ROCKY FLATS STEWARDSHIP COUNCIL

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Jefferson County ~ Boulder County ~ City and County of Broomfield ~ City of Arvada ~ City of Boulder
City of Golden ~ City of Northglenn ~ City of Thornton ~ City of Westminster ~ Town of Superior
League of Women Voters ~ Rocky Flats Cold War Museum ~ Rocky Flats Homesteaders
Steven Franks

Board of Directors Meeting – Agenda

Monday, October 31, 2016, 8:30 AM – 12:00 PM

Rocky Mountain Metropolitan Airport, Terminal Building, Mount Evans Room
11755 Airport Way, Broomfield, Colorado

8:30 AM Convene/Introductions/Agenda Review

8:35 AM Chairman's Review of October 6, 2016, Executive Committee meeting

8:40 AM Business Items

1. Consent Agenda (briefing memo attached)
   - Approval of contract amendment, meeting minutes and checks

2. Executive Director's Report

8:50 AM Public Comment

9:00 AM Board Approval of 2017 Work Plan (briefing memo attached)
- The Board reviewed the draft 2017 Work Plan at the September meeting.
- The three changes from the draft plan that the Board reviewed at the September meeting are noted using track changes.

Action item: Approve 2017 Work Plan

9:05 AM Board Approval of 2017 Budget (briefing memo attached)
- The Board reviewed the draft budget at the September meeting.
- The only change that has been made to the budget document is to increase 2017 anticipated expenditures to account for the contract amendment. No changes were offered or otherwise made.
- Prior to finalizing the budget, the Board must hold a budget hearing and allow time for public comment.
- Following the public hearing, the Board must approve the budget resolution.

Action Item: Hold fiscal year 2017 budget hearing and approve resolution adopting the budget

9:15 AM Host DOE Quarterly Meeting (briefing memo attached)

- DOE will brief the Stewardship Council on site activities for the second quarter of 2016 (April – June).
- DOE has posted the report on its website and will provide a summary of its activities to the Stewardship Council.
- Activities include surface water monitoring, groundwater monitoring, ecological monitoring, and site operations.

10:15 AM Briefing on the Actinide Migration Evaluation and Associated Questions (briefing memo attached)

- Actinide migration concerns the movement of plutonium, americium and uranium in the environment at Rocky Flats.
- The Actinide Migration Evaluation (AME) was commissioned to address how actinide elements move in the environment at Rocky Flats.
- Understanding how actinides move in the environment is central to the cleanup and long-term protection strategies.
- The briefing will also address DOE and CDPHE's decision to cease air quality monitoring and why DOE does not continue to sample soils.

11:45 AM Public comment

11:55 AM Board Roundtable – Big Picture/Additional Questions/Issue Identification

Adjourn

Next Meetings: October 31st (4th Monday of month)
February 6, 2017

Acronym or Term	Means	Definition
Alpha Radiation		A type of radiation that is not very penetrating and can be blocked by materials such as human skin or paper. Alpha radiation presents its greatest risk when it gets inside the human body, such as when a particle of alpha emitting material is inhaled into the lungs. Plutonium, the radioactive material of greatest concern at Rocky Flats, produces this type of radiation.
Am	americium	A man-made radioactive element which is often associated with plutonium. In a mass of Pu, Am increases in concentration over time which can pose personnel handling issues since Am is a gamma radiation-emitter which penetrates many types of protective shielding. During the production era at Rocky Flats, Am was chemically separated from Pu to reduce personnel exposures.
AME	Actinide Migration Evaluation	An exhaustive years-long study by independent researchers who studied how actinides such as Pu, Am, and U move through the soil and water at Rocky Flats
AMP	Adaptive Management Plan	Additional analyses that DOE is performing beyond the normal environmental assessment for breaching the remaining site dams.
AOC well	Area of Concern well	A particular type of groundwater well
B	boron	Boron has been found in some surface water and groundwater samples at the site
Be	beryllium	A very strong and lightweight metal that was used at Rocky Flats in the manufacture of nuclear weapons. Exposure to beryllium is now known to cause respiratory disease in those persons sensitive to it
Beta Radiation		A type of radiation more penetrating than alpha and hence requires more shielding. Some forms of uranium emit beta radiation.

BMP	best management practice	A term used to describe actions taken by DOE that are not required by regulation but warrant action.
BZ	Buffer Zone	The majority of the Rocky Flats site was open land that was added to provide a "buffer" between the neighboring communities and the industrial portion of the site. The buffer zone was approximately 6,000 acres. Most of the buffer zone lands now make up the Rocky Flats National Wildlife Refuge.
CAD/ROD	corrective action decision/record of decision	The complete final plan for cleanup and closure for Rocky Flats. The Federal/State laws that governed the cleanup at Rocky Flats required a document of this sort.
CCP	Comprehensive Conservation Plan	The refuge plan adopted by the U.S. Fish and Wildlife Service in 2007.
CDPHE	Colorado Department of Public Health and Environment	State agency that regulates the site.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	Federal legislation that governs site cleanup. Also known as the Superfund Act
cfs	cubic feet per second	A volumetric measure of water flow.
COC	Contaminant of Concern	A hazardous or radioactive substance that is present at the site.
COU	Central Operable Unit	A CERCLA term used to describe the DOE-retained lands, about 1,500 acres comprised mainly of the former Industrial Area where remediation occurred
CR	Contact Record	A regulatory procedure where CDPHE reviews a proposed action by DOE and either approves the proposal as is or requires changes to the proposal before approval. CRs apply to a wide range of activities performed by DOE. After approval the CR is posted on the DOE-LM website and the public is notified via email.
Cr	chromium	Potentially toxic metal used at the site.
CRA	comprehensive risk assessment	A complicated series of analyses detailing human health risks and risks to the environment (flora and fauna).

