-established vegetation to Woman Creek. OLF berms and the EPC are shown in the attached figure.

Similar slumps into the EPC were removed during the 2014, 2015, and 2016 maintenance work. However, it appears that the current slump toe is acting as a buttress to the hillside above, which has moved in prior years. Before the May slump event, a small tension crack developed north of Berm 4 in the vicinity of the 2015 slump scarp (as noted in monthly reports). In order to minimize adverse impacts to the hillside stability, EPC slump material will not be removed during the 2017 maintenance work. Instead, the current flow path—as described above—will be left in place until the 2018 slope stabilization project design is underway and the discharge location(s) can be reevaluated. This new overland flow area will be inspected during all routine OLF inspections, and maintenance conducted as needed. No erosion has been noted in this area to date.

<u>Minor Adjustments to Berm Heights</u>

The 2009 *Original Landfill Monitoring and Maintenance Plan* (M&M Plan), Section 3.4.1, "Monitoring Locations and Procedures," discusses monitoring for the OLF soil cover and states:

> "If visual inspections of the diversion berms indicate a departure from the design heights, as shown in Figure 3−3, the height and gradient will be measured to determine if maintenance is required. In addition, the periodic topographical survey results shall be evaluated to determine if berm maintenance is required."

Contact Record (CR) 2015-06 "OLF Implementation of Interim Action to Reestablish Surface Water Management on Portions of the OLF, with Soil Disturbance Review Plan," states:

> "The important concept here is to not add any more weight to the OLF cover or water management structures during this interim action. Therefore, the designed berm heights and cover thickness will not be maintained in these areas during this action."

To minimize weight on the cover the designed berm heights will not be maintained until the longer-term implementation for the OLF stabilization is complete.

The periodic topographical survey required by the OLF M&M Plan was performed in 2017. A majority of the berm heights meet or exceed the minimum required heights recalculated in the 2013 technical memorandum. In 2015, berm areas impacted by slumping were regraded in accordance with CR 2015-06 and reconfigured to promote positive drainage, without adding additional weight to the OLF cover. Since 2015, positive drainage off the cover has been maintained to eliminate ponding. However, this Contact Records documents the proposal that minimum berm heights will not necessarily be maintained so as to minimize weight on the cover as recommend in CR 2015-06. Minor adjustments to berm heights may be required to prevent downgradient erosion. Work will be performed in some berm channels to reduce ponding.

The longer-term implementation for OLF stabilization, based on recommendations from the geotechnical evaluation in progress, is scheduled to be completed in fall 2018.

Soil disturbance, filling, and grading on the OLF cover are subject to the requirements of Rocky Flats Legacy Management Agreement (RFLMA) institutional controls (ICs), discussed below. An approved SDRP is required. Here, the SDRP is included as Attachment 1 to this CR. The *Erosion Control Plan for Rocky Flats Property Central Operable Unit*, which has been approved by CDPHE and EPA, provides erosion control best-management practices that meet the IC 3 requirements.

IC Evaluation: Soil disturbance work is subject to ICs 2, 3 and 6. Table 1 recaps these ICs.

Table 1. Institutional Controls

IC 2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central OU, and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.
IC 3	No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan (including Surface Water Protection Plans submitted to EPA under the Clean Water Act) approved by CDPHE or EPA. Soil disturbance that will not restore the soil surface to preexisting grade or higher may not be performed without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent migration of residual surface soil contamination to surface water. **Rationale:** Certain surface soil contaminants, notably plutonium-239/240, were identified in the fate and transport evaluation in the Remedial Investigation as having complete pathways to surface water if disturbed. This restriction minimizes the possibility of such disturbance and resultant impacts to surface water. Restoring the soil surface to preexisting grade maintains the current depth to subsurface contamination or contaminated structures.
IC 6	Digging, drilling, tilling, grading, excavation, construction of any sort (including construction of any structures, paths, trails, or roads), and vehicular traffic are prohibited on the covers of the Present Landfill and the Original Landfill, except for authorized response actions.
	Objective: Ensure the continued proper functioning of the landfill covers. **Rationale:** This restriction helps ensure the integrity of the landfill covers.

Resolution: CDPHE, after reviewing information regarding the proposed soil disturbance and excavation and after consultation with EPA, has approved proposed activities in this Contact Record. CDPHE has determined that the proposed activity: (1) will not compromise or impair the function of the remedy, and (2) will not result in an unacceptable release or exposure to residual subsurface contamination. CDPHE also determined that the proposed project meets the rationale and objectives of IC 2, 3 and 6.

DOE will conduct this work after (1) CDPHE's approval, and (2) 10 calendar days from the date stakeholders are notified of the posting in accordance with the RFLMA Public Involvement Plan (i.e., posting this Contact Record on DOE's Rocky Flats website).

Progress and the completion of the work will be reported by DOE in RFLMA quarterly and annual reports of surveillance and maintenance activities for the period(s) in which these activities occur.

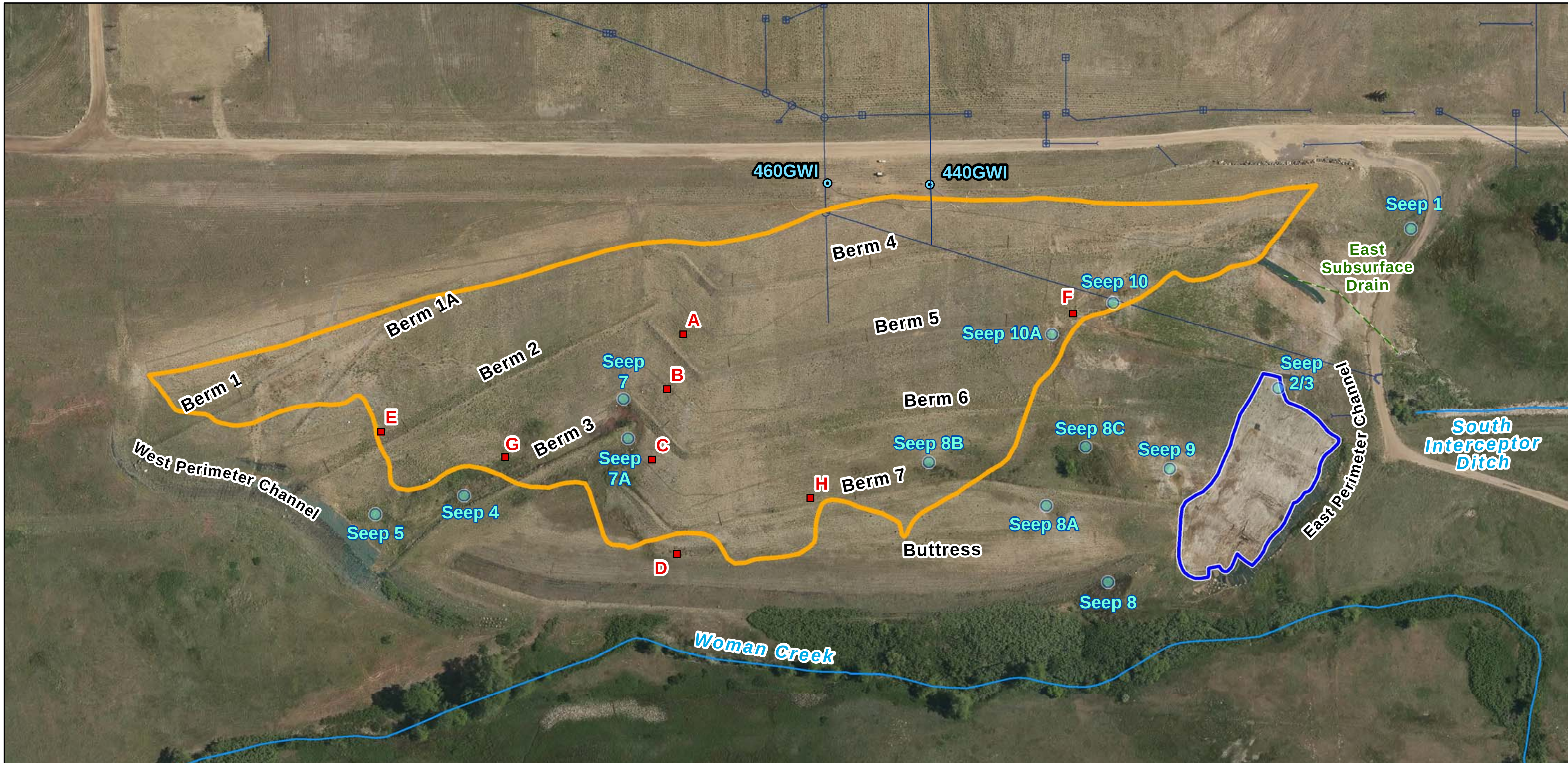
It is expected that additional, OLF maintenance activities will be required to maintain positive drainage off the OLF.

Closeout of Contact Record: This CR will be closed out when the longer-term implementation for the OLF stabilization is complete.

Contact Record Prepared by: David Ward, Patty Gallo and Jeremy Wehner

---

Distribution:
Carl Spreng, CDPHE
Vera Moritz, EPA
Lindsay Masters, CDPHE
Scott Surovchak, DOE
Linda Kaiser, Navarro
Rocky Flats Contact Record File



LEGEND

- Groundwater Intercept Well
- Settlement Monument
- Apparent Seep Source (July 17, 2017)
- Culverts, Storm Drains, and Associated Features
- East Subsurface Drain
- Streams
- Approximate OLF Waste Footprint
- Area of 2017 Slump Maintenance

Aerial Photo: June 26, 2017

N

SCALE IN FEET

150 100 50 0 150

U.S. DEPARTMENT OF ENERGY
OFFICE OF LEGACY MANAGEMENT

Work Performed by
Navarro Research & Engineering, Inc.
Under DOE Contract Number DE-LM0000421

Original Landfill
August 2017
Rocky Flats Site

DATE PREPARED: October 4, 2017

FILE NAME: S1705300-01

\\LM\ess\EnvProjects\EBM\LTS\111\0056\07\001\S17053\S1705300-01.mxd smithw 10/04/2017 2:37:34 PM

Attachment 1

Rocky Flats Legacy Management Agreement Soil Disturbance Review Plan

Proposed Project: Soil Disturbance Review Plan (SDRP) for Implementation of 2017 Interim Maintenance Work at the Original Landfill (OLF)

This SDRP provides information required by Rocky Flats Legacy Management Agreement (RFLMA) Attachment 2, "Legacy Management Requirements," Section 4.1, "Soil Disturbance Review Plan," regarding the work proposed by DOE.

<u>Description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.</u>

The purpose of the proposed project is to regrade portions of the OLF cover to reduce the slope grades in the slumped area, to improve slope stability, and improve or reestablish drainage features to minimize the potential for infiltration of precipitation in the short term.

The figure attached to Contact Record 2017-04 shows the location and the lateral extent of the planned regrading, excavation, and soil disturbance in the slump area. In addition, minor regrading of berms 1, 1A, 2, 4, 5, and 6, and the channels behind these berms, will be conducted to maintain positive drainage and maintain a minimum berm height of 1-foot. Regrading the face of the cover in the berm and channel areas will require no more than a 0.5-foot cut. Regrading in the slump area (outside the waste footprint and cover) may require excavation depths up to 3-feet.

<u>Information about any remaining subsurface structures in the vicinity of the proposed project (or state that there are none if that is the case).</u>

There are no remaining subsurface structures in the vicinity of the proposed project. An abandoned buried natural gas line operated by Xcel Energy is in the utility easement corridor north of the OLF. The location and alignment of this abandoned line is well known and marked with signs. It is well outside of the soil disturbance area.

<u>Information about any former Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern, or other known or potential soil or groundwater contamination in the vicinity of the proposed project.</u>

The OLF is former IHSS 115. The OLF design had a 2-foot-thick soil cover over the location of the disposed waste materials and clean Rocky Flats Alluvium fill surrounding the waste materials for the placement and configuration of storm water and seep water management features. Limits of the waste area are shown in the figure attached to Contact Record 2017-04.

The project area is in the Upper Woman Drainage Exposure Unit (EU) evaluated in the Comprehensive Risk Assessment, Appendix A, of the Remedial Investigation/Feasibility Study. The only contaminants of concern (COCs) identified for this EU are benzo[*a*]pyrene and dioxins/furans for surface soil/surface sediment.

Dioxin/furan concentrations were converted to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) toxicity equivalents (TEQs) for COC screening and risk characterization. Risks were calculated for benzo[*a*]pyrene and 2,3,7,8 TCDD TEQ. The estimated total excess lifetime cancer risk to the wildlife refuge worker at the EU is 8 in one million. Noncancer risks for benzo[*a*]pyrene and 2,3,7,8-TCDD TEQ were not evaluated because those COCs do not have noncancer toxicity values.

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2018-01

Purpose: Original Landfill (OLF) Geotechnical Investigation Work in accordance with attached Soil Disturbance Review Plan

---

Contact Record Approval Date: February 7, 2018

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); Jeremy Wehner, Linda Kaiser, David Ward (Navarro Research and Engineering, Inc.)

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Lindsay Masters, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: December 7, 2017; January 25, 2018

Consultation Meeting Participants: Scott Surovchak, Carl Spreng, Lindsay Masters, Linda Kaiser, Jeremy Wehner, John Boylan, George Squibb, Patty Gallo

Related Contact Records: CR 2010-01**,** CR 2013-02, CR 2013-03, CR 2014-09, CR 2015-03, CR 2015-06, CR 2016-03, CR 2016-04, CR 2017-01, CR 2017-04

Introduction: Following an intense precipitation event and flooding in 2013, DOE determined that a *Rocky Flats Legacy Management Agreement* (RFLMA) reportable condition existed at the Original Landfill (OLF) at the Rocky Flats Site, Colorado (Contact Record [CR] 2013-02). At that time, the RFLMA parties reviewed the existing conditions, which included localized surface cracking and differential settlement in the northeastern portion of the landfill, and previous post-closure observations of cracking and slumping on the landfill, including cracking on the West Perimeter Channel that occurred in 2010. Another major precipitation event involving several weeks of rainfall occurred in the spring of 2015. In fact, May 2015 has been noted as the wettest May in Colorado's recorded history. This event resulted in surficial cracks, subsidence, slumping, and ponding on the OLF hillside. Contact Record 2015-03 approved immediate actions to drain and divert surface water and groundwater from the landfill. These actions were successful in improving drainage of water on the surface of the OLF. In September 2015, CR 2015-06 approved additional actions to contour the East Perimeter Channel (EPC) and the eastern edge and western side of the OLF and lay back a large scarp at the top of the EPC as a short-term action.

In response to the 2013 and 2015 precipitation events and related slope instability (see "Related Contact Records" above), several studies and interim measures were completed. The interim measures were mainly repairs to, and maintenance of, storm water features that divert surface water and groundwater from the landfill. These measures include surface grading and compaction to minimize infiltration in the slump areas. The storm water features are generally located outside of the waste footprint. However, small areas within the waste footprint adjacent to these features have been impacted as a result of postclosure precipitation events and have been subject to repairs.

Discussion: A geotechnical investigation will be conducted to support the long-term slope stability project for the OLF hillside. Geotechnical investigation activities will include drilling vertical borings and excavating test pits on the eastern and western portion of the OLF. Figure 1 shows the areas where geotechnical investigation activities are anticipated to occur. The geotechnical subcontractor will have the discretion to alter the location and number of borings and test pits based on field conditions and data needs. Test pit excavation may present the opportunity to improve drainage around seeps, which could involve the installation of drainage materials (e.g., drain lines, gravel). The majority of the borings and test pits will be outside the waste footprint and therefore will not intercept the soil cover or underlying waste. However, some of the borings and test pits might be drilled or excavated within the waste footprint. Similar activities involving drilling and digging within the OLF waste footprint have been approved in the past. The most recent was a 2010 data collection effort to evaluate postclosure residual contamination levels at the landfill (CR 2010-01).

The geotechnical borings in this 2018 investigation will be used to further delineate the depth to weathered and unweathered bedrock and to collect geotechnical data on subsurface stratigraphy and material properties. Given the slope of the landfill, the construction of earthen pads to stabilize the drill rig may be necessary. Following drilling activities, the pads will be removed and the areas returned to pre-activity grade. Areas disturbed by the geotechnical investigation will be revegetated in accordance with the site *Revegetation Plan* (LMS/RFS/S04513-0.1).

Borings may be up to 14 inches in diameter and may be drilled to a depth of 75 feet or more below the ground surface. Upon completion, the borings will be converted to piezometers to monitor groundwater levels. A 30 to 36-inch diameter, 4-inch thick concrete pad may be installed around each piezometer. Although many of the piezometers are expected to be destroyed during the construction of long-term measures at the OLF in 2018/2019, some piezometers may remain active beyond this period. The long-term measures for OLF stabilization will be addressed in a different contact record.

Some of the intrusive work will be conducted within the Preble's Mouse Protection Areas or Critical Habitat (Unit 6), but all intrusive work will be contained within the original OLF construction boundary. Work within the original construction boundary is currently authorized by the U.S. Fish and Wildlife Service (USFWS) so long as a notification has been submitted to them. This notification will be sent to the USFWS prior to commencement of intrusive work. If the work extends beyond the original OLF construction boundary, there will be additional consultation with USFWS.

Institutional Controls (ICs) Evaluation: The geotechnical investigation work will involve activities restricted by RFLMA ICs 2, 3, and 6, which are shown in Table 1.

Boreholes will be drilled to a depth greater than 3 feet, which is prohibited by IC 2 without regulatory review and approval of a Soil Disturbance Review Plan (SDRP). The SDRP for this geotechnical investigation is provided as Attachment 1 of this Contact Record.

The drilling of boreholes and excavation of test pits will disturb surface soil, which is prohibited by IC 3 except when performed in accordance with a soil erosion control plan. The *Erosion Control Plan for Rocky Flats Property Central Operable Unit* (DOE-LM/1497-2007), approved by CDPHE and EPA, provides erosion control best management practices that meet the IC 3 requirements.

The geotechnical investigation may involve drilling at locations on the landfill cover (i.e., within the waste footprint) and may involve driving vehicles (e.g., drill rig, support vehicles) on to the cover. These activities are prohibited by IC 6 except for authorized response actions. The maintenance actions covered by the *Original Landfill Monitoring and Maintenance Plan* and the regulatory review and approval of this Contact Record constitutes authorization for these actions.

Table 1. Institutional Controls

IC 2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central OU, and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.
IC 3	No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan (including Surface Water Protection Plans submitted to EPA under the Clean Water Act) approved by CDPHE or EPA. Soil disturbance that will not restore the soil surface to preexisting grade or higher may not be performed without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent migration of residual surface soil contamination to surface water. **Rationale:** Certain surface soil contaminants, notably plutonium-239/240, were identified in the fate and transport evaluation in the Remedial Investigation as having complete pathways to surface water if disturbed. This restriction minimizes the possibility of such disturbance and resultant impacts to surface water. Restoring the soil surface to preexisting grade maintains the current depth to subsurface contamination or contaminated structures.
IC 6	Digging, drilling, tilling, grading, excavation, construction of any sort (including construction of any structures, paths, trails or roads), and vehicular traffic are prohibited on the covers of the Present Landfill and the Original Landfill, except for authorized response actions.
	Objective: Ensure the continued proper functioning of the landfill covers. **Rationale:** This restriction helps ensure the integrity of the landfill covers.

Resolution: A geotechnical investigation will be conducted to support the long-term slope stability project for the OLF. The slope stability project will implement actions to maintain the OLF remedy as required by the *Original Landfill Monitoring and Maintenance Plan*. CDPHE, after reviewing the proposed geotechnical investigation activities and after consultation with EPA, has approved the activities proposed in this Contact Record. CDPHE has determined that the proposed activities: (1) will not compromise or impair the function of the OLF remedy and (2) will not result in an unacceptable release or exposure to residual subsurface contamination. CDPHE also has determined that the proposed project meets the rationale and objectives of ICs 2, 3 and 6.

The geotechnical investigation work will be authorized upon CDPHE approval, but DOE will not conduct the approved soil disturbance work until 10 calendar days after this Contact Record is posted on the Rocky Flats Site website and stakeholders are notified of the posting in accordance with the RFLMA Public Involvement Plan.

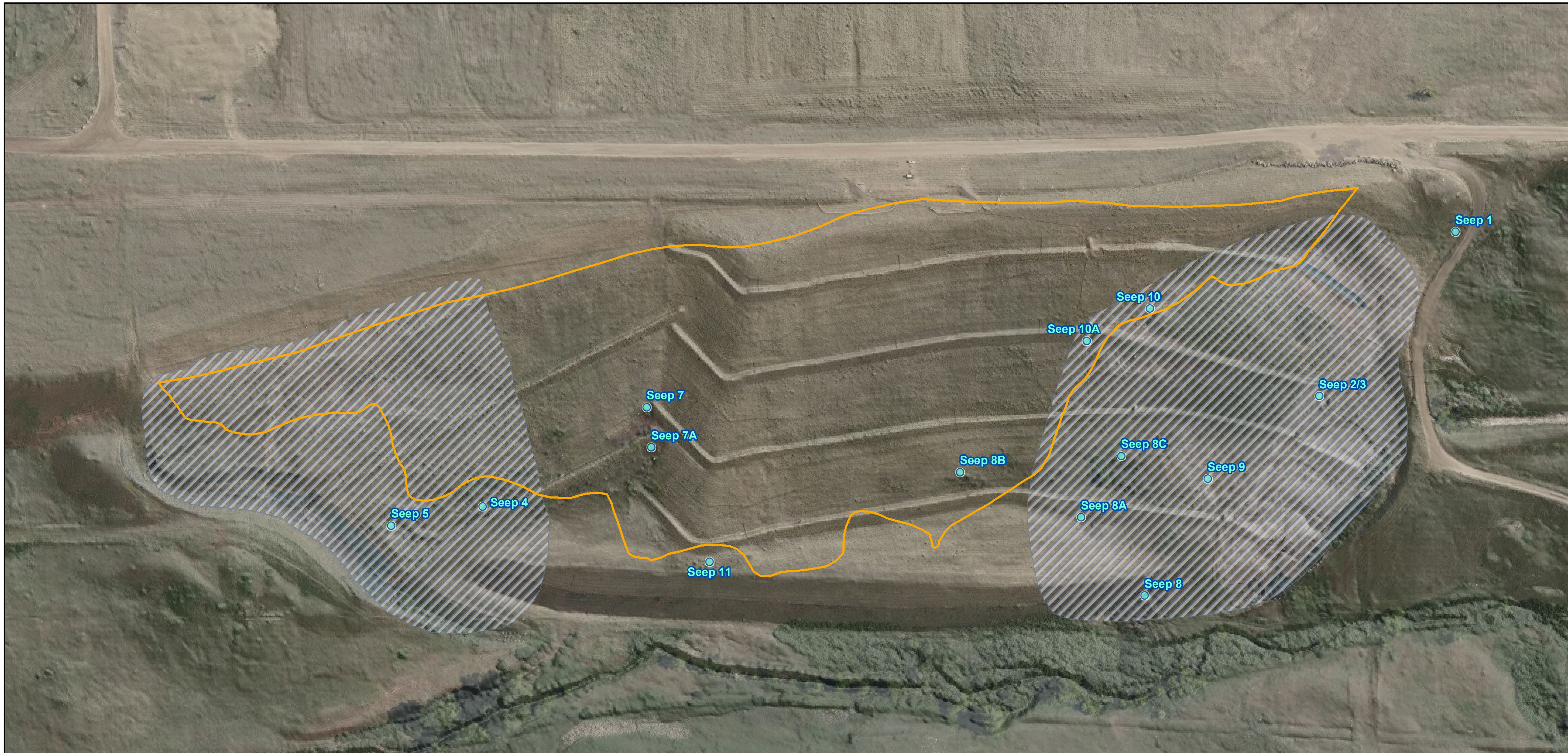
Progress and the completion of the work will be reported by DOE in RFLMA quarterly and annual reports of surveillance and maintenance activities for the period(s) in which these activities occur.

Closeout of Contact Record: This CR will be closed when the implementation of long-term OLF stabilization measures is complete.

Contact Record Prepared by: David Ward, Patty Gallo, and Jeremy Wehner

---

Distribution:
Carl Spreng, CDPHE
Vera Moritz, EPA
Lindsay Masters, CDPHE
Scott Surovchak, DOE
Linda Kaiser, Navarro
Rocky Flats Contact Record File



Apparent Seep Source (July 17, 2017)
Approximate OLF Waste Footprint
Geotechnical Investigation Work Area

N

SCALE IN FEET
150 100 50 0 150

U.S. DEPARTMENT OF ENERGY
OFFICE OF LEGACY MANAGEMENT

Work Performed by
Navarro Research & Engineering, Inc.
Under DOE Contract Number DE-LM0000421

Geotechnical Investigation Work Area
Original Landfill
Rocky Flats Site, CO

DATE PREPARED: January 30, 2018
FILE NAME: S1848500

\\Lm\ess\EnvProjects\EBM\LTS\111\0056\03\014\S18485\S1848500.mxd HyattT 01/31/2018 5:14:24 AM

Figure 1. Geotechnical Investigation Work Areas

Attachment 1

RFLMA Soil Disturbance Review Plan for Geotechnical Investigation Work at the OLF

Proposed Project: Soil Disturbance Review Plan (SDRP) for Geotechnical Investigation Work at the Original Landfill (OLF)

This SDRP provides information required by the *Rocky Flats Legacy Management Agreement* (RFLMA), Attachment 2, "Legacy Management Requirements," Section 4.1, "Soil Disturbance Review Plan," regarding the work proposed by the U.S. Department of Energy.

<u>A description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.</u>

The purpose of the 2018 geotechnical investigation is to collect data to support the design of repairs to existing storm water and groundwater management features, and to support the design for the required mechanical stabilization of the landfill toe.

The figure attached to Contact Record 2018-01 shows the areas where geotechnical investigation activities are anticipated to occur. These activities will include drilling boreholes, excavating test pits, and installing piezometers. Boreholes might be installed to a total depth of up to 75 feet or more below the ground surface. Most of the boreholes and test pits will be located outside the waste footprint, but one or more boreholes or test pits might be placed within the waste footprint. The boreholes will be converted to piezometers following sampling to collect water level data.

<u>Information about any remaining subsurface structures in the vicinity of the proposed project (or state that there are none if that is the case).</u>

There are no remaining subsurface structures in the vicinity of the proposed project. An abandoned buried natural gas line operated by Xcel Energy is in the utility easement corridor north of the OLF. The location and alignment of this abandoned line is well known and marked with signs. It is well outside of the area that will be disturbed during the geotechnical investigation project.

Some of the borings will be drilled in the vicinity of a 36-inch diameter culvert that was purportedly removed prior to OLF closure. Removal of this subsurface culvert is discussed in closure documents. During this geotechnical investigation, one of the test pits might be excavated near the former location of this feature in an effort to locate the end of the remaining section of this pipe.

<u>Information about any former Individual Hazardous Substance Sites [IHSSs], Potential Areas of Concern, or other known or potential soil or groundwater contamination in the vicinity of the proposed project (or state that there is no known contamination).</u>

The OLF is former IHSS 115. The OLF is not a hazardous waste unit because wastes were not disposed of in the landfill after the effective dates of the various hazardous waste regulations. However, the OLF's historical use is typical of solid waste dumps of the time, and the wastes disposed of were plant trash and construction debris that, based on sampling, likely contained some chemicals that subsequently were regulated as Comprehensive Environmental Response, Compensation, and Liability Act hazardous substances. The OLF Interim Measure/Interim Remedial Action (IM/IRA) describes the history of the OLF and the types of wastes disposed in the landfill. Use of the OLF for dumping trash and debris ended in 1968, and an unknown amount of soil was used to cover the waste. The OLF IM/IRA states that soil was used to cover the waste dumped in the OLF area during its use, and that the waste and soil are fairly well commingled.

The OLF was not a radioactive contaminated waste disposal area. However, there is a documented instance of placing a smoldering depleted uranium (DU) slab in the OLF to allow it to “burn out.” When the burned slab was recovered, not all of the DU mass was recovered. Surface soil monitoring at the OLF also located several hot spots. Before the soil cover was placed on the OLF, the hot spots were removed (see OLF IM/IRA, Appendix E).

The OLF closure design had a 2-foot-thick soil cover over the location of the disposed waste materials and clean Rocky Flats Alluvium fill surrounding the waste materials for the placement and configuration of storm water and seep water management features. Limits of the waste area are shown in the figure attached to Contact Record 2018-01. Because some of the geotechnical investigation boreholes and test pits will be located within the waste footprint, it is possible that workers will be exposed to contaminated soils, buried wastes, and/or contaminated groundwater. Contamination control and worker protection will be addressed in the project planning documents for the geotechnical investigation.

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2018-04

Purpose: Reportable condition for evaluation purposes for uranium at Walnut Creek Point of Compliance (WALPOC).

Contact Record Approval Date: March 22, 2018

Site Contact(s)/Affiliation(s): Scott Surovchak, Jeffrey Murl, U.S. Department of Energy (DOE); George Squibb, Linda Kaiser, David Ward, Patty Gallo, Navarro Research and Engineering, Inc. (Navarro)

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Lindsay Masters, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: March 20, 2018

Consultation Meeting Participants: Carl Spreng, Lindsay Masters, CDPHE; Vera Moritz, EPA; Scott Surovchak, Jeffrey Murl, DOE; Linda Kaiser, David Ward, George Squibb, Navarro.

Discussion: A reportable condition occurred at surface water Point of Compliance (POC) WALPOC at the Rocky Flats Site, based on the 30-day average for uranium. The validated analytical result received on March 3, 2018 for the sample retrieved on February 16, 2018, from the WALPOC composite sampler was 24 micrograms per liter (µg/L) total uranium. The validated analytical result for a duplicate sample was 21 µg/L total uranium. These composite sample results are representative of water flowing during the time period February 9, 2018 (11:27 a.m.), to February 16, 2018 (12:19 p.m.). Evaluation of the surface water data was performed in accordance with *Rocky Flats Legacy Management Agreement* (RFLMA) Attachment 2, Figure 5, "Points of Compliance," The evaluation resulted in a calculated 30-day average concentration for uranium of 18.0 micrograms per liter (µg/L) on February 11, 2018. This concentration exceeds the RFLMA-applicable Table 1 standard of 16.8 µg/L for uranium.

Pursuant to RFLMA Attachment 2, Section 6.0, "Action Determinations," a reportable condition necessitates the following actions:

- DOE must submit a plan and schedule for an evaluation to address the condition within 30 days of receiving the validated data for the reportable condition.
- DOE will consult with CDPHE and EPA to determine if mitigating actions are necessary.

- The objective of the consultation will be to determine a course of action (if necessary) to address the reportable condition and to ensure that the remedy remains protective.
- The results of the consultation will be documented in contact records, written correspondence, or both.

Representatives of CDPHE and DOE discussed these results on March 20, 2018, and developed a path forward. Formal notification to the regulatory agencies and the public—in accordance with RFLMA Attachment 2, Figure 5—was made by email on March 13, 2018.

The RFLMA Parties agreed that no mitigating actions are necessary at this time, for the following reasons:

- The remedy remains protective. The remedy performance standard for total uranium at the WALPOC sampling location is the calculated 12-month rolling average. Using the most recent validated data, the calculated 12-month rolling average at WALPOC for total uranium on January 31, 2018, is 10.4 µg/L, which is well below the RFLMA Table 1 standard of 16.8 µg/L.
- WALPOC has been a RFLMA surface water monitoring location for approximately 6.5 years (since September 2011). During that period, the Site experienced one of its driest years (2012), its wettest month (September 2013), and one of its wettest springs (2015). The 30-day average at WALPOC previously exceeded the RFLMA uranium standard in 2014 (CR 2014-05), 2016 (CR 2016-01), and 2017 (CR 2017-02). The 12-month rolling average for uranium at WALPOC was exceeded in 2015 (CR 2015-01). Because uranium concentrations are influenced by changing environmental conditions, varying uranium concentrations at WALPOC are expected. While measurable uranium concentration variability can be seen in both individual sample results and in the 30-day averages, the observed variability is not outside of expected ranges and remains well below 30 µg/L drinking water standard (i.e., the maximum contaminant level).
- The variability of the uranium concentration influenced by environmental conditions was detailed in a study conducted by a qualified geochemistry subcontractor, the results of which were published in the *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site* (September 2015). This report can be found at https://www.lm.doe.gov/Rocky_Flats/Documents.aspx and is scheduled to be updated in 2018 with recent monitoring data.
- CDPHE collected a split sample of the composite sample collected during the period of February 9, 2018, to February 16, 2018. The uranium result for the CDPHE split sample was 22 µg/L.
- Measured concentrations of total uranium at WALPOC include both naturally occurring and anthropogenic uranium. Previous high-resolution isotopic uranium analyses for WALPOC show signatures that are between 68−86% naturally occurring uranium.
- Although the recent result was above the 16.8 µg/L Site standard, it remains well below the 30 µg/L drinking water standard for uranium. The 16.8 µg/L standard is a level at which there are no known or anticipated adverse effects on the health of a person, and is based on an adult weighing 70 kilograms consuming 2 liters of water per day for a lifetime. Because WALPOC has an intermittent flow of water and Walnut Creek is not a source of drinking

water, there remains an adequate margin of safety. Therefore, the remedy remains protective of human health and the environment.

Plan and Schedule to Address the Reportable Condition: The RFLMA Parties agreed that the steps described in this Contact Record shall serve as the plan and schedule for the evaluation of this reportable condition. These steps include:

- Flow-paced composite samples routinely collected at WALPOC will continue to be analyzed on a 2-week turnaround.
- High-resolution isotopic uranium analysis will be conducted on the most recent WALPOC samples to determine the percentages of natural and anthropogenic uranium for comparison to the historical data.
- If the volume of the composite sample is sufficient, DOE will provide CDPHE with a split sample from the next composite sample collected at WALPOC. That composite sample was started on March 2, 2018. If the sample volume is insufficient, DOE will provide CDPHE with a split of the next WALPOC sample that has sufficient volume. The split sample will be analyzed for uranium by the State of Colorado.

DOE will report the results of continued monitoring, isotopic analysis, and of the subsequent evaluation in RFLMA quarterly and annual reports of surveillance and monitoring activities. This plan and schedule may be modified based on the outcome of RFLMA Party consultation related to the evaluation.

To keep the public informed, the outcome of continuing RFLMA Party consultation regarding the evaluation will be reported in RFLMA quarterly and annual reports of surveillance and monitoring activities or in subsequent contact records.

Resolution: CDPHE, after consultation with EPA, approves this contact record.

Evaluation Complete: The evaluation of the WALPOC uranium reportable condition will be considered complete when the results from the evaluation have been shared with the RFLMA Parties and the reportable condition at WALPOC no longer exists.

Contact Record Prepared by: George Squibb, David Ward, and Patty Gallo, Navarro

---

Distribution:
Carl Spreng, CDPHE
Vera Moritz, EPA
Scott Surovchak, DOE
Linda Kaiser, Navarro
Documentation Determination
Records

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2018-05

Purpose: Minor Modification of *Rocky Flats Legacy Management Agreement* (RFLMA) Attachment 2, "Legacy Management Requirements."

Contact Record Approval Date: December 4, 2018

Site Contact(s)/Affiliation(s): Scott Surovchak, U.S. Department of Energy (DOE); Linda Kaiser, Patty Gallo, David Ward, Navarro Research & Engineering, Inc. (Navarro)

Regulatory Contact(s)/Affiliation(s): Carl Spreng, Lindsay Masters, David Walker, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meetings: September 21, 2017; January 25, 2018; May 14, 2018; July 31, 2018; October 16, 2018

Consultation Meeting Participants: Carl Spreng, Lindsay Masters, David Walker, Vera Moritz, Scott Surovchak, Linda Kaiser, George Squibb, John Boylan, David Ward, Patty Gallo

---

Introduction: Approval of this contact record (CR) will indicate that the RFLMA parties agree that RFLMA Attachment 2 should be modified to reflect changes since the last modifications to this attachment in December 2012. In summary, these changes will include:

- Incorporation of minor modifications approved by CR 2014-02, CR 2014-07, and CR 2015-04.
- Removal of references to "environmental covenant." The 2011 environmental covenant was superseded in April 2017 by a restrictive notice (also referred to as Environmental Use Restrictions) issued under *Colorado Revised Statutes* §25-15-318.5.
- Modification to RFLMA Attachment 2, Table 1, "Surface Water Standards" that includes a targeted list of analytes based on closure decisions and post-closure analytical data evaluation as discussed below, and updates to select metals standards and practical quantitation limits (PQLs).
- Modification of RFLMA Attachment 2, Table 2, "Water Monitoring Locations and Sampling Criteria" to delete obsolete monitoring locations and update monitoring location nomenclature.

Modification of Table 1: The original Table 1 list of analytes was included in Attachment 2 of RFLMA when the agreement was signed in 2007. The list came from a number of sources, including State of Colorado surface water quality standards and cleanup action levels for accelerated actions established in the *Rocky Flats Cleanup Agreement*. Extensive effort was not made at the time to tailor the list of analytes to expected post-closure site conditions. Since that time, modifications to Table 1 have been limited to changes in surface water standards identified in the Rocky Flats five-year reviews. The list of analytes has not been updated since 2007.

DOE has been monitoring surface water and groundwater in accordance with RFLMA since 2007 and now has over 10 years of post-closure monitoring data. These monitoring data, in conjunction with identified site contaminants, were used in an evaluation of potential Table 1 modifications. The process for identifying modifications to Table 1 consisted of a two-part evaluation. The first part of the evaluation compared the analytes found on Table 1 to (1) analytes of interest (AOIs) identified in the *RCRA Facility Investigation-Remedial Investigation/Corrective Measures Study – Feasibility Study* (RI/FS) and (2) contaminants of concern (COCs) identified in the *Comprehensive Risk Assessment* (Appendix A to the RI/FS). If this CR is approved, all analytes found on Table 1 that were identified as AOIs or COCs for soil, surface water, sediment, and/or groundwater will be retained.

The second part of the evaluation used the decision logic in the existing flowcharts in RFLMA Attachment 2 and post-closure analytical data to determine if any monitoring objectives should be modified or discontinued. This review utilized a post-closure dataset that consists of all data collected from RFLMA surface water and groundwater monitoring locations over the time period April 1, 2007 through December 31, 2017. This dataset represents the post-closure period beginning with the first full calendar quarter after the effective date of RFLMA and ending with the last calendar quarter of 2017. If this CR is approved, all analytes found on the current Table 1 that were detected at any concentration, even if not identified as AOIs or COCs in the RI/FS, will be retained. The only analytes that will be removed from the current Table 1 are analytes that met both of the following criteria: (1) were not AOIs or COCs, and (2) were not detected in the post-closure dataset or for which no data were available (i.e., these were not targeted analytes and therefore no post-closure samples were analyzed for these analytes).

In order to ensure that Table 1 includes the most up to date information, all analytes retained as a result of the evaluation described above were further reviewed against current surface water quality standards and PQLs.

> *Standards.* The most recent changes to numerical standards in Table 1 occurred during the third five-year review for the Rocky Flats Site and were adopted into RFLMA shortly thereafter. The basis for some of the metals standards in Table 1 (i.e., Table Value Standards [TVS]), are derived from equations. Some of these equations have been updated since RFLMA was signed. Therefore, these metals standards were recalculated using the most current toxicity equations for chronic exposure of aquatic life and a water hardness value of 143 mg/L (see 5 CCR 1002-38, Appendix 38-1 Section 38.6(3)). Based on these calculations, the standards for five metals (cadmium, copper, lead, nickel, and zinc) will be revised in RFLMA Attachment 2, Table 1 as follows:

Analyte	Previous Standard (mg/L)	New Standard (mg/L)
Cadmium, dissolved	1.50E-03	5.60E-04
Copper, dissolved	1.60E-02	1.20E-02
Lead, dissolved	6.50E-03	3.70E-03
Nickel, dissolved	1.23E-01	7.00E-02
Zinc, dissolved	1.41E-01	1.68E-01

Practical Quantitation Limits. Table 1 will be revised to include new PQLs, when appropriate and as agreed to by the RFLMA parties. The RFLMA parties adopted the lowest, reliably achieved PQL based on the analyte, CDPHE Hazardous Waste Corrective Action Unit experience at other Colorado sites, the 2014 Water Quality Control Division Implementation Policy for Practical Quantitation Limits, advancements in analytical method capabilities, and analytical results from over 10 years of RFLMA monitoring at the Rocky Flats Site.

As a result of the Table 1 revisions described above, LM will need to replace some analytical methods currently in use with methods that can attain lower detection limits. RFLMA does not require the use of specific analytical methods, except in the Original Landfill (OLF) and the Present Landfill (PLF) Monitoring and Maintenance Plans (M&M Plans). These Plans are incorporated by reference as enforceable requirements of RFLMA (RFLMA, Attachment 2, Section 5.3). In order to facilitate the changes approved in this minor modification, the RFLMA parties agree that LM may use any EPA-approved analytical method to analyze RFLMA monitoring samples collected in accordance with the OLF and PLF M&M Plans. Approval of this CR does not formally modify the landfill M&M Plans; however, the RFLMA parties agree that the requirement to use specific analytical methods should be removed during the next revision of the Plans.

A new column will be added to Table 1 (Surface Water Standards) titled “Analyte Category.” This column will assign each Table 1 analyte to a category (metals, volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], or other) that can be directly tied to the required monitoring listed for each location in Table 2 (Water Monitoring Locations and Sampling Criteria). The ‘other’ analyte category is meant to capture analytes that are called out individually in Table 2 (e.g., plutonium, nitrate), as opposed to being part of a group of analytes. For example, samples from well 4087 are to be analyzed for VOCs, uranium (U), and nitrate according to Table 2. The VOC results in groundwater samples collected at well 4087 will be evaluated for each analyte marked ‘VOCs’ in the Table 1 “Analyte Category” column. The nitrate and uranium results from these samples will be evaluated using the individual nitrate and uranium standards in Table 1, which are categorized as ‘other’ in the last column.

Several of the footnotes to Table 1 and Table 2 will be modified. The majority of these modifications will be editorial in nature (e.g., renumbering or removing obsolete language). However, some will be modified to clarify how the standards are evaluated with respect to analytical data. Specifically, these clarifying changes will include:

- Table 1, footnote [d] will be modified to read, "Specific analyte categories are referenced in Table 2 for the RFLMA monitoring locations. Analytes categorized as 'other' are specified individually in Table 2, if targeted for that location." This modification was necessary to describe the purpose of the "Analyte Category" described in the paragraph above.
- Table 1, footnote [e] will be modified to read, "Groundwater samples collected from monitoring wells for analysis of metals, Pu, Am, and U will be field-filtered. Analytical results will be evaluated against the corresponding Table 1 value whether the standard is listed as dissolved or total." This modification clarifies that the metals, Pu, Am, and U results associated with RFLMA groundwater samples collected from wells represent the dissolved fraction. Because the designated groundwater use classification at the site is surface water protection, these dissolved fraction concentrations better represent the groundwater that ultimately reaches surface water. Particulates that would be present in an unfiltered sample are naturally impeded as groundwater moves through the subsurface before it reaches surface water. In addition, from a practical standpoint, some of the RFLMA groundwater monitoring wells yield very little water and would not allow collection of the extra samples needed to analyze for both total and dissolved analytes. Therefore, the RFLMA parties agree that the manner in which the dissolved data are used in the evaluation of RFLMA groundwater data collected at wells is appropriate.
- Table 1, footnote [i] will be modified to read, "Chromium analyses for RFLMA monitoring locations are reported as the total concentration of chromium, which includes both trivalent (Cr-III) and hexavalent (Cr-VI) forms. These data are evaluated against the chromium water supply standard of 50 µg/L established for those waters classified for domestic water use." [5 CCR 1002-38.6(3), table footnote 5]
- Table 1, footnote [j] will be modified to read, "Nitrate analyses are reported as nitrate + nitrite (as Nitrogen) and are evaluated against the nitrate standard." The RFLMA parties agree that this practice is appropriate because surface water and groundwater at the site typically present aerobic conditions, which favor the presence of nitrate and not nitrite. The RI/FS states, "Nitrites are particularly unstable in aerobic environments, such as those generally observed at [Rocky Flats], which facilitate the oxidation and conversion of nitrites to nitrates. Therefore…the vast majority of the combined nitrite/nitrate concentration can typically be attributed to nitrate." The RI/FS further states that because the groundwater at the site is generally well oxygenated, it is likely that the predominant dissolved nitrogen species is nitrate (RI/FS 2006).