D&D	decontamination and decommissioning	The process of cleaning up and tearing down buildings and other structures.
DG	discharge gallery	This is where the treated effluent of the SPPTS empties into North Walnut Creek.
DOE	U.S. Department of Energy	The federal agency that manages portions of Rocky Flats. The site office is the Office of Legacy Management (LM).
EA	environmental assessment	Required by NEPA (see below) when a federal agency proposes an action that could impact the environment. The agency is responsible for conducting the analysis to determine what, if any, impacts to the environment might occur due to a proposed action.
EIS	environmental impact statement	A complex evaluation that is undertaken by a government agency when it is determined that a proposed action by the agency may have significant impacts to the environment.
EPA	U.S. Environmental Protection Agency	The federal regulatory agency for the site.
EEOICPA	energy employees occupational illness compensation program act	This act was passed by Congress in 2000 to compensate sick nuclear weapons workers and certain survivors. Unfortunately the program has been fraught with difficulties in getting benefits to these workers over the years.
ETPTS	east trenches plume treatment system	The treatment system near the location of the east waste disposal trenches which treats groundwater contaminated with organic solvents emanating from the trenches. Treated effluent flows into South Walnut Creek.
FC	functional channel	Man-made stream channels constructed during cleanup to help direct water flow.
FACA	Federal Advisory Committee Act	This federal law regulated federal advisory boards. The law requires balanced membership and open meetings with published Federal Register meeting dates.
Gamma Radiation		This type of radiation is very penetrating and requires heavy shielding to keep it from exposing people. Am is a strong gamma emitter.
GAO	Government Accountability Office	Congressional office which reports to Congress. The GAO did 2 investigations of

		Rocky Flats relating to the ability to close the site for a certain dollar amount and on a certain time schedule. The first study was not optimistic while the second was very positive.
g	gram	metric unit of weight
gpm	gallons per minute	A volumetric measure of water flow in the site's groundwater treatment systems and other locations.
GWIS	groundwater intercept system	Refers to a below ground system that directs contaminated groundwater toward the Solar Ponds and East Trenches treatment systems.
IA	Industrial Area	Refers to the central core of Rocky Flats where all production activities took place. The IA was roughly 350 of the total 6,500 acres at the site.
IC	Institutional Control	ICs are physical and legal controls geared towards ensuring the cleanup remedies remain in place and remain effective.
IGA	intergovernmental agreement	A cooperative agreement between local governments which sets up the framework of the Stewardship Council.
IHSS	Individual Hazardous Substance Site	A name given during cleanup to a discrete area of known or suspected contamination. There were over two hundred such sites at Rocky Flats.
ITPH	interceptor trench pump house	The location where contaminated groundwater collected by the interceptor trench is pumped to either the Solar Ponds and East Trenches treatment systems
L	liter	Metric measure of volume, a liter is slightly larger than a quart.
LANL	Los Alamos National Laboratory	One of the US government's premier research institutions located near Santa Fe, NM. LANL is continuing to conduct highly specialized water analysis for Rocky Flats. Using sophisticated techniques LANL is able to determine the percentages of both naturally-occurring and man-made uranium which helps to inform water quality decisions.
LHSU	lower hydrostratigraphic unit	Hydrogeology term for deep unweathered bedrock which is hydraulically isolated from the upper hydrostratigraphic unit (see

		UHSU). Data shows that site contaminants have not contaminated the LHSU.
LM	Legacy Management	DOE office responsible for overseeing activities at closed sites.
LMPIP	Legacy Management Public Involvement Plan	This plan follows DOE and EPA guidance on public participation and outlines the methods of public involvement and communication used to inform the public of site conditions and activities. It was previously known as the Post-Closure Public Involvement Plan (PCPIP).
M&M	monitoring and maintenance	Refers to ongoing activities at Rocky Flats.
MOU	Memorandum of Understanding	MOU refers to the formal agreement between EPA and CDPHE which provides that CDPHE is the lead post-closure regulator with EPA providing assistance when needed.
MSPTS	Mound site plume treatment system	The treatment system for treating groundwater contaminated with organic solvents which emanates from the Mound site where waste barrels were buried. Treated effluent flows into South Walnut Creek.
NEPA	National Environmental Policy Act	Federal legislation that requires the federal government to perform analyses of environmental consequences of major projects or activities.
nitrates		Contaminant of concern found in the North Walnut Creek drainage derived from Solar Ponds wastes. Nitrates are very soluble in water and move readily through the aquatic environment
Np	neptunium	A man-made radioactive isotope that is found as a by-product of nuclear reactors and plutonium production.
NPL	National Priorities List	A listing of Superfund sites. The refuge lands were de-listed from the NPL while the DOE-retained lands are still on the NPL due to ongoing groundwater contamination and associated remediation activities.
OLF	Original Landfill	Hillside dumping area of about 20 acres which was used from 1951 to 1968. It underwent extensive remediation with the

		addition of a soil cap and groundwater monitoring locations.
OU	Operable Unit	A term given to large areas of the site where remediation was focused.
PCE	perchloroethylene	A volatile organic solvent used in past operations at the site. PCE is also found in environmental media as a breakdown product of other solvents.
pCi/g	picocuries per gram of soil	A unit of radioactivity measure. The soil cleanup standard at the site was 50 pCi/g of soil.
pCi/L	picocuries per liter of water	A water concentration measurement. The State of Colorado has a regulatory limit for Pu and Am which is 0.15 pCi/L of water. This standard is 100 times stricter than the EPA's national standard.
PLF	Present Landfill	Landfill constructed in 1968 to replace the OLF. During cleanup the PLF was closed under RCRA regulations with an extensive cap and monitoring system.
PMJM	Preble's Meadow Jumping Mouse	A species of mouse found along the Front Range that is on the endangered species list. There are several areas in the Refuge and COU that provide an adequate habitat for the mouse, usually found in drainages. Any operations that are planned in potential mouse habitat are strictly controlled.
POC	Point of Compliance (surface water)	A surface water site that is monitored and must be found to be in compliance with federal and state standards for hazardous constituents. Violations of water quality standards at the points of compliance could result in DOE receiving financial penalties.
POE	Point of Evaluation (surface water)	These are locations at Rocky Flats at which surface water is monitored for water quality. There are no financial penalties associated with water quality exceedances at these locations, but the site may be required to develop a plan of action to improve the water quality.
POU	Peripheral Operable Unit	A CERCLA term used to describe the Wildlife Refuge lands of about 4,000 acres.

Pu	plutonium	Plutonium is a metallic substance that was fabricated to form the core or "trigger" of a nuclear weapon. Formation of these triggers was the primary production mission of the Rocky Flats site. Pu-239 is the primary radioactive element of concern at the site. There are different forms of plutonium, called isotopes. Each isotope is known by a different number. Hence, there are plutonium 239, 238, 241 and others.
RCRA	Resource Conservation and Recovery Act	Federal law regulating hazardous waste. In Colorado, the EPA delegates CDPHE the authority to regulate hazardous wastes.
RFCA	Rocky Flats Cleanup Agreement	The regulatory agreement which governed cleanup activities. DOE, EPA, and CDPHE were signors.
RFCAB	Rocky Flats Citizen Advisory Board	This group was formed as part of DOE's site-specific advisory board network. They provided community feedback to DOE on a wide variety of Rocky Flats issues from 1993-2006.
RFCLOG	Rocky Flats Coalition of Local Governments	The predecessor organization of the Rocky Flats Stewardship Council
RFETS	Rocky Flats Environmental Technology Site	The moniker for the site during cleanup years.
RFLMA	Rocky Flats Legacy Management Agreement	The post-cleanup regulatory agreement between DOE, CDPHE, and EPA which governs site activities. The CDPHE takes lead regulator role, with support from EPA as required.
RFNWR	Rocky Flats National Wildlife Refuge	The approximate 4,000 acres which compose the wildlife refuge.
RFSOG	Rocky Flats Site Operations Guide	The nuts-and-bolt guide for post-closure site activities performed by DOE and its contractors.
SEP	Solar Evaporation Ponds	In the 1950's when the site's liquid waste treatment capability was surpassed by the liquid waste generation rate, the site resulted to transferring liquid wastes to open-air holding ponds where solar energy was utilized to evaporate and concentrate the waste. The original SEPs were not impermeable and substantial quantities of uranium and nitrates made their way into