Pursuant to RFLMA paragraph 66, the RFLMA parties do not consider that these changes constitute a significant change from existing requirements of RFLMA, and this contact record provides public notice of the proposed minor modifications. Approval of this CR authorizes DOE to modify RFLMA Attachment 2.

Discussion: The specific minor modifications are described in detail below. Several RFLMA Attachment 2 subsections, tables, and figures will be modified. The minor modifications approved by CR 2014-02, CR 2014-07, and CR 2015-04 are included in this CR for completeness. Text to be deleted is shown in single-line strikethrough, and new text is in bold. Modifications to tables and figures are summarized.

RFLMA Attachment 2

- Section 2.1, "Surface Water Standards"

Second paragraph: The remedy performance standards for surface water at the Rocky Flats Site are found in Table 1 and are based on the tables found in the WQCC Regulation No. 31: Basic Standards and Methodologies for Surface Water (5 CCR 1002-31) and on the site-specific standards in the WQCC Regulations No. 38 (5 CCR 1002-38). **The Table 1 standards are tailored to the conditions at the Rocky Flats Site and their use is limited to the evaluation of environmental monitoring data required by this agreement. The Table 1 standards do not supplant state of Colorado water quality standards applicable to surface waters at the site, which are named in the CAD/ROD.** If the numeric values from the basic standards and the site-specific standards differ, the site-specific standard applies. ~~In addition to~~ **Revisions to the practical quantitation** ~~levels~~ **limits** (PQLs) ~~allowed by the WQCC regulations, site-specific PQLs~~ **in Table 1** may be proposed to Colorado Department of Public Health and Environment (CDPHE) for approval. **The RFLMA parties should consider PQL guidance, applicable regulations, site-specific conditions, and other relevant information in establishing PQL values.** Any changes to the standards will be discussed in the annual legacy management report.

- Section 4.0, "Institutional Controls"

First paragraph: …These controls are embodied in ~~an environmental covenant granted by DOE to the CDPHE or by~~ a restrictive notice issued by CDPHE ~~instead of an environmental covenant,~~ and are listed in Table 4. **Prior to the restrictive notice, an environmental covenant was in place for the Central OU. The environmental covenant was superseded by the restrictive notice in April 2017 when the restrictive notice was** ~~with Jefferson County in April 2017. The environmental covenant or restrictive notice is~~ recorded in the land records in Jefferson County, Colorado. DOE will annually verify the ~~environmental covenant or the~~ restrictive notice is on file in accordance with Section 5.3.6.

- Section 5.0, "Monitoring Requirements"

Second paragraph:…DOE ~~will~~ submit**ted** the QAPP to CDPHE and EPA within two months of execution of the RFLMA.

- Section 5.1, "Monitoring Surface Water"

First sentence: Compliance with the surface-water standards in Table 1 will be measured at the Points of Compliance (POCs) ~~downstream of the terminal ponds~~ and consider groundwater in alluvium.

First bullet: Points of Compliance (POCs): Located in Woman and Walnut Creeks ~~at the downstream Central OU boundary~~. These locations are used to demonstrate compliance with the surface-water standards in Table 1 and are identified as WOMPOC and WALPOC respectively. ~~WALPOC, which replaced former POCs GS08 and GS11 on September 28, 2011, and~~

~~WOMPOC, which replaced former POC GS31 on September 9, 2011, will also replace GS03 and GS01 respectively upon DOE notification to EPA and CDPHE certifying that WALPOC and WOMPOC have been functioning as POCs for at least 2 years. EPA or CDPHE may extend the 2-year period by requiring DOE to submit a modification to this attachment in accordance with RFLMA paragraph 65 if either determines that such modification is necessary to ensure protection of human health and the environment.~~

- Section 5.3.6, "Monitoring Institutional Controls"

The effectiveness of the institutional controls described in Table 4 of this attachment and in the ~~environmental covenant or~~ restrictive notice required by Section 4.0 will be determined by inspecting the Central OU at least annually for any evidence of violations of those controls. DOE will also annually verify that the ~~environmental covenant or~~ restrictive notice for the Central OU remains in the Administrative Record and is recorded in Jefferson County.

- Section 5.4.2, "Pre-discharge Pond Sampling

First sentence: DOE will collect pre-discharge samples from Pond A-4, Pond B-5, ~~and~~ **or** Pond C-2~~, and as needed from any other pond upstream of a POC temporarily functioning as a terminal pond~~ when ~~said pond is~~ operated in batch and release mode.

- Section 7.1, "Quarterly Legacy Management Reports"

Delete fourth bullet: ~~Ecological sampling data~~

- Section 7.2, "Annual Legacy Management Reports"

Delete fourth bullet: ~~Discussion of ecological sampling data~~

Ninth bullet: Verification of the ~~Environmental Covenant~~ **restrictive notice** and evaluation of the effectiveness of institutional controls;

- Modify Table 1, "Surface Water Standards" list of analytes based on closure decisions and post-closure analytical data; update select metals standards and practical quantitation limits (PQLs); revise and renumber footnotes as necessary to reflect changes.
- Add "Analyte Category" column to Table 1 that assigns each Table 1 analyte to a category (metals, VOCs, SVOCs, or other) that can be directly tied to the required monitoring listed for each location in Table 2, "Water Monitoring Locations and Sampling Criteria".

- Modify Table 2, "Water Monitoring Locations and Sampling Criteria" to remove monitoring locations that have been deleted and update monitoring location nomenclature.
  - Table 2, footnote (2) will be modified to read, "Laboratory analytes are limited to those listed in Appendix C of the Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan. **Where noted for surface water samples, flow rate is required to pace the automatic samplers.**"
  - Table 2, footnote (3) will be modified to read, "Laboratory analytes are limited to those listed in Appendix C of the Landfill Monitoring and Maintenance Plan, RFETS Original

Landfill. **Groundwater samples collected from monitoring wells for analysis of metals, Pu, Am, and U will be field-filtered.**"

- Table 2, footnote (4) will be modified to read, "Analysis and evaluation of metals, and VOCs, **and SVOCs** will be performed for some or all of the analytes **within the corresponding Analyte Category** listed in Table 1."
- Table 2, footnote (5) will be modified to read, "Results for POCs are evaluated using Figure 5. POCs GS01 and GS03 will be replaced by WALPOC and WOMPOC per Section 5.1.
- Table 2, footnote (7) will be modified to read, "Results from AOC **wells** and SW018 are evaluated using Figure 7.
- Table 2, footnote (11) will be modified to read, "Results from Treatment System locations are evaluated using Figure 11. GWISINFNORTH and GWISINFSOUTH may be used for investigative purposes."
- Table 2, asterisk will be deleted: *Samples of ground water collected for U, Pu and Am analysis will be filtered in the field using a 0.45 um in-line filter.

- Table 3, "Present and Original Landfill Inspection and Maintenance Requirements"
  - Original Landfill: first row, second column, second dash: "visually inspect surface of landfill cover for cracks, depressions, heaving, sinkholes; visually inspect diversion berms; measure height and gradient if indicated (employ ~~inclinometer monitoring results and~~ topographic surveys as described in OLF M&M Plan).

    Note regarding deletion above: Seven inclinometers were installed in 2008 as part of a geotechnical investigation at the OLF. The movement of the inclinometers was monitored monthly from July 2008 until May 2015, when it was observed that the majority of the inclinometers were broken and could no longer generate reliable data. With the approval of the RFLMA parties, as documented in a June 5, 2015 email, inclinometer monitoring at the OLF was discontinued.
- Figure 1, "Water Monitoring at Rocky Flats":
  - Delete locations GS01, GS03, GWISINFNORTH, GWISINFSOUTH, Sentinel well 88104, and MOUND R2-E
  - Rename locations ET EFFLUENT to MSETEF and ET INFLUENT to MSETINF
  - Delete within legend: WALPOC and WOMPOC will replace POC locations GS01 and GS03 as described in Section 5.1
- Figure 2, "Composite Plume Map," update to reflect changes to ponds as a result of previous dam breaches and update treatment system nomenclature.
- Figure 5, "Points of Compliance," footnote 1:

  Calculated values for determining Reportable Condition and exceedances of remedy performance standards at POCs.
  - Reportable conditions (according to Section 6.0):
    - plutonium, americium, uranium, nitrate → 30-day average[2]

- — Reportable Conditions and evaluation of compliance with remedy performance standards in Table 1:
  - ➢ **plutonium, americium, uranium, nitrate** → 12-month rolling average[3] ~~for POCs inside COU; 30-day average for GS01 and GS03.~~
- Figure 11, "Groundwater Treatment Systems":
  - — Notes 2, 3, 4, 5 and 6: Change MSPTS to MSPCS
  - — Note 4, "Influent locations," rename ET INFLUENT to MSETINF
  - — Note 5, "Effluent locations,"
    - ➢ Replace R2-E with MSETEF
    - ➢ Rename ET EFFLUENT to MSETEF
  - — Note 6, "Performance locations," rename GS10 to POM2
- Figure 13, "Pre-discharge Pond Sampling", top of flowchart:

  Terminal Pond A-4, B-5, or C-2 ~~(or other pond upstream of a POC serving as a terminal pond)~~ operated in batch and release and conditions warrant routine non-emergency discharge

Actions Complete: The actions approved by this CR will be considered complete when this CR is approved, the minor modifications to RFLMA Attachment 2 have been made, and the modified RFLMA Attachment 2 is posted to the LM website.

Resolution: CDPHE, after reviewing the proposed minor modifications to RFLMA Attachment 2 and after consultation with EPA, has approved the modifications detailed in this CR. CDPHE has determined that the proposed modifications will not compromise or impair the function of the remedy.

Changes to the standards and PQLs in Table 1, as approved by this CR, will become effective on January 1, 2019, in order to synchronize with the RFLMA monitoring and reporting schedule. Because some of the analytical methods required to meet these revised standards and PQLs will require existing laboratory contracts to be revised, those methods will be used as they become available, but no later than April 1, 2019.

Contact Record Prepared by: Patty Gallo and David Ward

Distribution:

Lindsay Masters, CDPHE
Vera Moritz, EPA
Scott Surovchak, DOE
Linda Kaiser, Navarro
Rocky Flats Contact Record File

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2019-01

Purpose: Reportable condition for plutonium 12-month rolling average at Point of Evaluation (POE) SW027

Contact Record Approval Date: March 20, 2019

Site Contact(s)/Affiliation(s): Scott Surovchak and Andy Keim, U.S. Department of Energy (DOE); George Squibb, Linda Kaiser, and Patty Gallo, Navarro Research and Engineering, Inc. (Navarro)

Regulatory Contact(s)/Affiliation(s): Lindsay Masters, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meetings: January 30, 2019; February 4, 2019

Consultation Meeting Participants: Lindsay Masters and Rob Beierle, CDPHE; Vera Moritz, EPA; Scott Surovchak and Andy Keim, DOE; Jody Nelson, George Squibb, and Patty Gallo, Navarro

Introduction. Based on the 12-month rolling average for plutonium (Pu), a reportable condition exists at surface water Point of Evaluation (POE) SW027 at the Rocky Flats Site, Colorado. DOE performed the Pu water sample data evaluation in accordance with Attachment 2, Figure 6, "Points of Evaluation," of the *Rocky Flats Legacy Management Agreement* (RFLMA), which resulted in a 12-month rolling average value of 0.16 picocurie per liter (pCi/L) Pu. The applicable RFLMA Table 1 standard for Pu is 0.15 pCi/L. DOE provided notification of this reportable condition to the agencies and public via email on January 17, 2019. RFLMA Attachment 2, Figure 6 defines the 'agencies' as the EPA, CDPHE, and U.S. Fish and Wildlife Service and the 'public' as the Rocky Flats Stewardship Council and the cities of Broomfield, Northglenn, Thornton, and Westminster. Figure 1 shows the location of SW027 and the surrounding features discussed in this contact record (CR).

Discussion. The last continuous flow-paced composite sample collected at SW027 was retrieved from the field on May 4, 2018. Validated analytical results for this sample were received on June 18, 2018, and showed a result of 0.142 pCi/L Pu in the primary sample and 0.175 pCi/L Pu in the duplicate sample. These composite sample results are representative of water flowing between 9:01 a.m. May 3, 2018, and 12:28 p.m. May 4, 2018. Notification that an individual sample result from SW027 exceeded the RFLMA standard of 0.15 pCi/L for Pu was provided in a routine data exchange email on June 19, 2018. The subsequent composite sampling at SW027 was started immediately on May 4, 2018, at 12:28 p.m. At that time—and until results for the May 4, 2018, composite sample were received or the May 4, 2018, composite was discarded due to insufficient quantity for analysis—the May 31, 2018, and subsequent 12-month rolling average values could not be calculated.

The surface water sampling program at the Rocky Flats Site is designed to automatically collect a volume of water (a "grab sample" of typically 200 milliliters), with the frequency of collection based on the flow of surface water at that location. As a result, the total volume of water collected will be less during dry periods or periods of low flow than during times of higher flow. A minimum volume of water is required to analyze a sample for the RFLMA-required analytes. If this minimum volume of water is not available, a sample cannot be collected and analyzed. Due to dry conditions at SW027, only a small volume of water was collected after May 4, 2018. In fact, only five grab sample volumes were collected; 23 grab sample volumes are necessary to complete the required RFLMA analytical suite. At the end of the year, if an insufficient volume of water is available to analyze a RFLMA sample, DOE consults with CDPHE and EPA to determine a course of action. DOE met with CDPHE and EPA on December 6, 2018, to discuss surface water locations, including SW027, where insufficient volumes of water were available to run the required analyses. The RFLMA Parties agreed that sample volumes at surface water sample locations where an insufficient volume of water was collected, would be discarded. On January 3, 2019, the volume of water collected at SW027 since May 4, 2018, was discarded to close out calendar year 2018. Once the composite sample started on May 4, 2018, was discarded and it was known that results would not be forthcoming, the 12-month rolling averages for May 31, 2018, through December 31, 2018, could be calculated.

Sampling data for SW027 are evaluated in accordance with RFLMA, as described in Attachment 2, Figure 6, "Points of Evaluation." The 12-month rolling averages for the last day of the particular month are calculated and compared to the applicable values in RFLMA Attachment 2, Table 1, "Surface Water Standards." These values represent a volume-weighted average for a period covering the previous 12 months. With the absence of sample data at SW027 from May 4, 2018, forward, the calculation of the 12-month rolling average for May 31, 2018, resulted in a concentration of 0.16 pCi/L for Pu. This value exceeds the RFLMA Attachment 2, applicable Table 1 standard for Pu of 0.15 pCi/L, resulting in a reportable condition. Notice of this reportable condition was provided on January 17, 2019, since it was not confirmed until January 3, 2019, that there would be no additional flow at SW027 and the sample volume collected during the second half of calendar year 2018 would be of insufficient volume to analyze.

Nearby Sampling Locations. Flow-through operations at Pond C-2 (see Figure 1) were initiated on November 7, 2011, and continue today. All 2018 Pu results from downstream location GS31 (Pond C-2 outlet) are well below 0.15 pCi/L. Among the 2018 samples from GS31, a storm-event composite sample from May 3, 2018 (2:49 p.m. – 9:49 p.m.) was collected during the same runoff event as the SW027 composite sample (May 3–4, 2018). The Pu concentration in this sample was 0.006 pCi/L. No samples were analyzed from upstream sampling location GS51 during calendar year 2018 due to low runoff and subsequent insufficient sample volume for analysis.

In addition, the 30-day and 12-month averages at monitoring location WOMPOC, the RFLMA Point of Compliance downstream of SW027, did not exceed the RFLMA standard for Pu or any other RFLMA analyte at any time during calendar year 2018. The highest sample result for Pu at WOMPOC during all of 2018 was 0.021 (± 0.017) pCi/L for the composite sampling period May 21, 2018, to July 2, 2018.

Erosion Control Measures. In response to the previous reportable condition for Pu at SW027 in 2015 (see CR 2015-03), additional erosion control measures were established in the SW027 drainage and on the hillside above GS51. These measures included installation of erosion matting, wattles, GeoRidge berms, woodstraw, and seeding. Periodic inspection of these measures indicate that they are still in place and functional. The progress of vegetation cover in the area is another measure of erosion control success. Since 2015, the vegetation within the green hatched area in Figure 1 has been monitored annually as a best management practice (BMP). During that time, the vegetation cover in this area has ranged between 68% and 84% depending on the year; it averaged 70% in 2018. Environmental variation in the amount and timing of precipitation plays a large role in the annual fluctuation. A better measure of soil protection is total absolute ground cover. This is a measure of basal vegetation cover (a measure of the plant stem coverage per unit area), plant litter cover, and rock cover (see the *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado* Calendar Year 2017, Ecology Volume). These three factors determine how much of the soil is protected from raindrop impact. Since 2015, when additional seeding and erosion controls were installed, the average total absolute ground cover on the 903 hillside has increased from 86% to 98%. Looked at a different way, this means the amount of bare ground has decreased on the hillside during that time from 14% to 2%. That is, there is much less bare ground in 2018 in this area as compared to 2015. Figure 1 illustrates the general location on the 903 hillside where these data are collected.

These data suggest that the erosion controls installed on the hillside after 2015 continue to function and slow water movement off the hillside. Although Pu concentrations at SW027 were reportable during 2018, these concentrations were less than 15% of the concentrations observed in 2015, further suggesting continued effectiveness of erosion controls.

Pursuant to RFLMA Attachment 2, Section 6.0, "Action Determinations," a reportable condition necessitates the following actions:

- DOE must submit a plan and schedule to the regulators for an evaluation to address the condition within 30 days of receiving the validated data for the reportable condition.
- DOE will consult with CDPHE and EPA to determine if mitigating actions are necessary.
- The objective of consultation will be determining a course of action (if necessary) to address the reportable condition and ensure that the remedy remains protective.
- Results of consultation will be documented in CRs and/or written correspondence.

Plan and Schedule to Address the Reportable Condition: Representatives of CDPHE, EPA, and DOE discussed this reportable condition on January 30, 2019, and February 4, 2019, and developed a path forward. The RFLMA Parties agreed that the steps described in this CR shall serve as the plan and schedule for the evaluation of this reportable condition. These steps include:

- Mitigating actions are not currently necessary. Data from downstream sample locations indicate Pu concentrations well below 0.15 pCi/L. Based on the most recent inspections of the hillside, existing erosion control measures continue to function, and the erosion control measures continue to protect the hillside.

- In addition to the BMP vegetation monitoring area currently monitored on the hillside above GS51 and upstream of SW027, DOE, EPA, and CDPHE will assess an expanded area of the hillside to the east and south (beige hatched area in Figure 1). This assessment will take place during the 2019 growing season, when the full extent of vegetation will be visible. DOE will coordinate the assessment date and time with EPA and CDPHE regulators at least ten calendar days in advance.
- DOE will continue to monitor the vegetation within the BMP vegetation monitoring area in Figure 1 as part of the normal revegetation monitoring that is conducted in July. The erosion controls will continue to be evaluated annually as a BMP in the spring and fall, although they may be evaluated at other times during the year as warranted (e.g., after heavy precipitation events). DOE will repair and/or replace existing erosion control measures and revegetate the areas, as necessary, to maintain their function.
- Surface water sampling will continue as currently scheduled when surface water runoff is available.
- Status of the above items will be reported in quarterly or annual reports, or both, depending on when the activities occur.

Resolution: CDPHE, after consultation with EPA, approves this CR.

Evaluation Complete: The evaluation of the SW027 reportable condition for Pu will be considered complete when the results from the evaluation have been shared with the RFLMA Parties and the reportable condition at SW027 no longer exists.

Contact Record Prepared by: George Squibb, Jody Nelson, and Patty Gallo for Navarro

Distribution:
Scott Surovchak, DOE
Andy Keim, DOE
Lindsay Masters, CDPHE
Vera Moritz, EPA
Linda Kaiser, Navarro
Rocky Flats Contact Record File

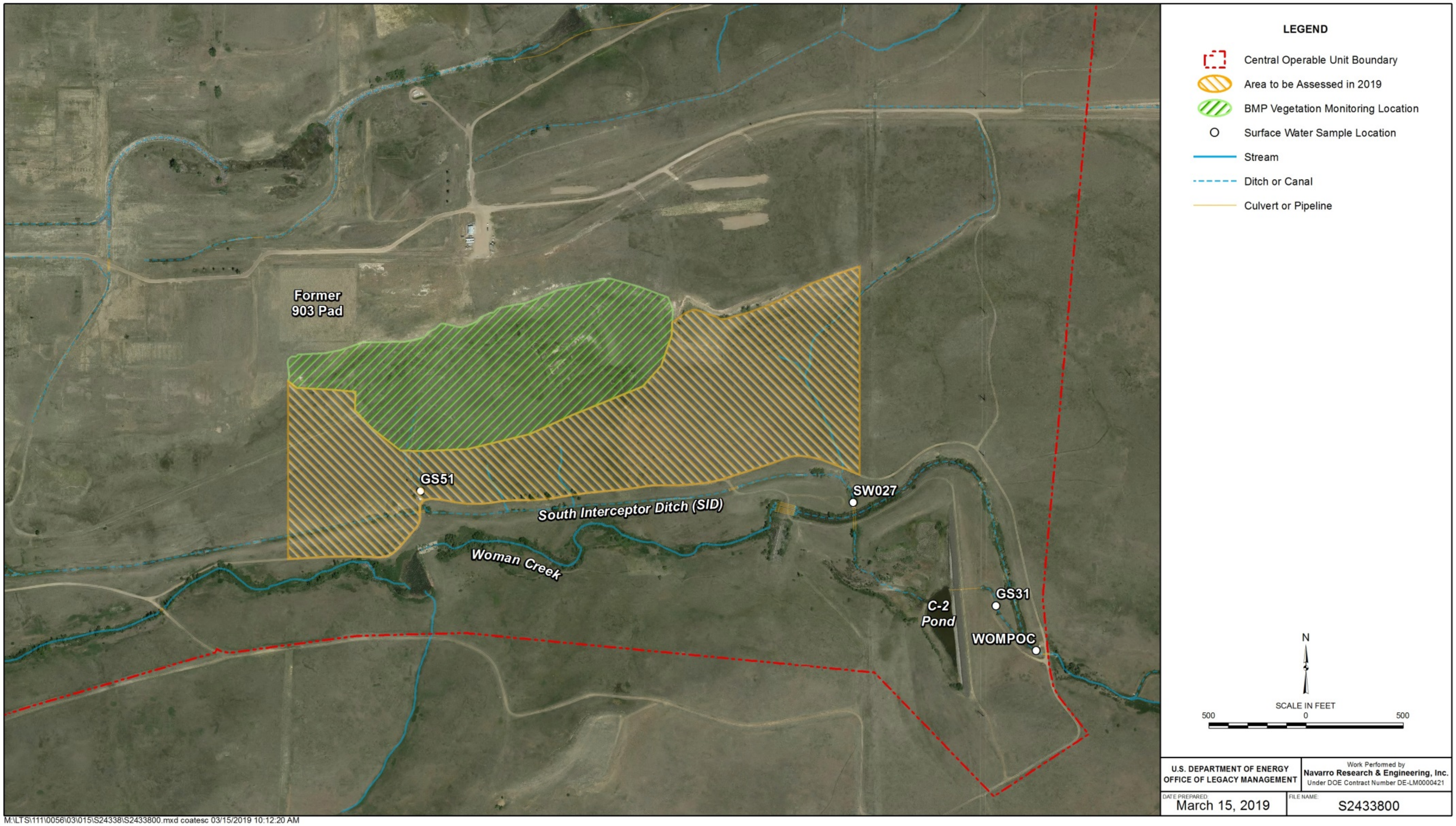


Figure 1. SW027 Location and Surrounding Features

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2019-02

Purpose: Original Landfill (OLF) Stabilization Project with Soil Disturbance Review Plan

---

Contact Record Approval Date: July 12, 2019

Site Contact(s)/Affiliation(s): Scott Surovchak and Andy Keim, U.S. Department of Energy (DOE); Linda Kaiser, David Ward, and Patty Gallo, Navarro Research and Engineering, Inc. (Navarro)

Regulatory Contact(s)/Affiliation(s): Lindsay Masters, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meetings: October 16, 2018; April 4, 2019

Consultation Meeting Participants: Lindsay Masters, CDHPE; Scott Surovchak, Andy Keim, DOE; Vera Moritz, EPA; Linda Kaiser, David Ward, Patty Gallo, Jeremy Wehner, John Boylan, George Squibb, Jody Nelson, Michelle Hanson, Navarro

Related Contact Records: CR 2013-02, CR 2013-03, CR 2014-09, CR 2015-03, CR 2015-06, CR 2016-03, CR 2016-04, CR 2017-01, CR 2017-04, CR 2018-01

Introduction: The Original Landfill (OLF) Stabilization Project is a maintenance action intended to stabilize the east and west portions of the landfill that were prone to movement since 2007. Geotechnical and civil engineering design firms were contracted in 2017 to investigate and evaluate this movement, propose alternatives to stabilize the areas prone to movement, and design a long-term solution to minimize hillside instability at the OLF. The U.S. Department of Energy (DOE) reviewed the alternatives evaluated by the design subcontractors and selected an alternative that employs ground anchors and subsurface trench drains. This design addresses the two primary contributors to hillside instability identified by the design subcontractors: (1) a weak subsurface soil layer further weakened by movement and (2) groundwater.

Discussion: The OLF Stabilization Project design includes the installation of approximately 263 ground anchors with reaction blocks installed in rows on the east and west portions of the OLF (see *Approximate Stabilization Area Limits* in Figure 1). These ground anchors (Figure 2) will be drilled at an angle into the OLF hillside. Each anchor will be embedded a minimum of 39 feet (ft) into competent bedrock to restrain slide-prone materials. The total lengths for the ground anchors range from approximately 53 to 95 ft. The reaction block at the top of each ground anchor will be an approximately 8 ft × 8 ft × 16-inch reinforced concrete pad that spreads out the restraining load of the ground anchor. When complete, the ground anchors and reaction blocks will be fully buried (i.e., they will not be visible on the ground surface). There will be seven rows of ground anchors on the east end and six rows on the west end of the OLF. Each row of ground anchors will have a subsurface drain (ground anchor drain) installed approximately 8.5 ft below the ground surface that runs the entire length of the row, to drain groundwater away from the concrete reaction blocks. The ground anchor drains will consist of a perforated or slotted high-density polyethylene drain pipe surrounded by drain rock and wrapped in geotextile fabric. Figure 3 shows a profile of the anchors and associated ground anchor drains. These drains will flow to subsurface exfiltration gallery features (Figure 4). The groundwater will be diverted to the west in the direction of the existing West Perimeter Channel (WPC) and to the east in the direction of the South Interceptor Ditch (SID) and the East Perimeter Channel (EPC) (Figure 1).

The design also includes the installation of one trench drain each on the west and east sides of the landfill (Figure 1). These trench drains are designed to control groundwater elevations on the east and west sides of the landfill area. The trench drain on the east side will be approximately 440 ft long and up to 20 ft deep; the trench drain on the west side will be approximately 300 ft long and up to 20 ft deep. Upon completion of the OLF Stabilization Project, the groundwater collected by the trench drains will be diverted via subsurface drains to the same subsurface exfiltration gallery features connected to the ground anchor drains described above. An additional 900 ft of trench drains will be excavated to complete the subsurface drainage system (e.g., connect the ground anchor and trench drains to the subsurface exfiltration gallery features). Figure 3 shows a profile of the trench drains in relation to the anchors and anchor bench drains.

In addition to these major design features, the OLF Stabilization Project will include (1) reinstallation of 2 ft of soil cover within the waste footprint at the east and west edges where movement has occurred in the past (see *Approximate Soil Cover Reinstallation Areas* in Figure 5), and (2) optimization of the storm-water management system within the *Approximate Stabilization Area Limits* in Figure 1.

<u>Soil Cover.</u> To the extent possible, soil that is excavated from installation of the anchor boreholes and trench drains outside the waste footprint that is not returned to the borehole or trench will be stockpiled for reuse as soil cover. However, additional soil cover material is required for the 2 ft cover over the waste footprint within the two *Approximate Soil Cover Reinstallation Areas* (Figure 5), as required by the *Original Landfill Monitoring and Maintenance Plan* (LMS/RFS/S05516) (OLF M&M Plan). This soil cover material will be imported from an off-site source approved by DOE.

The OLF M&M Plan requires that Rocky Flats Alluvium (RFA) be used as soil cover for the OLF. Because the availability of RFA from onsite or off-site sources is limited, the *Rocky Flats Legacy Management Agreement* (RFLMA) Parties authorize the use of RFA-equivalent material for the soil cover at the OLF.

Some of the ground anchors and a portion of the trench drains will be installed within the waste footprint. Consistent with past practices, soil and debris excavated from within the waste footprint will be returned to the excavation within the waste footprint where it originated, in accordance with applicable laws and regulations. This will be achieved through soil compaction and surface contouring, as necessary, to maintain cover drainage. If there is a surplus of landfill material excavated from within the waste footprint that cannot be returned to the excavation from where it came, this material will be buried within the waste footprint at one of the *Approximate Soil Cover Reinstallation Areas* (Figure 5) on the east or west side, prior to addition of the 2 ft soil cover. Topographic surveys will be completed in these two areas before and after the placement of the waste material, and after the reinstallation of the 2 ft cover to document the cover thickness and ensure that the minimum 2 ft cover requirement was achieved.

Optimization of Storm-Water Management System. The goal for the optimization of the storm-water management system is to create and maintain positive drainage off the landfill cover while simultaneously minimizing disturbance to the existing cover and established vegetation. Reconfiguration of the existing berms and channels in the central portion of the landfill is not necessary because this area has remained stable since closure. However, installation of the anchor blocks and trenches will require removal of some existing berms and channels within the *Approximate Stabilization Area Limits* (Figure 1). The berms and channels in these areas will be rebuilt in a slightly different orientation than the original design, to improve storm-water movement off the landfill soil cover. The rebuilt berms and channels will connect to the existing berms and channels to allow for the uninterrupted flow of water off the landfill cover. The reconfigured berms are designed to carry the 100-year, 24-hour design storm. Common borrow, as defined in this contact record (CR), will be used in the reconfiguration of the berms and channels and in the final regrading of the OLF at the end of the project. Maintenance of storm-water structures (e.g., EPC, berms) will be conducted as authorized by the OLF M&M Plan.

Operation of the groundwater intercept system and siphon will continue until maintenance construction takes them out of service permanently.

DOE plans to start the OLF Stabilization Project field work in August 2019 and complete the work in the spring and summer of 2020. Monthly inspections of the OLF will continue, as required by the OLF M&M Plan, for the duration of the OLF Stabilization Project. Most of the stabilization work will occur on the east and west portions of the landfill, outside the waste footprint. Thus, routine monthly inspection of the soil cover and storm-water features in the central portion of the landfill will continue uninterrupted. However, the RFLMA Parties recognize that inspection of areas where active construction is taking place (generally within the *Approximate Stabilization Area Limits* in Figure 1) will not be feasible for some periods during the project. For example, the berms and channels within the *Approximate Stabilization Area Limits* (Figure 1) will be removed to allow construction of the stabilization features (e.g., anchors, trench drains). These berms will ultimately be rebuilt, as described in the paragraph above, but routine inspection of these features will not resume until the OLF Stabilization Project is completed. In addition, some of the seeps are located with the *Approximate Stabilization Area Limits* (Figure 1), as is the EPC. These features may also not be available for routine inspection for some periods during the Project. Areas and features that cannot be inspected during the OLF Stabilization Project will be noted on the inspection form. Routine inspections of these areas and features in accordance with the OLF M&M Plan will resume as soon as practicable. The RFLMA Parties acknowledge that certain features of the OLF will not be routinely inspected during the OLF Stabilization Project and agree that this does not constitute noncompliance with the inspection requirements of the OLF M&M Plan.

Construction of the OLF stabilization features (anchors and trench drains) will occur in the vicinity of two existing settlement monuments installed during OLF closure: settlement monument F on the east side and settlement monument E on the west side of the landfill. Every effort will be made to protect these monuments during construction. Monuments will be replaced if damaged or otherwise rendered unusable.

Approval of this CR does not formally modify the OLF M&M Plan; however, the RFLMA Parties agree that the M&M Plan shall be modified to incorporate changes to the landfill features resulting from implementation of the OLF Stabilization Project.

Institutional Controls Evaluation: The OLF Stabilization Project will involve activities restricted by RFLMA institutional controls (ICs) 2, 3 and 6, which are shown in Table 1.

IC 2: The OLF Stabilization Project includes the drilling of anchor boreholes, the excavation of trench drains, and the installation of other subsurface features (e.g., subsurface exfiltration gallery features, ground anchor drains) at depths below 3 ft. The activities are prohibited by IC 2 without regulatory review and approval of a Soil Disturbance Review Plan (SDRP). The SDRP for the OLF Stabilization Project is provided as Attachment 1 to this CR.

IC 3: Drilling, excavation, and grading will disturb surface soil at the OLF, which is prohibited by IC 3 except when performed in accordance with a soil erosion control plan. The *Erosion Control Plan for Rocky Flats Property Central Operable Unit* (DOE-LM/1497-2007), approved by CDPHE and EPA, provides erosion control best management practices that meet the IC 3 requirements. The Erosion Control Plan and the erosion controls detailed on the project design drawings constitute the storm-water management plan for the OLF Stabilization Project.

IC 3 also prohibits soil disturbance that will not return the soil surface to preexisting grade without regulatory review and approval of a SDRP. Stabilization activities proposed in this CR will return the soil surface to preexisting grade or higher.

IC 6: The OLF Stabilization Project includes the drilling of anchor boreholes, the excavation of trench drains, and the installation of other subsurface features (e.g., subsurface exfiltration gallery features, ground anchor drains). These activities will occur on the landfill cover (i.e., within the waste footprint) and outside the waste footprint in other areas of the hillside (e.g., EPC). Vehicular traffic on the OLF cover and other areas of the hillside will be necessary to execute the project. Trucks and heavy equipment, such as a drill rig, crane, backhoe, and front-end loader, will be traversing the landfill cover and storm-water management features on the east and west sides of the landfill. These activities on the landfill cover are prohibited by IC 6 except for authorized response actions.

Table 1. Institutional Controls	
IC 2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central Operating Unit, and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.
IC 3	No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan (including Surface Water Protection Plans submitted to EPA under the Clean Water Act) approved by CDPHE or EPA. Soil disturbance that will not restore the soil surface to preexisting grade or higher may not be performed without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent migration of residual surface soil contamination to surface water. **Rationale:** Certain surface soil contaminants, notably plutonium-239/240, were identified in the fate and transport evaluation in the Remedial Investigation as having complete pathways to surface water if disturbed. This restriction minimizes the possibility of such disturbance and resultant impacts to surface water. Restoring the soil surface to preexisting grade maintains the current depth to subsurface contamination or contaminated structures.
IC 6	Digging, drilling, tilling, grading, excavation, construction of any sort (including construction of any structures, paths, trails, or roads), and vehicular traffic are prohibited on the covers of the Present Landfill and the Original Landfill, except for authorized response actions.
	Objective: Ensure the continued proper functioning of the landfill covers. **Rationale:** This restriction helps ensure the integrity of the landfill covers.

The lower half of the OLF is within critical habitat for the Preble's meadow jumping mouse (*Zapus hudsonius preblei*). Work that occurs within the original OLF construction boundary is still covered by the 2004 Programmatic Biological Assessment and Biological Opinion. However, because part of this project will occur outside the original construction boundary, a separate consultation document will be submitted to the U.S. Fish and Wildlife Service to address the additional area needed for the project.

Resolution: CDPHE, after reviewing information regarding the proposed soil disturbance and excavation and after consultation with EPA, has approved the OLF Stabilization Project activities described in this CR. CDPHE has determined that the proposed activities are not expected to: (1) compromise or impair the function of the remedy, or (2) result in an unacceptable release or exposure to residual subsurface contamination. CDPHE has also determined that the proposed activities meet the rationale and objectives of IC 2, 3 and 6. Therefore, certain activities normally prohibited by these institutional controls are authorized by this CR solely for the purpose of implementing the OLF Stabilization Project. Approval of this CR constitutes authorization to implement the actions described herein.

The work will be conducted after approval of this CR, but DOE will not conduct the approved soil disturbance until 10 calendar days after this CR is posted on the Rocky Flats website and stakeholders are notified of the posting in accordance with the RFLMA Public Involvement Plan.

Progress and the completion of the work will be reported by DOE in RFLMA quarterly and annual reports of surveillance and maintenance activities for the period(s) in which these activities occur.

Actions Complete: The actions approved by this CR will be considered complete when the OLF Stabilization Project actions approved by this CR are completed, post-construction reseeding has been performed, and post-construction erosion controls are in place. At that time, the reportable condition at the OLF described by CR 2013-02 will be resolved.

Contact Record Prepared by: Patty Gallo, David Ward, and Jeremy Wehner, Navarro

---

Distribution:
Lindsay Masters, CDPHE
Vera Moritz, EPA
Scott Surovchak, DOE
Andy Keim, DOE
Linda Kaiser, Navarro
Rocky Flats Contact Record File

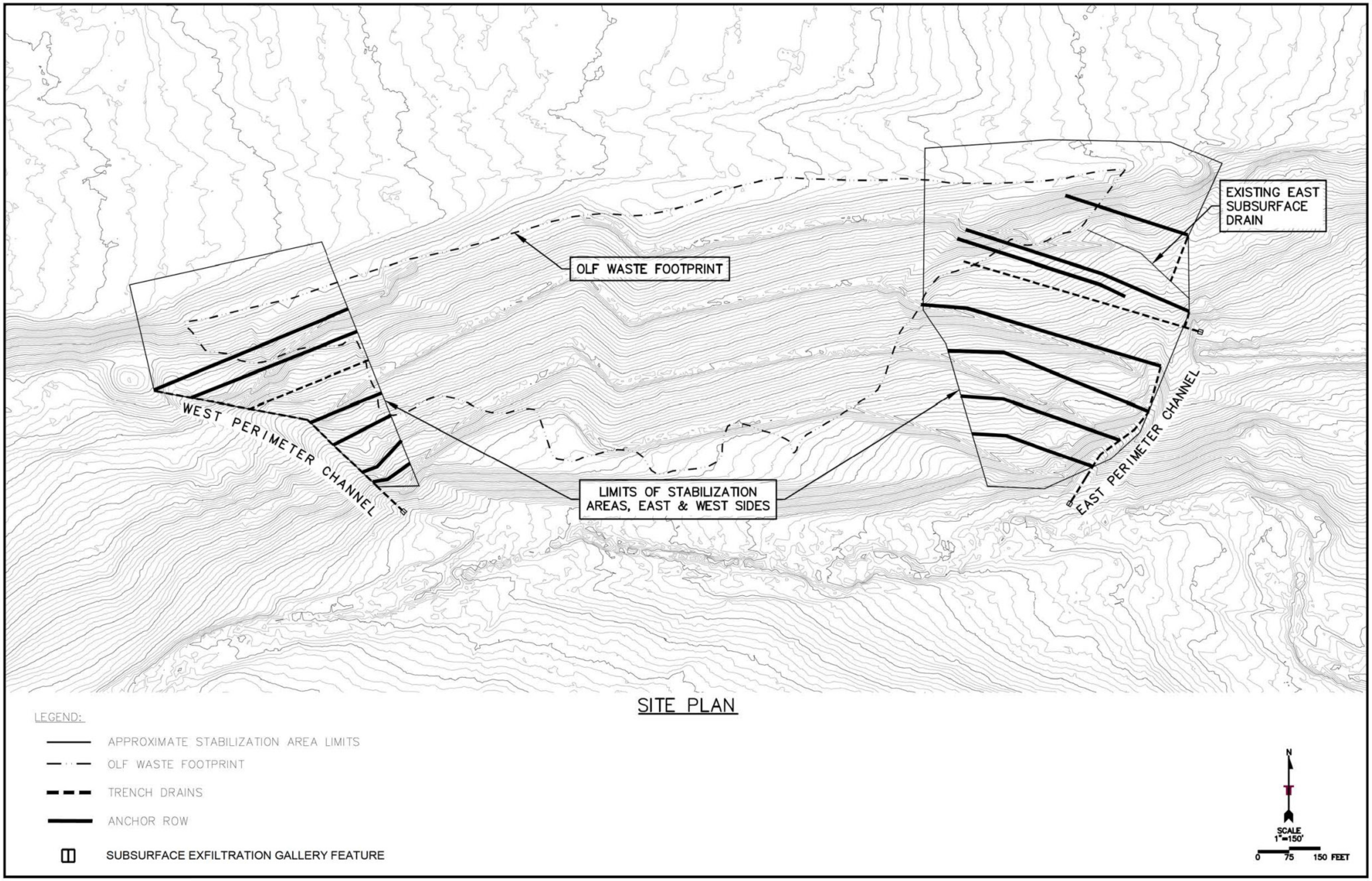


Figure 1. OLF Stabilization Design Features

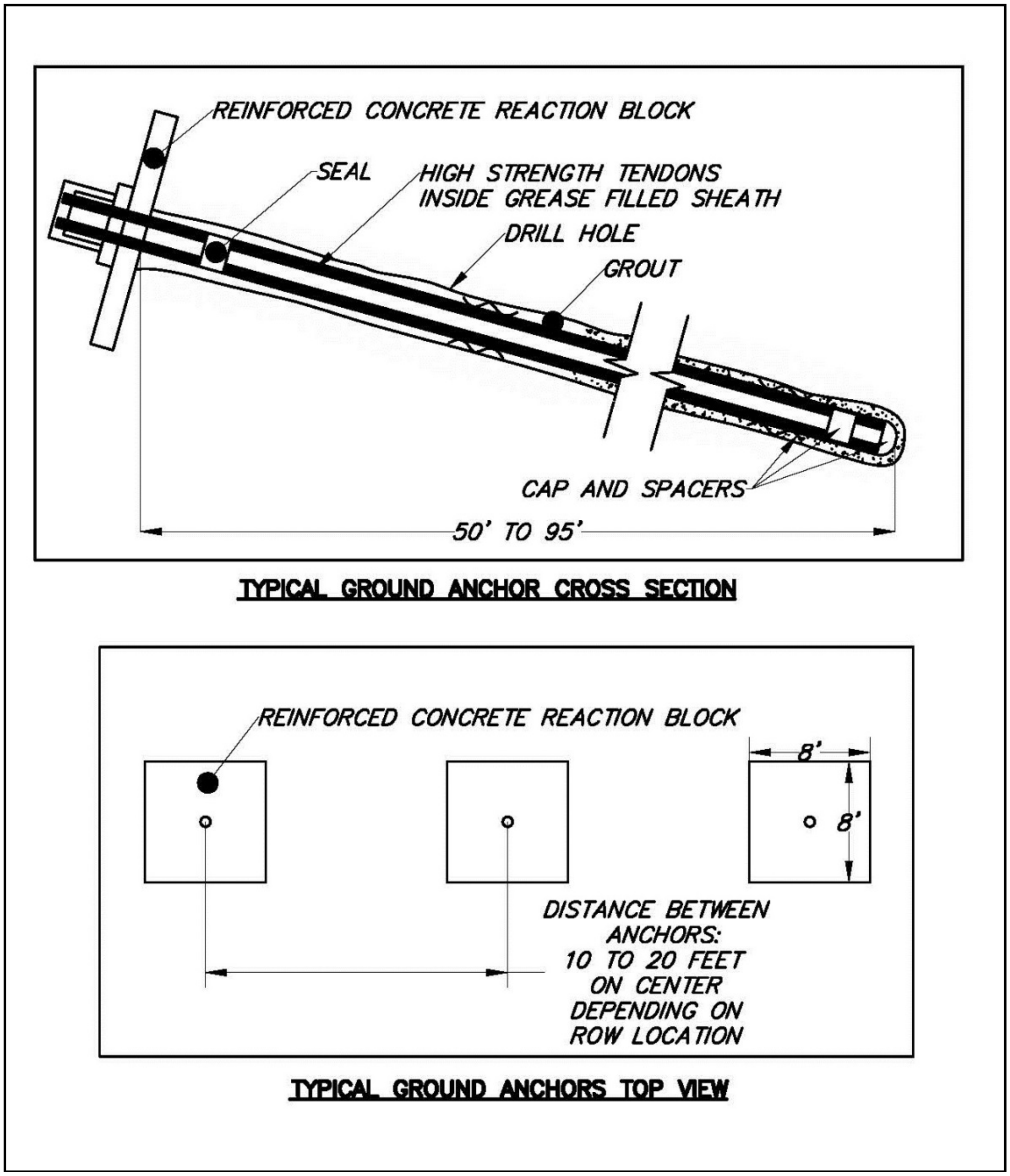


Figure 2. Ground Anchor Detail

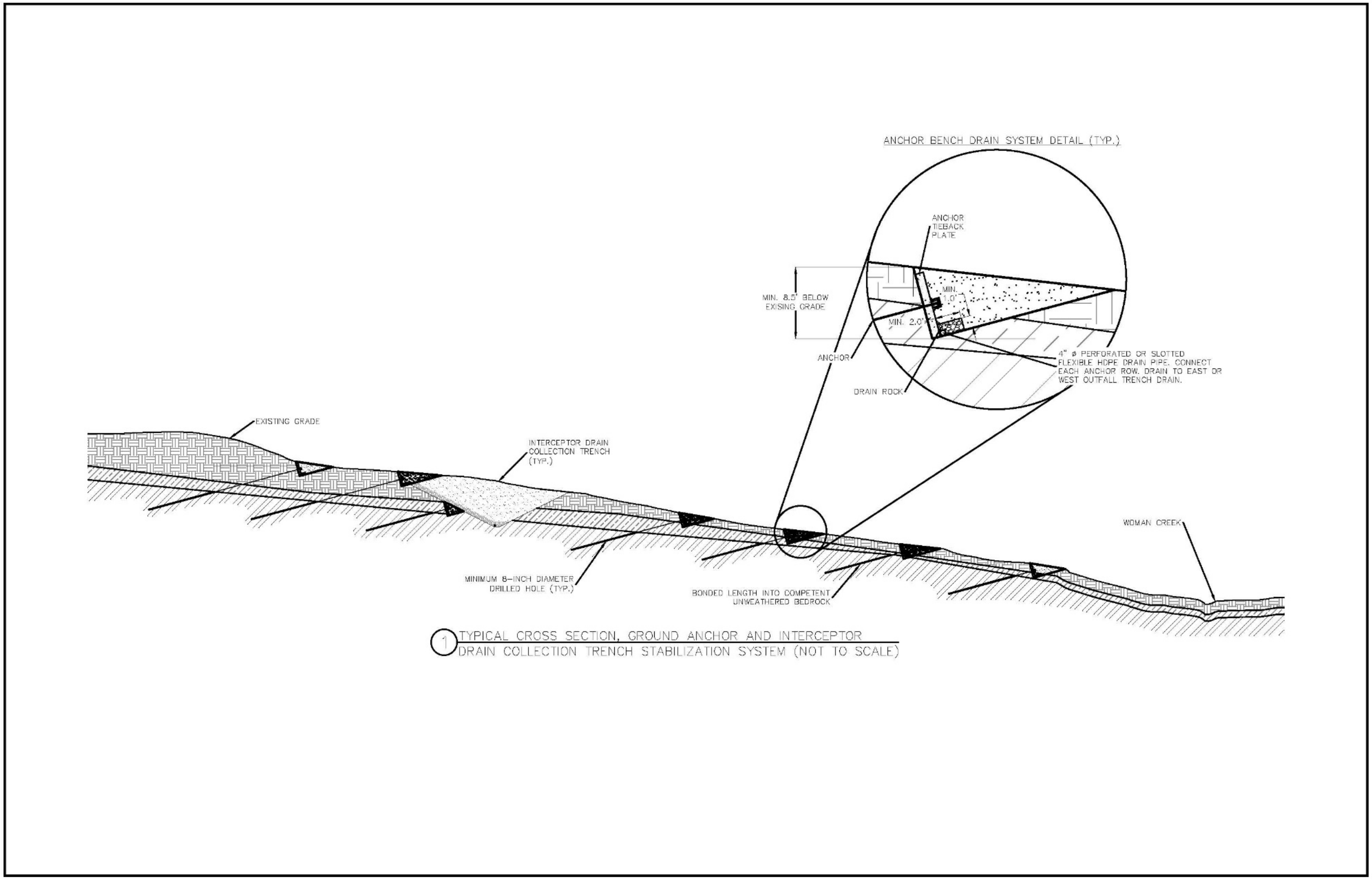


Figure 3. Ground Anchor and Trench Profile

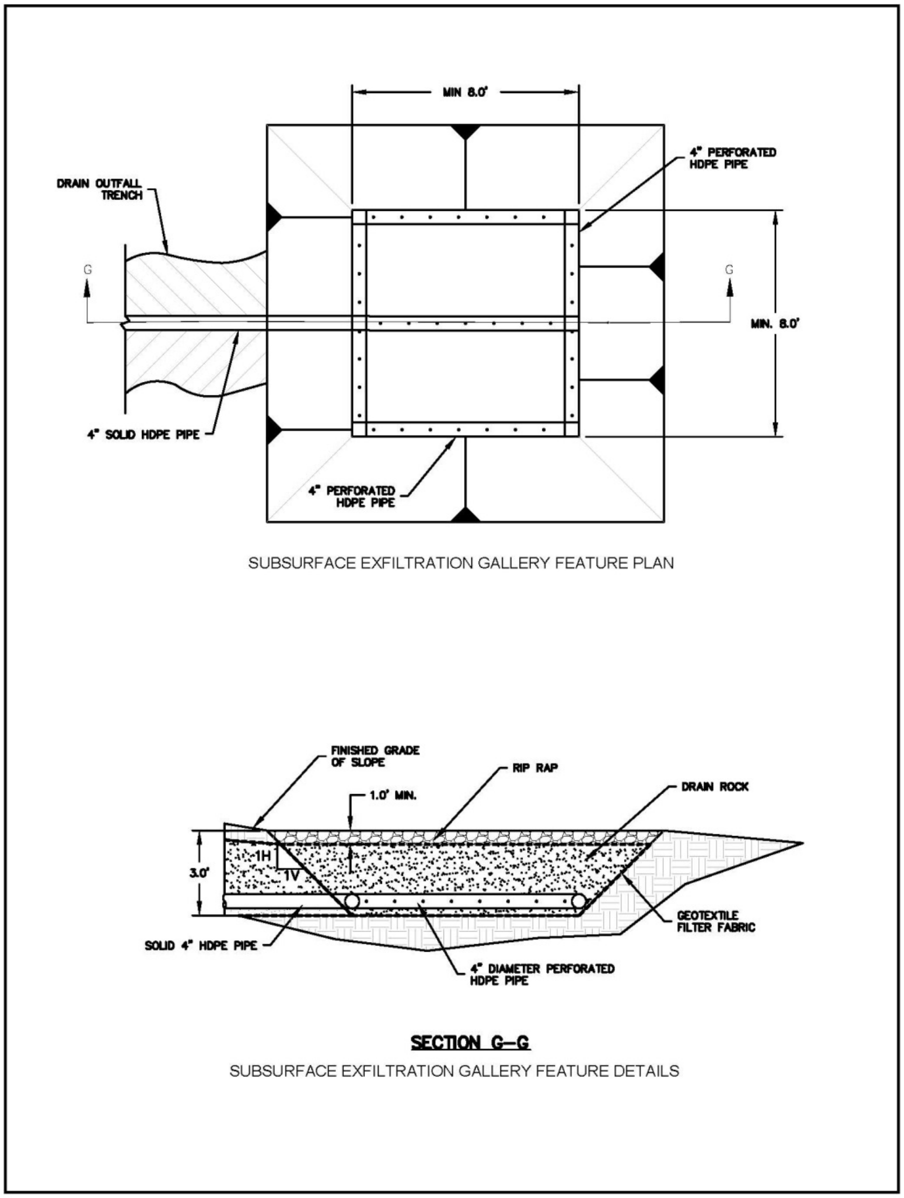


Figure 4. Subsurface Exfiltration Gallery Feature

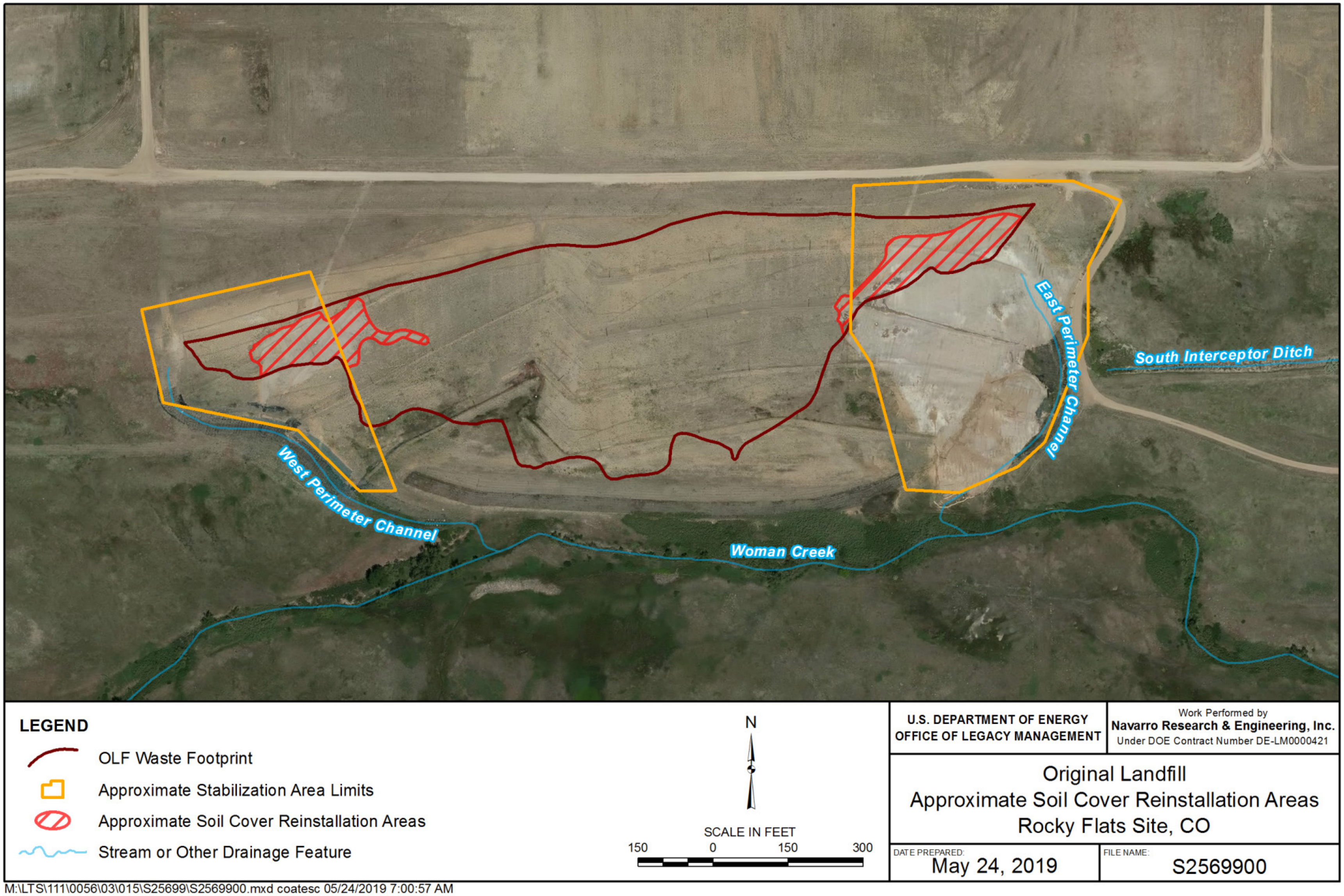


Figure 5. Soil Cover Reinstallation Areas

Attachment 1

Rocky Flats Legacy Management Agreement Soil Disturbance Review Plan

Proposed Project: Soil Disturbance Review Plan (SDRP) for the Original Landfill (OLF) Stabilization Project

This SDRP provides information required by the *Rocky Flats Legacy Management Agreement* (RFLMA) Attachment 2, "Legacy Management Requirements," Section 4.1, "Soil Disturbance Review Plan," regarding the work proposed by DOE.

<u>Description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.</u>

The Original Landfill (OLF) Stabilization Project is a maintenance action intended to stabilize the east and west portions of the landfill. The project will involve implementation of an engineered design that includes installation of ground anchor blocks and trench drains. This design addresses the two primary contributors to hillside instability: (1) a weak subsurface soil layer further weakened by movement and (2) groundwater. This project is intended to address the long-term stabilization of the OLF hillside.

Approximately 263 ground anchors with reaction blocks will be installed in rows on the east and west portions of the OLF where past movement and slumping have occurred (see *Approximate Stabilization Area Limits* in Figure 1 to CR 2019-02). These ground anchors will be drilled at an angle into the OLF hillside. Each anchor will be embedded a minimum of 39 feet (ft) into competent bedrock to restrain slide-prone materials. The total lengths for the ground anchors range from approximately 53 ft to 95 ft. The reaction block at the top of each ground anchor will be an approximately 8 ft × 8 ft × 16-inch reinforced concrete pad that spreads out the restraining load of the ground anchor. When complete, the ground anchors and reaction blocks will be fully buried (i.e., they will not be visible on the ground surface). There will be seven rows of ground anchors on the east end and six rows on the west end of the OLF. Each row of ground anchors will have a subsurface drain installed approximately 8.5 ft below the ground surface that runs the entire length of the row, to drain groundwater away from the landfill. These drains will flow to subsurface exfiltration gallery features that will allow groundwater to express at the ground surface in a manner similar to that of a seep (see Figure 4 to CR 2019-02). The groundwater collected by the ground anchor drains, and the trench drains described in the following paragraph, will be diverted to the west in the direction of the existing West Perimeter Channel and to the east in the direction of the South Interceptor Ditch (SID) and the East Perimeter Channel (EPC) (Figure 1 to CR 2019-02).

The design also includes the installation of one trench drain each on the west and east sides of the landfill (see Figure 1 to CR 2019-02). These trench drains are designed to control groundwater elevations within the landfill area. The trench drain on the east side will be approximately 440 ft long and up to 20 ft deep; the trench on the west side will be approximately 300 ft long and up to 20 ft deep. Upon completion of the OLF stabilization project, the groundwater collected by the trench drains will be diverted via subsurface drains to the same subsurface exfiltration gallery features connected to the ground anchor drains described above. An additional 900 ft of trench drains will be installed to complete the subsurface drainage system (e.g., connect the ground anchor and trench drains to the subsurface exfiltration gallery features).

DOE has conducted intrusive activities at the OLF, some of which occurred at locations within the waste footprint, several times since closure in 2005. Activities that involved soil disturbance (e.g., drilling, excavation) are listed below, along with the associated CRs:

- Investigation, repairs, and maintenance, including WPC regrade in 2008 (CR 2008-07)
- Soil sampling in 2010 (CR 2010-01)
- Regrading the EPC in 2013 (CR 2013-03 and CR 2014-09)
- Response to precipitation in 2015 (CR 2015-03 and CR 2015-06)
- Upgrade of East Subsurface Drain in 2016 (CR 2016-04)
- Interim maintenance work in 2017 (CR 2017-04)
- Geotechnical investigation in 2018 (CR 2018-01)

Additional information on these activities may be found in the *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado* for the calendar year in which the activity took place.

<u>Information about any remaining subsurface structures in the vicinity of the proposed project (or state that there are none if that is the case).</u>

There are no remaining subsurface structures (e.g., buried buildings, foundations) in the vicinity of the proposed project.

An abandoned buried natural gas line operated by Xcel Energy is in the utility easement corridor north of the OLF. The location and alignment of this abandoned line is well known and marked with signs. It is well outside of the soil disturbance areas.

Prior to OLF closure, a subsurface storm-water drain was present that cut across the northeast portion of the landfill and ended at the SID. This drain was abandoned during closure; part of the drain was removed and part of it was closed in place. The remnants of this drain have been shown to be a preferential pathway for groundwater originating on the pediment north of the landfill. During the 2018 geotechnical investigation at the OLF, the terminus of this storm-water drain was located. As part of the OLF Stabilization Project, the terminus will be connected to the trench drain that will be constructed on the east side of the landfill.

<u>Information about any former Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern, or other known or potential soil or groundwater contamination in the vicinity of the proposed project.</u>

The OLF is located on a south-facing hill slope north of Woman Creek. The landfill covers approximately 20 acres that encompasses two IHSSs: IHSS 115 (OLF), and IHSS 196 (Water Treatment Plant Backwash Pond). IHSS 196 was in the approximate center of the OLF. From the early 1950s until the 1970s, filter backwash wastewater generated by the nearby water treatment plant was discharged to a settling and evaporation pond (IHSS 196). The effluent from the water treatment plant was discontinuous and was made up of filter backwash, filter prewash, sludge blowdown, and other wastewater from the treatment of raw water. It contained all the silt, mud, and filterable solids removed from the raw water.

The OLF (IHSS 115) was not designed or operated as an engineered landfill. The OLF is not a hazardous waste unit because wastes were not disposed of in the landfill after the effective dates of the various hazardous waste regulations. However, the OLF's historical use is typical of solid waste dumps of the time, and the wastes disposed of were plant trash and construction debris that, based on sampling, likely contained some chemicals that subsequently were regulated as Comprehensive Environmental Response, Compensation, and Liability Act hazardous substances. The *Final Interim Measure/Interim Remedial Action for the Original Landfill* (IM/IRA) describes the history of the OLF and the types of wastes disposed of in the landfill (DOE 2005). Use of the OLF for dumping trash and debris ended in 1968, and an unknown amount of soil was used to cover the waste. The OLF IM/IRA states that soil was used to cover the waste dumped in the OLF area during its use, and that the waste and soil are fairly well commingled. The OLF was not a radioactive contaminated waste disposal area. However, there is a documented instance of placing a smoldering depleted uranium (DU) slab in the OLF to allow it to "burn out." When the burned slab was recovered, not all of the DU mass was recovered. Surface soil monitoring at the OLF also located several hot spots. Before the soil cover was placed on the OLF, the hot spots were removed (see OLF IM/IRA, Appendix E). The OLF IM/IRA contains environmental media analytical results, including results from 57 surface soil locations and 22 subsurface soil (to bedrock) borehole locations. A review of the OLF IM/IRA residual soil contamination data shows that concentrations of all analytes are below the Wildlife Refuge Worker (WRW) subsurface soil Preliminary Remediation Goals, which are based on 1×10^{-6} risk from activities involving occasional exposure to subsurface soils, such as drilling.

The OLF is within the Upper Woman Drainage Exposure Unit (EU) evaluated in the Comprehensive Risk Assessment, Appendix A, of the Remedial Investigation/Feasibility Study. The only contaminants of concern (COCs) identified for this EU are benzo[*a*]pyrene and dioxins/furans for surface soil/surface sediment. Dioxin/furan concentrations were converted to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) toxicity equivalents (TEQs) for COC screening and risk characterization. Noncancer risks for benzo[*a*]pyrene and 2,3,7,8-TCDD TEQ were not evaluated because those COCs do not have noncancer toxicity values. Risks were calculated for benzo[*a*]pyrene and 2,3,7,8 TCDD TEQ. The estimated Tier 1 total excess lifetime cancer risk to the WRW at the EU is 8×10^{-6}, and the Tier 2 risk is 4×10^{-6}.

A portion of the "Industrial Area Plume," which contains groundwater contaminated with volatile organic compounds (VOCs), has been mapped as extending beneath the northern part of the OLF. Based on pre-closure data, this area of the plume is characterized by low (part-per-billion) concentrations of VOCs. There are three Resource Conservation and Recovery Act wells positioned at the bottom of the OLF to monitor the groundwater that has passed through the landfill. In addition, surface water monitoring location GS59 monitors surface water downstream of the OLF in Woman Creek and the WOMPOC monitoring location ensures that surface water leaving the Central Operable Unit meets applicable RFLMA standards.

The OLF closure design had a 2-foot-thick soil cover over the location of the disposed of waste materials and clean RFA fill surrounding the waste materials for the placement and configuration of storm-water and seep water management features. The limits of the waste area (i.e., waste footprint) are shown in Figure 1 of CR 2019-02. Because some drilling and excavation will take place within the OLF waste footprint, it is possible that workers will be exposed to contaminated soils, buried wastes, or contaminated groundwater. Contamination control, worker protection, and identification and characterization processes are addressed in the project planning documents for the OLF Stabilization Project.

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2019-03

Purpose: North Walnut Creek Stormwater Diversion and Soil Disturbance Review Plan

Contact Record Approval Date: July 30, 2019

Site Contacts and Affiliations: Scott Surovchak and Andy Keim, U.S. Department of Energy (DOE); Linda Kaiser, Patty Gallo, David Ward, and Ryan Wisniewski, Navarro Research and Engineering, Inc. (Navarro)

Regulatory Contacts and Affiliations: Lindsay Masters, Colorado Department of Public Health and Environment (CDPHE); Vera Moritz, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meetings: May 23, 2019

Consultation Meeting Participants: Lindsay Masters, CDPHE; Vera Moritz, EPA; Scott Surovchak and Andy Keim, DOE; Linda Kaiser, Patty Gallo, David Ward, Ryan Wisniewski, John Boylan, George Squibb, Jeremy Wehner, Dana Santi, Navarro

Related Contact Records: None

Introduction. This project will be in the North Walnut Creek Drainage Basin upgradient of the Solar Ponds Plume Treatment System (SPPTS) and the North Walnut Creek Slump (NWCS) area that was regraded in 2017. The project involves the installation of a swale, a "low water" crossing, and rock crossings to improve the stormwater management. The swale will divert stormwater away from the SPPTS surface pad and the NWCS hillside and help to reduce erosion in those areas.

Discussion. The swale is planned to be approximately 1100 feet (ft) in length and will channel stormwater from west to east until it reaches the SPPTS access road at which point the stormwater will be directed in a northeastern direction away from the NWCS hillside as presented in Figure 1.

The swale will be constructed by digging a ditch approximately 6.5 feet (ft) wide and 2–3.5 ft deep. It will have sides that slope into the surface grade with contoured edges. Material generated from the ditch excavation will be placed on the downhill side (north) of the excavation to create a berm which will help to divert stormwater. A cross-section of the swale excavation is provided in Figure 2.

At the downhill end of the swale where stormwater will cross the SPPTS access road, a "low water" road crossing will be constructed. The road will be excavated about 1 foot deep along a 60–80 foot long section to allow stormwater from the swale to cross the road at low velocity and depth (Figure 3). A rock crossing to the east of the low water crossing along the SPPTS access road will also be installed. The rock crossing will be constructed by removing an approximate

2 ft wide by 1.5 ft depth of road base, creating a channel across the access road. The channel will then be filled with riprap rock back to grade. These installations will support the effectiveness of the swale and limit stormwater impacts to the surrounding area.

Surfaces that are disturbed as part of the installation will be managed in accordance with applicable laws and regulations. Specifically, DOE will manage stormwater to achieve compliance with applicable or relevant and appropriate requirements (ARARs) for stormwater, listed in Table 21 of the 2006 *Corrective Action Decision/Record of Decision* ("Storm Water Permit for Construction Activities" and "General Permits").

None of the activities associated with this project will take place in the Preble's Meadow Jumping Mouse (PMJM) Critical Habitat and Protection Area.

IC Evaluation: Institutional Controls **(**ICs) are listed in the Rocky Flats Legacy Management Agreement (RFLMA) Attachment 2, Table 4, including requirements for soil disturbance evaluation. The soil disturbance work is subject to ICs 2 and 3. Table 1 recaps these ICs.

Table 1. Institutional Controls

IC 2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central OU (Central Operable Unit), and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.
IC 3	No grading, excavation, digging, tilling, or other disturbance of any kind of surface soils is permitted, except in accordance with an erosion control plan (including Surface Water Protection Plans submitted to EPA under the Clean Water Act) approved by CDPHE or EPA. Soil disturbance that will not restore the soil surface to preexisting grade or higher may not be performed without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent migration of residual surface soil contamination to surface water. **Rationale:** Certain surface soil contaminants, notably plutonium-239/240, were identified in the fate and transport evaluation in the Remedial Investigation as having complete pathways to surface water if disturbed. This restriction minimizes the possibility of such disturbance and resultant impacts to surface water. Restoring the soil surface to preexisting grade maintains the current depth to subsurface contamination or contaminated structures.

The required Soil Disturbance Review Plan (SDRP) for IC 2 (excavation to a depth of 3 ft or greater) and IC 3 (not restoring surface to preexisting grade) is in Attachment 1. The *Erosion Control Plan for Rocky Flats Property Central Operable Unit*, provides erosion control best-management practices that meet the requirements of IC 3.

Resolution: CDPHE, after reviewing information regarding the proposed soil disturbance and excavation and after consultation with EPA, approves proposed activities described in this Contact Record. CDPHE determined that the proposed activities are not anticipated to compromise or impair the function of the remedy and are not expected to result in an unacceptable release or exposure to residual subsurface contamination. CDPHE also determined that the proposed project meets the rationale and objectives of IC 2 and 3.

DOE will not conduct the approved soil disturbance work until 10 calendar days after this Contact Record is posted on the Rocky Flats Site's website and stakeholders are notified of the posting in accordance with the RFLMA Public Involvement Plan.

Progress and the completion of the work will be reported by DOE in RFLMA quarterly and annual reports of surveillance and maintenance activities for periods in which these activities occur.

Actions Complete: The actions approved by this CR will be considered complete when the stormwater diversion features are installed, reseeding has been performed over disturbed areas, and temporary post-disturbance erosion controls are in place.

Contact Record Prepared by: Patty Gallo, David Ward, and Ryan Wisniewski, Navarro

---

Distribution:

Scott Surovchak, DOE
Andy Keim, DOE
Lindsay Masters, CDPHE
Vera Moritz, EPA
Linda Kaiser, Navarro
Rocky Flats Contact Record File

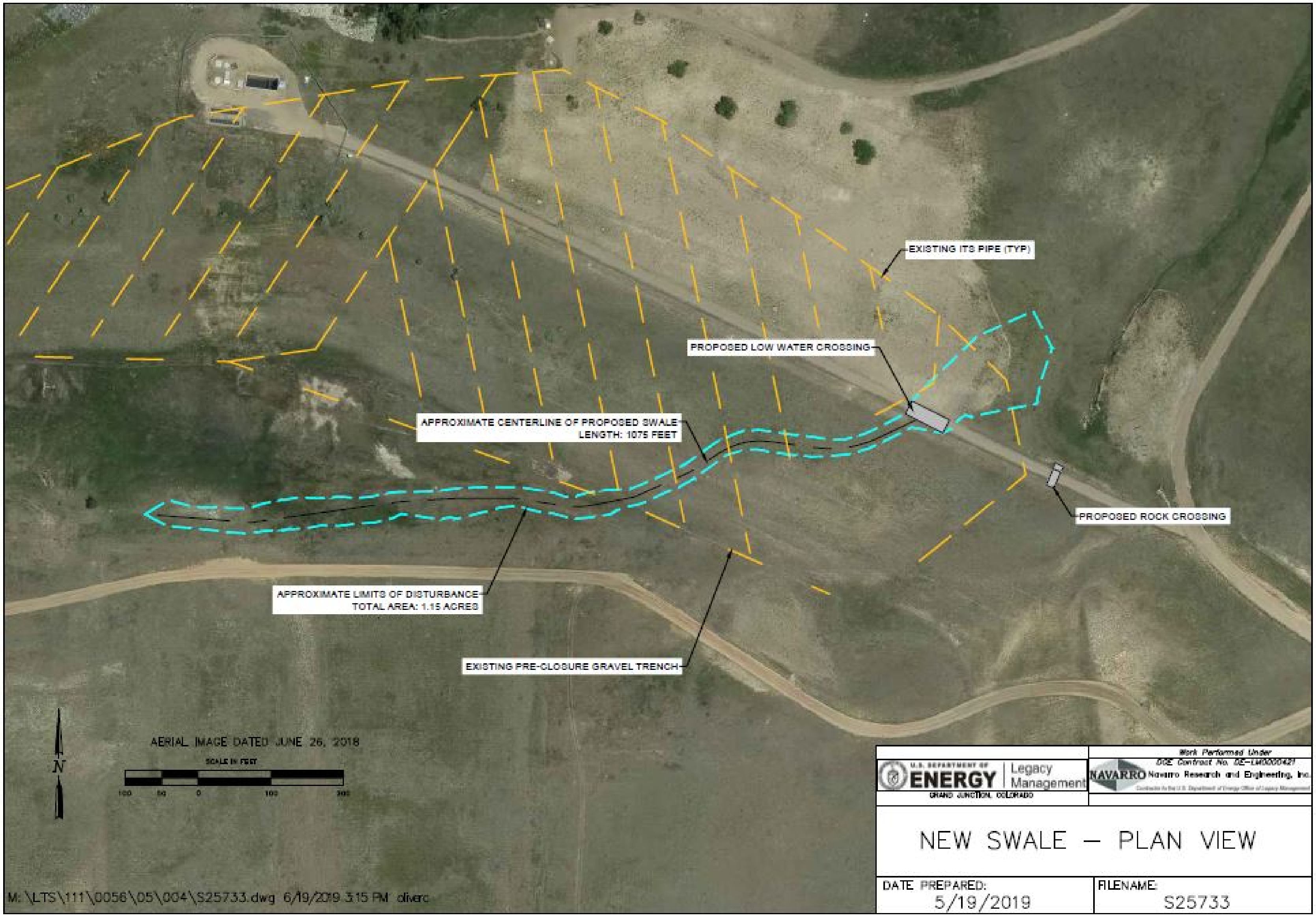


Figure 1. Site Plan for North Walnut Creek Swale Installation

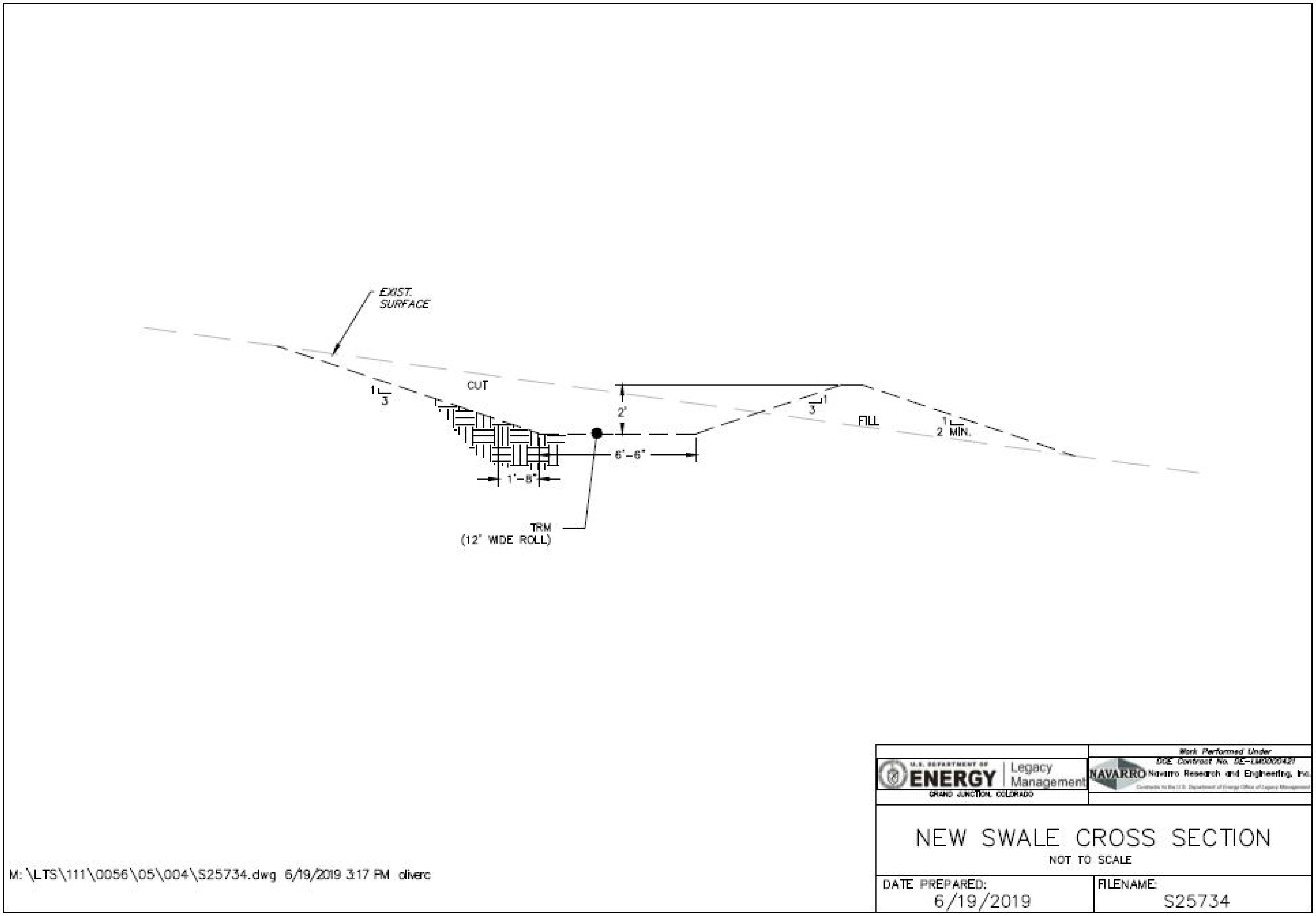


Figure 2. North Walnut Creek Swale Cross Section

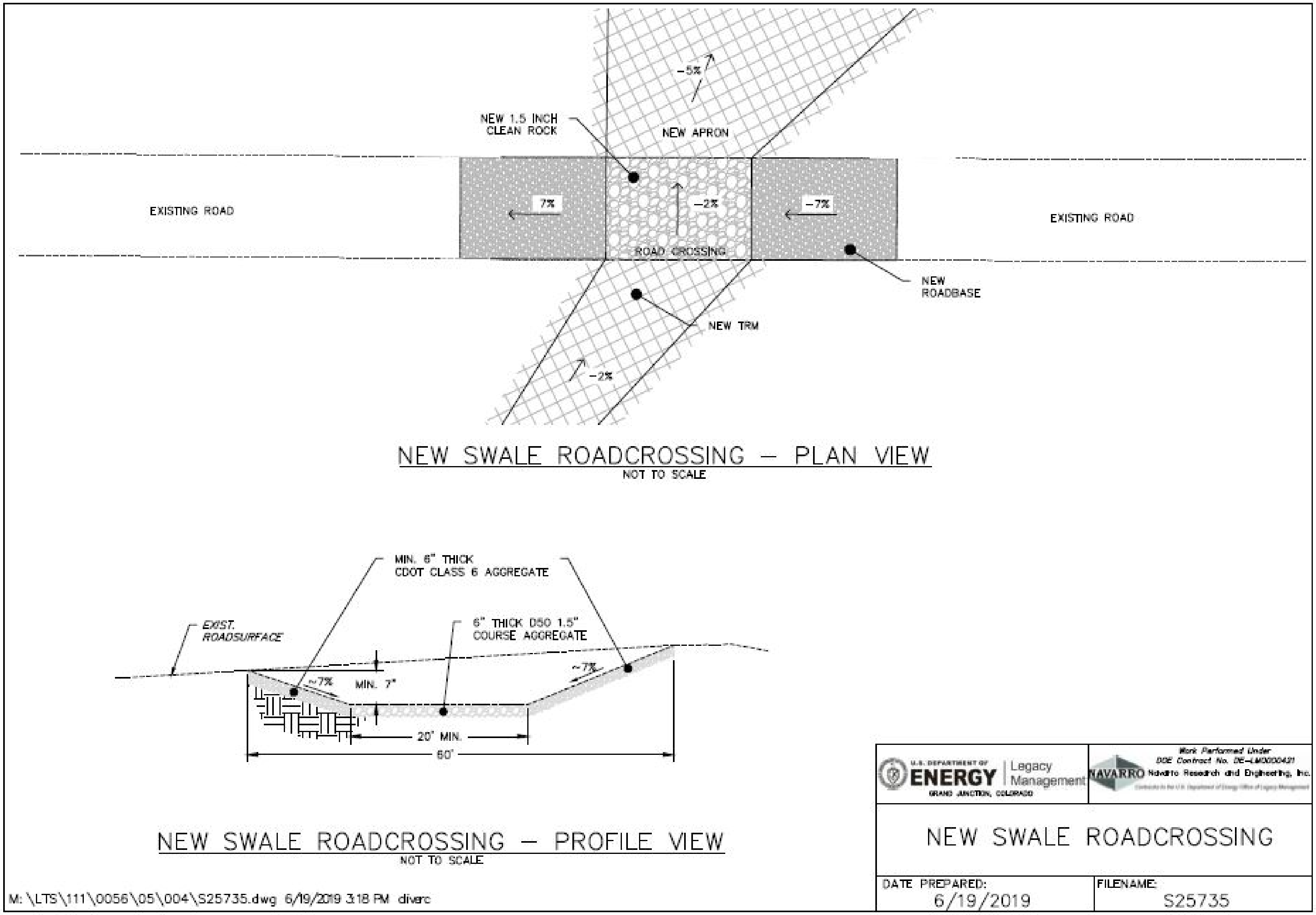


Figure 3. Solar Pond Plume Treatment System Access Road "Low Water" Crossing

Attachment 1

Rocky Flats Legacy Management Agreement Soil Disturbance Review Plan

Proposed Project: Soil Disturbance Review Plan (SDRP) for the North Walnut Creek Stormwater Diversion Project

This SDRP provides information required by *Rocky Flats Legacy Management Agreement* (RFLMA) Attachment 2, "Legacy Management Requirements," Section 4.1, "Soil Disturbance Review Plan," regarding the work proposed by the U.S. Department of Energy.

<u>Description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.</u>

This project will be in the North Walnut Creek Drainage Basin upgradient of the Solar Ponds Plume Treatment System (SPPTS) and the North Walnut Creek Slump (NWCS) area that was regraded in 2017. The project involves the installation of a swale, a "low water" crossing, and rock crossings to improve stormwater management.

The swale is planned to be approximately 1100 feet (ft) in length and channel stormwater from west to east until it reaches the SPPTS access road at which point the stormwater will be directed in a northeastern direction away from the NWCS hillside as presented in Figure 1 of CR 2019-03.

The swale will be constructed by digging a ditch of approximately 6.5 feet (ft) wide and 2–3.5 ft deep with sides that slope into the existing surface grade with contoured edges. Material generated from the ditch excavation will be placed on the downhill side (north) of the excavation to create a berm which will help to divert stormwater.

Surfaces that are disturbed as part of the installation will be managed in accordance with applicable laws and regulations. Specifically, DOE will manage stormwater to achieve compliance with applicable or relevant and appropriate requirements (ARARs) for stormwater, listed in Table 21 of the 2006 *Corrective Action Decision/Record of Decision* ("Storm Water Permit for Construction Activities" and "General Permits").

<u>Information about any remaining subsurface structures in the vicinity of the proposed project (or state that there are none if that is the case).</u>

The only remaining subsurface structures in the area are used in current operations and are not abandoned contaminated structures. They are the following:

- Interceptor Trench System (ITS) lines
- Gravel trench upgradient of the ITS lines

The swale will cross over a pre-closure gravel trench. In the same area, it is expected to cross three ITS lines. These features will be located by "potholing" before the swale is constructed. All excavation within 18 inches vertically and 24 inches laterally of these features will be done by hand. In the area where the features are expected to be, a geosynthetic clay liner will be placed in the bottom of the swale. This will be done whether the ITS and gravel trench are visually confirmed in this area or not.

Information about any former Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern, or other known or potential soil or groundwater contamination in the vicinity of the proposed project.

IHSS 101, Solar Evaporation Ponds. A large area south of the SPPTS, including the southern portion of the NWCS area, is located within former IHSS 101, Solar Evaporation Ponds. This IHSS was closed with No Further Accelerated Action in 2003. A closure summary is provided below.

In accordance with the Environmental Restoration Rocky Flats Cleanup Agreement (RFCA) Standard Operating Protocol (RSOP) Notification #02-08, soil was removed from six hot spot locations. Confirmation sampling was conducted in the excavations to confirm that sufficient soil had been removed. All contaminant concentrations and activities were less than RFCA Tier II Soil Action Levels (SAL), except for one beryllium concentration, which was slightly greater than the RFCA Tier II SAL (1.10 milligrams per kilogram [mg/kg] versus the SAL of 1.04 mg/kg). None of the results exceeded the wildlife refuge worker (WRW) SALs.

Fourteen surface and 25 subsurface soil samples were collected and analyzed for radionuclides and metals. Some of the samples were also analyzed for nitrate. All contaminant concentrations and activities in the sampled areas were below RFCA Tier II SALs, except for 1 beryllium concentration and 16 arsenic concentrations. The beryllium concentration that exceeded the Tier II SAL was 1.10 mg/kg for which the SAL was 1.04 mg/kg. The arsenic concentrations that exceeded the Tier II SAL ranged from 13.0 to 36.3 mg/kg and the SAL was 2.99 mg/kg. All exceedances were significantly less than the RFCA Tier I SALs. All contaminant concentrations and activities were less than the WRW SALs, except for one subsurface manganese concentration and eight arsenic concentrations (in surface and subsurface soil). The manganese concentration that exceeded the WRW SAL was 5900 mg/kg, and the WRW SAL is 3480 mg/kg. The arsenic concentrations that exceeded the WRW SAL ranged from 22.4 to 36.3 mg/kg and the WRW SAL is 22.2 mg/kg.

After completion of accelerated actions, No Further Action was recommended for IHSS 101 based on the following:

- Contaminant concentrations and activities were less that RFCA Tier II SALs, with minor exceptions. No Tier I SALs were exceeded.
- Results of an evaluation indicated additional action was not necessary.

After review of the Closeout Report for IHSS Group 000-1 by the regulatory agencies, DOE received approval from CDPHE for the No Further Accelerated Action status for the Solar Evaporation Pond Area of Concern (IHSS 101) on July 25, 2003.

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2021-02

Purpose: Reportable condition for uranium at Point of Evaluation (POE) GS10.

Contact Record Approval Date: November 2, 2021

Site Contacts and Affiliations: Andy Keim, U.S. Department of Energy (DOE); Dana Santi and Ryan Wisniewski, RSI EnTech, LLC (RSI)

Regulatory Contacts and Affiliations: Lindsay Murl, Colorado Department of Public Health and Environment (CDPHE); Jesse Aviles, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: July 21, 2021; September 8, 2021

Consultation Meeting Participants: Lindsay Murl, CDPHE; Jesse Aviles, EPA; Andy Keim, DOE; Dana Santi, Ryan Wisniewski, Patty Gallo, John Boylan, George Squibb, Jody Nelson, April Tischer, Chris Oliver, RSI

Related Contact Records: CR 2011-04, CR 2011-05

Discussion: A reportable condition at Point of Evaluation (POE) GS10 was determined upon receipt of recently available validated analytical results for uranium from the composite sample collected from 9:30 on 4/30/2021 to 10:38 on 5/4/2021. Validated results were received on June 3, 2021. DOE notified the *Rocky Flats Legacy Management Agreement* (RFLMA) Parties on June 8 of the reportable condition and provided a proposed response plan on June 30 in accordance with reportable conditions for a POE as outlined within the RFLMA.