		groundwater. As a result the solar ponds plume treatment system was necessary to treat the contaminated groundwater before it emerged as surface water in North Walnut Creek.
SPPTS	solar ponds plume treatment system	System used to treat groundwater contaminated with uranium and nitrates. The nitrates originate from the former solar evaporation ponds which had high levels of nitric acid. The uranium is primarily naturally-occurring with only a slight portion man-made. Effluent flows into North Walnut Creek
SVOCs	semi-volatile organic compounds	These compounds are not as volatile as the solvent VOCs. They tend to be similar to oils and tars. They are found in many environmental media at the site. One of the most common items to contain SVOCs is asphalt.
TCE	trichloroethlyene	A volatile organic solvent used in past operations at the site. TCE is also found in environmental media as a breakdown product of other solvents.
U	uranium	Naturally occurring radioactive element. There were two primary isotopes of U used during production activities. The first was enriched U which contained a very high percentage (>90%) of U-235 which was used in nuclear weapons. The second isotope was U-238, also known as depleted uranium. This had various uses at the site and only had low levels of radioactivity.
UHSU	upper hydrostratigraphic unit	A hydrogeology term describing the surficial materials and weathered bedrock found at Rocky Flats. The UHSU is hydraulically isolated from the lower hydrostratigraphic unit (see LHSU). Groundwater in some UHSU areas of the site is contaminated with various contaminants of concern while groundwater in other UHSU areas is not impacted. All groundwater in the UHSU emerges to surface water before it leaves the site.

USFWS	United States Fish & Wildlife Service	An agency within the US Department of the Interior that is responsible for maintaining the nation-wide system of wildlife refuges, among other duties. The regional office is responsible for the RFNWR.
VOC	volatile organic compound	These compounds include cleaning solvents that were used in the manufacturing operations at Rocky Flats. The VOCs used at Rocky Flats include carbon tetrachloride (often called carbon tet), trichloroethene (also called TCE), perchloroethylene (also called PCE), and methylene chloride.
WCRA	Woman Creek Reservoir Authority	This group is composed of the three local communities, the Cities of Westminster, Northglenn, and Thornton, who use Stanley Lake as part of their drinking water supply network. Water from the site used to flow through Woman Creek to Stanley Lake but the reservoir severed that connection. The Authority has an operations agreement with DOE to manage the Woman Creek Reservoir.
WQCC	Water Quality Control Commission	State board within CDPHE tasked with overseeing water quality issues throughout the state. DOE has petitioned the WQCC several times in the last few years regarding water quality issues.
ZVI	zero valent iron	A type of fine iron particles used to treat VOC's in the ETPTS and MSPTS.

Business Items

- Cover memo
- Contract amendment:
    - Cover memo
    - Contract amendment
    - Contract
- September 12, 2016, draft board meeting minutes
- List of Stewardship Council checks

ROCKY FLATS STEWARDSHIP COUNCIL

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MEMORANDUM

TO: Board of Directors
FROM: David Abelson
SUBJECT: Business Items
DATE: October 18, 2016

In addition to the minutes and checks, the consent agenda includes a contract amendment for Crescent Strategies, LLC.

Attached to this memo is a memo from Barb Vander Wall, the Stewardship Council's attorney, and a proposed contract amendment. The two changes being proposed are to increase my fee by 10% per year, and update the work scope. All others terms would remain unchanged. This fee increase will be the first for me since we signed the contract in 2007. We increased Rik Getty's portion of the fee at the June 2015 meeting.

Should the Board agree and accept the contract amendment, the amendment will take effect January 1, 2017.

Please let me know what questions you have. Barb is also available to discuss any legal issues.

Action Item: Adopt Consent Agenda

Seter & Vander Wall, P.C.
ATTORNEYS AT LAW

KIM J. SETER
BARBARA T. VANDER WALL
JEFFREY E. ERB
COLIN B. MIELKE
RUSSELL NEWTON
CAMERON J. RICHARDS

MEMORANDUM

TO: Board of Directors, Rocky Flats Stewardship Council

FROM: Barbara T. Vander Wall, Seter & Vander Wall, P.C.

DATE: September 28, 2016

RE: Second Amendment to Agreement for Executive Director / Technical Consulting Services

Background of Agreement:

The Rocky Flats Stewardship Council entered into an agreement with Crescent Strategies, LLC on November 6, 2007 for executive director and technical consulting services ("Agreement"). David Abelson is the principal of Crescent Strategies, LLC. Crescent Strategies engages the technical consulting services of Rik Getty. The Agreement established compensation for services in the fixed amount of $6,000 per month, plus the costs for technical services in the fixed amount of $850 per month, for a total of $6,850 per month. The Agreement was annually renewed without modification, through 2015.

First Amendment to Agreement:

In 2015, the Board approved the First Amendment to the Agreement, effective June 1, 2015. The First Amendment implemented an increase in the costs for technical services in the additional amount of $300 per month, required to retain the technical service provided by Rik Getty. The new total technical services costs amount was increased from $850 to $1,150.

Proposed Second Amendment to Agreement:

Crescent Strategies is now requesting the Stewardship Council approve an increase in the compensation for services. The compensation for the non-technical services is proposed to be increased by 10%, from $6,000 to $6,600 per month. The total compensation, including the technical services costs, would be $7,750 per month. The net change in the annual financial obligation over a 12 month period is $7,200, or an increase from $85,800 to $93,000.

In addition, the Exhibit A Scope of Services has been reviewed and updated to make changes consistent with the services currently being provided. The Recitals to the Second Amendment have been drafted to update and reflect the current parties to the Rocky Flats Stewardship Council.

All other obligations and commitments of the parties continue as provided in the original Agreement. The Agreement is drafted to take effect as of January 1, 2017.