The evaluation was performed in accordance with RFLMA Attachment 2, Figure 6, Points of Evaluation, which resulted in a calculated 12-month rolling average concentration for uranium of 18.1 micrograms per liter (µg/L) on April 30, 2021. This concentration exceeds the applicable RFLMA Attachment 2, Table 1, standard of 16.8 µg/L. This 12-month rolling average includes sample results for May 1, 2020, through April 30, 2021.

Subsequent uranium sample results for composite samples collected through August 5, 2021, are all below the 16.8 µg/L standard. As of May 31, 2021, the 12-month rolling average for uranium at GS10 was 12.4 µg/L, ending the reportable condition discussed here.

Based on the short-term nature of the current reportable condition, the similarity to previous reportable conditions for uranium at GS10, and the reasons listed below, no mitigating actions are warranted at this time.

- POEs are intended to provide an early indication of water-quality trends that may affect water quality at downstream Points of Compliance (POCs). The most recent uranium concentrations at GS10 are consistent with concentrations observed during the 15 years since closure. Figure 1 illustrates the 12-month rolling average for total uranium since late 1997. The absence of a significant increasing trend suggests no new source term to be present.[1,2]

- The calculated 12-month rolling average at the Walnut Creek POC (WALPOC) for total uranium on April 30, 2021, is 10.5 µg/L, which is well below the RFLMA Table 1 standard of 16.8 µg/L. Uranium results from subsequent composite samples collected at WALPOC through July 13, 2021, are all well below 16.8 µg/L. As of June 30, 2021, the 12-month rolling average for uranium at WALPOC is 8.1 µg/L.
- Postclosure, the increase in uranium concentrations at GS10 is primarily the result of proportionally increased groundwater contributions to surface water baseflow due to reduced surface runoff resulting from the removal of impervious surfaces (e.g., pavement, buildings) during site closure (Figure 1).
- Uranium concentrations in surface water are expected to vary due to the natural variability of environmental conditions such as precipitation runoff and groundwater recharge. Uranium concentrations have exceeded the RFLMA standard at GS10 several times since site closure (Figure 1). Previous reportable conditions for uranium at this location were triggered for April 30, 2006, to March 31, 2009, with the 12-month rolling averages in the range of 10.2 to 15.8 picocuries per liter (pCi/L). The RFLMA uranium standard was subsequently revised from an activity-based radionuclide parameter of 10 pCi/L to a concentration-based metal parameter of 16.8 µg/L, which equates to approximately 11.3 pCi/L. Since that standard change, the 12-month rolling average for uranium at GS10 has previously been above 16.8 µg/L for April 30, 2011, to February 28, 2013, and May 31, 2013, to August 31, 2013.
- The variability of the uranium concentration influenced by environmental conditions was detailed in a study conducted by a qualified geochemistry subcontractor, the results of which were published in the *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site* (September 2015). This report was updated in 2019 and can be found at https://www.lm.doe.gov/Rocky_Flats/SWB_Rpt_Eval_Water_Quality_Variability.pdf; this report is also scheduled to be updated in 2021 with recent monitoring data from the RFLMA and Adaptive Management Plan monitoring programs.

---

[1] Uranium in groundwater in the GS10 area is variable, and some locations have high concentrations of naturally occurring uranium. Since closure, numerous samples from GS10 have been sent to Los Alamos National Laboratory or Lawrence Berkeley National Laboratory for isotopic analysis to determine the percentages of natural and anthropogenic uranium. Historically, naturally occurring uranium has made up a much greater proportion of the concentration at GS10, averaging about 70%.

[2] Although the recent 12-month rolling average at GS10 is above the 16.8 µg/L site standard, it is well below the 30 µg/L drinking water maximum contaminant level (MCL) for uranium. Since closure, the 12-month rolling average for uranium at GS10 has never exceeded the drinking water MCL. The 16.8 µg/L standard is a level at which there are no known or anticipated adverse effects on the health of a person, based on an adult weighing 70 kilograms consuming 2 liters of water per day for a lifetime. Because Walnut Creek has an intermittent flow of water and is not a source of drinking water, there remains an adequate margin of safety.

Plan and Schedule to Address the Reportable Condition: The RFLMA Parties agreed that the steps described below in this contact record (CR) shall serve as the approved plan and schedule response for this reportable condition. These actions are consistent with the response to previous reportable conditions for uranium at GS10.

The following steps have been or are being taken:

- Sampling will continue in accordance with RFLMA Attachment 2, Table 2.
- Flow-paced composite samples routinely collected at GS10 will continue to be analyzed on an accelerated 2-week turnaround.
- DOE will make available, upon CDPHE's request, a split sample from a recent composite sample collected at GS10. That composite sample was started on June 4, 2021, and retrieved from the field on June 16, 2021.
- DOE will report the results of continued monitoring and of the subsequent evaluation in RFLMA quarterly and annual reports of surveillance and monitoring activities.

Resolution: CDPHE, after consultation with EPA, approves this CR.

Action Complete: The response approved in this CR will continue as part of the routine surface water monitoring and reporting as identified in the section above and documented within the RFLMA. Any future changes to these steps will be documented under separate cover.

Contact Record Prepared by: Ryan Wisniewski, RSI

Distribution:
Andy Keim, DOE
Lindsay Murl, CDPHE
Jesse Aviles, EPA
Dana Santi, RSI
Rocky Flats Contact Record File

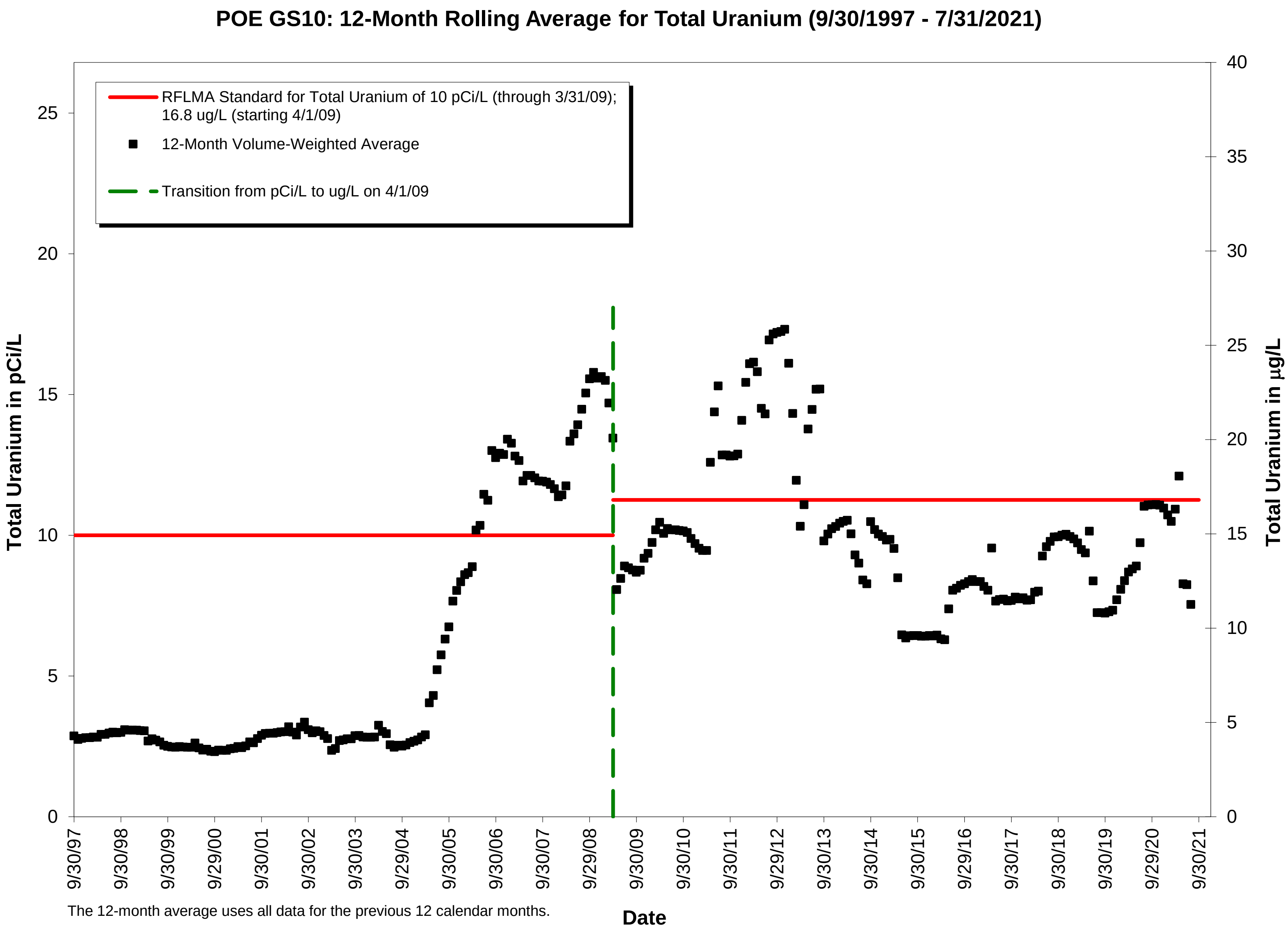


Figure 1. POE GS10: 12-Month Rolling Average for Total Uranium (9/20/1997–7/31/2021)

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2021-04

Purpose: East Trenches Plume Treatment System (ETPTS) discharge line replacement

---

Contact Record Approval Date: December 13, 2021

Site Contacts and Affiliations: Andy Keim, U.S. Department of Energy (DOE); Dana Santi and Ryan Wisniewski, RSI EnTech, LLC (RSI)

Regulatory Contacts and Affiliations: Lindsay Murl, Colorado Department of Public Health and Environment (CDPHE); Jesse Aviles, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: September 15, 2021

Consultation Meeting Participants:
Lindsay Murl, CDPHE; Jesse Aviles, EPA; Andy Keim, DOE

Related Contact Records: None

Introduction:
On the morning of Tuesday, September 14, 2021, Legacy Management Support (LMS) staff identified an ETPTS pump that had malfunctioned. It was determined that the pump had burned out because the effluent discharge line was clogged with calcium scale. This pump, which is in the effluent tank of the ETPTS (Figure 1), pumps treated groundwater to the ETPTS effluent discharge gallery. Since the burned-out pump was identified within hours of failure and response actions (see "Immediate Response" section below) were implemented immediately, all treated water was maintained within the system while the effluent tank pump was inoperable, and normal treatment operations were uninterrupted.

Background:
The ETPTS air stripper treats groundwater from both the Mound Site Plume Collection System and the ETPTS that is contaminated with volatile organic compounds. The treatment component of the ETPTS has been modified through the years from its original configuration and treatment methods as described in Contact Records CR 2012-02, CR 2014-01, CR 2014-04, and CR 2016-02.

Immediate Response:
A new pump was installed the same morning that the burned-out pump was identified in the effluent tank. A temporary, aboveground line was routed from the newly installed pump into the effluent manhole to bypass the clogged line. The temporary line was a measure that would maintain the operation of the system until a permanent solution for the clogged line could be implemented.

The temporary line required that certain components be propped open for line access. To prevent wildlife entrapment, the edges of the effluent vault and manhole were covered with geotextile fabric. The fabric was secured with rope and T-posts to prevent wildlife access yet allow easy removal during maintenance and repair activities.

The DOE Office of Legacy Management (LM) notified, via phone, the Rocky Flats Legacy Management Agreement (RFLMA) parties of the ETPTS status on September 15, 2021, and provided general details regarding the impact and planned response, which is regulated under the Rocky Flats Site, Colorado, institutional controls and the 2017 Restrictive Notice (see section "Institutional Control (IC) Evaluation" below for further detail). After discussion of the planned response, the RFLMA parties verbally approved proceeding with the replacement of the clogged subsurface discharge line.

Performed Correction:
Because of the temporary line's vulnerability to environmental conditions, such as freezing temperatures and disturbance by wildlife, the below ground line needed to be replaced as soon as feasible. On October 12, 2021, the clogged line was removed and replaced with approximately 13 feet (ft) of 2-inch high-density polyethylene (HDPE) pipe, which connected the ETPTS effluent vault with the effluent manhole. The line replacement required an excavation approximately 17 ft long by 6 ft wide with a varying depth of 2–5 ft. Photo 1 illustrates the general size of the excavation and the configuration of the newly installed discharge line.

Soil from the excavation was temporarily stored on the parking area just east of the ETPTS effluent tank and manhole and managed in accordance with all applicable or relevant and appropriate requirements as listed in Table 21 of the 2006 *Corrective Action Decision/Record of Decision* and consistent with the then in-effect approved *Erosion Control Plan for Rocky Flats Property Central Operable Unit* (currently, DOE-LM/1497-2007). Upon completion of the line replacement, all excavated soil was placed back into the excavation and compacted (photo 2).

The only waste generated from this action was the old discharge line with calcium scale buildup. A waste determination was made for this material, and it was disposed of in compliance with all applicable regulations. Specifically, LM made a determination no waste was hazardous and the calcium scale buildup was disposed of as solid waste.

Preble's Meadow Jumping Mouse:
The ETPTS line replacement work area is in Unit 6 of the critical habitat of the Preble's meadow jumping mouse (also called Preble's mouse or PMJM) (*Zapus hudsonius preblei*). Work activities at the groundwater treatment systems were consulted on in the Rocky Flats Programmatic Biological Assessment (PBA) and the associated Programmatic Biological Opinion (PBO). In addition, in 2018, as part of receiving credit for the habitat created in the former Industrial Area in the Central Operable Unit (Central OU), DOE also established exclusion zones around each of the groundwater treatment systems, including the ETPTS. DOE received approval for these exclusion zones in the concurrence letter from the U.S. Fish and Wildlife Service (USFWS) on July 18, 2018 (TAILS: 06E24000-2018-I-1200). The exclusion zones were established to allow work to be done at the groundwater treatment systems without requiring repeated consultation between DOE and USFWS. The exclusion zones were taken as a permanent loss of habitat, and mitigation was done to account for these areas. No further mitigation is required for work conducted within these exclusion zones, and only a project notification to USFWS is required prior to conducting work within these zones.

In accordance with PBA requirements, USFWS was notified of the emergency action for the ETPTS line replacement on September 22, 2021. The boundary of the exclusion zone was staked in the field. All work activities to excavate and replace the clogged line were conducted within the boundary of the exclusion area at the ETPTS. Erosion controls were already in place downgradient of the work area, and WoodStraw erosion control material was applied after work was complete to reduce potential for soil movement. No seeding of this area was conducted since it is desirable to have no vegetation present around the treatment system equipment.

Wetlands:
No wetlands were impacted as part of this work; therefore, no permitting or notifications related to wetlands were required.

Migratory Bird Treaty Act:
The migratory bird nesting season along the Front Range of Colorado extends from April 1 to August 31. Because activities related to the ETPTS line replacement were conducted after the typical nesting season, there was little likelihood of impacts to nesting migratory birds. In addition, the work area contained sparse vegetation that does not serve well as a nesting site. No birds or nests were noted in the area during work activities or while ecologists were establishing work boundaries.

Institutional Control (IC) Evaluation:
The *Corrective Action Decision/Record of Decision Amendment for Rocky Flats Plant (USDOE 2006) Central Operable Unit* requires specific ICs to ensure the protectiveness of the remedy at the Rocky Flats site. These ICs are required by and enforceable through the 2017 Restrictive Notice for Rocky Flats, recorded with Jefferson County. RFLMA Attachment 2, Table 4, lists the Restrictive Notice's ICs for the Central OU, including requirements for soil disturbance evaluation.

The soil disturbance work is subject to IC 2, which is shown in Table 1. The required Soil Disturbance Review Plan (SDRP) for IC 2 is included as Attachment 1.

Table 1. Institutional Controls

IC 2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central OU, and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.

Resolution:
CDPHE, after consultation with EPA, approved the activities described in this Contact Record (CR). Based on the information provided, CDPHE determined that the response activities would not result in an unacceptable release or exposure to residual subsurface contamination and would not damage any component of the remedy. CDPHE has also determined that the response activities met the rationale and objectives of IC 2. Progress and the completion of the work will be reported by DOE in RFLMA quarterly and annual reports of surveillance and maintenance activities for the periods in which these activities occur.

Action Complete:
The activities approved in this CR are complete.

Contact Record Prepared by:
Ryan Wisniewski, RSI

Distribution:
Andy Keim, DOE
Lindsay Murl, CDPHE
Jesse Aviles, EPA
Dana Santi, RSI
Rocky Flats Contact Record File

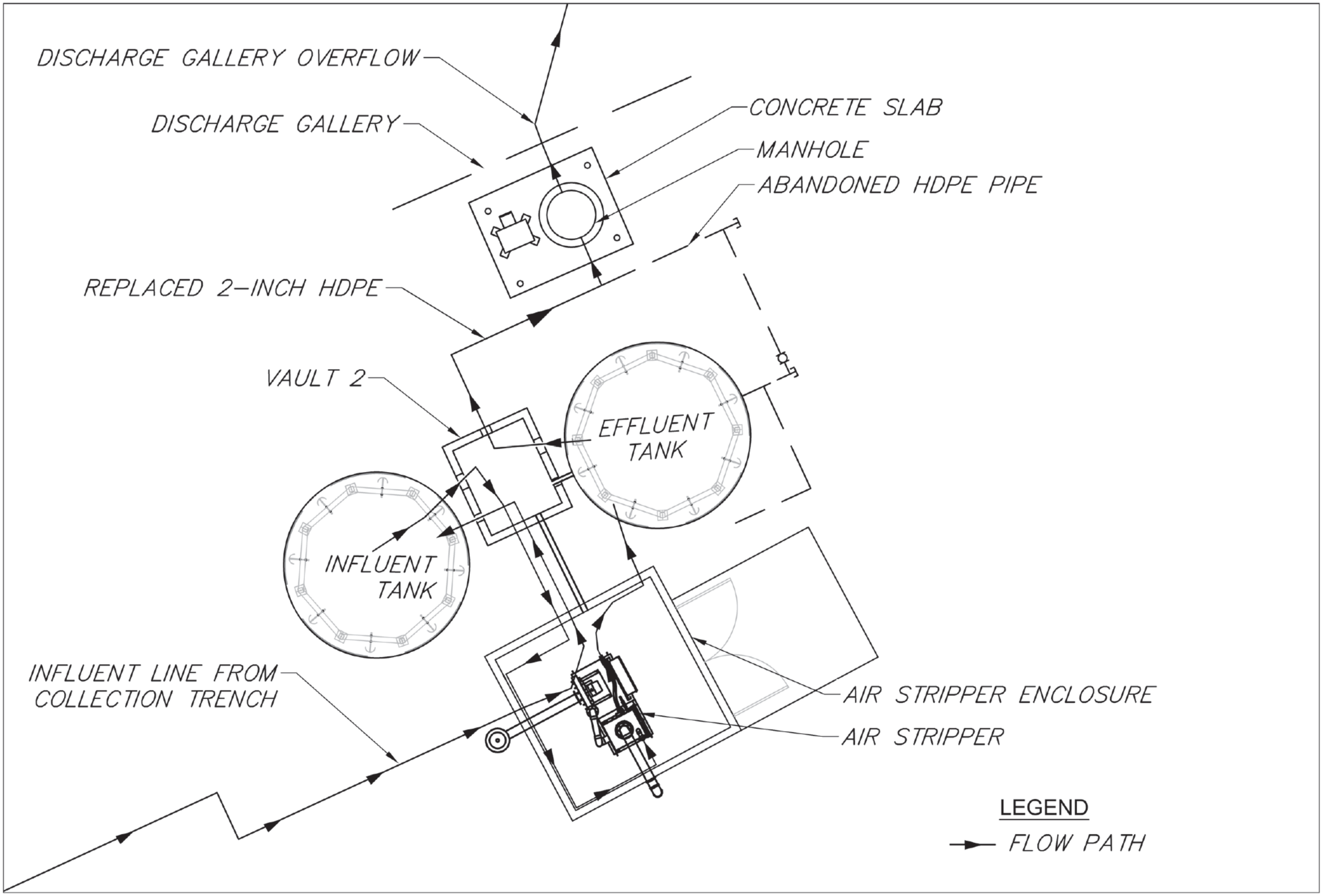


Figure 1. ETPTS Design Layout

Photo 1. Excavation with New Effluent Discharge Line Installed

Photo 2. Work Area After Line Replacement and Backfill

Attachment 1

Rocky Flats Legacy Management Agreement Soil Disturbance Review Plan

Proposed Project: East Trenches Plume Treatment System (ETPTS) discharge line replacement

This Soil Disturbance Review Plan (SDRP) provides information required by *Rocky Flats Legacy Management Agreement* (RFLMA) Attachment 2, "Legacy Management Requirements," Section 4.1, "Soil Disturbance Review Plan," regarding the work proposed by the U.S. Department of Energy (DOE).

<u>Description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.</u>

A buried pipeline used to convey treated water from the ETPTS to a subsurface discharge gallery was clogged with calcium scale that could not be removed using standard maintenance techniques (such as snaking). The clogged line needed to be replaced as soon as feasible with another buried line to ensure proper functioning through subfreezing temperatures. The line replacement required an excavation approximately 17 feet (ft) long by 6 ft wide with a varying depth of 2–5 ft. Figure 1 of CR 2021-04 shows the layout of the ETPTS along with the location of the line that was replaced. The RFLMA parties (DOE, Colorado Department of Public Health and Environment, U.S. Environmental Protection Agency) discussed this plan and it was verbally approved.

Refer to the "Performed Correction" section along with Figure 1 of the CR for additional detailed information on the completed activity.

<u>Information about any remaining subsurface structures in the vicinity of the proposed project</u>.

Other than components of the ETPTS, there are no structures near the activity. The eastern end of the B-Pond Bypass Pipeline is a short distance west of the project area but is not at risk from subsurface work conducted within this area.

<u>Information about any former Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), or other known or potential soil or groundwater contamination in the vicinity of the proposed project.</u>

This construction area was not an IHSS or PAC. In the *Facility Investigation - Remedial Investigation/Corrective Measures Study - Feasibility Study Report for the Rocky Flats Environmental Technology Site* (June 2006), the figures in Section 3, "Nature and Extent of Soil Contamination," do not indicate soil contamination in this area. No groundwater was encountered in the excavation activities associated with this work.

ROCKY FLATS SITE
REGULATORY CONTACT RECORD 2021-05

Purpose: East Trenches Plume Treatment System (ETPTS) Discharge Gallery Replacement

---

Contact Record Approval Date: January 7, 2022

Site Contacts and Affiliations: Andy Keim, U.S. Department of Energy (DOE); Dana Santi and Ryan Wisniewski, RSI EnTech, LLC (RSI)

Regulatory Contacts and Affiliations: Lindsay Murl, Colorado Department of Public Health and Environment (CDPHE); Jesse Aviles, U.S. Environmental Protection Agency (EPA)

Date of Consultation Meeting: November 8, 2021

Consultation Meeting Participants: Lindsay Murl, CDPHE; Jesse Aviles, EPA; Andy Keim, DOE; Dana Santi, Ryan Wisniewski, John Boylan, George Squib, Jody Nelson, Karin McShea, April Tischer, Harry Bolton, RSI

Related Contact Records: CR 2021-04

Introduction:
At the Rocky Flats Site, Colorado, the East Trenches Plume Treatment System (ETPTS) air stripper treats groundwater from both the Mound Site Plume Collection System (MSPCS) and the ETPTS. The groundwater is contaminated with volatile organic compounds. After passing through the air stripper, the treated water is dispensed into the ETPTS effluent tank, from which it is pumped out at a controlled rate to the below-grade discharge gallery. The ETPTS discharge gallery replacement project will not alter or impact the current air stripping operations or current air emissions. The current treatment operation does not require an Air Pollutant Emissions Notice (APEN).

The ETPTS discharge gallery was installed in 1999. In 2016, the ETPTS was reconfigured to begin treating groundwater collected at the MSPCS.

The ETPTS discharge gallery has already functioned beyond its expected operational life with periodic maintenance. Indicators upstream within the system suggest its functionality might soon begin to fail. One such indicator leading to this determination is the buildup of scale in the form of calcium carbonate within the system’s pipes. This buildup has begun to limit effluent water flow and has increased the risk of system failure. DOE, EPA, and CDPHE will continue to discuss operational improvements for effective long term groundwater treatment. This action will mitigate the immediate risk of system failure associated with scale buildup.

Discussion:
The ETPTS discharge gallery is due for periodic maintenance. DOE plans to replace or remove components of the ETPTS. These components include all effluent piping from the flow control vault to and including the discharge gallery (Figure 1). The only component of the system that will be removed and not replaced is the former effluent metering manhole between the flow control vault and the discharge gallery (Figure 1). That manhole was formerly used by workers to make flow measurements; flow measurement is now performed using in-line flow meters at other locations within the system.

During the replacement and removal of the ETPTS components, the treatment system will be turned off. Groundwater collected by the MSPCS and the ETPTS will be held within those systems as designed. No collected groundwater from the MSPCS or ETPTS will bypass the treatment component of the ETPTS. If there is risk that the collected groundwater will exceed the system's storage capacity, temporary lines will be utilized to support short-term, intermittent operation of the treatment system as currently designed. DOE shall ensure any temporary lines used during the performance of this action are in good condition and direct treated effluent to the designated discharge gallery. The field activities for this maintenance project are planned for 5 total working days that could be over a two-week period if inclement weather impacts performance safety. The treatment system shall not be turned off for a period greater than 14 calendar days without 48 hours prior notice to EPA and CDPHE regulators.

With the ETPTS turned off, DOE will excavate and remove the effluent metering manhole and all subsurface piping, which vary in depth from 1.5 to 6 feet (ft) below grade (Figure 2). Based on DOE's review of site records and information, there are no subsurface structures in this area or soil contamination. Once these are removed, the new pipe will be installed at similar depths ranging from 1.5 to 6 ft. The new pipe will follow a similar path as the old piping with some deviations, such as eliminating the use of 90-degree angles and no longer passing through the metering manhole. The path deviations, the elimination of 90-degree angles, and other system improvements are designed to maintain higher flow velocity, which is expected to reduce future scale buildup within the piping.

All soils and old gravel bedding will be temporarily stockpiled in a designated area near the excavation and within the identified disturbance limits (Figure 3). This temporary stockpile will be managed in accordance with all applicable or relevant and appropriate requirements listed in Table 21 of the 2006 *Corrective Action Decision/Record of Decision* and will be consistent with the then in-effect approved *Erosion Control Plan for Rocky Flats Property Central Operable Unit* (currently, DOE-LM/1497-2007). Once the new pipe has been installed, the staged soil and gravel bedding will be used as backfill. The surface area will be restored to the existing grade or higher while matching the surrounding area.

Rainfall and stormwater run-on that enters the excavation will be pumped to the ground surface in a manner that is consistent with the site's approved erosion control plan. If groundwater seeps into the excavation, it will be either (1) pumped to ground upgradient of the ETPTS intercept trench in a manner consistent with the site's approved erosion control plan or (2) containerized, decanted, and pumped through the treatment system once the project activities have concluded.

The only waste expected to be generated from this project is (1) the removed subsurface piping with calcium scale buildup and (2) concrete associated with the removed manhole access point. No hazardous waste is expected to be generated by this project, and initial planning is for all material to be disposed of as nonhazardous solid waste. DOE shall perform a waste determination at the time of excavation and dispose of waste in accordance with applicable regulatory requirements.

At project completion, the disturbed areas will be seeded with a native seed mix, and erosion controls will be installed.

Preble's Meadow Jumping Mouse:
The ETPTS discharge gallery replacement work area is in Unit 6 of the critical habitat of the Preble's meadow jumping mouse (PMJM) (*Zapus hudsonius preblei*). All work activities at the groundwater treatment systems were consulted on in the Rocky Flats Programmatic Biological Assessment (PBA) and the associated Programmatic Biological Opinion. In addition, in 2018, as part of receiving credit for the habitat created in the former Industrial Area in the Central Operable Unit (COU), DOE also established exclusion zones around each of the groundwater treatment systems, including the ETPTS. DOE received approval for these exclusion zones in a concurrence letter from the U.S. Fish and Wildlife Service (USFWS) on July 18, 2018 (TAILS: 06E24000-2018-I-1200). The exclusion zones were established to allow work to be done at the groundwater treatment systems without requiring repeated consultation between DOE and USFWS. The exclusion zones were taken as a permanent loss of habitat, and mitigation was done to account for these areas. No further mitigation is required for work conducted within these exclusion zones, and only a project notification to USFWS is required prior to conducting work within these zones.

Most of the work activities related to the ETPTS discharge gallery project will occur within the exclusion zone at the ETPTS. However, 0.08 acre of PMJM habitat outside the exclusion area will be impacted as part of the project; therefore, USFWS concurrence is required. In accordance with PBA requirements, USFWS was notified of the planned project for the ETPTS discharge gallery replacement, including the intent to include the extra 0.08 acre as part of the work area, on October 21, 2021. DOE received concurrence from USFWS on November 30, 2021. Figure 4 illustrates the existing PMJM exclusion area along with the additional project area for which USFWS was notified.

Wetlands:
As part of the work for the ETPTS discharge gallery project, a narrow band of short marsh consisting of cattails (*Typha angustifolia*) and bulrush (*Scirpus pallidus*) will be impacted. Because this project is a Comprehensive Environmental Response, Compensation, and Liability Act project associated with maintaining the remedy at the Rocky Flats Site, the small amount of wetland impact expected from the project (< 0.008 acres) will be addressed by following the substantive requirements of the appropriate Clean Water Act regulations. In addition, the wetlands are in an upland area and are considered "man-induced" wetlands that are present only because of the release of water from the subsurface ETPTS discharge gallery. If the water from the discharge gallery were stopped, the wetland vegetation would disappear and be replaced by upland vegetation. "Man-induced" wetlands are described in the 1987 U.S. Army Corps of Engineers *Corps of Engineers Wetlands Delineation Manual*, Part IV, "Methods," Section F, "Atypical Situations," Subsection 4, "Man-Induced Wetlands," as follows: "*CAUTION: If hydrophytic vegetation is being maintained only because of man-induced wetland hydrology that would no longer exist if the activity (e.g., irrigation) were to be terminated, the area should not*

be considered a wetland." Once the new discharge gallery begins operation, some or all of the existing wetland vegetation is expected to return.

Migratory Bird Treaty Act:
The migratory bird nesting season along the Front Range of Colorado extends from April 1 to August 31. Given that the ETPTS discharge gallery project is scheduled to occur before April 1, 2022, there is little likelihood that the project will impact nesting migratory birds. Should a bird nest be found in the work area, the site ecologist will be contacted immediately. DOE shall comply with applicable requirements of the Migratory Bird Treaty Act.

Institutional Control (IC) Evaluation:
The *Corrective Action Decision/Record of Decision Amendment for Rocky Flats Plant (USDOE 2006) Central Operable Unit* requires specific ICs to ensure the protectiveness of the remedy at the Rocky Flats Site. These ICs are required by and enforceable through the 2017 Restrictive Notice for Rocky Flats, recorded with Jefferson County. The *Rocky Flats Legacy Management Agreement* (RFLMA) Attachment 2, Table 4, lists the Restrictive Notice's ICs for the COU, including requirements for soil disturbance evaluation.

The soil disturbance work is subject to IC 2, which is shown in Table 1. The required Soil Disturbance Review Plan for IC 2 is included as Attachment 1.

Table 1. Institutional Controls

IC 2	Excavation, drilling, and other intrusive activities below a depth of three feet are prohibited, without prior regulatory review and approval pursuant to the Soil Disturbance Review Plan in RFLMA Attachment 2.
	Objective: Prevent unacceptable exposure to residual subsurface contamination. **Rationale:** Contaminated structures, such as building basements, exist in certain areas of the Central OU, and the Comprehensive Risk Assessment did not evaluate the risks posed by exposure to this residual contamination. Thus, this restriction eliminates the possibility of unacceptable exposures. Additionally, it prevents damage to subsurface engineered components of the remedy.

Resolution:
CDPHE, after consultation with EPA, has approved the activities described in this contact record (CR). Based on the information provided, CDPHE determined that the proposed activities will not result in an unacceptable release or exposure to residual subsurface contamination and will not damage any component of the remedy. CDPHE has also determined that the proposed activities meet the rationale and objectives of IC 2.

The work will be conducted after approval of this CR, but DOE will not conduct the approved soil disturbance until 10 calendar days after this CR is posted on the Rocky Flats Site website and stakeholders are notified of the posting in accordance with the RFLMA Public Involvement Plan.

Progress and the completion of the work will be reported by DOE in RFLMA quarterly and annual reports of surveillance and maintenance activities for the periods in which these activities occur.

Action Complete:
The activities approved in this CR will be complete when the components of the ETPTS as identified above have been removed or replaced, the excavations have been backfilled to the original grade or higher, post-disturbance reseeding has been performed, and post-disturbance soil erosion controls as identified in the approved *Erosion Control Plan for Rocky Flats Property Central Operable Unit* (DOE-LM/1497-2007) are in place.

Contact Record Prepared by:
Ryan Wisniewski, RSI

Distribution:
Andy Keim, DOE
Lindsay Murl, CDPHE
Jesse Aviles, EPA
Dana Santi, RSI
Rocky Flats Contact Record File

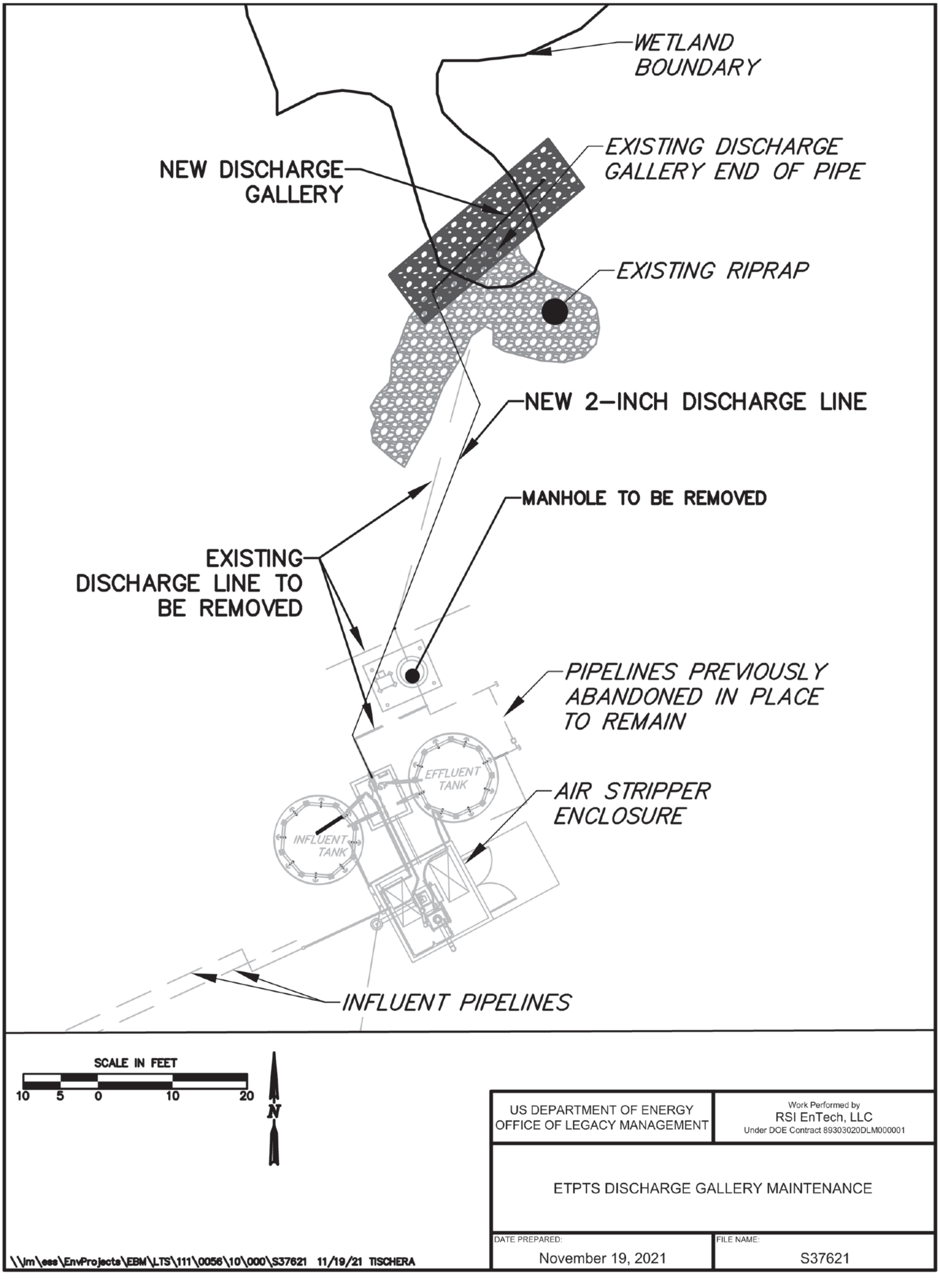
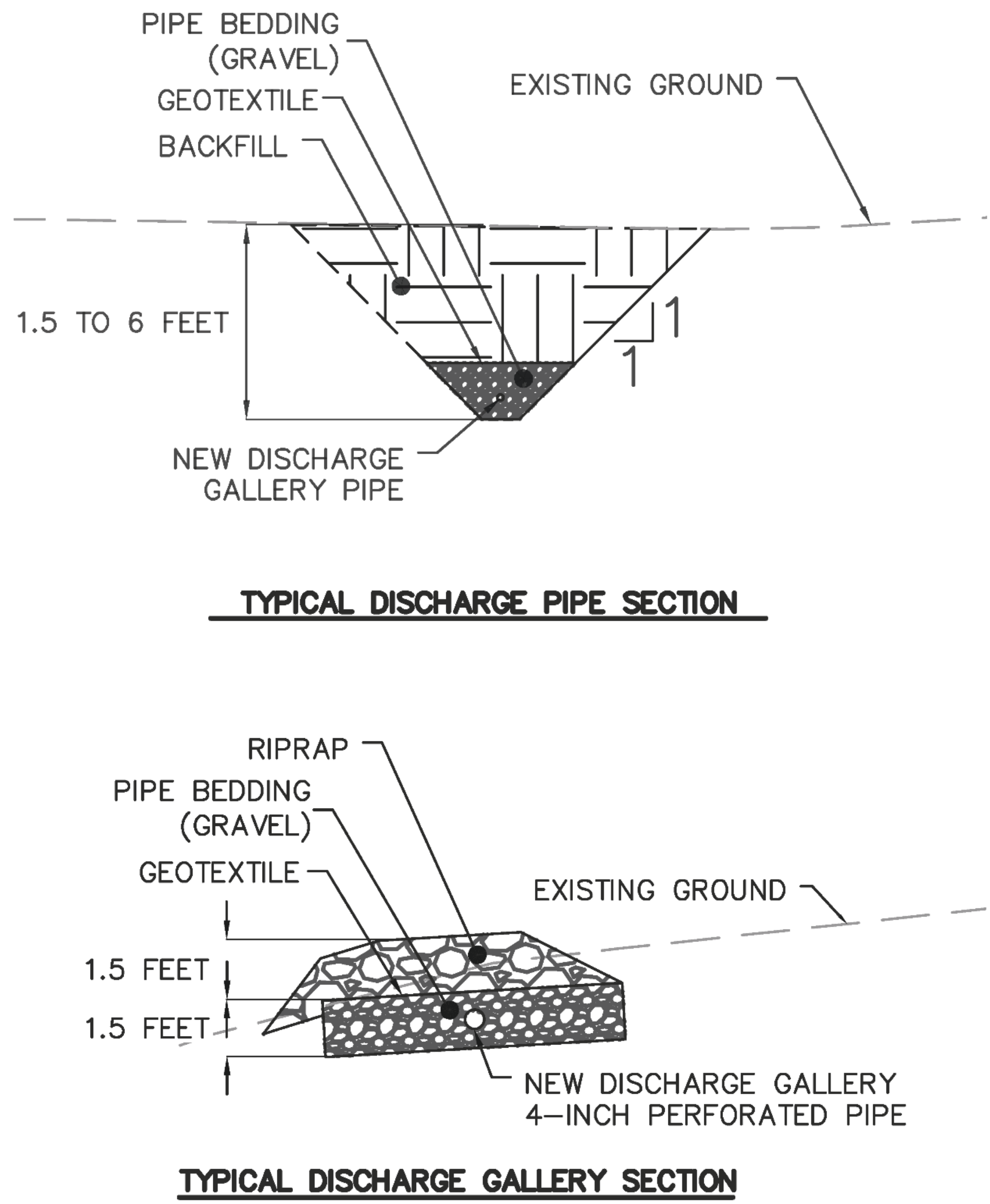


Figure 1. ETPTS Discharge Gallery Overview



US DEPARTMENT OF ENERGY OFFICE OF LEGACY MANAGEMENT	Work Performed by RSI EnTech, LLC Under DOE Contract 89303020DLM000001
ETPTS DISCHARGE GALLERY MAINTENANCE TYPICAL SECTIONS	
DATE PREPARED: November 19, 2021	FILE NAME: S37623

\\lm\ess\EnvProjects\EBM\LTS\111\0056\10\000\S37622-S37623 11/19/21 TISCHERA

Figure 2. Project Excavation Cross Sections

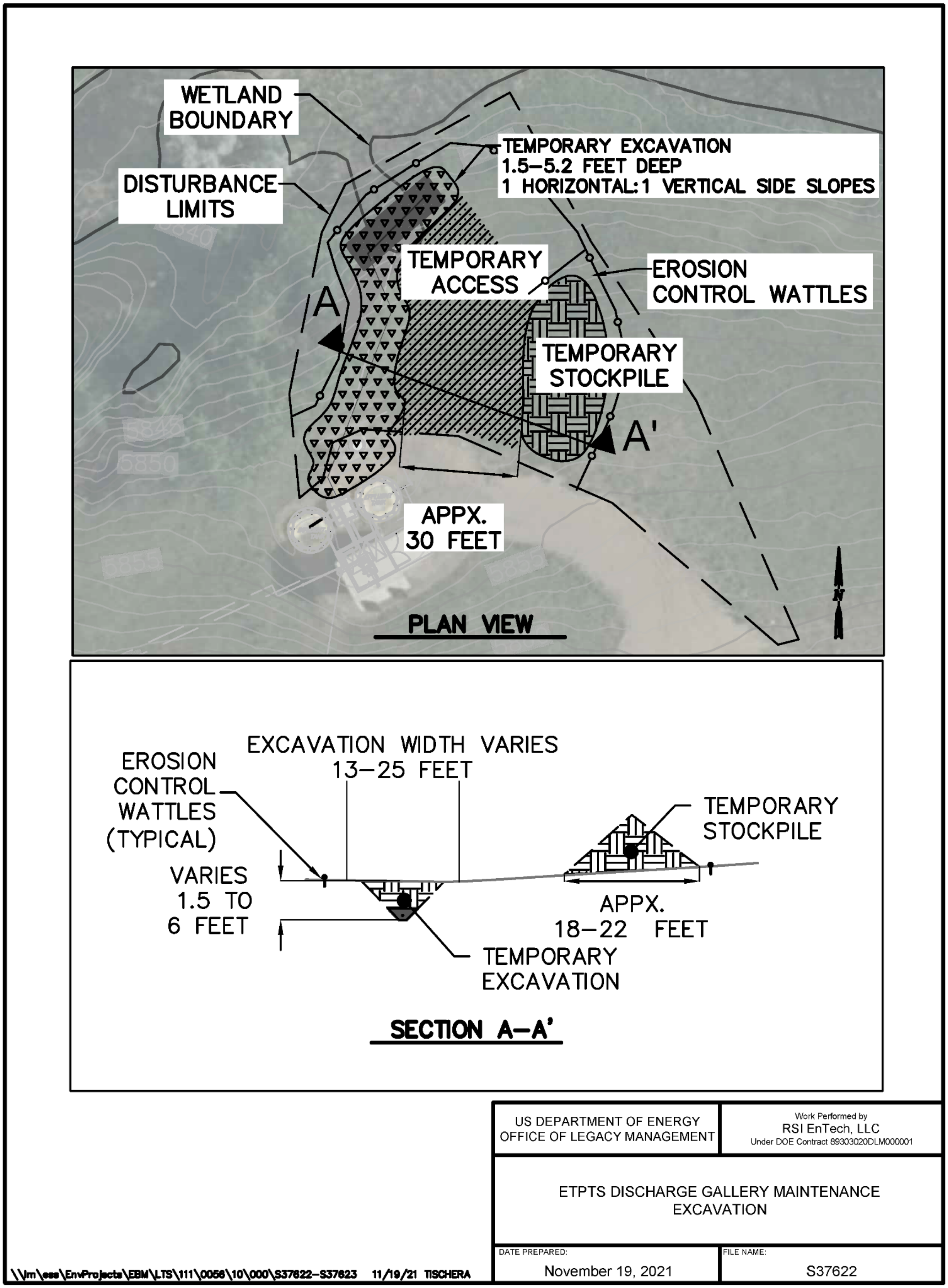


Figure 3. Project Activity Layout

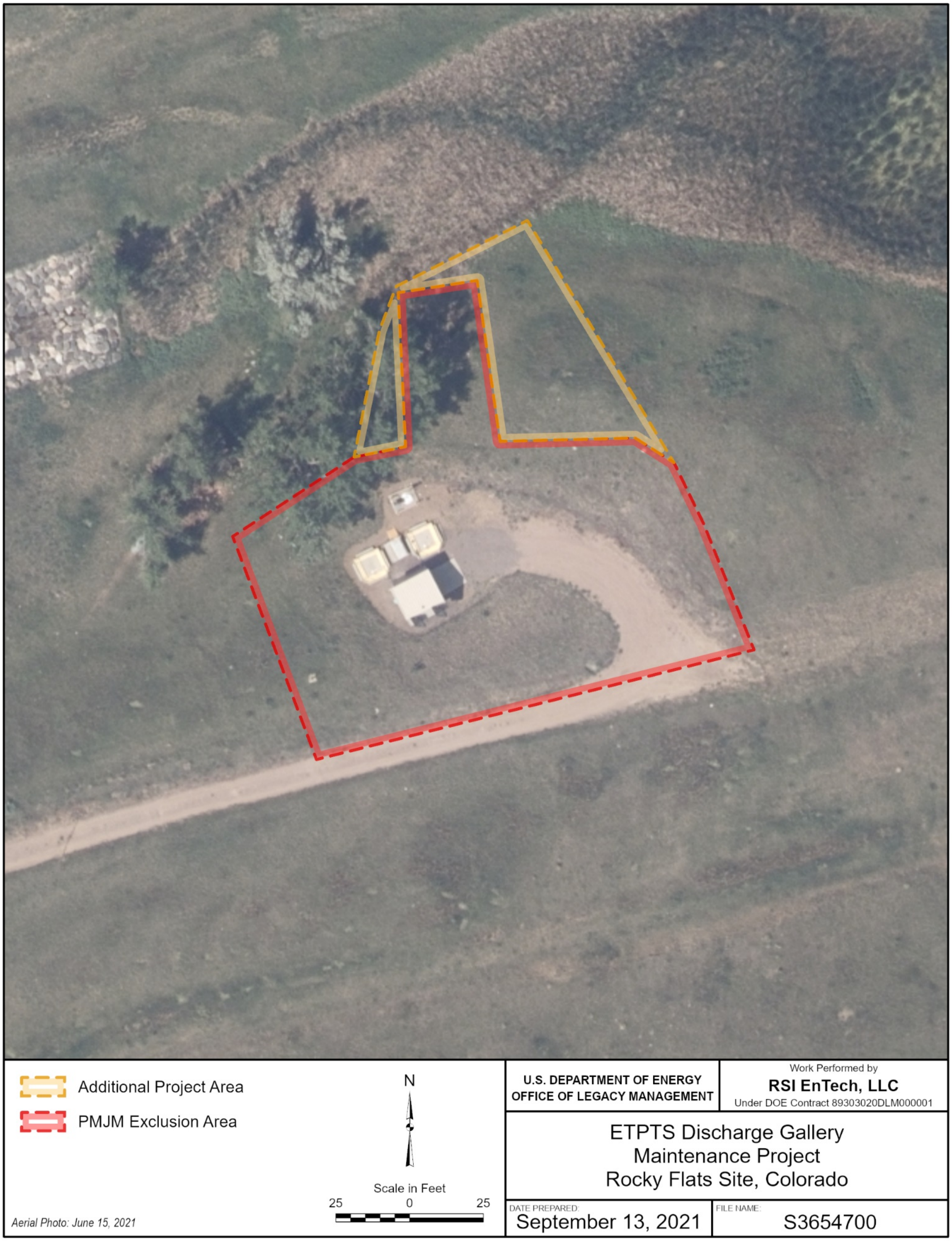


Figure 4. Preble's Meadow Jumping Mouse Exclusion Areas

Attachment 1

Rocky Flats Legacy Management Agreement Soil Disturbance Review Plan

Proposed Project: East Trenches Plume Treatment System (ETPTS) discharge gallery replacement

This Soil Disturbance Review Plan provides information required by *Rocky Flats Legacy Management Agreement* Attachment 2, "Legacy Management Requirements," Section 4.1, "Soil Disturbance Review Plan," regarding the work proposed by the U.S. Department of Energy (DOE).