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SECOND AMENDMENT TO AGREEMENT
FOR
EXECUTIVE DIRECTOR/ TECHNICAL CONSULTING SERVICES

THIS SECOND AMENDMENT TO AGREEMENT ("Amendment") is entered into effective the 1st day of January, 2017 by and between the **ROCKY FLATS STEWARDSHIP COUNCIL**, a separate legal, public entity, created by intergovernmental agreement (as permitted by Colo. Const. Art. XIV, and section 18(2), part 2 of article 1, title 29, C.R.S.) (the "Stewardship Council"), and **CRESCENT STRATEGIES, LLC,** a Colorado limited liability company (the "Consultant").

RECITALS

WHEREAS, the Stewardship Council was created by an intergovernmental agreement effective February 13, 2006, as modified by First Amendment dated February 6, 2012 (collectively, the "IGA"), by and among Boulder County, Jefferson County, the City of Arvada, the City of Boulder, the City and County of Broomfield, the City of Westminster, the Town of Superior, the City of Golden, the City of Northglenn, and the City of Thornton, created to allow local governments to work together on issues related to the long-term protection of Rocky Flats; and

WHEREAS, the Stewardship Council entered into an agreement with Consultant, dated November 6, 2007, as modified by a First Amendment dated June 1, 2015 (collectively, the "Agreement"), for executive director and technical services in order to manage the Stewardship Council's activities, as described therein (the "Services"); and

WHEREAS, in providing the Services under the Agreement, the Consultant has made available the specialized skills and services of the individuals David Abelson and Rik Getty, who have unique familiarity and knowledge of Rocky Flats, as well as the Stewardship Council, and their purposes, which familiarity is not available through any other source; and

WHEREAS, the Consultant has advised that the expenses required to continue to perform the non-technical portion of the Services have increased since the Agreement was originally approved; and

WHEREAS, the Consultant desires to increase the allowable compensation under the Agreement; and

WHEREAS, the Stewardship Council desires to allow for an increase in compensation to assure the continuation of the Consultant's Services; and

WHEREAS, the Stewardship Council has also identified a need for certain changes to be made to the Scope of Services to be performed by the Consultant since the Agreement was originally approved, and the Consultant agrees that such changes are appropriate;

NOW THEREFORE, in consideration of the foregoing recitals and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Stewardship Council and Consultant agree as follows:

COVENANTS AND AGREEMENTS

1. SCOPE OF SERVICES. Paragraph 1 of the Agreement shall be revised to modify the description of the Services as shown below:

> The Consultant shall be responsible for performing all things stated in the Scope of Services attached as ***Amended Exhibit A*** in connection with the provision of executive director and technical services (collectively referred to as the "Services"), as desired by the Stewardship Council. The Consultant shall perform such Services as set forth herein, and as may be directed, from time to time, by the Stewardship Council in accordance with ***Amended Exhibit A***, using that degree of skill and knowledge customarily employed by others performing similar services in the United States. The parties acknowledge that Consultant may employ the services of Rik Getty to perform the "technical" portion of Consultant's Services.

All other references to "Exhibit A" in the Agreement shall be modified to read "Amended Exhibit A."

2. COMPENSATION. Paragraph 4 of the Agreement shall be revised by $600 per month to increase the compensation for the Services from the total fixed monthly amount of $7,150 to the revised total amount of $7,750, as shown below:

> In consideration of the performance of the Services, following the submittal of a satisfactory invoice, the Stewardship Council shall pay Consultant the fixed amount of ***$6,600*** per month, plus the costs for the technical services performed by Rik Getty, at the fixed amount of $1,150 per month. In addition, the Stewardship Council shall provide reimbursement of eligible direct costs, not to exceed the amount of $250 per month without prior Board approval, except as noted below. Only actual costs incurred shall be funded pursuant to this Agreement. Actual direct costs incurred by Consultant in connection with the Services which are eligible for reimbursement include consumable supplies, meeting expenses, postage, printing, delivery services, mileage reimbursement (paid at the federally imposed per mile rate), and telecommunications (fax, internet and telephone) charges. Costs for any out-of-state travel require prior approval by the Stewardship Council, through its Chair or Vice-Chair. In the event that Additional Services are requested, the Stewardship Council will compensate the Consultant for such services in an amount mutually agreeable to the parties.

3. PRIOR PROVISIONS. Except as amended herein, all provisions set forth in the Agreement and its exhibits shall remain in full force and effect.

IN WITNESS WHEREOF, the parties have executed this Second Amendment to Agreement for Executive Director / Technical Consulting Services as of the date first above written.

ROCKY FLATS STEWARDSHIP COUNCIL

By: _____

Lisa Morzel, Chair

Attest:

_____

Jeannette Hillery, Secretary

CRESCENT STRATEGIES, LLC, a Colorado limited liability company

By: _____

David Abelson, Manager

AMENDED EXHIBIT A

Responsibilities

1. Manage organization and help assure compliance with state and federal requirements.

2. Advise Board on strategic direction and specific policies to achieve organizational mission and make recommendations where appropriate.

3. Review technical data and provide technical assistance to the organization. Summarize, analyze, and provide comment and advice as necessary or requested. Prepare technical memos and issue briefs as needed. Items include:

    a. Monitoring and data produced by DOE-Legacy Management (LM), including LM status reports;
    b. CERCLA Five-Year Review.

4. Negotiate with outside entities, convey and advocate for organizational policies, as directed by the Board.

5. Serve as spokesperson with Department of Energy, Department of the Interior, state and federal agencies, the media and public. Monitor regional issues and coordinate with outside agencies on issues affecting Rocky Flats.

6. Prepare legislative strategies and positions for Board consideration.

7. Prepare work plan and budget for consideration by Board and implement as appropriate.

8. Implement public information strategies on behalf of the organization.

9. Respond to and/or forward as appropriate comments, questions and concerns raised by members of the public and Congress.

10. Make presentations to the Board and at other forums on a range of technical and policy issues.

11. Prepare periodic update, focusing on relevant congressional and DOE policies and actions.

12. Represent organization at national meetings.

13. Ensure legal, financial, and office responsibilities (including minutes) are met.

14. Report on progress on work plan.

Responsibilities exclude:

1. Providing legal advice
2. Managing organization's finances
3. Managing website
4. Take meeting notes and prepare draft minutes

AGREEMENT FOR EXECUTIVE DIRECTOR/ TECHNICAL CONSULTING SERVICES

THIS AGREEMENT ("Agreement") is entered into the 5th day of November, 2007 by and between the **ROCKY FLATS STEWARDSHIP COUNCIL**, a separate legal, public entity, created by intergovernmental agreement (as permitted by Colo. Const. Art. XIV, and section 18(2), part 2 of article 1, title 29, C.R.S.) (the "Stewardship Council"), and **CRESCENT STRATEGIES, LLC,** a Colorado limited liability company (the "Consultant").