<u>Description of the proposed project, including the purpose, the location, and the lateral and vertical extent of excavation.</u>

DOE is proposing to perform component replacement or removal to the ETPTS as part of the maintenance of the overall system. Specific components to be removed or replaced are identified in CR 2021-05. Recently, parts of the system have begun to fail as a result of scale buildup within the discharge pipe, limiting flow capacity.

The ETPTS component replacement and removal will require excavations ranging from 1.5 to 6 feet. The extent of the required excavations is shown in Figures 2 and 3 of CR 2021-05.

<u>Information about any remaining subsurface structures in the vicinity of the proposed project</u>.

Other than components of the ETPTS, there are no structures near the activity. The eastern end of the B-Pond Bypass Pipeline is a short distance west of the project area but is not at risk from subsurface work conducted within this area.

<u>Information about any former Individual Hazardous Substance Sites (IHSSs), Potential Areas of Concern (PACs), or other known or potential soil or groundwater contamination in the vicinity of the proposed project.</u>

This construction area was not an IHSS or PAC. In the *Facility Investigation - Remedial Investigation/Corrective Measures Study - Feasibility Study Report for the Rocky Flats Environmental Technology Site* (June 2006), the figures in Section 3, "Nature and Extent of Soil Contamination," do not indicate soil contamination in this area. Any groundwater that is encountered in an excavation will be managed as described in CR 2021-05.

Written Correspondence

Notification
020818

Purpose: Notification of Maintenance Activities at OLF Berms 6 and 7

Concurrence Date: Notification provided via email to CDPHE and EPA on February 8, 2018.

Related Contact Record: 2015-06 (approved July 28, 2015)

Description of Activity: On January 25, 2018, DOE provided CDPHE and EPA a summary of upcoming maintenance activities scheduled for the OLF. Within the next month, DOE will conduct the following routine maintenance activities at the OLF on the eastern ends of Berms 6 and 7. The activities will involve (1) filling the channel behind the existing check dam at Berm 7 and (2) installing surface drainage pipes at Berm 6. The purpose of these activities is to eliminate ponding on the landfill by reestablishing positive runoff flow from the landfill. Both of the berms were truncated as a result of previous slumping in this area. Check dams have been installed to prevent flow carried by the channels behind these berms from discharging directly onto the slump area. Three 4-inch corrugated HDPE drain pipes were previously installed at Berm 7 immediately upgradient of the check dam to collect flow and convey it beyond the toe of the OLF. The area immediately surrounding the inlet to these pipes has settled approximately three inches and requires filling to promote positive drainage. Berm 6 was prepared for pipe installation during the OLF regrade project in the fall of 2017. Similar to Berm 7, three 4-inch corrugated HDPE drain pipes will be installed at Berm 6 immediately upgradient of the existing check dam to collect and divert flow beyond the toe of the OLF. The disturbed areas will be reseeded and erosion controls applied.

The installation of drainage pipes as an interim measure to control runoff was specifically addressed in CR 2015-06. Although this CR is closed, the routine maintenance activities at Berm 6 and 7 are within the scope of activities previously approved by the RFLMA parties. This notification is provided for informational purposes only.

Consultation Posting
010819

Purpose: To provide notice of a reportable condition for trichloroethene (TCE) at Area of Concern (AOC) well 10304 and document the plan and schedule to evaluate the reportable condition. On December 6, 2018, the *Rocky Flats Legacy Management Agreement* (RFLMA) parties consulted on the reportable condition and proposed response.

Concurrence Date: Concurrence with the actions specified in this notification was received via email from the Colorado Department of Public Health and Environment (CDPHE) and the U.S. Environmental Protection Agency (EPA) on January 8, 2019.

Related Contact Records: 2015-10

Description of Activity:

The RFLMA defines several categories of groundwater monitoring wells at the Rocky Flats Site. Of these, AOC wells have reportable conditions defined. AOC wells are located within a drainage and downgradient of one or more contaminant plumes and are monitored semiannually to determine whether the plume(s) may be impacting surface water quality. The primary objective of AOC well 10304 is to evaluate groundwater quality adjacent to Woman Creek, downgradient of the former 903 Pad and Ryan's Pit (Figure 1).

As documented in Contact Record 2015-10, the TCE concentration in AOC well 10304 triggered a reportable condition under RFLMA in the fourth quarter of 2015. This reportable condition lasted through the second quarter of 2017 (see Figure 1 table inset). The TCE concentration at well 10304 in the fourth quarter of 2017 was below the RFLMA Table 1 standard, ending the reportable condition for TCE that had applied since the fourth quarter of 2015. However, in the second quarter of 2018, the TCE concentration in this well was 26 micrograms per liter (µg/L), which is above the RFLMA Table 1 standard of 2.5 µg/L. As outlined in RFLMA Attachment 2, Figure 7, a reportable condition for an AOC well exists when two consecutive, routine, semiannual samples contain the same analyte at concentrations exceeding the corresponding RFLMA standard. The fourth-quarter 2018 sample collected from well 10304 showed TCE at 5.43 µg/L, which is also above the RFLMA Table 1 standard (see Figure 1 table inset). The fourth-quarter 2018 sample result represents the second consecutive semiannual result above the RFLMA standard, and, therefore, a reportable condition was triggered for AOC well 10304 at that time. In accordance with the RFLMA, within 15 days of receiving validated data defining a reportable condition, DOE must notify the agencies. Within 30 days of that date, DOE must provide a plan and schedule to the regulators for an evaluation to address the occurrence.

DOE received validated data for the fourth-quarter sample at well 10304 on December 3, 2018, and notified EPA and CDPHE of the reportable condition at a consultation meeting held on December 6, 2018. During this consultation, the parties agreed on the following plan for evaluating the reportable condition at AOC well 10304, which is the same plan the parties agreed to in CR 2015-10:

- Concurrent with the next routine RFLMA sampling of well 10304, which is scheduled to occur in the second quarter of 2019, a grab sample will be collected from surface water sample location SW10200. SW10200 is located within Woman Creek downgradient and downstream of well 10304 (Figure 1). The results of this sample will be used to evaluate the potential for volatile organic compound-contaminated groundwater to adversely affect surface water quality in this reach of Woman Creek.
- When validated results from second-quarter 2019 sampling of well 10304 and SW10200 are available, DOE will consult with EPA and CDPHE to determine if further action or evaluation to address the reportable condition is warranted.
- Grab samples will be collected from SW10200 each time AOC well 10304 is sampled until there is no longer a reportable condition for TCE at the well.

Analytical results from these samples will be included in the corresponding quarterly and annual reports.

The RFLMA parties agreed in the December 6, 2018, consultation that this notification would be used to document the reportable condition at AOC well 10304 and the plan for evaluation in lieu of a contact record. EPA and CDPHE concurrence on this notification indicates agreement with the plan and schedule to evaluate the reportable condition at AOC well 10304 as outlined above.

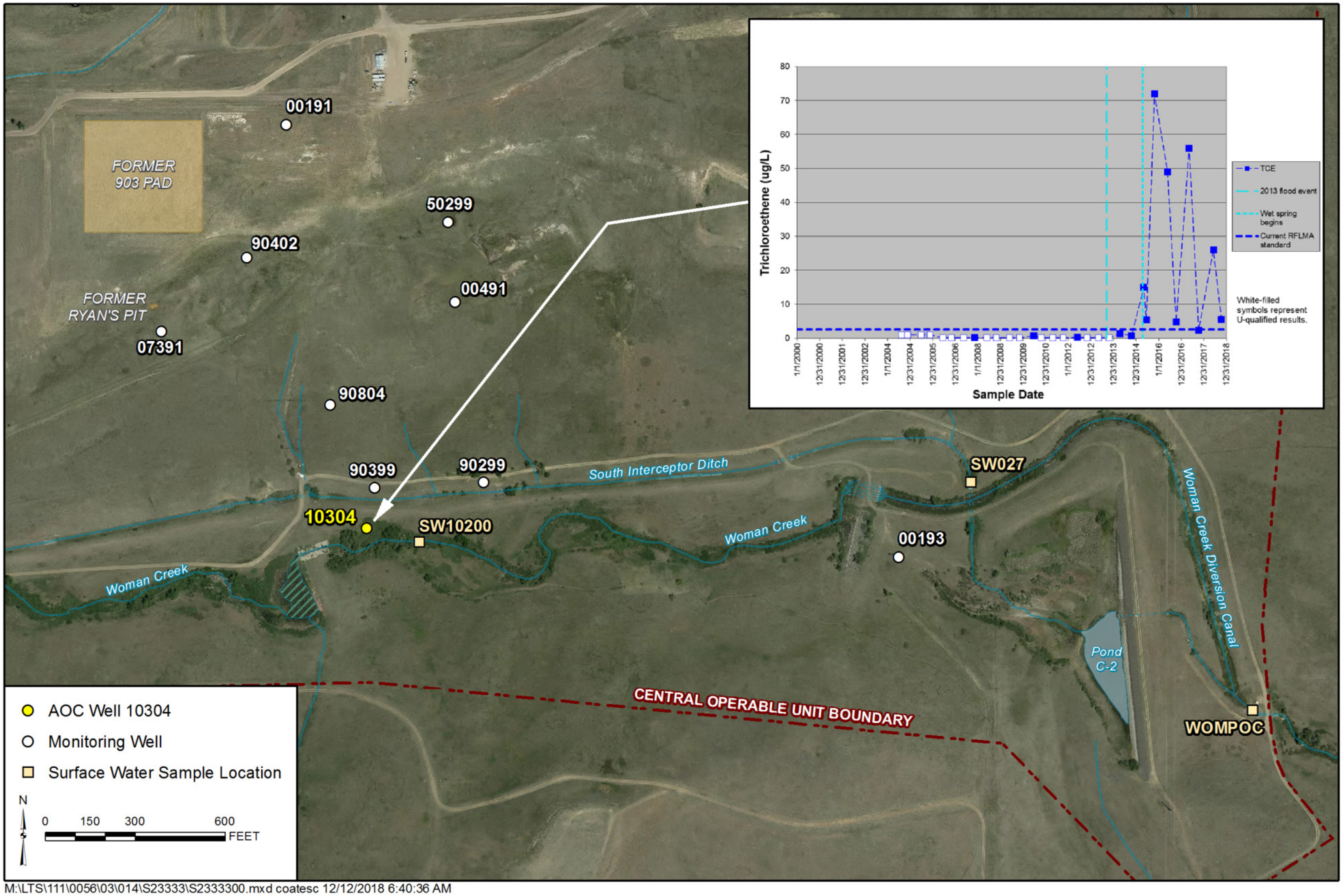


Figure 1. AOC Well 10304 Location and TCE Data

Appendix E

Groundwater and Surface Water Monitoring

Contents

Figures

Table

E1.0 Groundwater and Surface Water Monitoring

E1.1 Groundwater

The designated groundwater use classification at the COU is surface water protection because groundwater contaminated by historical operations emerges to surface water before exiting the COU. The numeric values for measuring potential effects of contaminated groundwater on surface water quality are the surface water standards in RFLMA Attachment 2, Table 1. It should be noted that the CAD/ROD and RFLMA incorporated some MCLs as surface water standards in cases where surface water standards were not available.

The groundwater monitoring network includes four classifications of monitoring wells: AOC, Sentinel, Evaluation, and RCRA. A fifth classification applies to a single surface water location and is termed Surface Water Support; this has the same objectives and decision rules as AOC wells. The AOC wells provide data directly relevant to groundwater RAO 1 and are discussed in Section 6.1.2.1. The Sentinel wells provide data directly relevant to groundwater RAO 2 and soil RAO 1 and are discussed in Section 6.1.2.2. The RCRA wells are directly related to the remedies implemented at the PLF and OLF and are discussed in Sections 6.1.4.1 and 6.1.4.2, respectively. The data collected during this FYR period at the Evaluation wells are summarized in this appendix.

The remedy in the CAD/ROD incorporated the four passive groundwater treatment systems in place when the COU closed in 2005: the PLFTS, SPPTS, MSPTS, and ETPTS (DOE, EPA, and CDPHE 2006). As a result of technology improvements and optimization completed in 2016 at the MSPTS and ETPTS, the number of treatment systems was reduced to three, although there are still four groundwater collection systems. This change was documented in an Explanation of Significant Differences (see CR 2016-02 [Appendix D]) and is composed of the removal of the existing treatment media and small air stripper component from the MSPTS and the rerouting of groundwater intercepted at the MSPTS to the ETPTS for treatment. The subsurface collection system for groundwater impacted by the Mound Site Plume was not altered. With the removal of treatment capabilities, this system is now referred to as the MSPCS. Additional detail on the reconfiguration of the treatment systems is provided in RFLMA annual reports. Monitoring of groundwater treatment system influent, effluent, and surface water locations associated with each of the treatment systems is summarized in this appendix.

E1.1.2 Evaluation Wells

Evaluation wells are typically within plumes or near plume source areas or in the interior of the COU (Figure E-1). There are 42 Evaluation wells within the COU that are sampled every 2 years (biennially) in accordance with the RFLMA. The primary purpose of these wells is to determine when monitoring can be modified or discontinued. Data from these wells may also be used to support other objectives, such as providing input to groundwater modeling efforts, modification of groundwater monitoring and treatment requirements, or evaluation of changing contaminant conditions as indicated by downgradient AOC or Sentinel wells.

The RFLMA Attachment 2 decision logic flowchart in Figure 9, “Evaluation Wells” (Appendix B), is relevant to Evaluation well data. In general, groundwater quality within plumes that were identified and characterized through the decades of preclosure groundwater monitoring has changed little since site closure. Groundwater quality during this FYR period was largely consistent with data reported in previous years. As anticipated, because of their locations within or adjacent to groundwater contaminant plumes, groundwater did not meet applicable RFLMA surface water standards at most of the Evaluation wells during this FYR period. Thus, continued monitoring of most of these Evaluation wells is necessary to determine when groundwater is of sufficient quality to discontinue monitoring and remove ICs. However, an evaluation of the monitoring well network has identified four Evaluation wells for which discontinuation or a reduction in monitoring is appropriate. This evaluation is discussed in Section E1.1.3. Discussion of plume-specific Evaluation well data for this FYR period may be found in the RFLMA annual reports for 2018 and 2020 (DOE 2019; DOE 2021).

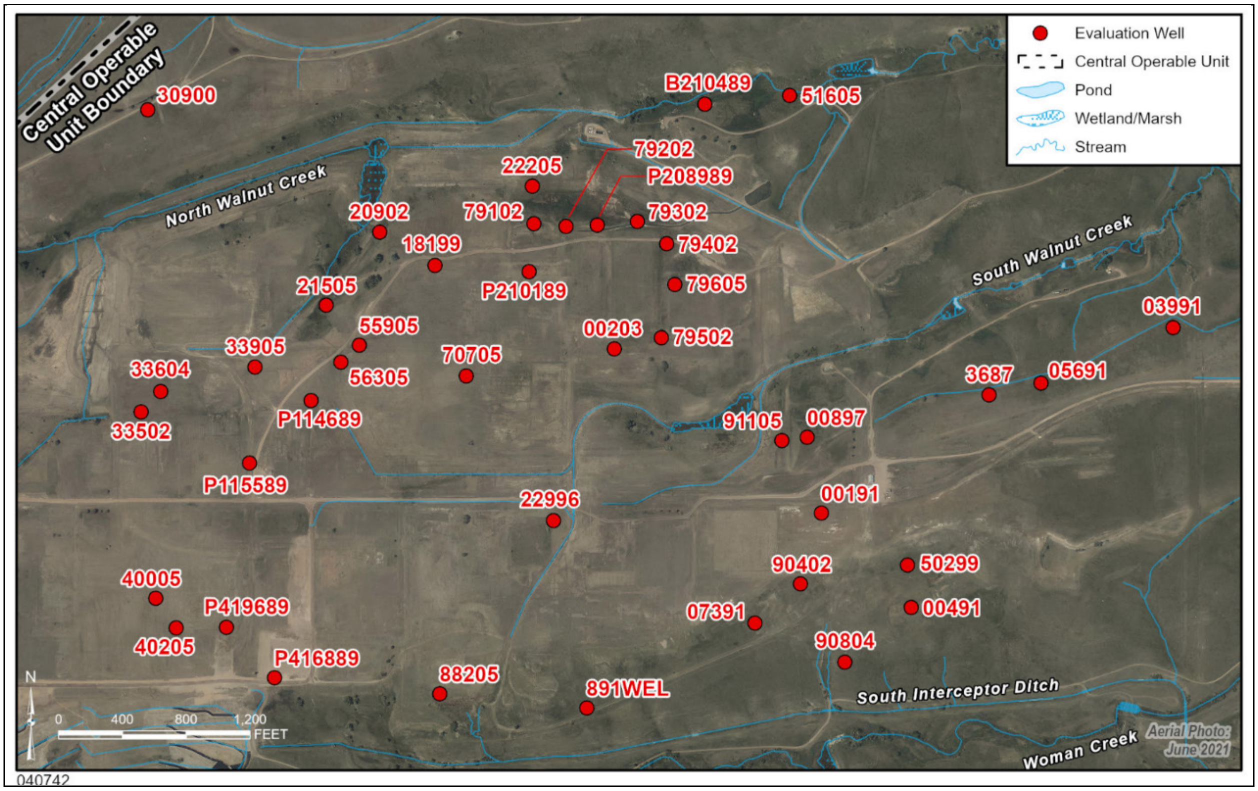


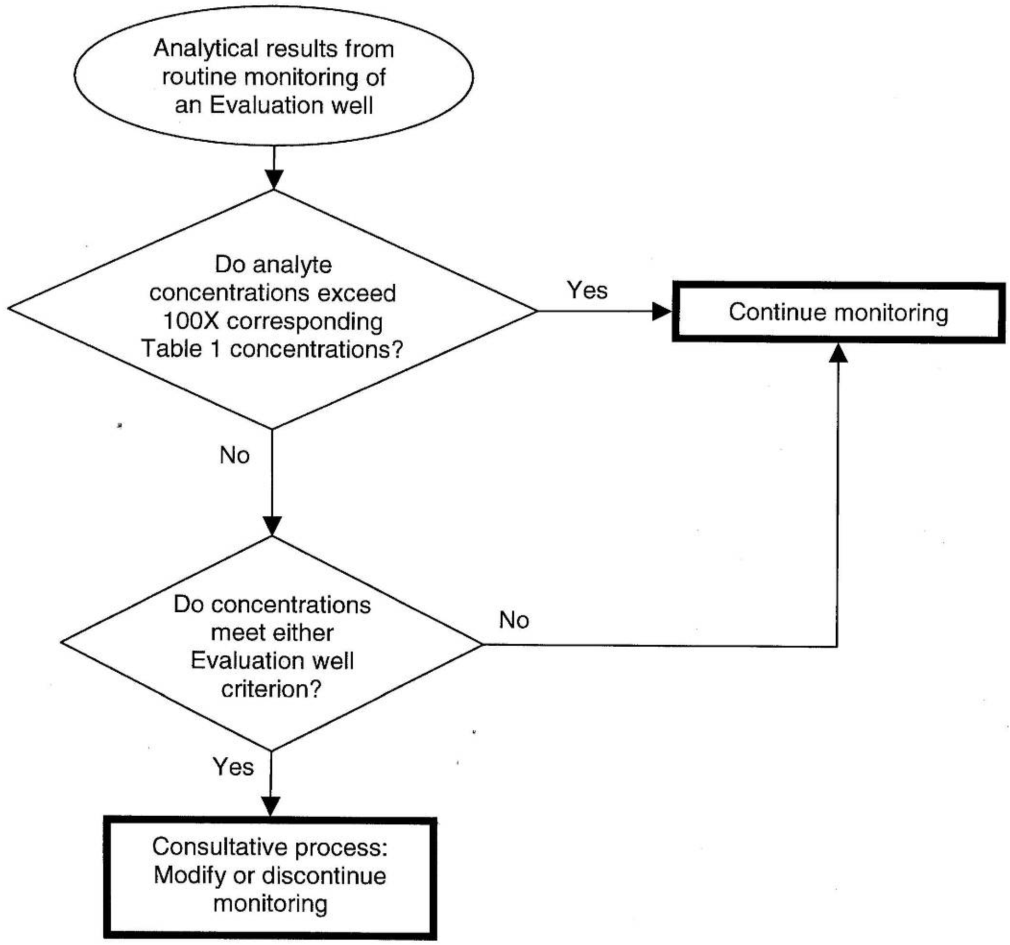
Figure E-1. Evaluation Well Locations

E1.1.3 Nonroutine Sampling at Evaluation Wells

During this FYR period, additional nonroutine samples from select Evaluation wells were collected to screen for the presence of two PFAS: PFOA and PFOS. These constituents are discussed in Section 6.2.2.3.

E1.1.4 Modifications to Evaluation Well Monitoring

An assessment of the Evaluation well network was completed during this FYR to determine if modifications to the network and/or analytical requirements should be considered. This assessment is conducted in accordance with the flowchart shown in Figure E-2 (DOE, EPA, and CDPHE 2007).



Notes: see Fig. 1 and Tables 1 and 2 for locations, standards, and sampling criteria.

- Evaluation wells are listed in Table 2.

Evaluation Well Criteria:

1. The 85th percentile concentration of an analyte *is less than or equal to* the corresponding concentration in Table 1, or, for uranium, 240 ug/L or highest pre-CY05 concentration, whichever is higher.
2. Analyte concentrations exhibit an indeterminate or statistically-significant *decreasing* trend at the 95% confidence level.

Figure E-2. Evaluation Well Flowchart from RFLMA Attachment 2

Review of analytical data collected over the period of record (January 1, 2000, through December 31, 2021) suggests that modifications to the monitoring network can be considered for some wells. The primary decisions upon which the monitoring exit strategy depends concern analyte concentrations and concentration trends. Concentrations of analytes must meet certain criteria:

Step 1: Cannot exceed 100 times the corresponding RFLMA Attachment 2, Table 1 value, ***AND*** either

Step 2a: The 85th percentile concentration is less than that Table 1 concentration, or for U is less than the exit-strategy threshold (240 µg/L or twice the highest pre-2005 concentration, whichever is higher), ***OR***

Step 2b: Statistically significant decreasing or indeterminate concentration trends are calculated, rather than increasing concentration trends of the same significance. (The level of statistical significance is deemed sufficient when it reaches 95%.)

Meeting the requirements of exit strategy step 1 and either step 2a or 2b allows for consideration of the well for removal from the network. In addition to evaluation of individual contaminants, the entire group of analytes (i.e., analytical suite) is also considered. For example, recommending removal of one or a few individual VOCs from monitoring is not of value because VOCs are analyzed as a group and samples would still need to be collected to obtain data for the VOCs that did not meet the exit criteria.

Four Evaluation wells are suitable for consideration either for removal from the monitoring network or reduction of analytical requirements. None of these wells produce contaminant concentrations nearing 100 times the corresponding RFLMA Attachment 2, Table 1 concentration, and, therefore, they all meet the initial threshold summarized in step 1. Analytical data confirm that two of these wells warrant removal from the network while the analytical suites for the other two may be reduced.

Table E-1 summarizes the proposed network modifications, which are discussed in greater detail in the following sections. Refer to Figure E-1 for well locations.

Table E-1. Proposed Changes to the Monitoring Network

Well	Proposed Change	RFLMA Analytical Suite	Affected Analytes	General Location	Concentration Trend(s) or 85th Percentile Concentration(s)	Rationale
22996	Delete from network	VOCs, U	VOCs, U	On pediment surface in center of COU; not in a plume	Step 2a: 85th percentile of VOC concentrations are below their corresponding standards; U concentrations are well below exit threshold. Step 2b: VOC and U concentrations exhibit indeterminate trends (most VOC results are nondetects; U data do not define a trend with required level of statistical significance.	Meets exit strategy. VOCs are rarely detected, and U concentrations are low (highest: 13 µg/L in 2008). 85th percentile concentrations are less than Table 1 values for VOCs and well below exit threshold of 240 µg/L for U. Numerous other monitoring wells are positioned closer to surface water and will be retained.
03991	Delete from network	VOCs	VOCs	On pediment surface in eastern portion of East Trenches Plume	Step 2a: 85th percentile concentrations of CF, PCE, TCE, and nondetect VOCs are below their corresponding standards. Step 2b: CT, CF, and TCE are decreasing; zero slope for nondetect VOCs; data for PCE do not define a trend with required level of statistical significance.	Meets exit strategy. Four VOCs have been detected since closure (CT, CF, PCE, TCE). CT is main contaminant of interest; the highest postclosure concentration of CT was 9.1 µg/L in 2012 (RFLMA standard is 1 µg/L). A Sentinel well positioned farther downgradient monitors eastern East Trenches Plume and will be retained.
P419689	Reduce analytical suite	VOCs, U	U	On pediment surface between OLF and 400 Area in southern portion of Industrial Area Plume	Step 2a: 85th percentile concentration of U is approximately 1.2 µg/L. Step 2b: Statistically significant decreasing slope is calculated.	Meets exit strategy for U and is in area monitored by several other nearby wells; highest postclosure concentration is 1.13 µg/L.
P416889	Reduce analytical suite	VOCs, U	VOCs	On pediment surface between OLF and 400 Area in southern portion of Industrial Area Plume	Step 2a: 85th percentile concentrations of VOCs except PCE and TCE are below their standard. Step 2b: Decreasing trends in PCE, TCE, and *cis*-1,2-DCE; indeterminate trend for nondetect VOCs; data for 1,1-DCE do not define a trend with required level of statistical significance.	Meets exit strategy for VOCs and is in area monitored by several other nearby wells; is very close to Sentinel well supporting same monitoring objectives. PCE and TCE have exceeded standard; highest postclosure PCE was 21.3 µg/L in 2006 (standard = 5 µg/L), TCE was 3.2 µg/L in 2010 (standard = 2.5 µg/L).

Note:
All wells in the table meet step 1 because all analyte concentrations are less than 100 times the corresponding RFLMA Attachment 2, Table 1 concentration.

Abbreviations:
CF = chloroform
cis-1,2-DCE = *cis*-1,2-dichloroethene
CT = carbon tetrachloride
DCE = dichloroethane

***Evaluation Well 22996*:** Well 22996 is in the middle of the COU, adjacent to former Building 886, a U-focused facility. Well 22996 is monitored biennially (every other year) for VOCs and U, the latter is of particular interest due to the proximity of B886. The well is not within the Industrial Area Plume or other area of groundwater with elevated contaminant concentrations. Several other RFLMA wells are downgradient of well 22996.

In the 16 years since closure, four VOCs have been detected in samples from well 22996 for a total of seven detections. All VOC detections were reported at estimated (J-qualified) concentrations of less than 1 µg/L; each was also much lower than its respective RFLMA Attachment 2, Table 1 standard. Detected constituents have included 1,3-dichlorobenzene (DCB) (detected twice), chloroform (detected once), PCE (detected twice), and TCE (detected twice). Exit strategy step 1 is satisfied for VOCs at this well because no VOC exceeds 100 times its respective RFLMA standard. Exit strategy step 2a is satisfied for VOCs at this well because the 85th percentile concentration of every monitored VOC is below its respective RFLMA value.

With respect to U, concentrations in samples collected from well 22996 have always been below the RFLMA standard of 16.8 µg/L; the highest concentration detected since closure was 13 µg/L in 2008. Therefore, exit strategy step 1 is satisfied for U at this well. Step 2a of the exit strategy requires U concentrations to be lower than 240 µg/L or twice the highest pre-2005 concentration, whichever is greatest. At this well, the greater of the two would be 240 µg/L. Concentrations of U in samples collected from well 22996 are consistently well below this exit threshold. Therefore, exit strategy step 2a is also satisfied for U.

With respect to step 2b, trending calculations using the Mann-Kendall method provide indeterminate concentration trends in all monitored constituents (VOCs and U); neither an upward nor downward trend in concentration is calculated to be statistically significant. Because VOCs and U meet all exit criteria (Steps 1, 2a, and 2b), continued monitoring of well 22996 is not warranted.

***Evaluation Well 03991*:** Evaluation well 03991 is monitored biennially for VOCs. It is within the East Trenches Plume, near its eastern margin; farther downgradient to the east, Sentinel well 04091 also monitors this plume. Because well 03991 is within the plume, low concentrations of VOCs are consistently detected. Only carbon tetrachloride exceeds its corresponding RFLMA standard. The highest concentration of carbon tetrachloride reported since site closure in 2005 was 9.1 µg/L in 2012; the corresponding standard is 1 µg/L. Other VOCs detected over the postclosure period are chloroform, PCE, and TCE, with most results being J-qualified as estimated concentrations. The highest concentration reported for any of these other constituents since closure was 3.1 µg/L for PCE in 2016; the RFLMA standard is 5 µg/L. Exit strategy step 1 is satisfied for VOCs at this well because no VOC exceeds 100 times its respective RFLMA standard.

Exit strategy step 2a refers to 85th percentile concentrations. The 85th percentile concentration of every monitored constituent except carbon tetrachloride is below its respective RFLMA value. Therefore, all VOCs except carbon tetrachloride meet steps 1 and 2a, thereby warranting consideration of removal from the monitoring. With respect to step 2b, Mann-Kendall trend calculations yield a statistically significant decreasing trend for carbon tetrachloride (and for chloroform and TCE). Therefore, carbon tetrachloride satisfies the exit strategy by meeting step 1 and step 2b.

Collectively, these data show that well 03991 satisfies the exit strategy requirements. Step 1 is satisfied for all monitored constituents, and step 2a is satisfied for all but carbon tetrachloride, which meets the requirements of step 2b. Therefore, continued monitoring of well 03991 is not warranted.

***Evaluation Well P419689*:** Evaluation well P419689 is currently monitored biennially for VOCs and U. This well is in the former 400 Area (in the southern portion of the former Industrial Area) and monitors for releases from former Building 444 (particularly U) and VOCs in the southern portion of the Industrial Area Plume. Several other wells with the same monitoring objectives are relatively close to one another in this same area (Figure E-1).

VOCs commonly detected in postclosure samples from well P419689 include 1,1-dichloroethene (DCE), chloroform, *cis*-1,2-dichloroethene (*cis*-1,2-DCE), PCE, and TCE. Only PCE and TCE have exceeded their corresponding RFLMA standards since closure, with PCE reported at concentrations above its 5 µg/L standard in each sample (highest: 30 µg/L in 2006) and TCE above its 2.5 µg/L standard in most samples (highest: 4 µg/L in 2018). The highest postclosure concentration of U reported at this location is 1.13 µg/L in a sample collected in 2016. Thus, exit strategy step 1 is satisfied for VOCs at this well because no VOC exceeds 100 times its respective RFLMA standard.

Exit strategy step 2 is not fully satisfied for VOCs. Neither PCE nor TCE have 85th percentile concentrations that are lower than the RFLMA value (step 2a), nor are they on a statistically significant decreasing trend (step 2b). Mann-Kendall trending calculations for PCE show a decreasing trend of a lower statistical confidence level and, for TCE, show an increasing trend that is also of a lower confidence level.

Although satisfying either step 2a or 2b would suffice, both steps are satisfied for U. The 85th percentile concentration is well below the RFLMA threshold value and Mann-Kendall trending calculations indicate a statistically significant decreasing trend in U concentrations.

Because the step 2 exit criteria are not met for all VOCs, removal of the well from the network is not warranted. However, because U meets all exit criteria (Steps 1, 2a, and 2b), the removal of U monitoring at this well is warranted. Continued monitoring for VOCs and elimination of U monitoring is proposed for well P419689.

***Evaluation Well P416889*:** Like nearby well P419689, Evaluation well P416889 is near the former 400 Area in the southern portion of the former Industrial Area and is currently monitored biennially for VOCs and U. Well P416889 is positioned near the southern edge of the pediment, while well P419689 is farther north and closer to former B444.

Well P416889 is west of nearby Sentinel well 11502, which has the same analytical suite and similar monitoring objectives. As with well P419689, only PCE and TCE have exceeded their corresponding RFLMA standards in well P416889 since closure. The highest postclosure concentrations of these compounds have been 21.3 µg/L for PCE (in 2006; standard is 5 µg/L) and 3.2 µg/L for TCE (in 2010, the last sample to exceed the TCE standard of 2.5 µg/L). Other VOCs that have frequently been detected since closure include 1,1-DCE, 1,3-DCB, chloroform, and *cis*-1,2-DCE, all at concentrations well below their respective RFLMA standard. Thus, exit strategy step 1 is satisfied for VOCs at this well because no VOC exceeds 100 times its respective RFLMA standard. Step 2a in the RFLMA exit strategy is satisfied for all analyzed VOCs except PCE and TCE. However, Mann-Kendall trend calculations identify statistically significant decreasing trends in PCE and TCE (as well as *cis*-1,2-DCE); therefore, step 2b is satisfied for those VOCs that do not meet step 2a requirements.

Concentrations of U over the post-closure period have all been in the 1.6–3.4 µg/L range until 2020, when its highest concentration of 10 µg/L was reported. Thus, exit strategy step 1 is satisfied for U. Step 2a for U is also met, however, in contrast to trending results for VOCs, a statistically significant increasing trend is calculated for U at this well.

Although both criteria are met for U in this well (Step 1 and 2a), due to the increasing trend, U monitoring is recommended to continue as a conservative measure. However, because VOCs meet all exit criteria (Step 1 and Step 2a or Step 2b), the removal of VOC monitoring at this well is warranted. Continued monitoring for U and elimination of VOC monitoring is proposed for well P416889.

Proposed Modifications**:** In conclusion, Evaluation wells 22996 and 03991 both satisfy the exit strategy requirements defined in RFLMA Attachment 2, Figure 9. As such, both are proposed to be removed from the monitoring network and no longer sampled. Evaluation wells P419689 and P416889 are proposed for reduced analytical suites, with those analytes/analyte groups that have satisfied exit requirements omitted from future sampling events with one exception: although it meets the requirements for removal, as a conservative measure, U will continue to be monitored at well P416889. With respect to wells 22996 and 03991, it is further proposed that rather than be abandoned, they instead continue to be monitored quarterly for water level data through the next CERCLA FYR period (i.e., through calendar year 2026). After that time, the wells may be abandoned or retained for continued use at the discretion of DOE.

E1.1.5 Groundwater Treatment System Monitoring

The locations of the groundwater treatment systems in the COU are shown in Figure E-3. The groundwater treatment systems are being properly maintained and operated. The groundwater treatment systems are designed to reduce target contaminant concentrations in groundwater and reduce contaminant load to surface water. Each groundwater treatment system is monitored, at a minimum, for untreated influent and treated effluent and for impacts to surface water downstream of each subsurface effluent discharge point. Evaluation of groundwater treatment system performance determines whether (1) influent water quality indicates that treatment is still necessary, (2) effluent water quality indicates that system maintenance is required, and (3) surface water quality suggests impacts from inadequate treatment of influent. The RFLMA Attachment 2 decision logic flowchart in Figure 11, “Groundwater Treatment Systems” (Appendix B), is relevant to the treatment systems’ monitoring data.

E1.1.5.1 PLFTS

The PLFTS was installed in 2005 and consists of a gravity-fed, passive system designed to treat groundwater and seep water for VOCs. In contrast to the other treatment systems in the COU, there have been no alterations to this system since it was installed, and no opportunities for optimization have been identified. Operation and monitoring of the PLFTS during this FYR period is discussed in Section 6.1.4.1 and is not repeated herein. A yearly account of sampling data and evaluation of the PLFTS may be found in the RFLMA annual reports.

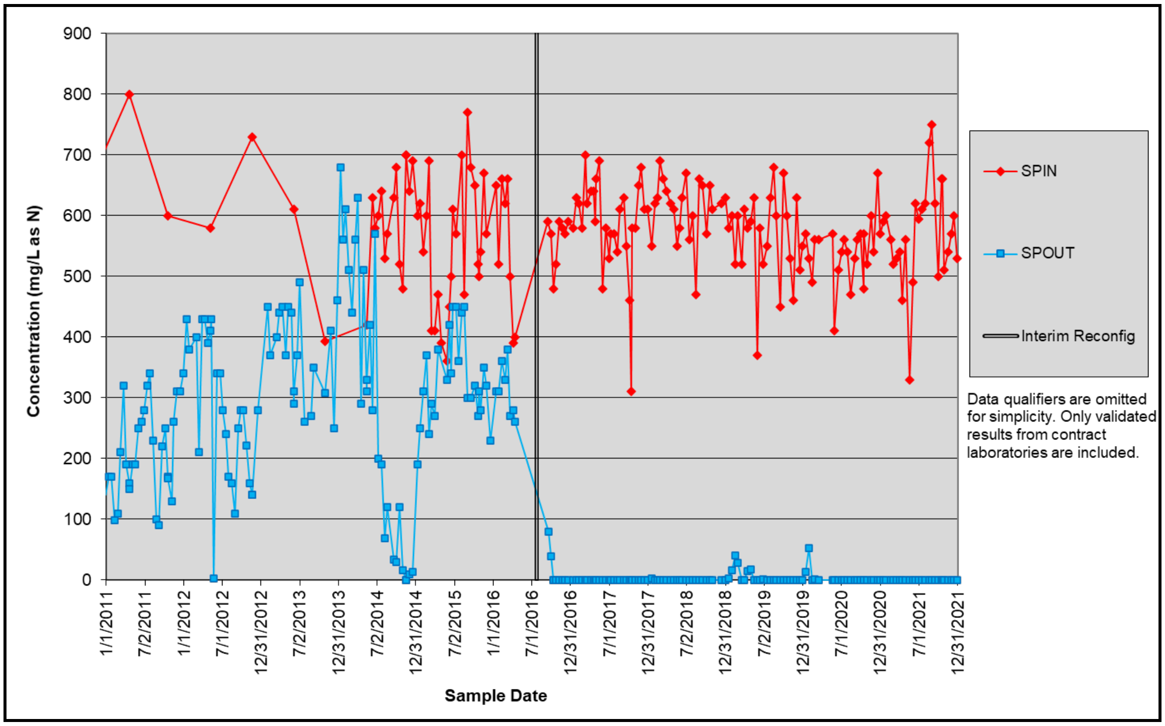
E1.1.5.2 SPPTS

The SPPTS was installed in 1999 and was designed to treat groundwater contaminated with nitrate and U from the Solar Ponds source area. In accordance with RFLMA routine monitoring requirements, SPPTS influent and effluent, and downstream surface water location GS13 (Figure E-3) are sampled semiannually for U and nitrate. Additional nonroutine monitoring samples are collected at these locations as needed; validated data from these nonroutine samples were considered in this FYR. Nitrate and U were regularly detected in SPPTS influent above the respective RFLMA standards during this FYR period. With few exceptions, nitrate was not detected in SPPTS effluent above the RFLMA standard during this FYR period, however, U was consistently detected in effluent above the RFLMA standard. In addition, nitrate or U were detected above the RFLMA standard in some samples from the downstream surface water location GS13.

Figure E-4 and Figure E-5 present nitrate and U data, respectively, for influent and effluent monitoring at the SPPTS from 2011 through 2021. Nitrate treatment has been highly effective throughout this FYR period, but U treatment requires further improvement. Uranium treatment will be a focal point in the next FYR period, and is planned to result in the construction of a full-scale uranium treatment component at the SPPTS (see Section 6.1.4.3).

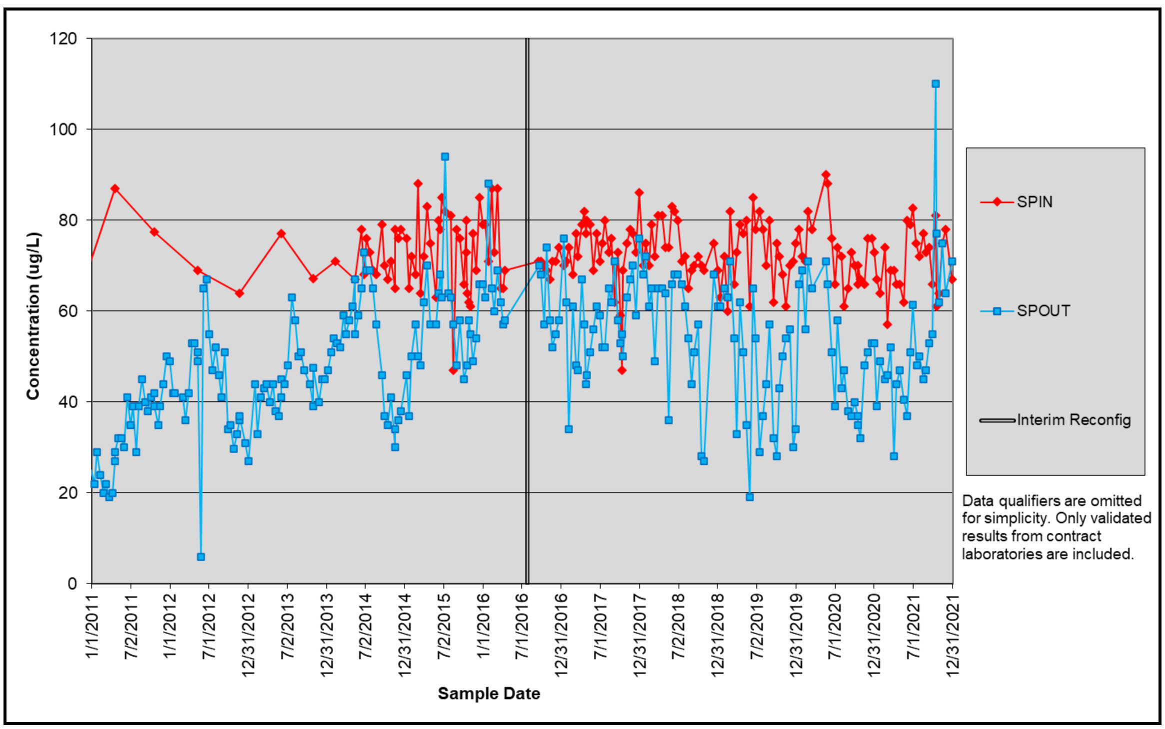
Uranium was detected above the RFLMA standard in some samples from the downstream surface water location GS13. An evaluation of the Walnut Creek drainage system concluded that approximately 15%–20% of the U load measured at location GS13 and approximately 10% at WALPOC comes from SPPTS effluent. This indicates that effluent from the SPPTS does not have a large impact on U concentrations detected at GS13 or WALPOC. Although the nitrate standard for surface water at WALPOC has consistently been met, the 30-day average U concentration at WALPOC exceeded the RFLMA standard twice during this FYR period. These U exceedances are discussed in Section 6.1.3.1.

Figure E-3. Groundwater Treatment Systems and Surface Water Performance Monitoring Locations



Notes: The RFLMA standard for total nitrate is 10 mg/L. "Interim Reconfig" indicates when the 2016 interim reconfiguration project was completed, converting from flow-through reactive media to a denitrifying "lagoon."
Abbreviations: SPIN = system influent, SPOUT = system effluent

Figure E-4. Total Nitrate Concentrations in SPPTS Influent and Effluent



Notes: The RFLMA standard for uranium is 16.8 ug/L. "Interim Reconfig" indicates when the 2016 interim reconfiguration project was completed, converting from flow-through reactive media to a denitrifying "lagoon."
Abbreviations: SPIN = system influent, SPOUT = system effluent

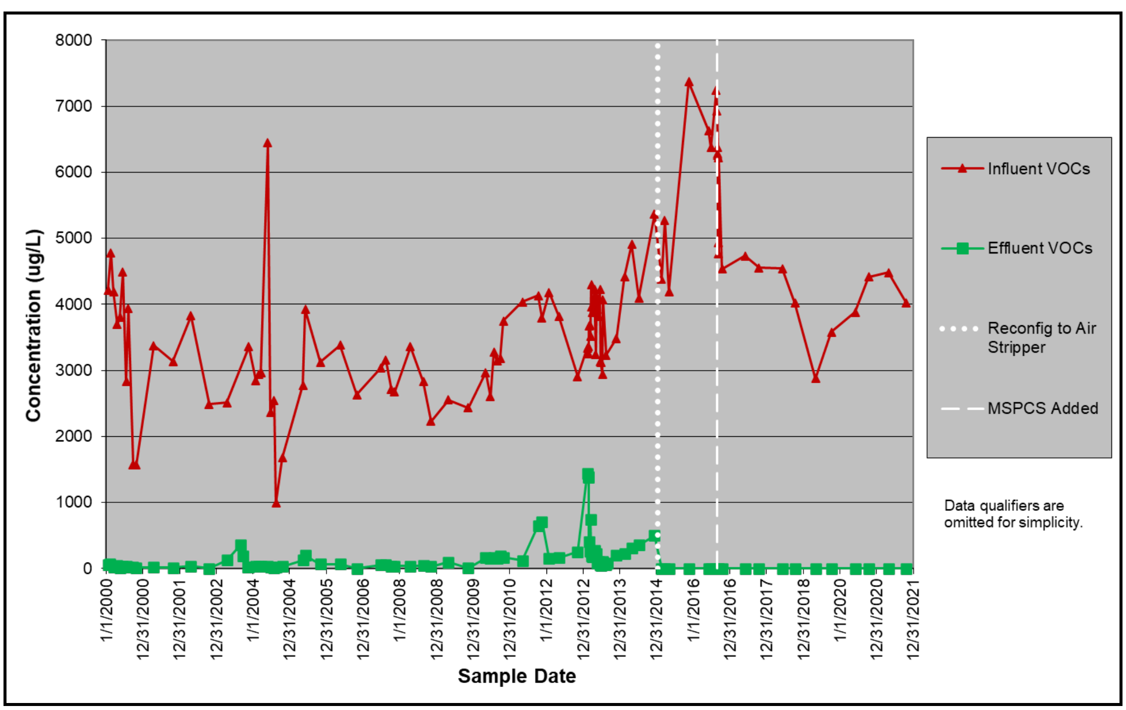
Figure E-5. Total Uranium in SPPTS Influent and Effluent

E1.1.5.3 ETPTS

The ETPTS was installed in 1999 and was designed to treat groundwater contaminated with VOCs from the East Trenches source area. Optimization of the ETPTS was an iterative process executed over several years and culminating in 2015 with the installation of a solar/battery-powered commercial air stripper (DOE 2016). This improvement resulted in more cost-effective treatment and a dramatic reduction of VOC contaminants in treated effluent. Since 2016, the ETPTS has also treated groundwater impacted by the Mound source area (see CR 2016-02 in Appendix D).

In accordance with the RFLMA, the ETPTS influent and effluent and downstream surface water location POM2 are sampled semiannually for VOCs. Figure E-6 presents total VOC concentration data for influent and effluent monitoring at the ETPTS from 2000 through 2021. During this FYR period, there were no instances of VOCs exceeding applicable RFLMA standards in the effluent. Concentrations of VOCs in system influent were consistently above their corresponding RFLMA standards. The primary contaminant in ETPTS influent is TCE (also the primary contaminant in MSPCS water). Figure E-6 illustrates that the ETPTS has been extremely effective in reducing VOC concentrations in groundwater treated by the system and reducing contaminant load to surface water.

The surface water performance monitoring location associated with the ETPTS and MSPCS is POM2 (Figure E-3). Low concentrations of VOCs were occasionally detected in surface water samples collected during this FYR period from this location. However, no VOCs have ever been detected above their respective RFLMA standards at this location.



Notes: VOC data shown represent arithmetic sums of all validated detections. "Reconfig to Air Stripper" indicates when treatment was changed from flow-through reactive media to air stripping. "MSPCS Added" refers to when groundwater collected by the MSPCS began to be transferred to the ETPTS for treatment; thereafter, influent and effluent data represent the combined ETPTS+MSPCS water.

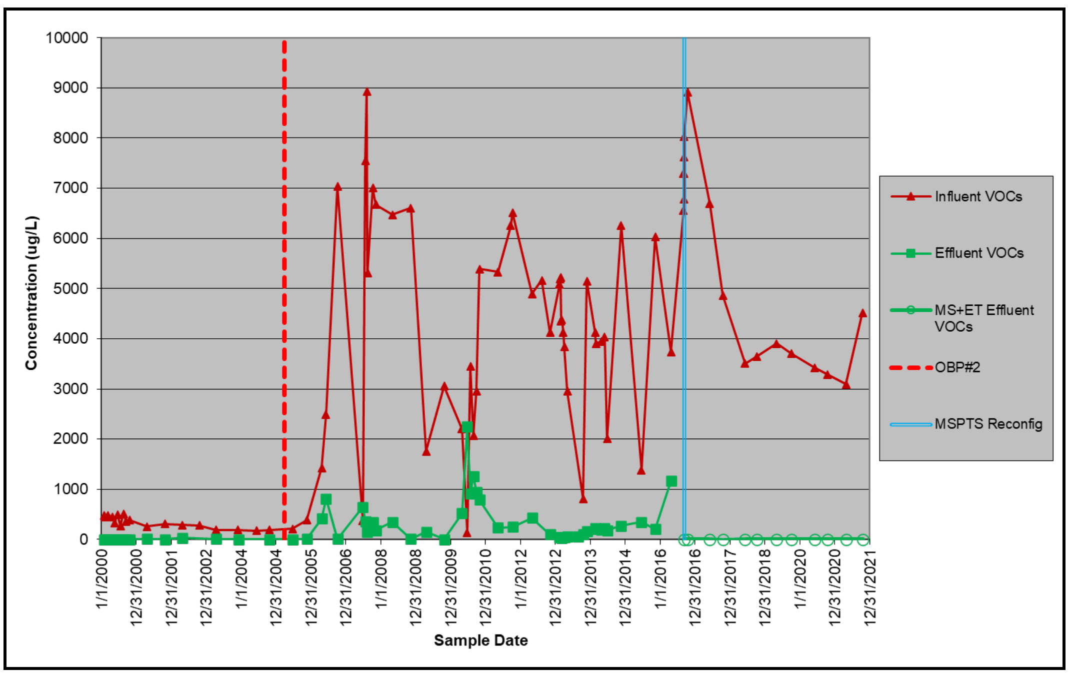
Figure E-6. Total Detected VOCs in ETPTS Influent and Effluent

E1.1.5.4 MSPCS (Formerly MSPTS)

The MSPTS was installed in 1998 and was designed to treat groundwater contaminated with VOCs from the Mound source area. The MSPTS was reconfigured in 2016, when treatment capabilities were removed (see CR 2016-02[1] in Appendix D). The system components that collect contaminated groundwater are still in place and are now referred to as the MSPCS. Groundwater collected in the MSPCS is combined with ETPTS influent and treated at the ETPTS. Additional information on the reconfiguration and optimization of the MSPTS may be found in the 2016 RFLMA annual report (DOE 2017a).

In accordance with the RFLMA, the MSPCS influent, together with ETPTS effluent and downstream surface water location POM2 (because this influent is treated at the ETPTS), are sampled semiannually for VOCs. Figure E-7 presents total VOC concentration data for influent and effluent monitoring at the MSPTS/MSPCS from 2000 through 2021. During this FYR period, several VOCs have consistently exceeded applicable RFLMA standards in the MSPCS influent, but none have exceeded those standards in treated effluent.

The surface water performance monitoring location associated with the MSPCS is POM2 in the South Walnut Creek drainage (Figure E-3). This performance monitoring location is also used for the ETPTS because that system treats contaminated groundwater from both the MSPCS and ETPTS. No VOCs have ever exceeded their respective RFLMA standards at this location.



Notes: VOC data shown represent arithmetic sums of all validated detections. "OBP#2" shows when remediation of a second source area nearby was completed, and groundwater from that source area began to be routed to the MSPTS for treatment. "MSPTS Reconfig" refers to when groundwater collected by the MSPCS began to be transferred to the ETPTS for treatment. Before that point, effluent data represent MSPTS effluent, and thereafter, the effluent data ("MS+ET Effluent VOCs") represent the treated groundwater from both systems. All influent data represent influent to the MSPTS or MSPCS.

Figure E-7. Total VOCs in MSPCS Influent and Effluent

[1] This Contact Record also serves as an Explanation of Significant Difference (ESD), which is required by CERCLA when there is a significant change to the remedy selected in the CAD/ROD.

E1.2 Surface Water

The protection of surface water was a basis for making cleanup decisions at the former RFP so that surface water within and leaving the COU would be of sufficient quality to support all uses. The applicable surface water uses are consistent with the following Colorado surface water use classifications:

- Water supply
- Aquatic life—warm 2
- Agriculture
- Recreation N (North and South Walnut Creek, lakes and reservoirs on COU, and Pond C-2)
- Recreation E (Woman Creek)

These classifications are applicable to surface water in the COU; however, the ICs established for the COU prohibit some of these uses, specifically, water supply and agriculture uses. That is, although the state regulations mandate the protection of the surface water in the COU to support each of the use classifications above and surface water must meet the water quality standards for each classification, the ICs prohibit some uses.

The surface water monitoring network includes three types of locations: POCs, POEs, and performance monitoring locations. The evaluation of data collected at the POCs during this FYR period is discussed in Section 6.1.3.1. The evaluation of data collected during this FYR period at the POEs and performance monitoring locations is summarized in this section.

E1.2.1 Points of Evaluation

The POEs (GS10, SW027, and SW093) are upstream of the POCs and provide an early indication of the quality of surface water flowing toward the POCs. The RFLMA Attachment 2 decision logic flowchart in Figure 6, "Points of Evaluation" (DOE, EPA, and CDPHE 2007), is relevant to data collected at these locations. During this FYR period, there were periodic exceedances of the surface water quality standards for U and Pu at locations GS10 and SW027, respectively. The exceedances resulted in reportable conditions for these locations. There were no reportable conditions during this FYR period for location SW093.

E1.2.1.1 GS10

Surface water monitoring location GS10 is the POE in South Walnut Creek upstream of WALPOC (Figure E-8). This location monitors surface water from the drainage area for a major portion of the former industrial area of the RFP.

Uranium: The 12-month rolling average for U at GS10 (18.1 µg/L) exceeded the RFLMA standard of 16.8 µg/L at the end of April 2021 (see CR 2021-02 in Appendix D), resulting in a reportable condition. The plan to address this reportable condition included continuation of routine sampling at monitoring location GS10 with an accelerated sample analyses turnaround time and providing a split sample to CDPHE for independent verification. At the end of May 2021, the 12-month rolling average for U (12.4 µg/L) fell below the RFLMA standard and remained below the standard through the end of this FYR period.

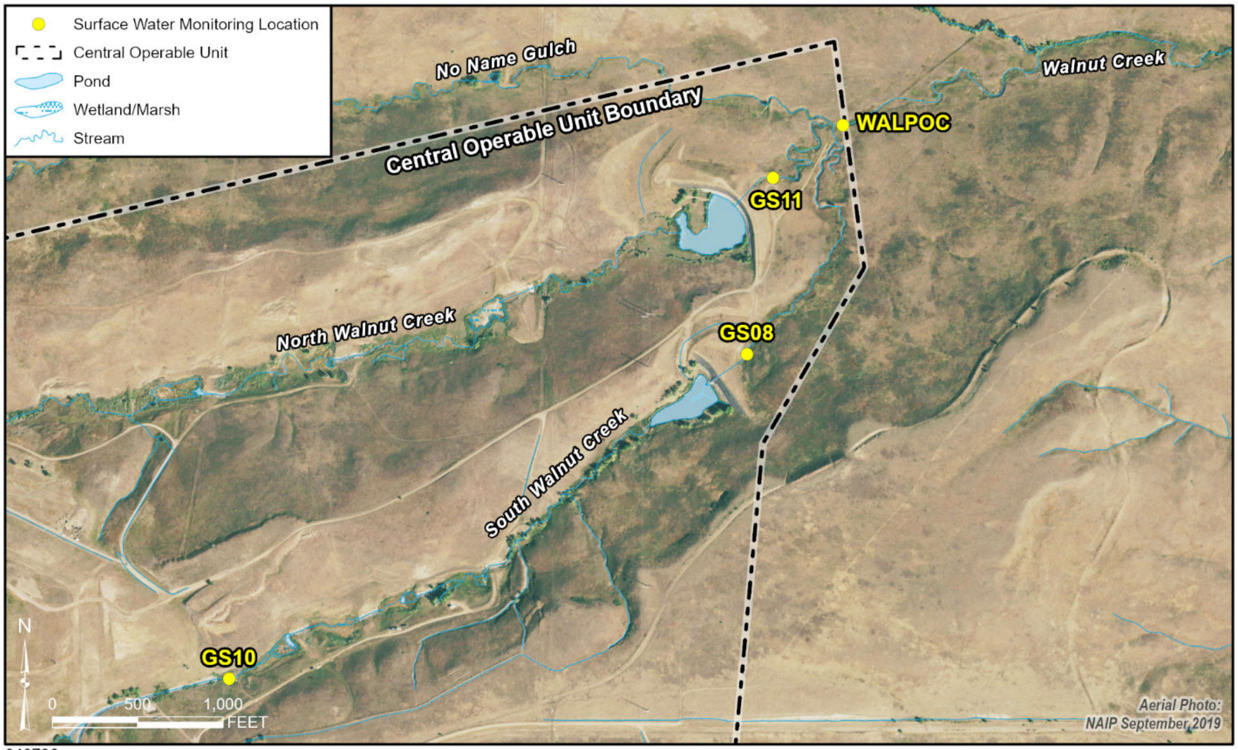


Figure E-8. GS10 and Associated Monitoring Locations

Figure E-9 presents the 12-month rolling average data for total U at monitoring location GS10 from 2005–2021.

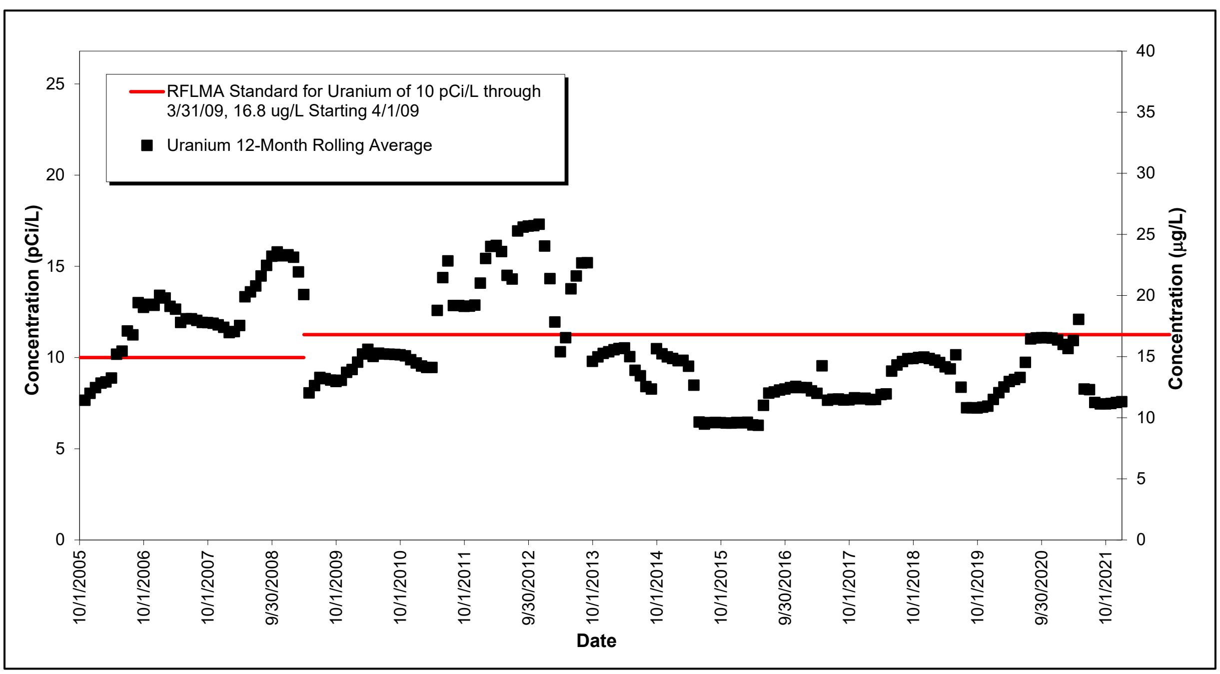


Figure E-9. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at GS10: Postclosure Period Ending Calendar Year 2021

Uranium concentrations downstream of monitoring location GS10 at WALPOC were below the RFLMA standard during the April 2021 reportable condition at monitoring location GS10. At the end of April 2021 and the end of May 2021, the 12-month rolling average U concentrations at WALPOC were 10.5 µg/L and 8.1 µg/L, respectively.

During this FYR period, reportable conditions for U occurred at WALPOC in 2018 (see CR 2018-04 [Appendix D]) and 2017 (see CR 2017-02 [Appendix D]). The 12-month rolling averages for U at WALPOC from 2011 through the end of 2021 are shown in Figure 5 of the main document. Additional discussion of the reportable conditions at WALPOC is presented in Section 6.1.3.1.

E1.2.1.2 SW027

Surface water monitoring location SW027 is the POE at the eastern (downstream) end of the South Interceptor Ditch, upstream of WOMPOC (Figure E-10). This location monitors surface water in the southern portion of the COU, including the former 903 Pad/Lip Area (Figure E-3).

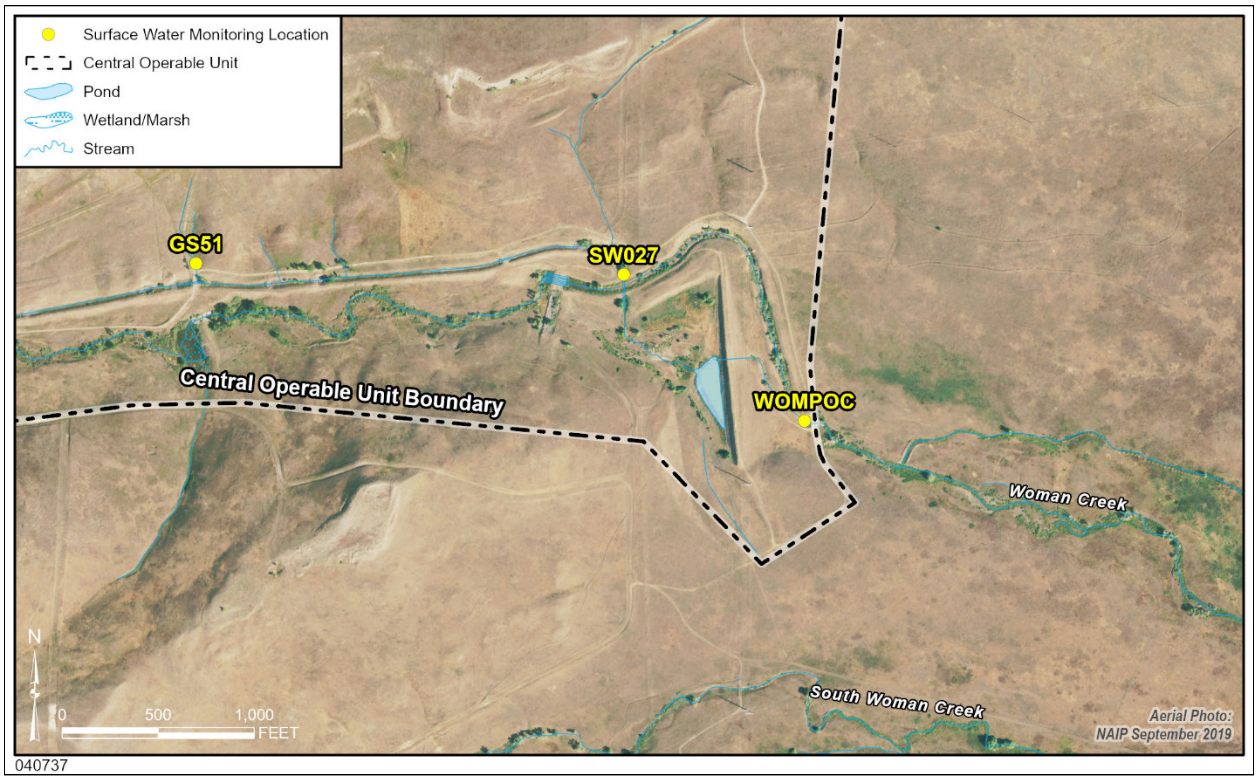


Figure E-10. SW027 and Associated Monitoring Locations

Three reportable conditions for Pu have occurred during this FYR period. The 12-month rolling average for Pu at SW027 exceeded the RFLMA surface water standard of 0.15 pCi/L starting in the previous FYR period (April 2015) and extending through March 2017 (see CR 2015-05 [Appendix D]). Although this reportable condition extended through March 2017, there was no flow at monitoring location SW027 for January through March 2017.

The 12-month rolling average for Pu at monitoring location SW027 (0.16 pCi/L) exceeded the RFLMA standard of 0.15 pCi/L at the end of May 2018 (see CR 2019-01 [Appendix D]), resulting in a reportable condition. The 12-month rolling average values for 2018 include results from only a single composite sample collected May 3–4, 2018. Due to the relatively small volumes of water monitored at monitoring location SW027 in 2018, only one sample could be collected. This reportable condition continued through April 2019 because there was no additional flow or sample collection after May 2018 and, therefore, no additional samples to include in the 12-month rolling average calculation. Downstream monitoring at WOMPOC continued to show Pu concentrations well below 0.15 pCi/L for the entire period of this reportable condition at monitoring location SW027. The plan to address this reportable condition included continuing routine sampling at monitoring location SW027, continuing source evaluation monitoring at upstream location GS51, continuing vegetation monitoring and erosion control maintenance upstream of GS51, and assessment of an expanded area for vegetation and erosion control enhancement.

The 12-month rolling average for Pu at monitoring location SW027 (0.90 pCi/L) exceeded the RFLMA standard of 0.15 pCi/L at the end of April 2021, resulting in a reportable condition. At the end of May 2021, the 12-month rolling average for Pu (0.06 pCi/L) fell below the RFLMA standard and remained below the standard through the end of this FYR period. The RFLMA consultation between DOE, EPA, and CDPHE on the 2021 reportable condition for Pu at monitoring location SW027 is ongoing. The CR describing the plan and schedule for responding to this reportable condition will be posted to the LM website when consultation is completed.

Figure E-11 presents the 12-month rolling average Pu and Am data for monitoring location SW027 from site closure from 2005–2021.

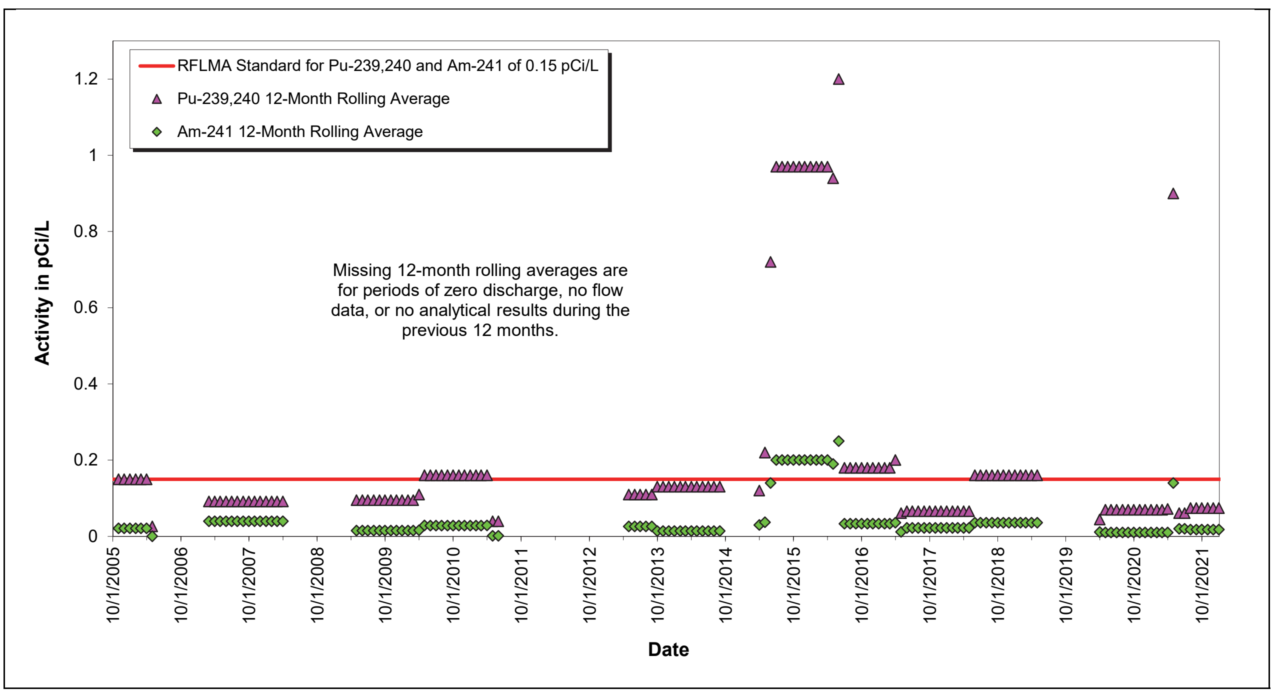


Figure E-11. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at Location SW027: Postclosure Period Ending Calendar Year 2021

E1.2.2 Performance Monitoring Locations

Performance monitoring locations are downstream of specific remedies (Figure E-3) and are used to determine the short- and long-term effectiveness of these remedies where known contaminants may affect surface water. The results of monitoring at these locations are discussed in the sections indicated below. The performance monitoring locations are as follows:

- NNG01, which monitors surface water downstream of the PLF and PLFTS (sampling at this location was not required during this FYR period; see Section 6.1.4.1).
- GS13, which monitors surface water downstream of the SPPTS (see Section E1.1.5.2).
- POM2, which monitors surface water downstream of the ETPTS (see Section E1.1.5.3).
- GS05, which monitors surface water upstream of the OLF (see Section 6.1.4.2).
- GS59, which monitors surface water downstream of the OLF (see Section 6.1.4.2).

Appendix F

Documents Reviewed

In addition to documents referenced in the 2022 FYR report, the following documents were reviewed as part of the FYR process to form the basis of the technical assessment of remedy protectiveness in the COU.

(in alphabetical order of document title)

Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2016, LMS/RFS/S15402, U.S. Department of Energy Office of Legacy Management, April 2017.

Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2017, LMS/RFS/S18141, U.S. Department of Energy Office of Legacy Management, April 2018.

Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2018, LMS/RFS/S23330, U.S. Department of Energy Office of Legacy Management, April 2019.

Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2019, LMS/RFS/S27935, U.S. Department of Energy Office of Legacy Management, April 2020.

Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2020, LMS/RFS/S32449, U.S. Department of Energy Office of Legacy Management, April 2021.

Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats Site, Colorado, Calendar Year 2021, LMS/RFS/S38162, U.S. Department of Energy Office of Legacy Management, April 2022.

Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit, *Jefferson and Boulder Counties, Colorado*, U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment, September 2006.

Corrective Action Decision/Record of Decision Amendment for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit, U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment, September 2011.

First Five-Year Review Report for Rocky Flats Environmental Technology Site, Golden, Colorado, Rocky Flats Field Office, Golden, Colorado, July 2002.

Fourth Five-Year Review Report for the Rocky Flats Site Jefferson County, Colorado, LMS/RFS/S15528, U.S. Department of Energy Office of Legacy Management, June 2017.

Notice of Environmental Use Restrictions (Restrictive Notice) Pursuant to §25-15-321.5, Colorado Revised Statutes, March 2017.

Original Landfill Monitoring and Maintenance Plan, LMS/RFS/S05516, U.S. Department of Energy Office of Legacy Management, September 2009.

Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan U.S. Department of Energy Rocky Flats, Colorado, Site, LMS/RFS/S03965, U.S. Department of Energy Office of Legacy Management, December 2014.

RCRA Facility Investigation-Remedial Investigation/Corrective Measures Study-Feasibility Study Report for the Rocky Flats Environmental Technology Site, June 2006.

Rocky Flats Legacy Management Agreement, U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment, March 2007.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2017, LMS/RFS/S16527, U.S. Department of Energy Office of Legacy Management, July 2017.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2017, LMS/RFS/S16811, U.S. Department of Energy Office of Legacy Management, October 2017.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2017, LMS/RFS/S17916, U.S. Department of Energy Office of Legacy Management, January 2018.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2018, LMS/RFS/S20094, U.S. Department of Energy Office of Legacy Management, July 2018.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2018, LMS/RFS/S20699, U.S. Department of Energy Office of Legacy Management, October 2018.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2018, LMS/RFS/S22335, U.S. Department of Energy Office of Legacy Management, January 2019.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2019, LMS/RFS/S25989, U.S. Department of Energy Office of Legacy Management, July 2019.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2019, LMS/RFS/S26669, U.S. Department of Energy Office of Legacy Management, October 2019.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2019, LMS/RFS/S28506, U.S. Department of Energy Office of Legacy Management, January 2020.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2020, LMS/RFS/S29725, U.S. Department of Energy Office of Legacy Management, July 2020.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2020, LMS/RFS/S31439, U.S. Department of Energy Office of Legacy Management, October 2020.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2020, LMS/RFS/S32823, U.S. Department of Energy Office of Legacy Management, January 2021.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2021, LMS/RFS/S35048, U.S. Department of Energy Office of Legacy Management, July 2021.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2021, LMS/RFS/S36559, U.S. Department of Energy Office of Legacy Management, October 2021.

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities, Third Quarter Calendar Year 2021, LMS/RFS/S37871, U.S. Department of Energy Office of Legacy Management, January 2022.

Second Five-Year Review Report for the Rocky Flats Site Jefferson and Boulder Counties, Colorado, DOE-LM/1504-2007, U.S. Department of Energy Office of Legacy Management, September 2007.

Third Five-Year Review Report for the Rocky Flats Site Jefferson and Boulder Counties, Colorado, LMS/RFS/S07693, U.S. Department of Energy Office of Legacy Management, July 2012.

Appendix G

Site Inspection

EPA guidance (EPA 2001) indicates that the FYR should include a recent site inspection (generally, within the last nine months). The objective of this inspection is to visually confirm and document the conditions of the remedy, the site, and the surrounding area. An annual inspection of the site is required by the *Rocky Flats Legacy Management Agreement* (DOE, EPA, and CDPHE 2007) (RFLMA) Attachment 2. The annual site inspection of the COU was conducted March 30–April 4, 2022, and focused on the following:

- Evidence of significant erosion in the COU and evaluation of the proximity of significant erosion to subsurface features. This monitoring includes visual observation for precursor evidence of significant erosion (e.g., cracks, rills, slumping, subsidence, and sediment deposition).
- The effectiveness of institutional controls (ICs), as determined by any evidence of violation.
- Evidence of adverse biological conditions, such as unexpected morbidity or mortality, observed during the inspection and monitoring activities.

As part of the IC inspection, the presence of the Notice of Environmental Use Restrictions in the Administrative Record and in Jefferson County records was verified on April 4, 2022. During the annual inspection, marker flags were placed at locations requiring follow-up by subject matter experts. Several minor depressions were found in Area C, including previously filled areas along the perimeter of B881. A hole measuring 19 inches deep and 3 ft wide was discovered approximately 100 ft due east of well location 37591. Site historical documents identify the location of the hole as an abandoned sewer system manhole that was filled in during closure. Site field operations subject matter experts visited the areas to determine if any observations were significant or required repairs and to collect trash and debris. Depressions will continue to be monitored during quarterly COU inspections and the hole will be compacted and filled with native soil before May 2022. No evidence of violations of ICs or physical controls was observed, and no adverse biological conditions were noted. The annual site inspection notes and site maps indicating the areas surveyed are provided following the FYR Site Inspection Checklist. The FYR Site Inspection Checklist below was completed by reviewing site monitoring and inspection records for this FYR period and discussing checklist items with site staff.

Inspections of the engineered remedy components, such as landfill covers and groundwater treatment systems, are conducted regularly at a frequency established in RFLMA. These components were not inspected specifically during the March 30–April 4, 2022, annual site inspection. Instead, the most recent routine and weather-related inspections of these components were considered in completing the FYR Site Inspection Checklist below. Thus, observations from the annual site inspection and the results of RFLMA routine and weather-related inspections are used in combination to satisfy the FYR site inspection requirement.

The remedy in the COU also includes physical controls (signs placed along the COU boundary), which are inspected quarterly (four times a year). The most recent sign inspection was performed on March 28, 2022; several signs were replaced because they were absent or illegible. Minor repairs to the boundary fence are performed quarterly following inspection.

March 30–April 4, 2022, Annual Site Inspection Team Roster

Name	Title	Affiliation
Nathan Krohn	Field Services Specialist	DOE-LMS contractor
Chuck Brown	Groundwater Treatment Operations	DOE-LMS contractor
Jordan Lukkes	Surface Water Field Lead	DOE-LMS contractor
Karin McShea	Ecology Lead	DOE-LMS contractor
Jody Nelson	Ecologist	DOE-LMS contractor

Site Inspection Checklists and Site Map

Five-Year Review Site Inspection Checklist

I. SITE INFORMATION

Site name: Rocky Flats, Central Operable Unit	**Date of inspection:** March 30–April 4, 2022
Location and Region: Jefferson County, Colorado	**EPA ID:** CO7890010526
Agency, office, or company leading the five-year review: DOE-LM	**Weather/temperature:** Various

Remedy Includes: (Check all that apply)

- **x** Landfill cover/containment
- **x** Access controls
- **x** Institutional controls
- □ Groundwater pump and treatment
- □ Surface water collection and treatment
- **x** Other
  Monitoring (surface water, groundwater, site conditions) and groundwater collection and treatment (SPPTS, ETPTS, MSPCS, PLFTS).
- □ Monitored natural attenuation
- □ Groundwater containment
- □ Vertical barrier walls

Attachments: **x** Inspection team roster attached **x** Site map attached

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Andrew Keim (Name) RF Site Manager (Title) Various (Date)
   Interviewed □ at site □ at office □ by phone Phone no. ______________
   Problems, suggestions; □ Report attached

2. **O&M staff** Dana Santi (Name) RF Site Lead (Title) Various (Date)
   Interviewed □ at site □ at office □ by phone Phone no. ______________
   Problems, suggestions; □ Report attached _________

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

   Agency Environmental Protection Agency
   Contact Jesse Aviles (Name) RFLMA Project Coordinator (Title) Various* (Date) Phone no.
   Problems; suggestions; □ Report attached ______________________________

   ____

   Agency Colorado Department of Public Health and Environment
   Contact Lindsay Murl (Name) RFLMA Project Coordinator (Title) Various* (Date) Phone no.
   Problems; suggestions; □ Report attached ______________________________

   * Interaction with RFLMA project coordinator regarding site conditions is not limited to the annual site inspection but is continuous through the RFLMA consultation process. See Section 3.3.1 of this fifth FYR for details of the RFLMA consultation process.

4. **Other interviews** (optional) □ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)*				
1.	**O&M Documents**			
	x O&M manual	x Readily available	x Up to date	☐ N/A
	x As-built drawings	x Readily available	x Up to date	☐ N/A
	x Maintenance logs	x Readily available	x Up to date	☐ N/A
	Remarks			
2.	**Site-Specific Health and Safety Plan**	x Readily available	x Up to date	☐ N/A
	x Contingency plan/emergency response plan	x Readily available	x Up to date	☐ N/A
	Remarks			
3.	**O&M and OSHA Training Records**	x Readily available	x Up to date	☐ N/A
	Remarks			
4.	**Permits and Service Agreements**			
	☐ Air discharge permit	☐ Readily available	☐ Up to date	x N/A
	☐ Effluent discharge	☐ Readily available	☐ Up to date	x N/A
	☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	x N/A
	☐ Other permits____________________	☐ Readily available	☐ Up to date	x N/A
	Remarks			
5.	**Gas Generation Records**	☐ Readily available	☐ Up to date	x N/A
	Remarks			
6.	**Settlement Monument Records**	x Readily available	x Up to date	☐ N/A
	Remarks Settlement monuments are located at the OLF and PLF.			
7.	**Groundwater Monitoring Records**	x Readily available	x Up to date	☐ N/A
	Remarks Surface water monitoring records are also readily available and up-to-date.			
8.	**Leachate Extraction Records**	☐ Readily available	☐ Up to date	x N/A
	Remarks			
10.	**Daily Access/Security Logs**	☐ Readily available	☐ Up to date	x N/A
	Remarks			

* Documents discussed in this section are generally kept in LMS contractor offices and not onsite unless they are required to be available onsite.

IV. O&M COSTS*
1. **O&M Organization** ☐ State in-house ☐ Contractor for State ☐ PRP in-house ☐ Contractor for PRP ☐ Federal Facility in-house ☐ Contractor for Federal Facility ☐ Other________
2. **O&M Cost Records** ☐ Readily available ☐ Up to date ☐ Funding mechanism/agreement in place Original O&M cost estimate________ ☐ Breakdown attached Total annual cost by year for review period if available From_____ To_____ (Date, Date) _____ Total cost ☐ Breakdown attached From_____ To_____ (Date, Date) _____ Total cost ☐ Breakdown attached From_____ To_____ (Date, Date) _____ Total cost ☐ Breakdown attached From_____ To_____ (Date, Date) _____ Total cost ☐ Breakdown attached From_____ To_____ (Date, Date) _____ Total cost ☐ Breakdown attached
3. **Unanticipated or Unusually High O&M Costs During Review Period** Describe costs and reasons: ________
V. ACCESS AND INSTITUTIONAL CONTROLS **x** Applicable ☐ N/A
A. Fencing**
1. **Fencing damaged** **x** Location shown on site map **x** Gates secured ☐ N/A Remarks The COU fence is in good condition. Minor fence repairs are conducted during quarterly sign inspections.
B. Other Access Restrictions
1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A Remarks Inspected quarterly and in good condition. Signs are replaced during quarterly inspections if damaged or missing.

*See Section 6.1.5 for discussion of O&M costs in this fifth FYR.
**Fences are not part of the CERCLA remedy but are inspected regularly.

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented	☐ Yes	x No	☐ N/A
Site conditions imply ICs not being fully enforced	☐ Yes	x No	☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by): On-site Visits
Frequency: Most workdays
Responsible party/agency: DOE-LM
Contact ______________________ Name ______________ Title ________ Date __________ Phone no.

Reporting is up-to-date	x Yes	☐ No	☐ N/A
Reports are verified by the lead agency	x Yes	☐ No	☐ N/A
Specific requirements in deed or decision documents have been met	x Yes	☐ No	☐ N/A
Violations have been reported	☐ Yes	x No	☐ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** x ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks
ICs are enforceable by the State of Colorado via the Notice of Environmental Use Restrictions filed with the local county.

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map x No vandalism evident
Remarks
See Section 6.1.1 of this fifth FYR report regarding trespassing on the COU.