RECITALS

WHEREAS, the Stewardship Council was created by intergovernmental agreement ("IGA") effective February 13, 2006, and was created to allow local governments to work together on issues related to the long-term protection of Rocky Flats; and

WHEREAS, the Stewardship Council is governed by a Board of Directors made up of public official representatives of nine Colorado local governments including Boulder County, Jefferson County, the City of Arvada, the City of Boulder, the City and County of Broomfield, the City of Golden, the City of Northglenn, the City of Westminster, and the Town of Superior; and community stakeholder representatives currently including the League of Women Voters, the Rocky Flats Cold War Museum, the Rocky Flats Homesteaders and Ken Foelske; and

WHEREAS, the Stewardship Council requires executive director and technical services in order to manage the Stewardship Council's activities; and

WHEREAS, the Consultant has available to offer the specialized skills and services of the individuals David Abelson and Rik Getty, both of whom have unique familiarity and knowledge of Rocky Flats, as well as the Stewardship Council, and their purposes, which familiarity is not available through any other source; and

WHEREAS, the Stewardship Council desires to engage the Consultant to provide the executive director and technical services described herein, pursuant to the terms and conditions of this Agreement, and the Consultant desires to provide such services;

NOW THEREFORE, in consideration of the mutual covenants and agreements hereinafter set forth, the sufficiency of which is hereby acknowledged, the parties hereto agree as follows:

COVENANTS AND AGREEMENTS

1. **SCOPE OF SERVICES.** The Consultant shall be responsible for performing all things stated in the Scope of Services attached as Exhibit A in connection with the provision of executive director and technical services (collectively referred to as the "Services"), as desired by the Stewardship Council. The Consultant shall perform such Services as set forth herein, and as may be directed, from time to time, by the Stewardship Council in accordance with Exhibit A, using that degree of skill and knowledge customarily employed by others performing similar services in the United States. The parties acknowledge that Consultant may employ the services of Rik Getty to perform the "technical" portion of Consultant's Services.

2. **ADDITIONAL SERVICES.** The Stewardship Council may request the Consultant to provide the Stewardship Council with certain additional services not covered in Exhibit A ("Additional Services"). Authorization to proceed with any additional work shall not be given unless Stewardship Council funds have been appropriated sufficient to cover the additional compensable amount under the Agreement. Compensation for Additional Services will be as outlined in paragraph 4 below, unless mutually agreed otherwise in writing. The Consultant shall perform such Special Services using that degree of skill and knowledge customarily employed by other professionals performing similar services in the State of Colorado.

3. **TERM OF AGREEMENT.** The term of this Agreement shall begin effective as of the 1st day of January, 2008, and shall expire on the 31st day of December, 2008, unless terminated sooner as provided for in paragraph 9 hereof. Thereafter, the Agreement shall renew each year on January 1st for successive one-year terms unless the Stewardship Council elects to exercise its termination provisions provided in paragraph 9; provided further that it shall be a condition precedent to each such renewal that the Stewardship Council make an appropriation for the ensuing year sufficient to pay for the Services. It is the Stewardship Council's intent to annually review the Agreement in the fourth quarter of the fiscal year.

4. **COMPENSATION.** In consideration of the performance of the Services, following the submittal of a satisfactory invoice, the Stewardship Council shall pay Consultant the fixed amount of $6,000 per month, plus the costs for the technical services performed by Rik Getty, at the fixed amount of $850 per month. In addition, the Stewardship Council shall provide reimbursement of eligible direct costs, not to exceed the amount of $250 per month without prior Board approval, except as noted below. Only actual costs incurred shall be funded pursuant to this Agreement. Actual direct costs incurred by Consultant in connection with the Services which are eligible for reimbursement include consumable supplies, meeting expenses, postage, printing, delivery services, mileage reimbursement (paid at the federally imposed per mile rate), and telecommunications (fax, internet and telephone) charges. Costs for any out-of-state travel require prior approval by the Stewardship Council, through its Chair or Vice-Chair. In the event that Additional Services are requested, the Stewardship Council will compensate the Consultant for such services in an amount mutually agreeable to the parties.

5. **INDEPENDENT CONTRACTOR.** The Consultant hereby declares itself to be an independent contractor and nothing herein contained shall constitute or designate the Consultant as an employee or agent of the Stewardship Council. The Stewardship Council is

concerned only with the results to be obtained. **AS AN INDEPENDENT CONTRACTOR, THE CONSULTANT ACKNOWLEDGES THERE IS NO ENTITLEMENT TO WORKER'S COMPENSATION BENEFITS THROUGH THE STEWARDSHIP COUNCIL AND THAT THE CONSULTANT IS OBLIGATED TO PAY FEDERAL AND STATE INCOME TAX ON ANY MONEYS EARNED UNDER THIS AGREEMENT.**

6. SUBCONTRACTORS. The parties acknowledge that the Consultant may subcontract for the performance of certain of the Services; however, the Consultant shall be solely and fully responsible for the performance of the Services.

7. CONSULTANT'S INSURANCE. The Consultant shall acquire and maintain, during the entire term of this Agreement, including any extensions of the term, statutory worker's compensation insurance coverage, general liability insurance coverage and automobile liability insurance in the minimum amounts set forth below:

Workers' compensation insurance: in accordance with applicable law;

General liability insurance: in the minimum amount of $1,000,000 general aggregate.

Automobile liability insurance: in the amount of $1,000,000 combined single limit bodily injury and property damage, each accident, covering all owned, hired and non-owned automobiles.

A current certificate evidencing such policies together with the amounts of coverage for the respective types of coverage shall be submitted to the Stewardship Council.

8. INDEMNIFICATION. The Consultant hereby agrees to indemnify and hold harmless the Stewardship Council and each of its directors, employees, agents, and consultants, from and against any and all claims, demands, losses, liabilities, actions, lawsuits, and expenses (including reasonable attorneys' fees), arising directly or indirectly, in whole or in part, out of the negligence or any criminal or tortious act or omission of the Consultant, in connection with this Agreement and/or the Consultant's Services or work hereunder, whether within or beyond the scope of its duties or authority hereunder. The provisions of this section shall survive termination of this Agreement.

9. TERMINATION NOT-FOR-CAUSE. In addition to any other rights provided herein, either party shall have the right, at any time and in its sole discretion, to terminate, not for cause, in whole or in part, this Agreement and further performance of the Services by delivery to the other party 30 days' prior written notice of termination specifying the extent of termination and the effective date of termination. Upon termination of this Agreement, Consultant shall be entitled to pro-rated payment for the Services performed.