2. **Land use changes on site** x N/A
Remarks

3. **Land use changes off site** x N/A
Remarks

VI. GENERAL SITE CONDITIONS

A. Roads x Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map x Roads adequate ☐ N/A
Remarks

B. Other Site Conditions

Remarks

VII. LANDFILL COVERS **x** Applicable □ N/A (OLF and PLF)
A. Landfill Surface
1. **Settlement** (Low spots) □ Location shown on site map **x** Settlement not evident Areal extent______________ Depth____________ Remarks <u>Inspections are performed regularly in accordance with the OLF and PLF Monitoring and Maintenance Plans. See corresponding inspection checklists and reports in site records and annual site reports.</u>
2. **Cracks** □ Location shown on site map **x** Cracking not evident Lengths____________ Widths___________ Depths__________ Remarks <u>See VII A.1. of this checklist.</u>
3. **Erosion** □ Location shown on site map **x** Erosion not evident Areal extent______________ Depth____________ Remarks <u>See VII A.1. of this checklist.</u>
4. **Holes** □ Location shown on site map **x** Holes not evident Areal extent______________ Depth____________ Remarks ____
5. **Vegetative Cover** **x** Grass **x** Cover properly established **x** No signs of stress □ Trees/Shrubs (indicate size and locations on a diagram) Remarks ____
6. **Alternative Cover (armored rock, concrete, etc.)** **x** N/A Remarks ____
7. **Bulges** □ Location shown on site map **x** Bulges not evident Areal extent______________ Height____________ Remarks ____
8. **Wet Areas/Water Damage** □ Wet areas/water damage not evident □ Wet areas □ Location shown on site map Areal extent______________ □ Ponding □ Location shown on site map Areal extent______________ **x** Seeps **x** Location shown on site map Areal extent____NA__________ □ Soft subgrade □ Location shown on site map Areal extent______________ Remarks <u>See VII A.1. of this checklist.</u>
9. **Slope Instability** □ Slides □ Location shown on site map **x** No evidence of slope instability Areal extent______________ Remarks <u>Addressed during the 2018–2020 OLF maintenance project. See VII A.1. of this checklist.</u>
B. Benches **x** Applicable □ N/A (Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)
1. **Flows Bypass Bench** □ Location shown on site map **x** N/A or okay Remarks ____

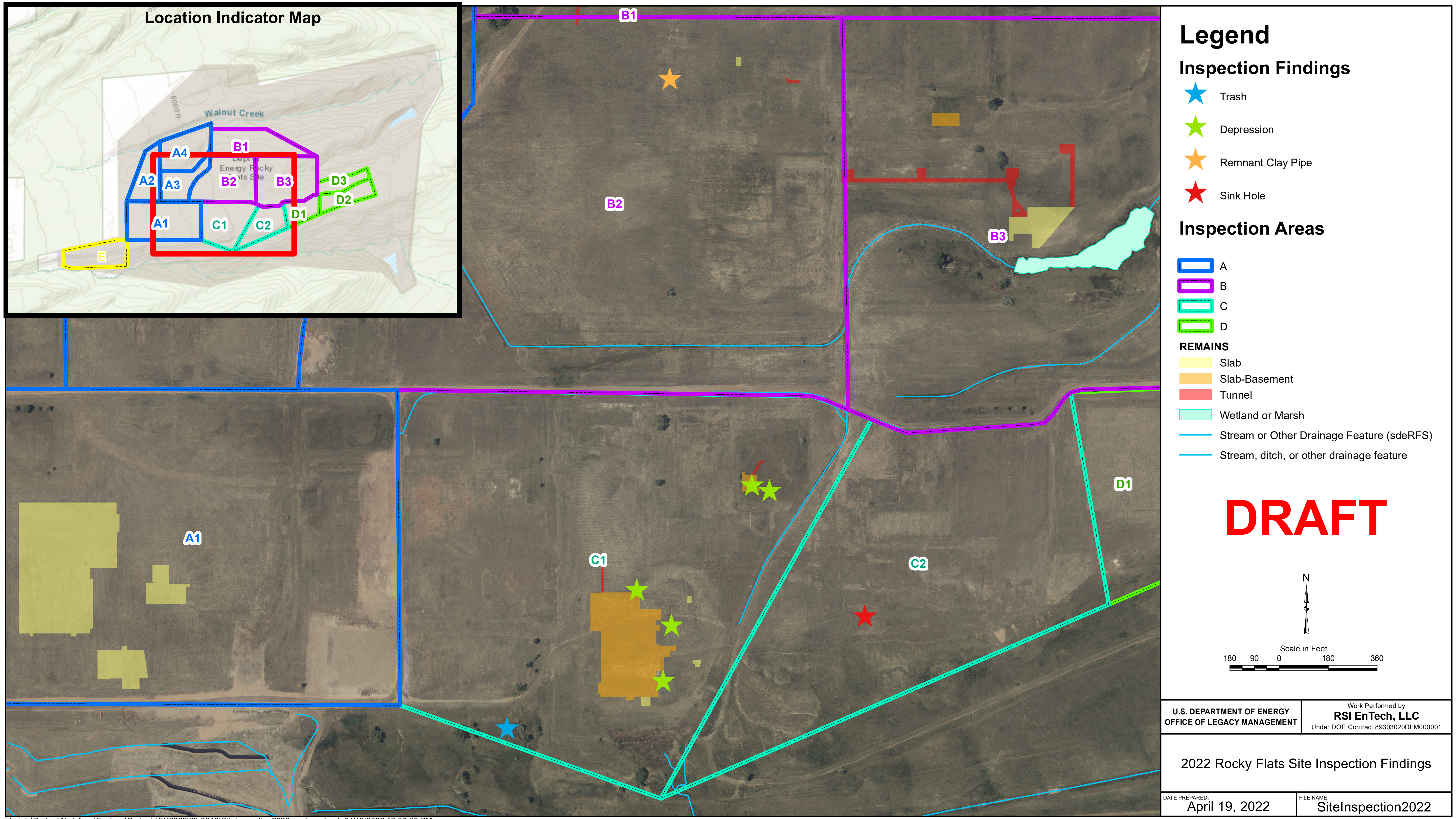
2.	**Bench Breached** □ Location shown on site map **x** N/A or okay Remarks ______________________________
3.	**Bench Overtopped** □ Location shown on site map **x** N/A or okay Remarks ______________________________
C. Letdown Channels	**x** Applicable □ N/A (OLF*) (Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.) *The OLF has two perimeter channels (East Perimeter Channel and West Perimeter Channel).
1.	**Settlement** □ Location shown on site map **x** No evidence of settlement Areal extent______________ Depth____________ Remarks See VII A.1. of this checklist.
2.	**Material Degradation** □ Location shown on site map **x** No evidence of degradation Material type_______________ Areal extent_____________ Remarks See VII A.1. of this checklist.
3.	**Erosion** □ Location shown on site map **x** No evidence of erosion Areal extent______________ Depth____________ Remarks See VII A.1. of this checklist.
4.	**Undercutting** □ Location shown on site map **x** No evidence of undercutting Areal extent______________ Depth____________ Remarks See VII A.1. of this checklist.
5.	**Obstructions** Type_____________________ **x** No obstructions □ Location shown on site map Areal extent______________ Size____________ Remarks See VII A.1. of this checklist.
6.	**Excessive Vegetative Growth** Type____________________ **x** No evidence of excessive growth **x** Vegetation in channels does not obstruct flow □ Location shown on site map Areal extent______________ Remarks See VII A.1. of this checklist.
D. Cover Penetrations	**x** Applicable □ N/A
1.	**Gas Vents** □ Active **x** Passive □ Properly secured/locked □ Functioning □ Routinely sampled **x** Good condition □ Evidence of leakage at penetration □ Needs Maintenance □ N/A Remarks Only the PLF has gas vents on the cover.
2.	**Gas Monitoring Probes** □ Properly secured/locked □ Functioning □ Routinely sampled □ Good condition □ Evidence of leakage at penetration □ Needs Maintenance **x** N/A Remarks ______________________________

3.	**Monitoring Wells** (within surface area of landfill) x Properly secured/locked x Functioning x Routinely sampled x Good condition □ Evidence of leakage at penetration □ Needs Maintenance □ N/A Remarks Monitoring wells are located outside of surface area of OLF and PLF.
4.	**Leachate Extraction Wells** ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ Evidence of leakage at penetration ☐ Needs Maintenance x N/A Remarks ____
5.	**Settlement Monuments** x Located x Routinely surveyed ☐ N/A Remarks See Sections 6.1.4.1 (PLF) and 6.1.4.2 (OLF) of this fifth FYR.
E. Gas Collection and Treatment ☐ Applicable x N/A	
1.	**Gas Treatment Facilities** ☐ Flaring ☐ Thermal destruction ☐ Collection for reuse ☐ Good condition ☐ Needs Maintenance Remarks ____
2.	**Gas Collection Wells, Manifolds and Piping** ☐ Good condition ☐ Needs Maintenance Remarks ____
3.	**Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings) ☐ Good condition ☐ Needs Maintenance ☐ N/A Remarks ____
F. Cover Drainage Layer ☐ Applicable x N/A	
1.	**Outlet Pipes Inspected** ☐ Functioning ☐ N/A Remarks ____
2.	**Outlet Rock Inspected** ☐ Functioning ☐ N/A Remarks ____
G. Detention/Sedimentation Ponds ☐ Applicable x N/A	
1.	**Siltation** Areal extent__________ Depth__________ ☐ N/A ☐ Siltation not evident Remarks ____
2.	**Erosion** Areal extent__________ Depth__________ ☐ Erosion not evident Remarks ____
3.	**Outlet Works** ☐ Functioning ☐ N/A Remarks ____
4.	**Dam** ☐ Functioning ☐ N/A Remarks ____

H. Retaining Walls	☐ Applicable	**x** N/A	
1.	**Deformations** Horizontal displacement____________ Rotational displacement____________ Remarks ___________________________________	☐ Location shown on site map Vertical displacement_______________	☐ Deformation not evident
2.	**Degradation** Remarks ___________________________________	☐ Location shown on site map	☐ Degradation not evident
I. Perimeter Ditches	**x** Applicable	☐ N/A	
1.	**Siltation** ☐ Location shown on site map **x** Siltation not evident Areal extent______________ Depth____________ Remarks ___________________________________		
2.	**Vegetative Growth** ☐ Location shown on site map ☐ N/A **x** Vegetation does not impede flow Areal extent______________ Type____________ Remarks ___________________________________		
3.	**Erosion** ☐ Location shown on site map **x** Erosion not evident Areal extent______________ Depth____________ Remarks ___________________________________		
4.	**Discharge Structure** **x** Functioning ☐ N/A Remarks ___________________________________		
VIII. VERTICAL BARRIER WALLS	☐ Applicable	**x** N/A	
1.	**Settlement** ☐ Location shown on site map ☐ Settlement not evident Areal extent______________ Depth____________ Remarks ___________________________________		
2.	**Performance Monitoring** Type of monitoring__________________________ ☐ Performance not monitored Frequency______________________________ ☐ Evidence of breaching Head differential__________________________ Remarks ___________________________________		

IX. GROUNDWATER/SURFACE WATER REMEDIES **x** Applicable ☐ N/A
A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable **x** N/A
1. **Pumps, Wellhead Plumbing, and Electrical** ☐ Good condition ☐ All required wells properly operating ☐ Needs Maintenance ☐ N/A Remarks ______
2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks ______
3. **Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks ______
B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable **x** N/A
1. **Collection Structures, Pumps, and Electrical** ☐ Good condition ☐ Needs Maintenance Remarks ______
2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances** ☐ Good condition ☐ Needs Maintenance Remarks ______
3. **Spare Parts and Equipment** ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided Remarks ______
C. Treatment System **x** Applicable ☐ N/A (Only for Groundwater)
1. **Treatment Train** (Check components that apply) **x** Metals removal (SPPTS) ☐ Oil/water separation **x** Bioremediation (SPPTS) **x** Air stripping (MSPCS/ETPTS) ☐ Carbon adsorbers ☐ Filters ______ **x** Additive (*e.g.*, chelation agent, flocculent) Carbon nutrient source (SPPTS) ☐ Others ______ **x** Good condition ☐ Needs Maintenance **x** Sampling ports properly marked and functional **x** Sampling/maintenance log displayed and up to date **x** Equipment properly identified **x** Quantity of groundwater treated annually 500,400 gal (average annual volume 2017–2021) ☐ Quantity of surface water treated annually NA______ Remarks Uranium treatability studies are ongoing at SPPTS.
2. **Electrical Enclosures and Panels** (properly rated and functional) ☐ N/A **x** Good condition ☐ Needs Maintenance Remarks ______
3. **Tanks, Vaults, Storage Vessels** ☐ N/A **x** Good condition ☐ Proper secondary containment ☐ Needs Maintenance Remarks ______

4.	**Discharge Structure and Appurtenances** ☐ N/A x Good condition ☐ Needs Maintenance Remarks ___	
5.	**Treatment Shed/Enclosures** ☐ N/A ☐ Good condition (esp. roof and doorways) ☐ Needs repair x Chemicals and equipment properly stored Remarks ___	
6.	**Monitoring Wells** (pump and treatment remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance x N/A Remarks ___	
D. Monitoring Data (For surface water and groundwater)		
1.	Monitoring Data x Is routinely submitted on time x Is of acceptable quality	
2.	Monitoring data suggests: ☐ Groundwater plume is effectively contained ☐ Contaminant concentrations are declining	
D. Monitored Natural Attenuation		
1.	**Monitoring Wells** (natural attenuation remedy) ☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition ☐ All required wells located ☐ Needs Maintenance x N/A Remarks ___	
X. OTHER REMEDIES		
If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.		
XI. OVERALL OBSERVATIONS		
A.	**Implementation of the Remedy**	
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.). <u>See Section 6.1 of this fifth FYR.</u>	
B.	**Adequacy of O&M**	
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. <u>See Section 6.1.4 of this fifth FYR.</u>	
C.	**Early Indicators of Potential Remedy Problems**	
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. <u>See Section 6.1.4 of this fifth FYR.</u>	
D.	**Opportunities for Optimization**	
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. <u>See Section 7.0 of this fifth FYR.</u>	



\\lm\gis\ProjectWorkArea\Ecology\Projects\FY2022\22-0018\SiteInspection2022.mxd mcsheak 04/19/2022 12:07:35 PM

Annual Site Inspection Checklist (See RFLMA Attachment 2, section 5.3.4; 5.3.6 and 5.4.3)

Date: 3/31/22 – 4/1/22 Inspection Area: A

PERFORMED BY (print each name): Jordan Lukhes

Site Conditions to Note on the inspection form (other items as determined by the Team Leader can be added, i.e. metal debris or concrete with rebar):
Evidence of Soil Erosion or Deposition; Evidence of Cracks, Rills or Gullies; Evidence of Sink Holes or Burrows; Evidence of Depressions or Subsidence; Evidence of Institutional Control Violation[1]; Problem with Signs or other Physical Controls[2]; Adverse Biological Condition)

Flag ID #	Site Condition Observed (see above) and Comments	Photo(s) Taken?[3]
	A1 no issues	N
	A2 no Issues	N
	A3 no issues	N
	A4 no issues,	N
	- still need to walk building	
	Building area walked 4/4/22	N

[1] Indicate the RFLMA IC# (RFLMA Attachment 2, Table 1-7) for which violation is indicated.
[2] These are required to be inspected Quarterly per RFLMA Attachment 2 section 5.3.5, and completion is documented separately-document here if problem noted during Annual Inspection.
[3] If Photo taken, show location and orientation on Area Map provided.

Page _______ of _______

Annual Site Inspection Checklist (See RFLMA Attachment 2, section 5.3.4; 5.3.6 and 5.4.3)

Date: 3/31/2022 Inspection Area: B

PERFORMED BY (print each name): Nate Krohn, Chuck Brown

Site Conditions to Note on the inspection form (other items as determined by the Team Leader can be added, i.e. metal debris or concrete with rebar):
Evidence of Soil Erosion or Deposition; Evidence of Cracks, Rills or Gullies; Evidence of Sink Holes or Burrows; Evidence of Depressions or Subsidence; Evidence of Institutional Control Violation[1]; Problem with Signs or other Physical Controls[2]; Adverse Biological Condition)

Flag ID #	Site Condition Observed (see above) and Comments	Photo(s) Taken?[3]
	Remnants of clay pipe stuck in ground	Y (2)

[1] Indicate the RFLMA IC# (RFLMA Attachment 2, Table 1-7) for which violation is indicated.
[2] These are required to be inspected Quarterly per RFLMA Attachment 2 section 5.3.5, and completion is documented separately-document here if problem noted during Annual Inspection.
[3] If Photo taken, show location and orientation on Area Map provided.

Page 1 of 15

Annual Site Inspection Checklist (See RFLMA Attachment 2, section 5.3.4; 5.3.6 and 5.4.3)

Date: 4/4/22 Inspection Area: C

PERFORMED BY (print each name): Jody Nelson / Karin McShea

Site Conditions to Note on the inspection form (other items as determined by the Team Leader can be added, i.e. metal debris or concrete with rebar):
Evidence of Soil Erosion or Deposition; Evidence of Cracks, Rills or Gullies; Evidence of Sink Holes or Burrows; Evidence of Depressions or Subsidence; Evidence of Institutional Control Violation[1]; Problem with Signs or other Physical Controls[2]; Adverse Biological Condition)

no flags placed in field

Area # ~~Flag ID #~~	Site Condition Observed (see above) and Comments	Photo(s) Taken?[3]
1	Trash in willow patch - black plastic	Y
2	low spot where previously filled - east side of B881	Y
3	low spot south of old ATV Trail	Y ?
4	subsidence along N wall of B881 - previously filled	Y ?
5	low spots where 2 building previously located	Y ?
6	hole - ~3' diameter, 19" deep	Y

[1] Indicate the RFLMA IC# (RFLMA Attachment 2, Table 1-7) for which violation is indicated.
[2] These are required to be inspected Quarterly per RFLMA Attachment 2 section 5.3.5, and completion is documented separately-document here if problem noted during Annual Inspection.
[3] If Photo taken, show location and orientation on Area Map provided.

Page 1 of 1

Annual Site Inspection Checklist (See RFLMA Attachment 2, section 5.3.4; 5.3.6 and 5.4.3)

Date: 3/30/2022 Inspection Area: D

PERFORMED BY (print each name): Nate Krohn

Site Conditions to Note on the inspection form (other items as determined by the Team Leader can be added, i.e. metal debris or concrete with rebar):
Evidence of Soil Erosion or Deposition; Evidence of Cracks, Rills or Gullies; Evidence of Sink Holes or Burrows; Evidence of Depressions or Subsidence; Evidence of Institutional Control Violation[1]; Problem with Signs or other Physical Controls[2]; Adverse Biological Condition)

Flag ID #	Site Condition Observed (see above) and Comments	Photo(s) Taken?[3]
	No issues.	N

[1] Indicate the RFLMA IC# (RFLMA Attachment 2, Table 1-7) for which violation is indicated.
[2] These are required to be inspected Quarterly per RFLMA Attachment 2 section 5.3.5, and completion is documented separately-document here if problem noted during Annual Inspection.
[3] If Photo taken, show location and orientation on Area Map provided.

Page 1 of 1

Annual Site Inspection Checklist (See RFLMA Attachment 2, section 5.3.4; 5.3.6 and 5.4.3)

Date: 4/4/22 Inspection Area: E

PERFORMED BY (print each name): Jody Nelson / Karin McShea

Site Conditions to Note on the inspection form (other items as determined by the Team Leader can be added, i.e. metal debris or concrete with rebar):
Evidence of Soil Erosion or Deposition; Evidence of Cracks, Rills or Gullies; Evidence of Sink Holes or Burrows; Evidence of Depressions or Subsidence; Evidence of Institutional Control Violation[1]; Problem with Signs or other Physical Controls[2]; Adverse Biological Condition)

Flag ID #	Site Condition Observed (see above) and Comments	Photo(s) Taken?[3]
	Nothing out of the ordinary observed in the area	NO
	Did not find actual Ash Pit Survey marker -	
	The tall orange stake is present but the actual	
	Survey pin & cap must be buried under the	
	existing vegetation.	

[1] Indicate the RFLMA IC# (RFLMA Attachment 2, Table 1-7) for which violation is indicated.
[2] These are required to be inspected Quarterly per RFLMA Attachment 2 section 5.3.5, and completion is documented separately-document here if problem noted during Annual Inspection.
[3] If Photo taken, show location and orientation on Area Map provided.

Page 1 of 1

Present Landfill Inspection Form and Photographs
(March 14, 2022)

PRESENT LANDFILL – MONITORING AND MAINTENANCE PROGRAM

INSPECTION FORM First Quarter 2022

INSPECTOR: Nathan Krohn DATE: 3/14/22 TIME: 1030 REVIEWED BY: ____________

TEMPERATURE: 48°F WEATHER CONDITIONS: Partly Cloudy 48°F Ambient REVIEW DATE: ____________

METEOROLOGICAL STATION LOCATION: 1.36 inches (Jan 1 - Mar 14, 2022)

SUBSIDENCE/CONSOLIDATION

REGION	EVIDENCE OF CRACKS?	EVIDENCE OF DEPRESSIONS?	EVIDENCE OF SINK HOLES?	EVIDENCE OF PONDING?	OTHER (DESCRIBE BELOW)
TOP OF COVER – WEST	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
TOP OF COVER – EAST	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
COVER SIDESLOPE – NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
COVER SIDESLOPE – SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – CENTRAL	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – NORTH SEEP*	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	

Settlement Plates and side-slope monitoring points to be inspected for integrity. During Year 1, they will be surveyed quarterly, and annually thereafter

Integrity intact? ☒ Yes ☐ No

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

No issues.

* AREA OF SEEP IS OUTSIDE OF LANDFILL COVER AND EAST OF THE COVER ANCHOR TRENCH

SLOPE STABILITY

REGION	EVIDENCE OF CRACKS?	EVIDENCE OF BLOCK OR CIRCULAR FAILURE?	EVIDENCE OF SEEPS?	OTHER (DESCRIBE BELOW)
COVER SIDESLOPE – NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
COVER SIDESLOPE – SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
PERIMETER CHANNEL OUTER SLOPE – NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
PERIMETER CHANNEL OUTER SLOPE – SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – CENTRAL	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – NORTH SEEP*	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

No issues.

* AREA OF SEEP IS OUTSIDE OF LANDFILL COVER AND EAST OF THE COVER ANCHOR TRENCH

SOIL COVER

REGION	EVIDENCE OF SOIL DEPOSITION OR EROSION?	EVIDENCE OF EROSION RILLS/GULLIES?	EVIDENCE OF BURROWING ANIMALS?	OTHER (DESCRIBE BELOW)
TOP OF COVER – WEST	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
TOP OF COVER – EAST	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
COVER SIDESLOPE – NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
COVER SIDESLOPE – SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE – SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
EAST FACE SLOPE — CENTRAL	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
AREA WHERE EAST SLOPE CENTRAL MEETS EAST SLOPE NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
AREA WHERE EAST SLOPE CENTRAL MEETS EAST SLOPE SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	
	VENT CAPS IN PLACE & SECURE?	**STANDPIPES IN GOOD CONDITION?**	**BIRDS OR INSECTS IN VENT CAPS?**	
COVER – BAROMETRIC VENTS	☐ Yes ☒ No	☒ Yes ☐ No	☐ Yes ☒ No	

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

Four vent caps fell off and one vent is damaged beyond repair.
Fallen caps were resecured to standpipes.

SEEP TREATMENT SYSTEM

REGION	EVIDENCE OF PLUGGING, OBSTRUCTIONS, OR EXCESS DEBRIS?	EVIDENCE OF CRACKS OR DETERIORATION?	OTHER (DESCRIBE BELOW)
GWIS INLET PIPES	☐ Yes ☒ No	☐ Yes ☒ No	
STRIP DRAIN INLET PIPE	☐ Yes ☒ No	☐ Yes ☒ No	
NORTH MANHOLE OUTLET PIPE	☐ Yes ☒ No	☐ Yes ☒ No	
SOUTH MANHOLE OUTLET PIPE	☐ Yes ☒ No	☐ Yes ☒ No	
TREATMENT UNIT	☐ Yes ☒ No	☐ Yes ☒ No	
TREATMENT UNIT OUTLET PIPE	☐ Yes ☒ No	☐ Yes ☒ No	
NORTH MANHOLE	☐ Yes ☒ No	☐ Yes ☒ No	
SOUTH MANHOLE	☐ Yes ☒ No	☐ Yes ☒ No	
TREATMENT UNIT GRATING	NA	☐ Yes ☒ No	

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

Treatment system cleaned earlier this month using mechanical pipe cleaner.

STORMWATER MANAGEMENT STRUCTURES

CHANNELS/LINING

STRUCTURE	EVIDENCE OF EXCESSIVE EROSION, GULLYING, SCOUR, OR UNDERMINING?	EVIDENCE OF SETTLEMENT/ SUBSIDENCE OR DEPRESSIONS?	EVIDENCE OF BREACHING OR BANK FAILURE?	EVIDENCE OF BURROWING ANIMALS?	EVIDENCE OF SEDIMENT BUILD-UP OR OTHER BLOCKAGE?	EVIDENCE OF LINING DETERIORATION, HOLES, RIPS, OR SEPARATION?	EVIDENCE OF LINING DISPLACEMENT?
DIVERSION BERM	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
VEGETATION-LINED PERIMETER CHANNEL – NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
VEGETATION-LINED PERIMETER CHANNEL – SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
RIPRAP-LINED PERIMETER CHANNEL	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
C350-LINED EAST FACE	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
EAST FACE RIPRAP CHANNEL – NORTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No
EAST FACE RIPRAP CHANNEL – SOUTH	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	☐ Yes ☒ No	

OTHER DEFICIENCIES?

N/A

MAINTENANCE REQUIRED/COMMENTS/PHOTO LOG

No Issues.

STORMWATER MANAGEMENT STRUCTURES (CONTINUED)

OUTFALLS

CHECK EACH STRUCTURE FOR EXCESSIVE EROSION AND SEDIMENT DEPTH. IF SEDIMENT DEPTH IS COMPROMISING THE DESIGN CHARACTERISTICS, REMOVE SEDIMENT.

STRUCTURE	CONDITION/SEDIMENT DEPTH
DIVERSION BERM OUTFALL – NORTH	No issues
DIVERSION BERM OUTFALL – SOUTH	
CULVERT 1 OUTFALL	
CULVERT 2 OUTFALL	
SOUTHWEST CULVERT OUTFALL	

CULVERTS

CHECK EACH STRUCTURE FOR BLOCKAGE, SURROUNDING CONDITIONS, BREACHING, SEDIMENT BUILD-UP, AND INLET/OUTLET CONDITIONS.

STRUCTURE	CONDITION
CULVERT 1	No issues
CULVERT 2	
SOUTHWEST CULVERT	

MAINTENANCE REQUIRED/PHOTO LOG

No issues.

"RUN-ON" EROSION CONTROL

AREA	ADVERSELY AFFECTING PLF?		
RUN-ON INTO PERIMETER CHANNEL – NORTH	☐ Yes	☒ No	COMMENT:
RUN-ON INTO PERIMETER CHANNEL – SOUTH	☐ Yes	☒ No	COMMENT:
NATURAL DRAINAGE FED BY CULVERT 1	☐ Yes	☒ No	COMMENT:
NATURAL DRAINAGE FED BY NORTHEAST PERIMETER CHANNEL	☐ Yes	☒ No	COMMENT:
NATURAL DRAINAGE FED BY RIPRAP	☐ Yes	☒ No	COMMENT:

MAINTENANCE REQUIRED/PHOTO LOG

No issues.

INSTITUTIONAL CONTROLS

ITEM			
EVIDENCE OF EXCAVATION(S) OF COVER AND IMMEDIATE VICINITY OF COVER?	☐ Yes	☒ No	COMMENT:
EVIDENCE OF CONSTRUCTION OF ROADS OR TRAILS ON COVER OR BUILDINGS?	☐ Yes	☒ No	COMMENT:
EVIDENCE OF UNAUTHORIZED ENTRY?	☐ Yes	☒ No	COMMENT:
EVIDENCE OF DRILLING OF WELLS OR USE OF GROUNDWATER?	☐ Yes	☒ No	COMMENT:
DISRUPTION OR DAMAGE OF SEEP TREATMENT SYSTEM?	☐ Yes	☒ No	COMMENT:
DAMAGE OR REMOVAL OF ANY SIGNAGE OR GROUNDWATER MONITORING WELLS?	☐ Yes	☒ No	COMMENT:

OTHER DEFICIENCIES/PHOTO LOG

No issues.

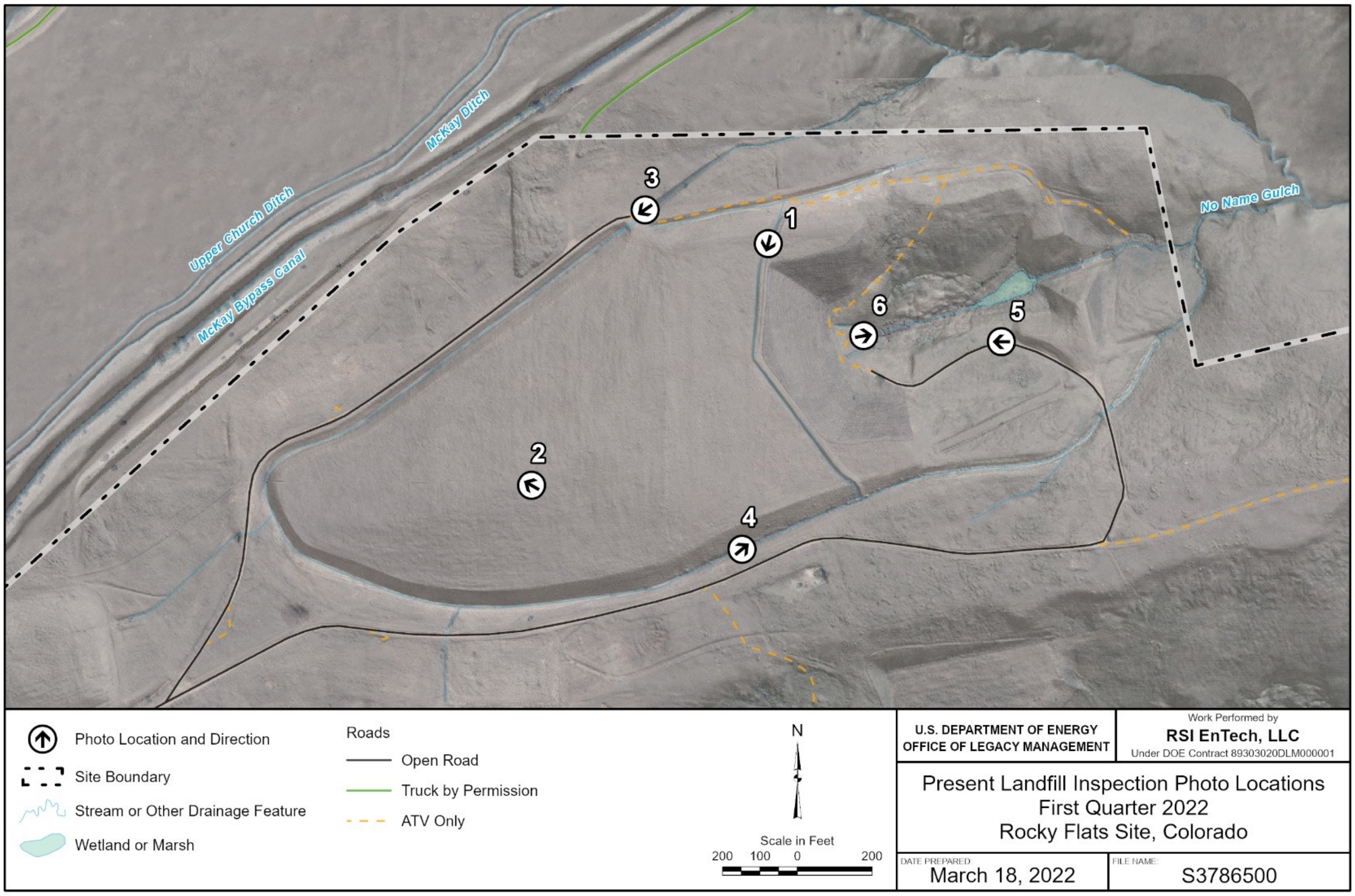
ACTION ITEMS

DEFICIENCY	DATE NOTED	ACTION	DATE COMPLETED	COMMENTS
4 vent caps fell off	3/14/2022	Resecure caps	3/14/2022	
1 vent cap damage	3/14/2022	Purchase new cap	TBD	

INSPECTOR SIGNATURE: [signature] DATE: 3/14/2022

REVIEWER SIGNATURE: ______________________ DATE: ______________

First Quarter 2022 PLF Inspection photos



Locations of PLF Inspection Report Figure Photographs, Rocky Flats Site, Colorado

Figure 1. Looking Southwest at the Present Landfill Diversion Berm Located Between the East Face Slope and the Top of the Landfill Cover, Which Was in Good Condition

Figure 2. Looking West-Northwest at One of Four Caps that Have Fallen Off of their Gas Vents

Figure 3. Looking West at the Northern Vegetation-lined Perimeter Channel and North Slope of the Present Landfill Cover, Which Were in Good Condition

Figure 4. Looking Northeast at the Southern Vegetation-lined Perimeter Channel and South Slope of the Present Landfill Cover, Which Were in Good Condition

Figure 5. Looking West-Northwest at the East Face Slope, Which Was in Good Condition

Figure 6. Looking East at the Present Landfill Treatment System. Small amounts of Bio-growth were removed from the North and South Manhole Outlet Pipes, treatment unit outlet pipe, and system outfall using a mechanical pipe cleaner as part of routine preventative maintenance.

Original Landfill Inspection Form and Photographs
(March 22, 2022)

Attachment 1: March 2022 Monthly Report of the Original Landfill Inspection at the Rocky Flats Site, Colorado

The monthly inspection of the Original Landfill (OLF) at the Rocky Flats Site, Colorado, was completed on March 24, 2022. The weather was clear with an ambient temperature of 60 °F during the inspection. The Rocky Flats Site meteorological tower recorded 0.62 inch of precipitation between this inspection and the previous monthly inspection performed on February 25, 2022.

Monthly inspection forms are completed to document current conditions at the OLF. Items previously indicated as deficient on an inspection form that have since been repaired are not marked again on the form unless further action is required.

Figure 1 provides a panoramic view of the OLF hillside with approximate locations of report photographs (photographs in **Figures 2–7** were taken on March 24, 2022).

No issues were noted during the inspection. Berms 1–3 (**Figure 2**) and Berms 4–7 (**Figure 3**) were in good condition. The East Perimeter Channel (EPC) (**Figure 4**) and West Perimeter Channel (WPC) were in good condition (**Figure 5**).

The Seep 4 (**Figure 6**) and Seep 8 (**Figure 7**) locations had flows of less than 1 gallon per minute (gpm). The Seep 7 location had dampened soil. All other historical seep locations were dry.

No issues were noted with the East Subsurface Drain (ESSD) or the South Interceptor Ditch (SID), which receives groundwater from an interceptor drain on the eastern hillside.

The revegetation of recently disturbed areas on the OLF is managed and monitored under the *Erosion Control Plan for Rocky Flats Property Central Operable Unit* (DOE 2007)[1] and under sitewide vegetation and revegetation plans, as appropriate. Established vegetation is visible across the hillside areas that were reseeded after the stabilization effort in 2019–2020.

Summary of March 2022 Inspection Findings

Berms 1–7 were in good condition. The EPC and WPC were in good condition. The Seep 4 and Seep 8 locations had flows of less than 1 gpm. All other historical seep locations were dry. No issues were noted with the ESSD or the SID, which receives groundwater from an interceptor drain on the eastern hillside.

[1] DOE (U.S. Department of Energy), 2007. *Erosion Control Plan for Rocky Flats Property Central Operable Unit*, DOE-LM/1497-2007, Office of Legacy Management, July.

Original Landfill – Monitoring and Maintenance Plan Inspection Form

Inspector: Nathan Krohn Date: 3/24/22 Time: 1030
Precipitation: MET* 0.62 inch NREL* NA Weather: Clear, 60°F Ambient Report Type: ☒ Monthly ☐ Weather-related
Reviewed by: Review date:
*Since last report

Subsidence/Consolidation					
Region	**Visible Cracks**	**Visible Depressions**	**Visible Ponding**	**Within Waste Footprint**	**Other (Describe Below)**
Berm 1 Basin - West	NO	NO	NO	NA	
Berm 1 Basin - East	NO	NO	NO		
Berm 2 Basin	NO	NO	NO		
Berm 3 Basin	NO	NO	NO		
Berm 4 Basin	NO	NO	NO		
Berm 5 Basin	NO	NO	NO		
Berm 6 Basin	NO	NO	NO		
Berm 7 Basin	NO	NO	NO		
Buttress fill	NO	NO	NO		
Settlement monuments—inspect integrity.	Intact:	YES			

Maintenance required, comments, and photo log:

No issues.

Original Landfill – Monitoring and Maintenance Plan Inspection Form

Slope Stability

Region	Visible Cracks	Visible Seeps	Visible Block or Circular Failure	Other (Describe Below)
Cover– West	NO	YES	NO	Seeps 4 + 7
Cover– East	NO	YES	NO	Seep 8B (partial)
Buttress fill side slope	NO	NO	NO	
West perimeter channel side slopes	NO	NO	NO	
East perimeter channel side slopes	NO	NO	NO	

Maintenance required, comments, and photo log:

No issues.

Soil Cover and Buttress

Region	Visible Erosion	Visible Gullies	Visible Animal Burrows	Other (Describe Below)
Cover– West	NO	NO	NO	
Cover– East	NO	NO	NO	
Buttress fill	NO	NO	NO	
Buttress fill side slope	NO	NO	NO	

Maintenance required, comments, and photo log:

No issues.

Original Landfill – Monitoring and Maintenance Plan Inspection Form

Seep Evaluation

Seep	Visible Saturation	Visible Flow	Approximate Flow	Description
Seep 1*	NO			
Seep 2/3*	NO			
Seep 4*	YES	YES	< 1 GPM	
Seep 5*	NO			
Seep 6*	NO			
Seep 7*	YES	~~YES~~ NK 3/24/21 NO		
Seep 8a	NO			
Seep 8b	NO			
Seep 8c	NO			
Seep 9	NO			
Seep 10	NO			
Seep 10a	NA	NA	NA	Not an official seep. See "NOTE"
Seep 8	YES	YES	< 1 GPM	

Maintenance required, comments, and photo log:

No issues.

* Indicates seep was observed during or shortly after OLF closure in 2005.

NOTE: A seep is defined as an area where water percolates to the land surface or an area persistently moist whose source, as observed in multiple inspections, is confirmed to be groundwater and not surface water.

Original Landfill – Monitoring and Maintenance Plan Inspection Form

Water Management Structures

Channels

Structure	Visible Excessive Erosion, Gullying, or Undermining	Visible Settlement, Subsidence, or Depressions	Visible Breaching or Bank Failure	Visible Animal Burrows	Visible Sediment Build-Up or Other Blockage	Comments
Diversion Berm 1	NO	NO	NO	NO	NO	
Diversion Berm 2	NO	NO	NO	NO	NO	
Diversion Berm 3	NO	NO	NO	NO	NO	
Diversion Berm 4	NO	NO	NO	NO	NO	
Diversion Berm 5	NO	NO	NO	NO	NO	
Diversion Berm 6	NO	NO	NO	NO	NO	
Diversion Berm 7	NO	NO	NO	NO	NO	
West perimeter channel	NO	NO	NO	NO	NO	
East perimeter channel	NO	NO	NO	NO	NO	

Drains/Outfalls

Structure	Visible Excessive Erosion, or Gullying	Visible Sediment Build-Up or Other Blockage	Is Water Draining or Flowing from Structure?	Comments
East Subsurface Drain – Solid pipe	NO	NO	NO	
East Subsurface Drain – Perforated pipe	NO	NO	YES	
French Drain (SID)	NO	NO	NO	

Maintenance required and photo log:

No issues.

Original Landfill – Monitoring and Maintenance Plan Inspection Form

"Run-On" Control		
Area	**Adversely Affecting OLF**	**Comments**
Run-on to the OLF (any direction)	No issues	
Maintenance required and photo log:		
No issues.		

Violations of Institutional Controls		
Item		**Comments**
Evidence of unauthorized[1] excavations of cover and immediate vicinity of cover?	No	
Evidence of unauthorized[1] construction of roads, trails, or buildings on cover?	No	
Evidence of unauthorized[1] drilling of wells or use of groundwater?	No	
Damage to groundwater monitoring wells at OLF (upgradient or downgradient)?	No	
Other observations, maintenance required, comments, and photo log:		
No issues.		
If "Yes" is marked on any item in the Institutional Controls section, immediately notify your supervisor.		

[1] Unauthorized means not approved by RFLMA parties (DOE, EPA, CDPHE) through the consultative process. Actions covered under an approved soil disturbance review plan are authorized actions.

Original Landfill – Monitoring and Maintenance Plan Inspection Form

Action Items			
Deficiency	**Action**	**Date Completed**	**Comments**
None			

Signatures

Inspector signature: [signature] Date: 3/24/2022

Reviewer signature: Date:

Figure 1. Locations of OLF Inspection Report Figure Photographs, Rocky Flats Site, Colorado (Photo Taken September 1, 2020)

Figure 2. Looking South-Southeast at Berms 1–3 that Were in Good Condition

Figure 3. Looking Southeast at Berms 4–7 that Were in Good Condition

Figure 4. Looking South-Southwest at the EPC that Was in Good Condition

Figure 5. Looking West-Northwest at the WPC that Was in Good Condition

Figure 6. Looking East at Seep 4 and the Surrounding Area, Which Was in Good Condition

Figure 7. Looking West-Northwest at Seep 8 and the Surrounding Area, Which Was in Good Condition

Appendix H

Changes to Applicable or Relevant and Appropriate Requirements

ARAR[1]		Change	Impact to Remedy Protectiveness	Revision Reference	Effective Date	Comments
National Emission Standard for Asbestos	40 CFR 61, Subpart M	None.	None.			
Colorado Basic Standards and Methodologies for Surface Water; Basic Standards Applicable to Surface Waters of the State	5 CCR 1002-31.11	Revisions to basic standards for specific PAHs and metals.	None. Changes to standards for RFLMA Table 1 analytes: Cadmium standards (acute and chronic) are less stringent; chrysene standard is less stringent. Benzo(a)pyrene and Dibenzo(a,h)anthracene standards are more stringent, however, PQLs in RFLMA are used in lieu of standards due to difficulty in achieving detection limits at standard. Changes to standards not required to be monitored under RFLMA do not affect remedy protectiveness.	Cadmium (5 CCR 1002-31.57 and 1002-38.100) (Statement of Basis) PAHs (5 CCR 1002-31.57) (Statement of Basis)	June 30, 2020	Standards revised for PAHs: benzo(a)pyrene benzo(a,h)anthracene chrysene benzo(a)anthracene benzo(b)fluoranthene benzo(k)fluoranthene indeno(1,2,3-cd)pyrene). Table value standard (TVS) revised for total cadmium.
		New standards promulgated for RDX, 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene.	None. New standards promulgated for RDX, 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene. Addition of new standards to be evaluated by RFLMA Parties for applicability to Rocky Flats.	(5 CCR 1002-31.57) (Statement of Basis)	June 30, 2020	
Classification and Numeric Standards South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin; Classification Tables	5 CCR 1002-38.6(4)(k) Appendix 38-1	Segment 5 was separated into 5a (North Walnut Creek from the western edge of the COU and South Walnut Creek from its source, including all tributaries and wetlands, to the eastern boundary of the COU) and 5b (All lakes and reservoirs from the western edge of the COU to the eastern boundary of the COU and Pond C-2 on Woman Creek). Segment 4a (Mainstem and all tributaries to Woman and Walnut Creeks from sources to Standley Lake and Great Western Reservoir, respectively, except for listings in Segments 4b and 5a).	None. Revisions were limited to stream segment numbers and clarification of stream descriptions.	5 CCR 1002-38.101(A) (Statement of Basis)	December 31, 2020	Big Dry Creek Segment 5 (COSPBD05): Lakes and reservoirs from Segment 5 were moved into new Segment 5b. Segment 5a retained the stream portions from the parent segment. As part of this change, an exception for Segment 5a was added to the segment description for Segment 4a and an exception for Segment 5b was added to the segment description for Segment 7.
		Addition of missing ammonia standards for Big Dry Creek Segments 4b (acute and chronic ammonia), 5a (acute and chronic ammonia), and 5b (acute and chronic ammonia).	None. Addition of missing standards not required to be monitored under RFLMA does not affect remedy protectiveness.	5 CCR 1002-38.101(B) (Statement of Basis)	December 31, 2020	
Colorado Basic Standards for Groundwater	5 CCR 1002-41	The changes to SW standards in section 31.11 were also adopted for the statewide groundwater organic chemical standards in Regulation No. 41 (41.5(C)(3)).	None. See changes to 5 CCR 1002-31.11.	(5 CCR 1002-41.30) (Statement of Basis)	June 30, 2020	
Site-Specific Water Quality Classifications and Standards for Groundwater	5 CCR 1002-42.7(1)	None.	None.			