10. WORK PRODUCT. All work product of the Consultant prepared pursuant to this Agreement, including but not limited to all maps, plans, drawings, specifications, reports, electronic files and other documents, in whatever form, shall remain the property of the

Stewardship Council under all circumstances, whether or not the Services are completed. All work product shall be provided to the Stewardship Council at the time of completion of any of the discrete tasks specified in the Services or at the time of termination of this Agreement, whichever event first occurs. The Consultant shall maintain reproducible copies on file of any such work product involved in the Services, shall make them available for the Stewardship Council's use, and shall provide such copies to the Stewardship Council, upon request, at commercial printing rates. At any time, the Stewardship Council may obtain reproducible copies of the Consultant's work product by paying printing costs as set forth above.

11. NOTICES. Any notices or other communications required or permitted by this Agreement or by law to be served on, given to, or delivered to either party hereto, by the other party, shall be in writing and shall be deemed duly served, given, or delivered when personally delivered to the party to whom it is addressed or in lieu of such personal services upon receipt in the United States Mail, first class postage prepaid, addressed to the Stewardship Council at:

Rocky Flats Stewardship Council
P.O. Box 17670
Boulder, Colorado 80308

with a copy to:

Seter & Vander Wall, P.C.
7400 Orchard Road, Suite 3300
Greenwood Village, Colorado 80111

Attn: Barbara T. Vander Wall

or to the Consultant at:

Crescent Strategies, LLC
1400 Riverside Avenue
Boulder, Colorado 80304
Attn: David Abelson
Phone: 303-859-1807

Either party may change its address for purposes of this paragraph by giving written notice of such change to the other party in a manner provided in this paragraph.

12. ENTIRE AGREEMENT. This Agreement constitutes the entire agreement between the parties hereto and sets forth the rights, duties, and obligations of each to the other as of this date. Any prior agreements, promises, negotiations, or representations not expressly set forth in this Agreement are of no force and effect.

13. ASSIGNMENT. The Consultant shall not assign this Agreement or parts thereof, without the express written consent of the Stewardship Council. The Stewardship Council may assign this Agreement.

14. AMENDMENT/MODIFICATION. This Agreement may not be amended or otherwise modified except by a writing executed by both parties.

15. FUNDING. To the extent necessary, the funding of this Agreement shall be subject to the annual appropriation of funds by the Stewardship Council in accordance with applicable law.

16. CONFLICT OF INTEREST. The Consultant shall not participate in any circumstance which might cause or appear to cause the Consultant's (or any of its members, employees or agents) impartiality to be questioned, without disclosing such conflict of interest to the Stewardship Council Executive Committee, and obtaining consent by the Stewardship Council, through its Executive Committee, for such participation.

17. BINDING AGREEMENT. This Agreement shall inure to and be binding on the heirs, executors, administrators, successors and assigns of all parties hereto.

18. NO WAIVER. No waiver of any of the provisions of this Agreement shall be deemed to constitute a waiver of any other of the provisions of this Agreement, nor shall such waiver constitute a continuing waiver unless otherwise expressly provided herein, nor shall the waiver of any default hereunder be deemed a waiver of any subsequent default hereunder.

19. CONTROLLING LAW. This Agreement shall be governed by and construed in accordance with the law of the State of Colorado.

20. ADDITIONAL PROVISIONS. This Contract is awarded pursuant to funds received through an agreement between the Stewardship Council and the DOE and under the direction of the DOE. In compliance with the requirements imposed by the awarding federal agency, the following provisions are included in this Contract:

A. All work product shall be subject to the copyright and publishing provisions of DOE's regulations.

B. All work product shall be subject to DOE's policies and procedures concerning patent rights.

C. The DOE requires that the Stewardship Council submit annual reports to the DOE for each year that the Stewardship Council continues to receive federal assistance, and for one year thereafter, which reports shall include the status of the Stewardship Council's activities funded by DOE, the costs incurred for each completed and/or partial activity, and any operational costs of activities, the degree to which the activities have achieved their goals, and the overall effectiveness of the economic assistance provided in meeting the adjustment needs of the area.

D. The Stewardship Council, the DOE, the Comptroller General of the United States, or any of their duly authorized representatives shall have access to any books, documents, papers, and records of the Consultant which are directly pertinent to this Contract for the purpose of making audit, examination, excerpts and transcriptions.

E. All required records developed in connection with this Contract shall be retained for a period of three years after the Stewardship Council makes final payment to the Consultant and all other pending matters are closed.

F. This Contract is subject to all mandatory standards and policies relating to energy efficiency which are contained in the state energy conservation plan issued in compliance with the Energy Policy and Conservation Act (Pub. L. 94-163).

21. ILLEGAL ALIENS. Pursuant to the requirements established by §§ 8-17.5-101, *et seq.*, C.R.S., the following provisions are incorporated herein and made a part of this Agreement:

a. Consultant acknowledges that, prior to executing the Agreement, Consultant has certified that it does not knowingly employ or contract with an illegal alien and that the Consultant has participated or attempted to participate in the Basic Pilot Program[1] in order to confirm the employment of all employees who are newly hired for employment in the United States.

b. Consultant shall not:

(i) Knowingly employ or contract with an illegal alien to perform work under the Agreement; or

(ii) Enter into a contract with a subcontractor that fails to certify to the Consultant that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under the Agreement.

c. The Consultant has confirmed or attempted to confirm the employment eligibility of all employees who are newly hired for employment in the United States through participation in the Basic Pilot Program and, if the Consultant is not accepted into the Basic Pilot Program prior to entering into this Agreement, the Consultant shall apply to participate in the Basic Pilot Program every three months until the Consultant is accepted or the Agreement has been completed, whichever is earlier. This provision shall be applicable for so long as the Basic Pilot Program is in effect.

[1] "Basic Pilot Program" is described in § 8-17.5-101(1), C.R.S., as amended, and further defined as the Basic Pilot Employment Verification Program created in Public Law 208, 104th Congress, as amended, and expanded in Public Law 156, 108th Congress, as amended, that is administered by the United States Department of Homeland Security.

d. Consultant is prohibited from using Basic Pilot Program procedures to undertake pre-employment screening of job applicants while the Agreement is in effect.

e. If the Consultant obtains actual knowledge that a subcontractor performing work under the Agreement knowingly employs or contracts with an illegal alien, the Consultant shall:

(i) Notify the subcontractor and the District within three days that the Consultant has actual knowledge that the subcontractor is employing or contracting with an illegal alien; and

(ii) Terminate the subcontract with the subcontractor if within three days of receiving the notice the subcontractor does not stop employing or contracting with the illegal alien; except that the Consultant shall not terminate the contract with the subcontractor if during such three days the subcontractor provides information to establish that the subcontractor has not knowingly employed or contracted with an illegal alien.

f. Consultant shall comply with any reasonable request by the Colorado Department of Labor and Employment ("Department") made in the course of an investigation that the Department is undertaking, pursuant to the law.

g. If the Consultant violates any of the provisions under this paragraph 21, the District may terminate the Agreement for breach of contract. The Consultant shall be liable for actual and consequential damages to the District.

h. In case of any conflict between the Agreement and this paragraph 21, the provisions of this paragraph shall control.

IN WITNESS WHEREOF, the parties have executed this agreement on the date first above written. By signature of its representatives below, each party affirms that it has taken all necessary action to authorize said representative to execute this agreement.

ROCKY FLATS STEWARDSHIP COUNCIL

Jeannette Hillery

By: Jeannette Hillery

Title: Vice Chairman

ATTEST:

Karen Dubrin

CRESCENT STRATEGIES, LLC,
a Colorado limited liability company

David M. Allen

By: David M Allen

Title: Principal

ATTEST:

RFSC/Agrt
0756.1601
BTVW1030

EXHIBIT A

Responsibilities

1. Manage organization and help assure compliance with state and federal requirements.

2. Advise Board on strategic direction and specific policies to achieve organizational mission and make recommendations where appropriate.

3. Review technical data and provide technical assistance to the organization. Summarize, analyze, and provide comment and advice as necessary or requested. Prepare technical memos and issue briefs as needed. Items include:

    a. Monitoring and data produced by DOE-Legacy Management (LM), including LM status reports
    b. EPA certification of site cleanup and CERCLA delisting of site

4. Negotiate with outside entities, convey and advocate for organizational policies, as directed by the Board.

5. Serve as spokesperson with Department of Energy, Department of the Interior, state and federal agencies, the media and public. Monitor regional issues and coordinate with outside agencies on issues affecting Rocky Flats.

6. Prepare legislative strategies and positions for Board consideration.

7. Prepare work plan and budget for consideration by Board and implement as appropriate.

8. Implement public information strategies on behalf of the organization.

9. Make presentations to the Board and at other forums on a range of technical and policy issues.

10. Prepare periodic newsletter updating on relevant congressional and DOE policies and actions.

11. Represent organization at national meetings.

12. Ensure legal, financial, and office responsibilities (including minutes) are met.

13. Report on progress on Work Plan.

Responsibilities exclude:

1. Providing legal advice
2. Managing organization's finances
3. Managing website
4. Take meeting notes and prepare draft minutes

FIRST AMENDMENT TO AGREEMENT
FOR
EXECUTIVE DIRECTOR/ TECHNICAL CONSULTING SERVICES

THIS FIRST AMENDMENT TO AGREEMENT ("Amendment") is entered into effective the 1st day of June, 2015 by and between the **ROCKY FLATS STEWARDSHIP COUNCIL**, a separate legal, public entity, created by intergovernmental agreement (as permitted by Colo. Const. Art. XIV, and section 18(2), part 2 of article 1, title 29, C.R.S.) (the "Stewardship Council"), and **CRESCENT STRATEGIES, LLC,** a Colorado limited liability company (the "Consultant").

RECITALS

WHEREAS, the Stewardship Council was created by intergovernmental agreement ("IGA") effective February 13, 2006, and was created to allow local governments to work together on issues related to the long-term protection of Rocky Flats; and

WHEREAS, the Stewardship Council entered into an agreement with Consultant, dated November 6, 2007 (the "Agreement"), for executive director and technical services in order to manage the Stewardship Council's activities, as described therein (the "Services"); and

WHEREAS, in providing the Services under the Agreement, the Consultant has made available the specialized skills and services of the individuals David Abelson and Rik Getty, who have unique familiarity and knowledge of Rocky Flats, as well as the Stewardship Council, and their purposes, which familiarity is not available through any other source; and

WHEREAS, the Consultant has advised that the expenses required to continue to perform the technical portion of the Services have increased; and

WHEREAS, the Consultant desires to increase the allowable compensation under the Agreement associated with the costs of the technical services; and

WHEREAS, the Stewardship Council desires to allow for an increase in compensation to cover the Consultant's costs, to assure the continuation of the Consultant's Services;

NOW THEREFORE, in consideration of the foregoing recitals and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the Stewardship Council and Consultant agree as follows:

COVENANTS AND AGREEMENTS

1. COMPENSATION. The costs for technical services performed by Rik Getty, as described in paragraph 4 of the Agreement, shall be increased from the fixed monthly amount of $850 to the fixed monthly amount of $1,150.

2. PRIOR PROVISIONS. Except as amended herein, all provisions set forth in the Agreement and its exhibits shall remain in full force and effect.

IN WITNESS WHEREOF, the parties have executed this First Amendment to Agreement for Executive Director / Technical Consulting Services as of the date first above written.

ROCKY FLATS STEWARDSHIP COUNCIL

By: _____
Joyce Downing, Chair

Attest:

_____
Jeannette Hillery, Secretary

CRESCENT STRATEGIES, LLC, a Colorado limited liability company

By: _____
David Abelson, Manager

ROCKY FLATS STEWARDSHIP COUNCIL
Monday, September 12, 2016, 8:30 AM – 12:00 P.M.
Rocky Mountain Metropolitan Airport, Terminal Building, Mount Evans Room
11755 Airport Way, Broomfield, Colorado

Board Members in attendance: Mark McGoff (Director, Arvada), Sandra MacDonald (Alternate, Arvada), Deb Gardner (Director, Boulder County), Megan Davis (Alternate, Boulder County), Mike Shelton (Director, Broomfield), David Allen (Alternate, Broomfield), Laura Weinberg (Director, Golden), Libby Szabo (Director, Jefferson County), Pat O'Connell (Alternate, Jefferson County), Joyce Downing (Director, Northglenn), Shelley Stanley (Alternate, Northglenn), Joe Cirelli (Director, Superior), Jan Kulmann (Director, Thornton), Emily Hunt (Alternate, Thornton), Sue Vaughan (Alternate, League of Women Voters), Arthur Widdowfield (Director, Rocky Flats Cold War Museum), Ron Heard (Alternate, Rocky Flats Cold War Museum), Roman Kohler (Director, Rocky Flats Homesteaders).