ARAR[1]		Change	Impact to Remedy Protectiveness	Revision Reference	Effective Date	Comments
Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List	5 CCR 1002-93.3	Segments 4a and 5 were added to 303(b) list of impaired waters. Segment 4a: Aquatic Life Use for total iron. Segment 5: Water Supply Use for NO2 + NO3.	None. Segments were listed as low (4a) and medium (5) priority for TMDL development. TMDLs have not yet been developed for these segments.	5 CCR 1002-93.18 (Statement of Basis)	March 1, 2020	Not listed as an ARAR in CAD/ROD.
Permits for Dredged or Fill Materials; Discharges of Dredged or Fill Materials into Waters of the United States	33 CFR 323	None.	None.			
DOE Compliance with Floodplain/Wetland Environmental Review Requirements	10 CFR 1022	None.	None.			
Stormwater Permit for Construction Activities	40 CFR 122.26	2022 Construction General Permit (CGP) replaced the 2017 CGP.	None. Remedy protectiveness is not impacted by these changes because all activities subject to this ARAR, such as construction work to maintain the landfill covers and groundwater treatment systems, are conducted in accordance with the substantive requirements of the GCP.	87 FR 3522 (2022)	February 17, 2022	
General Permits (Pesticide General Permit)	40 CFR 122.28	2021 NPDES Pesticide General Permit (PGP) replaced the 2016 PGP.	None. Remedy protectiveness is not impacted by these changes because all activities subject to this ARAR, such as application of pesticides near onsite streams, are conducted in accordance with the substantive requirements of the PGP.	86 FR 51665 (2021)	October 31, 2021	
RCRA Subtitle C Hazardous Waste Landfill Effluent Limitations	40 CFR 445.11	None.	None.			
Endangered Species Act	16 USC 1531 et seq.	Preble's Meadow Jumping Mouse Recovery Plan was published on August 28, 2018. The Colorado butterfly plant (*Gaura neomexicana ssp. coloradensis*) was removed from the endangered species list on 12/5/2019. This species could have occurred in the Rocky Flats Area but has never been found there (84 FR 59570).	None. Remedy protectiveness is not impacted by these changes.	84 FR 59570	August 28, 2018 December 5, 2019	
Migratory Bird Treaty Act	16 USC 701-715	USFWS published the final rule limiting "take" to apply only to actions directed at migratory birds, their nests, or their eggs.	None. Remedy protectiveness is not impacted by these changes.	86 FR 1134 (2021)	February 8, 2021	
Colorado Wildlife Statutes	Colorado Revised Statutes (CRS) 33-1-101 to 33-6-209	Various changes by the Colorado State Parks and Wildlife Department. The introduction of gray wolves to the Western Slope of Colorado was passed by voters in 2020.	None. Remedy protectiveness is not impacted by these changes.			
Federal Noxious Weed Act	Pub. L. 93-629; 7 USC 2814 et seq.	None.	None.			
Colorado Noxious Weed Act	CRS 35-5.5-101 et seq.	Revisions to noxious weed lists and management plans.	None. Remedy protectiveness is not impacted by these changes.	8 CCR 1206-2	March 30, 2017 March 30, 2018 October 30, 2020	
National Wildlife Refuge System Administration Act	16 USC 668dd(c)	None.	None.			

Changes to Applicable or Relevant and Appropriate Requirements (ARARs) (continued)

ARAR[1]		Change	Impact to Remedy Protectiveness	Revision Reference	Effective Date	Comments
Radiation Protection Standards and Decommissioning US Nuclear Regulatory Commission Licensed Facilities	6 CCR 1007-1 10 CFR	None.	None.			
Identification and Listing of Hazardous Wastes	6 CCR 1007-3, Part 261 (40 CFR 261)	Addition of PFOA and PFOS to Appendix VIII (hazardous waste constituent list).	Potential PFOA and PFOS risk to human and ecological receptors has not been fully evaluated and a protectiveness determination for the site is deferred.	6 CCR 1007-3 Part 8.90 (Statement of Basis)	April 14, 2018	
		As stated in the CAD/ROD Table 21, CHWA/RCRA requirements are listed as ARARs, but they also apply independently. As such, all revisions made during this FYR period to 6 CCR 1007-3, including revisions to ARARs specified in the CAD/ROD, were reviewed for relevancy to remedy protectiveness. Several revisions were made to 6 CCR 1007-3 during this FYR period. These changes included the addition of chemicals to Appendix VII and VIII; adoption of the Hazardous Waste Generator Improvements rule; modifications to the requirements for the import and export of hazardous waste, modifications to the hazardous waste manifest system; modifications to very small quantity generator requirements (including adoption of the Episodic Generation rules), modifications of the used oil standards; and other administrative changes.	None. Remedy protectiveness is not impacted by these various revisions because all activities subject to CHWA/RCRA are conducted in accordance with the applicable requirements of these regulations.	See Code of Colorado Regulations eDocket at www.sos.state.co.us/CCR	April 14, 2017 June 30, 2017 November 30, 2017 April 14, 2018 June 30, 2018 January 14, 2019 April 14, 2019 May 30, 2019 June 30, 2019 July 15, 2020 April 14, 2021 June 30, 2021	
Generator Standards	6 CCR 1007-3, Part 262 (40 CFR Part 262)					
General Facility Standards; Preparedness and Prevention; Contingency Plan and Emergency Procedures	6 CCR 1007-3, Part 265, Subparts A-D (40 CFR 265, Subparts A-D)					
Groundwater Protection (Releases from SWMUs)	6 CCR 1007-3, Part 264, Subpart F (40 CFR 264, Subpart F)					
Groundwater Monitoring; Closure and Postclosure; Landfills	6 CCR 1007-3, Part 265, Subpart F, G, and N (40 CFR 265, Subparts F, G and N)					
Polychlorinated Biphenyls (PCB) Storage Disposal	40 CFR 761 Subpart D (40 CFR 761.62(c))	None.	None.			
Environmental Covenants	CRS 25-15-317 et seq.	None.	None.			The Environmental Covenant for the COU was superseded in April 2017 by a Restrictive Notice established in accordance with Section 25-15-318.5, Colorado Revised Statutes (CRS 25-15-318.5).

Note:
[1] From Table 21 in CAD/ROD for Rocky Flats Plant (USDOE), September 2006, unless otherwise noted.

Abbreviations:
CHWA = Colorado Hazardous Waste Act
SW = surface water
SWMU = solid-waste management unit

Appendix I

Responses to Stakeholder Input on the FYR

Responses to Stakeholder Input on the FYR

As summarized in Section 5.0 of this fifth FYR report, the public received notification of the start of the FYR process in September 2021. A written notice of the start of the FYR was posted to the LM website on September 23, 2021, and was emailed to identified public stakeholders on September 30, 2021. To meet the FYR report schedule, the notice requested that public input be provided no later than December 31, 2021. On November 1, 2021, DOE presented information regarding the upcoming FYR at the Rocky Flats Stewardship Council (RFSC) meeting.

The scope of this fifth FYR report is the COU. Some of the input received from stakeholders concerned topics that are not related to remedy implementation or performance at the COU or are outside the scope of this FYR. As such, these topics are not addressed in this appendix. Stakeholder input was grouped into general topics, when possible, to streamline the response process. The following table provides a summary of input received from the public and DOE's corresponding responses. Input that did not readily fit into one of the groups identified in the first column of the table below is addressed at the end of the table.

References

CDPHE (Colorado Department of Public Health and Environment), 2020. "Review of Potential Radiation Doses During Construction of the Jefferson Parkway," June.

CDPHE (Colorado Department of Public Health and Environment), 2021a. Lindsay Murl, CDPHE, letter ("January SAP for PFAS – CDPHE approval with modifications letter") to Andrew Keim, Office of Legacy Management, U.S. Department of Energy, April 22.

CDPHE (Colorado Department of Public Health and Environment), 2021b. CDPHE, letter ("RE: Minor correction to CDPHE's 2020 Jefferson Parkway Analysis") to Rocky Flats Stewardship Council, March 3.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 120 (42 USC 9620, "Federal Facilities") and Section 121(c), (42 USC 9621(c), "Cleanup Standards."

DOE (U.S. Department of Energy), 2006. *RCRA Facility Investigation – Remedial Investigation/Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site*, prepared by Kaiser-Hill Company, LLC for the U.S. Department of Energy, June.

DOE, EPA, and CDPHE (U.S. Department of Energy, U.S. Environmental Protection Agency, and Colorado Department of Public Health and Environment), 2006. *Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit, Jefferson and Boulder Counties, Colorado*, September.

EPA (U.S. Environmental Protection Agency), 2001. *Comprehensive Five-Year Review Guidance*, EPA 540-R-01-007, Office of Emergency and Remedial Response, June.

Executive Order 12580, *Superfund Implementation*, 23 January 1987.

WWE (Wright Water Engineers, Inc.), 2015. *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site*, Rev. 1, September.

WWE (Wright Water Engineers, Inc.), 2019. *2019 Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site*, July.

WWE (Wright Water Engineers, Inc.), 2021. *2021 Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site*, December.

Group Topic	Input Summary	Response
FYR Process	1. The FYR should include the former buffer zone (POU), which is now the Refuge.	1. CERCLA requires that a FYR be conducted for sites where hazardous substances, pollutants, or contaminants remain above levels that allow for UU/UE: If DOE "selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, [DOE] shall review such remedial action no less often than each five years after the initiation of such remedial action…" (CERCLA Section 121(c)). The COU meets this condition, and, therefore, CERCLA requires that a FYR be completed for the COU every 5 years. The remaining operable units associated with the former Rocky Flats Plant (the POU [now the Rocky Flats National Wildlife Refuge, the "Refuge"] and OU3) were determined to meet UU/UE conditions in 2007 and were deleted from the NPL (Vol. 72 Federal Register 29276). Although a FYR is not required for the POU or OU3, this fifth FYR report evaluated changes to toxicity factors and other risk parameters for these two operable units to determine if the UU/UE designation is still valid (see Section 6.2.2.3 and Appendix C).
	2. EPA is required by statute and, as a matter of policy, reviews the remedies at certain sites every five years. Shouldn't the public respond to the EPA? Why would the public submit comments to DOE as they are being directed? Is DOE the responsible party? Is the RFSC website an official repository for public input to the FYR?	2. CERCLA Section 120 allows, and Executive Order 12580 directs, the federal department with control of the site to serve as the lead agency for the FYR with EPA providing oversight. However, EPA retains final authority to make or concur with protectiveness determinations (EPA 2001). For the COU, DOE is considered the lead agency and completes the FYR; EPA (and CDPHE) review the report and provide comments. Ultimately, EPA will either concur with the lead agency protectiveness determination or provide independent findings. CERCLA does not require that an independent authority, other than EPA, evaluate the protectiveness of the remedy. As noted in the public notice issued at the start of the FYR, public comments were to be directed to DOE as the lead agency (see response #3 below).
	3. These comments are submitted without the benefit of being able to review the draft CERCLA FYR report. Staff from the downstream communities request active discussions prior to completion of the draft document. As the request for comments has occurred before the completion of the document, a second public comment period should be opened prior to finalization of the document. The RFSC meeting on November 1, 2021, did not provide the public an opportunity to participate in a dialogue with DOE regarding the Rocky Flats FYR. There was no information or additional information provided for review for the public at the meeting. The public should have received a current DOE-prepared preliminary review of the site for the last five years available to review for public input to DOE. DOE did not adequately address some public input for the fourth FYR, specifically a December 31, 2016, letter to DOE from the University of Denver submitted on behalf of the Rocky Mountain Peace and Justice Center (RMPJC). Commentors expressed concerns about the format of RFSC meetings.	3. CERCLA does not require formal public comment on the FYR report; it only requires that the public be notified of the start of the FYR process and of the availability of the final FYR report (EPA 2001). Interested stakeholders were notified of the start of the FYR via email and a notice was posted to the LM website in September 2021. The public was invited to submit questions and other input to the email address (RFInfo@doe.lm.gov) or LM contacts identified in the notice and on the LM website. The FYR team presented information regarding this FYR at the November 1, 2021, RFSC meeting, which was open to the public. The public was invited to submit questions and other input to the email address provided in the notice and listed on the LM website. A notice when the final FYR report is issued will be distributed in the same manner as the initial FYR notice. As always, DOE accepts input from the public during RFSC meetings, in response to quarterly and annual reports and presentations, in response to CRs, and through other means of contact (formal or informal). All public input to the fourth FYR was reviewed, including the letter submitted on behalf of the RMPJC. As stated in Appendix I of the fourth FYR, responses to stakeholder input that was not related to remedy implementation or performance at the COU or was not within the scope of the FYR were not included in the FYR appendix. The RFSC determines the agenda and organization of RFSC meetings; requests to change the meeting format should be directed to the RFSC. Members of the public were given the opportunity to ask questions following the DOE FYR presentation at the November 1, 2021, RFSC meeting.
	4. It appears there is no DOE dialogue with the public and that DOE does not take public comment into consideration. Members of the public would like to be consulted and included in decisions about the RFS.	4. DOE, CDPHE, and EPA, as the signatories to the *Rocky Flats Legacy Management Agreement* (RFLMA), are responsible for evaluating data and determining actions required to maintain the remedy and protect human health and the environment. The RFLMA parties keep the public and local community governments informed by making all RFLMA-required reports (e.g., annual and quarterly reports) and CRs available on the LM website, making quarterly presentations at RFSC meetings, and holding periodic technical meetings with local community governments. Responses to input received from the public for the FYR are included in this appendix.
Reportable Conditions	1. TCE at well 10304 continues to exceed standards. As the hydrologic system moves from surface water dominated to groundwater dominated, it is likely that exceedances will continue to occur more frequently. Onsite water quality remains in a dynamic condition and water quality uncertainty persists at the site.	1. Well 10304 has not been reportable since the fourth quarter of 2019. The highest concentration of TCE reported in this FYR period was 56 µg/L(the RFLMA standard is 2.5 µg/L) in the sample collected in May 2017. Groundwater modeling performed before site closure predicted that concentrations of TCE would increase in this area following periods of higher-than-normal precipitation. Since 2015, concentrations of TCE have been steadily but irregularly decreasing as the effects of very wet periods in 2013 and 2015 wane. Further discussion is included in Section 6.1.2.1 of the FYR.
	2. Uranium concentrations in North Walnut Creek and South Walnut Creek continue to be a concern. Over the course of this five-year period, approximately 50% of individual sample results collected at GS10 exceeded the RFLMA standard for uranium. Additionally, there have been two reportable conditions for uranium at the Walnut Creek Point of Compliance (WALPOC) and one reportable condition for uranium at GS10. Follow-up actions beyond issuing a CR have not been taken. The contamination source should be remediated rather than just assuming the reportable condition will return to a concentration below the site standard. Will there be a corrective action other than continued evaluation?	2. CR 2021-02, approved November 2, 2021, describes the evaluation of the reportable condition for uranium at GS10 and the plan and schedule for responding to the condition. As detailed in the CR, the most recent uranium concentrations at GS10 are consistent with concentrations observed during the 15 years since site closure. The absence of a significant increasing trend suggests that a new source of uranium contamination is not present. Given this and based on the short-term nature of the reportable condition and the similarity to previous reportable conditions for uranium at GS10, no mitigating actions were warranted. The 30-day average for uranium at WALPOC exceeded the RFLMA standard on two occasions during this FYR period (see CR 2017-02 and CR 2018-04 in Appendix D). Mitigating actions were not required for the two reportable conditions because the data did not suggest a new source of uranium contamination, the exceedances did not persist, and because varying uranium concentrations at WALPOC are anticipated. The fact that the 12-month rolling average at WALPOC, which is the measure of remedy performance, remained below the RFLMA standard during these two reportable conditions was also considered when evaluating the need for mitigating actions. Varying uranium concentrations are anticipated at WALPOC because of the relationship between precipitation and uranium concentrations in surface water. Specifically, heavy precipitation events (1) increase the mobility of uranium in soil, which allows increased migration of uranium to groundwater; (2) increase groundwater discharge to surface water; and (3) increase uranium concentrations in surface water once direct runoff has diminished. Additional information on the influence of environmental conditions on uranium concentrations in North and South Walnut Creek may be found in *Evaluation of Water Quality Variability for Uranium and Other Selected Parameters in Walnut Creek at the Rocky Flats Site* (WWE 2021). The uranium exceedances at GS10 and WALPOC are further discussed in Section 6.1.3 and Appendix E, Section E1.2.1.1, respectively.

Group Topic	Input Summary	Response
	3. Various exceedances of the total uranium concentration standard for waters leaving the COU have been reported. DOE does not investigate and report upon the actual source of the uranium, whether it is a natural weathering phenomenon from uranium rock formations or contains some component of anthropogenic uranium originating from past Rocky Flats activities. Anthropogenic uranium has a different isotopic signature from natural uranium. DOE must investigate the potential presence of buried uranium sources to understand sources associated with DOE activities.	3. Extensive subsurface sampling was performed during closure to investigate subsurface contamination and remediate where appropriate. In addition, DOE has performed isotopic analysis on many samples, both during and after closure, to evaluate whether uranium in groundwater or surface water is natural or anthropogenic. Results of these analyses are reported in quarterly and annual reports. Based on the isotopic analysis of 39 composite surface water samples collected at WALPOC from 2011 to 2018, 69–87% of the total uranium concentration is naturally occurring uranium (WWE 2021). Isotopic analysis of some groundwater wells with very high uranium concentrations has shown that the uranium in those areas is natural uranium from surrounding soil and bedrock; analysis shows that uranium in groundwater in other areas is from both natural and anthropogenic sources. In 2015, a comprehensive evaluation of the distribution, transport mechanisms, sources, and isotopic composition of uranium in North and South Walnut Creeks was completed to evaluate the reportable conditions that occurred during the fourth FYR period (WWE 2015). This evaluation was updated in 2019 and 2021 (WWE 2019; WWE 2021). These reports contain detailed discussions of natural versus anthropogenic uranium in Rocky Flats surface water and groundwater and are available on the LM website.
	4. DOE should provide splits of any/all routinely collected water samples to interested and qualified community members to conduct scientifically sound, legally defensible and independent (non-U.S. Government funded) analyses of the uranium isotope composition of water leaving the site.	4. RFLMA Attachment 2, Section 5.4.1, provides the CDPHE and EPA the opportunity to collect duplicate or split samples for any monitoring. Split samples will not be provided to private parties.
	5. POE location SW027 has had multiple exceedances of the RFLMA standard. During this FYR period, there was a reportable condition for plutonium at this location. Previous erosion control methods have not corrected the issue. This raises the question if the remedy in this area is protective. It is apparent there is a contamination source and it should be remediated rather than just assuming the reportable condition will return to a concentration below the site standard. Will there be a corrective action other than continued evaluation? When will the RFLMA CR be posted? What are DOE's plans and schedule for addressing this reportable condition? Will this reportable condition be addressed in the FYR? In June 2021, DOE communicated an informal notification of a reportable condition for plutonium at SW027 based on the 12-month rolling average from May 1, 2020, to April 30, 2021. DOE also reported that subsequent sample results from May 3 to May 20, 2021, a separate and subsequent 12-month rolling average temporal window, were "well below 0.15 pCi/L," ending the reportable condition. Please explain how this is calculated in accordance with RFLMA.	5. The RFLMA consultation between DOE, CDPHE, and EPA on the 2021 reportable condition for plutonium at SW027 is ongoing. The CR describing the plan and schedule for responding to this reportable condition will be posted to the LM website when consultation is completed. Details of the reportable conditions at SW027 during this FYR period may be found in Appendix E, Section E1.2.1.2 of this FYR report. The 12-month rolling average is calculated once per month for the last day of each month. The 12-month rolling average for a specific analyte is a volume-weighted average of the concentrations for all composite samples collected at a particular location during a 12-month period. For example, the 12-month rolling average for April 30 includes all sample results back through May of the previous calendar year. In the case of the 2021 reportable conditions at POEs GS10 and SW027, the April 30, 2021, averages exceeded the applicable RFLMA surface-water standards (uranium at GS10; plutonium at SW027). These April 30, 2021, averages included all sample results back to (and including) May 1, 2020. When the May 31, 2021, averages were subsequently calculated for GS10 and SW027, these values were less than the applicable RFLMA surface-water standards. The calculated averages changed between April 30, 2021, and May 31, 2021, because the May 2020 samples were removed from the calculation, while the May 2021 samples were added to the calculation. Even though the reportable periods ended with the May 31, 2021, calculation, the reportable conditions had already been triggered and subsequent consultation and evaluation was still required. A detailed description of RFLMA surface-water data evaluation can be found in Section 6.1.11.1 of the Rocky Flats Site Operations Guide (Rocky Flats Site, Colorado, Site Operations Guide (doe.gov)). A similar description is provided in Section B2.2 (Appendix B) of each annual report.
Solar Ponds Plume Treatment System (SPPTS)	1. In 2016, an improved denitrification treatment system was implemented that has reduced nitrate contamination entering North Walnut Creek from the Solar Ponds Plume. However, higher nitrate concentrations are still observed at the SPPTS effluent (SPOUT).	Section 6.1.4.3 in the FYR report and Section E1.1.4.2 of Appendix E provide additional discussion on the SPPTS. 1. The nitrate treatment component was reconfigured as a full-scale test component (lagoon) in July 2016. Following testing and refinement of operations, it was converted to the formal nitrate treatment component in December 2018. Throughout this FYR period, nitrate treatment effectiveness overall has been very good, with very few instances in which nitrate at SPOUT exceeded the RFLMA standard of 10 mg/L as N (see Appendix E, Section E1.1.4.2). Operational refinements have continued, largely to address these instances and leading to further improvements in nitrate treatment. In fact, there were no exceedances of the RFLMA standard for nitrate at SPOUT in 2021. The last instance when nitrate in system effluent exceeded the RFLMA standard was in January 2020. For this FYR period, nitrate concentrations (as N) in system influent averaged slightly more than 576 mg/L and in effluent, averaged 1.63 mg/L, based on 121 samples each. Of those 121 samples of effluent, 7 exceeded the RFLMA standard and 114 were below that level, including 66 in which nitrate was nondetect (incorporated in the averages as the value of the reported detection limit – therefore, this average is an overestimate). See Section 6.1.4.3 for more information.
	2. A 2019 update of the Wright Water Engineers (WWE) study raised the possibility that some Solar Ponds Plume nitrate contamination was not being captured by the SPPTS collection system. To address this uncertainty, additional wells were installed west of the SPPTS in 2020, to be monitored in 2021 for nitrate and uranium.	2. DOE installed a row of piezometers west of the SPPTS collection trench in 2020 to investigate groundwater in this area. The investigation is ongoing. However, surface water quality downgradient of this area (as measured at SW093) does not indicate surface water impacts from the Solar Ponds Plume.
	3. The need to improve the effectiveness of the SPPTS for uranium removal has been discussed and multiple pilot systems tested since 2017, but the time frame for implementing a permanent treatment method for uranium continues to be pushed out. Implementation of an effective treatment system for uranium should be prioritized to protect surface waters from uranium contamination. Uranium has essentially not been treated at the SPPTS since 2019. There exist tried and true treatment options for uranium, zero valent iron is one such treatment. Three nearby city governments request that until a permanent solution is installed, a dependable system be installed.	3. DOE has been evaluating uranium treatment technology for the SPPTS for several years. While the current nitrate treatment component does remove a portion of the uranium, the quantity removed is not adequate to meet treatment targets. A wide variety of standard technologies have been evaluated and many have been tested onsite. Numerous experts have been consulted regarding appropriate treatment technology to use. However, the chemical composition of the contaminated groundwater of the Solar Ponds Plume, combined with constraints, such as very low (~ 1 gallon per minute) flow rate and the lack of onsite utilities like electric power, make standard technologies unsuitable for use at SPPTS. The use of zero valent iron (ZVI) technology for uranium removal has been tested repeatedly through various approaches and including both upstream and downstream of the nitrate treatment component. The chemistry of the untreated SPPTS influent renders ZVI ineffective in a very short time frame (a few weeks). Using ZVI to treat uranium downstream of the nitrate treatment unit, so that the effects of the high nitrate in influent are mitigated, introduces other difficulties due to the high alkalinity and biomass in this water. If a standard off-the-shelf technology could be implemented at SPPTS, DOE would already have done so. Procurement efforts in 2021 led to a contract being established in early 2022 with a company that will perform laboratory and field tests of a short-list of uranium removal technologies previously identified as having the greatest potential for success.

Group Topic	Input Summary	Response
	4. In 2017, the NWCS was identified as a potential threat to the operation of the SPPTS and its collection system. The SPPTS is an essential part of the remedy. The 450-foot long crack has recurred after each regrading project. The situation has been studied extensively, but no remedial action has been taken except to minimize infiltration into the slump area by diverting surface water from the SPPTS access road. A re-evaluation of the risk associated with continued slump movement is warranted due to the variability of environmental conditions. Possible impacts to surface water quality in North Walnut Creek, independent of impacts to the SPPTS, should also be evaluated.	4. DOE continues to evaluate hillside movement at the NWCS and its potential effect on the SPPTS as discussed in Section 6.1.4.3 of the FYR report. DOE also continues to evaluate surface water quality in North Walnut Creek, which is discussed in Section 6.1.3 in the FYR report and Appendix E, Section E1.1.4.2. DOE will continue to monitor movement of the hillside and will evaluate options for addressing hillside instability, as appropriate, through the RFLMA consultative process.
	5. Downstream city governments would appreciate the ability to review the geotechnical reports for NWCS. Please provide the links on the LM website.	5. Geotechnical reports for NWCS may be requested through the DOE Freedom of Information Act process at https://www.energy.gov/management/freedom-information-act.
Landfills	1. There has not been a sufficient amount of data collected in extreme conditions to determine if the remedy at the OLF remains protective. DOE should continue the weekly best management practice (BMP) inspections, as well as the monthly inspections required in RFLMA until sufficient data (in extreme weather events) has been collected to demonstrate the success of the stabilization project.	1. Monitoring data collected in all conditions, including extreme conditions, are important in the evaluation of site protectiveness and are reviewed in conjunction with information, such as the results of monthly and weather-related landfill inspections. The current monthly inspection frequency for the OLF is mandated by RFLMA and cannot be changed unless authorized by the RFLMA parties. In addition to the monthly inspections, the OLF is also inspected following extreme weather events as required by RFLMA. Although not required by RFLMA, weekly BMP inspections of the OLF have continued throughout this FYR period. Section 6.1.4.2 in the FYR report provides additional description of the OLF stabilization project and OLF monitoring.
	2. Are there any plans to prevent the negative impacts from elk migration on the OLF cover?	2. Erosion controls placed in construction areas at the OLF following soil disturbances, such as the OLF stabilization project, have sustained minor damage, presumably from elk. Erosion controls are inspected and repaired as necessary to ensure that they continue to function effectively until vegetation has been reestablished in the areas. Vegetation is currently growing well in the areas disturbed by the OLF stabilization project and will ultimately replace the erosion controls. No additional controls are warranted at this time.
	3. What is the cause of the eight depressions between the anchor blocks above the east Berm 6? Could the depressions be caused by improper compaction in this area or a potential water path in this area?	3. The areas between the anchor blocks were too narrow to compact using mechanical means (heavy equipment) and were compacted by hand during the OLF stabilization project. There is no suggestion of a potential water path in these areas that could have resulted in the depressions. The depressions were very minor and were filled in by hand. The depressions have not reappeared, but staff will continue to monitor these areas during OLF inspections and determine the best response should further soil movement be identified.
Remedial Action Objectives	1. Components of the prescribed remedy are not functioning as intended and additional efforts and resources are required to meet the RAOs outlined in the CAD/ROD.	1. As stated in EPA guidance (EPA 2001), the FYR should include an evaluation of remedy performance (assessed in Question A of this FYR report; Section 6.1.) and a determination of the validity of RAOs (assessed in Question B of this FYR report; Section 6.2). Depending on the outcome of this evaluation, it may be necessary to modify the RAOs, modify the remedy, or conduct further response actions. The fact that an RAO is not currently being met, however, does not necessarily compel action. For example, the 2006 CAD/ROD acknowledged that residual concentrations of VOCs in groundwater in some areas "are likely to persist in the environment at Rocky Flats for decades to hundreds of years" (DOE, EPA, CDPHE 2006). The CAD/ROD recognized that the Groundwater RAO 2 (see Table 2 of this FYR report) may not be achieved for some time. The RFLMA consultative process provides the mechanism for the identification of data needs and allows for the collection of additional information to support evaluation of site conditions (e.g., POC exceedances). This information and evaluation may lead, if appropriate, to additional future activities to assist in meeting RAOs. Section 6.2.3 and Table 2 of this FYR report contain a detailed discussion of the status of each RAO and DOE activities associated with that RAO. While not all RAOs have been met at the site, the RAOs remain valid, as determined in this FYR.
Emerging Contaminants (PFAS)	1. RFP operations included many potential sources of PFOA and PFOS. When will these locations be evaluated for PFOA/PFOS?	1. PFOA and PFOS are part of a larger group of chemicals known as PFAS. The current PFAS sample locations do not represent every possible source of PFAS at the site. Their selection was tailored to areas with the highest potential for PFAS based on historical site operations, interviews with former RFP fire department personnel, and industry-wide knowledge of potential PFAS sources (e.g., landfills). These locations were approved by CDPHE and EPA as screening locations that would provide an indication of the presence or absence of PFAS at the site. DOE has committed to a minimum of eight quarters of PFAS water sampling at 12 locations. In addition to analyzing for PFOA and PFOS, DOE has volunteered to analyze groundwater and surface water samples for an additional 20+ types of PFAS chemicals. Once these data are collected, DOE will consult with CDPHE and EPA on the need for additional action at the site.
	2. When will a CR for PFOA/PFOS be published?	2. Under CDPHE's RCRA/Colorado Hazardous Waste Act (CHWA) authority, the regulatory decision(s) regarding PFAS are documented via letter (CDPHE 2021a), with detailed information in the 2021 Rocky Flats Sampling and Analysis Plan (SAP) for upcoming PFAS sampling and analysis efforts. CDPHE believed this decision was best captured by the state in letter format. As a result, a CR for the currently-implemented SAP will not be prepared because a regulatory decision has already been made in the CDPHE letter.
	3. When is the PFOA/PFOS investigation expected to be completed and when will the public be informed of any PFOA/PFOS corrective action measures?	3. As noted in CDPHE's April 22, 2021, letter, "While the nature and extent of PFAS contamination at Rocky Flats has not been completely delineated, CDPHE is not currently requiring corrective action in light of the relatively low levels at both points of compliance, and the protections afforded by the Restrictive Notice." DOE is performing expanded quarterly sampling under the new PFAS SAP. At this time, the agencies' mutual goal is to collect an expanded PFAS dataset with greater sampling event frequency over time to further delineate nature and extent. Sampling locations near multiple potential sources of different types of PFAS chemicals were selected by the RFLMA parties. PFAS is also being discussed as part of the CERCLA FYR dialogue with CDPHE and EPA regulators (Section 6.2.2.3).
	4. Is Rocky Flats subject to the decision of the Colorado WQCC and regulation of the Colorado Hazardous Waste Regulation, Part 261, within the jurisdiction of CDPHE regarding PFOA, PFOS, and its anions and not only the RFLMA?	4. The Rocky Flats Site is subject to CERCLA and RCRA/CHWA, including Colorado Hazardous Waste Regulations Part 261. Specific provisions of the RCRA/CHWA regulations and the WQCC surface water regulations at 5 CCR 1002-31 (basic standards) and 5 CCR 1002-38 (site-specific standards) are ARARs established in the 2006 CAD/ROD and are applicable to the RFS.

Group Topic	Input Summary	Response
Emerging Contaminants (1,4-dioxane)	1. Evidence indicates that the former Rocky Flats Nuclear Weapons Plant utilized and maintained an inventory of 1,4-dioxane that was utilized in conjunction with a Rocky Flats contaminant of concern, 1,1,1-trichloroethane (TCA). Why did DOE decide not to sample and analyze for 1,4-dioxane after the standard was established in 2009 and became more stringent in 2012 and how is this inaction protective of the remedy? What assurances exist that dioxane is not present, at the more stringent standard, when LM does not sample and analyze dioxane? A RFLMA CR for the December 22, 2009 RFLMA Attachment 2 modification is not readily available on the DOE website for RFS, a RFLMA requirement. Is the December 22, 2009 modification a monitoring requirement or not?	1. The surface water and groundwater to be monitored at the former RFP following closure were determined in the 2006 CAD/ROD, based on the results of the RI/FS (DOE 2006). Monitoring frequency and sample analyses are prescribed in Table 2, *Water Monitoring Locations and Sampling Criteria* of Attachment 2 to RFLMA. 1,4-dioxane was not determined to be an analyte of interest (AOI) in the RI/FS or a COC in the CRA. The original list of analytes was included in Table 1, *Surface Water Standards* of Attachment 2 to RFLMA when the agreement was signed in 2007. The list came from a number of sources, including State of Colorado surface water quality standards and cleanup action levels for accelerated actions established in the Rocky Flats Cleanup Agreement. An extensive effort was not made at the time to tailor the list of analytes to expected postclosure site conditions. Since that time, modifications to Table 1 have been limited to updating changes in surface water standards. The 2009 1,4-dioxane standard change was adopted via a December 22, 2009, letter from DOE to CDPHE (available at https://lmpublicsearch.lm.doe.gov/SitePages/CERCLA.aspx?sitename=Rocky_Flats [Administrative Record document number PD-A-000200]). In 2018 DOE, CDPHE, and EPA completed a comprehensive review of the analyte list and standards included in Table 1. CR 2018-05 outlines the process utilized by the RFLMA parties to evaluate analytes on this table. In accordance with this process, the only analytes removed from Table 1 were those that met both of the following criteria: (1) the analyte was not considered an AOI in the RI/FS or a COC in the CRA and (2) the analyte was not detected in the postclosure dataset or no postclosure data were available (i.e., these were not targeted analytes and, therefore, no postclosure samples were analyzed for these analytes). Although 1,4-dioxane had been listed in Table 1 since RFLMA was signed in 2007, it was not identified as an AOI or COC and had not been analyzed in postclosure monitoring samples because it was not a targeted analyte. As a result, in December 2018, the RFLMA parties agreed to remove 1,4-dioxane from Table 1 (see CR 2018-05 in Appendix D of this FYR report).
Climate Change	1. Due to the unpredictable nature of climate change, floods and other natural disasters threaten to erode the soil at Rocky Flats. The increasing incidence of drought in Colorado will increase the incidence of wildfires, which could release hot radioactive particles into the air and downwind areas.	1. DOE provided a presentation titled, "Climate Change Resilience at the Rocky Flats Site, Colorado" at the May 3, 2021, RFSC meeting. This presentation is summarized in Section 6.3 of this FYR report and is available on the LM website. This presentation touched on the potential impacts of drought and wildfires at the site. In response to recent wildfires in the area of the RFS, DOE has developed a webpage to provide public information on RFS wildland fire management (Rocky Flats Wildland Fire Information | Department of Energy). DOE also initiated a nationwide assessment of DOE sites and their susceptibility to climate change impacts. It is expected that this nationwide assessment will be completed in the fall of 2022. Resilience plans are anticipated to be developed and implemented based on the assessments.
Accelerated Cleanup	1. The protocols and cleanup standards applied during accelerated actions at the RFP were insufficient, and the cleanup was incomplete.	1. The former RFP was investigated and remedies were selected in compliance with the Rocky Flats Cleanup Agreement (RFCA), which served as both a federal facilities agreement under CERCLA and a consent order under CHWA. This agreement was signed by DOE, EPA, and CDPHE in 1996. The RFCA prescribed an accelerated closure process based on applicable environmental regulations and close consultation among the agencies. For example, the surface soil action levels in the agreement were calculated using protective methodologies based on a lifetime excess cancer risk of 1 in 100,000 for a WRW. For comparison, the normal lifetime cancer risk in the United States is approximately one in three (1 in 3). When exceeded, these action levels triggered removal actions. Plutonium was one of the primary contaminants of concern in surface soil at the former RFP; for plutonium, a 1 in 100,000 carcinogenic risk was calculated to be equivalent to 116 pCi/g of plutonium in soil. After discussions with community officials, DOE, EPA, and CDPHE further reduced the surface soil action level for plutonium to 50 pCi/g. Following remediation, residual plutonium concentrations in surface soil were below action levels. The final remedy in the CAD/ROD was based on the RI/FS report, which included a comprehensive risk assessment that evaluated both human and ecological risks. The remedy chosen in the 2006 CAD/ROD conformed to state and federal environmental regulations. As stated in the CAD/ROD, the selected remedy consists of institutional and physical controls with surface water and groundwater monitoring, including ongoing treatment of groundwater at the existing groundwater treatment systems and landfill cover maintenance at the two landfills.

Group Topic	Input Summary	Response
Air Monitoring	1. Conduct air and dust monitoring within the COU.	1. Monitoring of airborne contaminants was not required by the CAD/ROD as part of the final remedy for the COU because substantial, relevant data on air quality at and near the former RFP had been gathered previously and for a number of years. Ambient air monitoring began when the RFP began operating in 1952; large-scale, continuous ambient air monitoring began in 1971. DOE conducted both effluent monitoring (e.g., measuring stack and building air contaminant emissions) and ambient air monitoring to demonstrate regulatory compliance, as well as to monitor fugitive particulate radionuclide emissions from decommissioning, remediation, and demolition operations. CDPHE also operated an ambient particulate radionuclide air-monitoring network inside the RFP boundary and a network of five ambient nonradioactive pollutant air monitors at the site perimeter. During closure, DOE and the regulatory agencies monitored air quality around demolition and cleanup activities to ensure that air quality standards and radiation limits for workers and the public were not exceeded. In 1989, federal regulations were issued for the protection of the public from radioactive air emissions from DOE facilities (40 CFR 61, Subpart H). These regulations, the “National Emission Standards for Emissions of Radionuclides Other than Radon From Department of Energy Facilities” (Rad NESHAP), limit annual dose to any member of the public to 10 mrem/year through the air pathway. The dose from radionuclide air emissions (plutonium, americium, and uranium) at the RFP never exceeded this limit. Based on historical ambient air monitoring, the annual dose to the public during both RFP operation and closure was consistently less than 3% of the annual standard. This includes the period of active demolition and remediation at the site, when the highest levels of dust emissions would have been generated. During site cleanup, the maximum radiation dose from the site to any member of the public through the air pathway was less than 1 mrem/year. For comparison, 1 mrem/year is comparable to the dose received from traveling 1000 miles by plane or watching television. To put this into context, the average annual dose to a person in the United States due to all sources is 620 mrem, including both natural sources of radiation and medical tests. With completion of accelerated actions in 2005, all point sources of radioactive air emissions (e.g., building stacks and vents) had been eliminated and nonpoint (diffuse) sources had been significantly reduced by remediation of contaminated soil. Subsequent revegetation of all disturbed areas further stabilized soils and reduced diffuse source emissions. The CAD/ROD acknowledged that the resuspension of residual radioactive contaminants attached to surface soil particles would remain a potential source of ongoing air emissions at the site (DOE, EPA, and CDPHE 2006). However, air dispersion modeling conducted during and following accelerated actions concluded that the resulting dose to a member of the public from these diffuse sources would still be much less than the 10 mrem/year federal standard (DOE 2006). The CAD/ROD concluded, "With completion of all accelerated actions and the attendant removal of all historical air emissions sources except for wind erosion of the minor, remnant contamination in surface soils, future air emissions from the site will be less than those in the past" (and past emissions were consistently less than 3% of the standard). After demonstrating that the federal standard was not exceeded for many years before, during, and after site cleanup, DOE sampling was terminated in 2007. CDPHE discontinued air monitoring in 2005.
Refuge	1. Stakeholders are concerned about risks from plutonium in soil inside the Refuge and along the Indiana Street corridor. The plutonium originating from Rocky Flats is found in two distinct forms: a) plutonium that is dispersed relatively uniformly on the surfaces of all the soil particles, and b) “hot particles” of essentially pure plutonium dioxide. The results of soil samples since 2016 show that more thorough soil sampling is needed on the Rocky Flats Refuge, with a particular focus on identifying “hot particles” of plutonium. The results of these studies must be taken into consideration before any further development on the RFS.	1. The selected remedy for the POU (Rocky Flats National Wildlife Refuge) in the CAD/ROD is no action. The National Oil and Hazardous Substances Pollution Contingency Plan provides for the selection of a no action remedy when an OU is in a protective state and, therefore, no remedial action for the POU is warranted (DOE, EPA, and CDPHE 2006). The Refuge and the Indiana Street corridor are not located within the COU and are not under DOE management. As such, the remedy implemented in the COU does not apply to these locations. The lands that constitute the Refuge and the Indiana Street corridor were previously part of the POU, which was under DOE management until 2007, when much of the land area comprising the POU was transferred to USFWS to establish the Refuge. The lands comprising the POU were determined to be suitable for any use (i.e., UU/UE) and were deleted from the NPL. This means that there are no restrictions on the use of the Refuge; it may be used for any activity (i.e., under any exposure scenario). Soil data collection is not required because the data available at the time of the final remedy decision showed that contaminant levels in soils in the POU were below risk-based regulatory levels that would have required remediation or restrictions. Therefore, site conditions on the Refuge are protective of the public, and soil monitoring is not necessary. As summarized in Appendix C, Section C3.3, soil samples were collected by the USFWS and Jefferson Public Parkway Highway Authority in 2019 and 2020 on the Refuge and along the transportation corridor. CDPHE performed a dose assessment using these data and concluded that “remaining Rocky Flats plutonium in the Jefferson Parkway transportation corridor and offsite poses a small risk, well within regulatory limits for radiation. This conclusion is consistent with previous findings and the cleanup process.” (CDPHE 2020; CDPHE 2021b).
	2. Stakeholders expressed concern about importing prairie dogs to the Refuge, as their digging below the surface soils can unearth contaminated soil and bring higher concentrations of radioactive particles to the surface.	2. There is no subsurface contamination related to RFS operations on the Refuge. The introduction of prairie dogs to the Refuge was evaluated in the USFWS *Rocky Flats National Wildlife Refuge, Final Comprehensive Conservation Plan and Environmental Impact Statement* (September 2004). The COU is monitored for prairie dog activity. If prairie dogs move into the COU, DOE will evaluate and develop a plan of action as appropriate.
	3. Detailed and comprehensive signage is needed at all entrances to the Refuge, informing visitors of any and all risks of exposure to the radionuclides present on the site.	3. The Rocky Flats National Wildlife Refuge is managed by the USFWS, which establishes signage requirements at the Refuge entrances. To ensure that the COU boundary is more clearly identified to Refuge visitors, DOE posted additional warning signs around the COU perimeter in early 2022. These signs supplement the existing signs around the COU boundary that are part of the remedy (see Section 6.1.1).