Stewardship Council staff members and consultants in attendance: David Abelson (Executive Director), Barbara Vander Wall (Seter & Vander Wall, P.C.), Chelsie Gonzalez (Seter & Vander Wall, P.C.), Rik Getty (Technical Program Manager)

Attendees: Oliva Blumenthal (MSU-Denver), Mallory Ownrell (MSU-Denver), Shirley Garcia (City of Broomfield), Judith Mohling (Rocky Mountain Peace and Justice Center), Leona Dunlap (Boulder), Jeffery Murl (DOE-LM), Bonnie Graham-Reed (citizen), Christine Hawley (WCRA-Hydros Consulting), Marian Whitney (citizen), Mark Marshall (former Rocky Flats worker), Ann Parker (citizen), LeRoy Moore (Rocky Mountain Peace and Justice Center), Ted Ziegler (former Rocky Flats safety rep), Anne Fenerty (citizen), Jon Lipsky (citizen), S. Shank (citizen), Alesya Casse (Rocky Flats Downwinders), W. Gale Biggs (citizen), Diane Vigil (Rocky Flats Downwinders), Bob Darr (Navarro), Gwen Hooten (DOE-LM), Lindsay Masteb (CDPHE), Darina Castillo (DOE), Carl Spreng (CDPHE), David Ward (Navarro), Scott R. Surovchak (DOE-LM), Vera Moritz (EPA), Alan D. Smith (Navarro), Jeremy Wehner (Navarro), Pat Mellen (citizen), John Boylan (Navarro), Lynn Segal (citizen), Harvey Nichols (citizen).

Convene / Agenda Review

Joyce Downing convened the meeting at 8:36 a.m. The first order of business was introductions of Board members and the audience.

Consent Agenda

The Board next addressed the consent agenda. Roman Kohler moved to approve the June 2016 Board minutes and the checks. The motion was seconded by Mark McGoff. The motion to accept the minutes and checks passed 11-0.

Executive Director's Report

David Abelson noted that DOE-Legacy Management has hired Karen Edson to lead its community outreach efforts. That works includes engaging governmental governments and the public. He is unsure what role she might occupy as USFWS responds to questions about

contaminants at the Rocky Flats Refuge. He noted USFWS' public meeting process will begin in October.

David next raised a question that emerge at the June meeting—whether there was contamination in the Rock Creek drainage. David explained that based on soil, air and water testing, no contaminants of concern were identified. He noted that this does not mean there are no contaminants present, just none at a level of concern. He also noted that the Board had received a document from a constituent that showed that plutonium, americium, uranium and tritium were at background levels, or were considered non-detects.

David then noted that, following the last Board meeting, a call was placed to the DOE Inspector General hotline filing a complaint about the status of the Rocky Flats Stewardship Council audit. David said it was unclear whether the caller was concerned about the fact that an audit is not required by the DOE grant, or whether it was something else. David said that not only does the Stewardship Council conduct an annual audit, but DOE provides as part of the grant the necessary funding.

Public Comment

Joyce Downing requested that anyone who is speaking to please be respectful in their comments, and that any personal attacks on any Board members or members of the public would not be tolerated.

Gale Biggs began by circulating a document to the board. He brought copies of "FT Weekend Magazine" that was sent by his daughter living in England. He asked about the future of Rocky Flats and what is to be done about informing future generations of the dangers associated with Rocky Flats. He encouraged the Stewardship Council and DOE to look at a disposal site used in France, as outlined in the documentation presented, for inspiration for what more can be done to ensure the safety of anyone exposed to Rocky Flats. Gale suggested that all of the remaining contamination at Rocky Flats be dug up and disposed is a deep depository somewhere near Rocky Flats.

Marianne Whitney began by introducing her friend Bonnie Graham-Reed and explaining that the two have begun holding public informational meetings in Arvada. Rocky Flats Right to Know is a group they have formed to work alongside the Rocky Flats Downwinders. She talked about the importance of protesting, and feels inspired by the Standing Rock Tribe currently protesting in North Dakota. She encouraged everyone to stay engaged in these meetings and stay interested in the future of Rocky Flats.

Ann Fenerty requested clarification in regards to the 1989 Superfund designations. OU1 is the 1,300-acre industrial section of Rocky Flats, and is still regulated under the Superfund law. OU2 is the 5,000-acre Refuge and was released from the CERLCA Superfund list in 2007. OU3 is the 20,500 acres adjacent to Rocky Flats; OU3 was released from the Superfund list in 1997. She wondered if OU1 is about to be released from Superfund status. She is confused about how the Refuge could be opened to the public given the OU1 section is still regulated under CERCLA. She is curious about the missing plutonium as reported by the DOE. She feels the public is potentially being exposed to toxic elements because of inaccurate reporting by DOE. She asked

that the Stewardship Council keep an eye on what is happening and make sure no one has or will have health trouble in the future. She is worried about the flood plains and how that may bring toxic materials to the surface. She also wondered what the $8 million donated by DOE for the Visitor Center will be used for.

Judith Mohling read out loud a letter from Jay Christopher Hormel. The letter begins by stating the writer read an article on the E! News website from August 2016 that talked about the corporate money associated with the cleanup of Rocky Flats. The writer mentioned that the DOE's reputation is tarnished because of relaxed regulation and corporate cover-ups, and that nuclear weapons production around the United States has tainted our environment more than the DOE lets on. He does not believe assurance from DOE about the safety of Rocky Flats. The letter described how concerned citizens are about the safety of Rocky Flats. Mr. Hormel mentioned David Abelson in the letter, and accused him of saying that concerned citizens are "fear mongering." The writer is starting a campaign called Keep Kids off of Rocky Flats, and is asking schools to refuse any invite to bring students to Rocky Flats. After reading the letter, Judith talked about her history in Colorado. She feels as if she is in an "adversarial" relationship with, specifically, David Abelson, if not the whole Board. She is still very worried about the safety of Rocky Flats.

Joyce Downing reiterated the request to keep public comments respectful.

John Lipsky distributed to the Board a printed email from Scott Surovchak relating to the contact record released March 29, 2016. He would like all emails sent directly to David Abelson to be made public.

LeRoy Moore spoke about David Abelson's report criticizing the packet distributed by Rocky Flats Downwinders at the last meeting, which referenced the lack of a Health Department study on citizens living near Rocky Flats. LeRoy believes no health evaluations were done on citizens living near Rocky Flats; he talked about how the study performed by the Health Department was not a true health study because it was a dose reconstruction study and only estimated doses that the public received. He said they did not monitor any actual people for health risks posed by Rocky Flats. He thinks the Downwinders were correct in stating the Health Department did not actually do a study.

Lynn Segal began by stating she did not have any prepared remarks, but would like to see a format change with the meetings that would allow for additional public comments. She talked about her history in Colorado and her "horror" at Rocky Flats becoming a Wildlife Refuge. Her mother passed away from cancer in Utah. She cannot prove it was because of radioactive contamination, but she believes it to be true. She does not want that same risk exposed to the public at Rocky Flats. She also stated she believes members of the Board have attacked concerned citizens in the past. Joyce Downing explained there is an opportunity for public comment at the end of the meeting as well as the beginning, so Lynn was free to talk about any issues presented at this meeting in the final public comments portion.

DOE Quarterly Report of Site Surveillance and Maintenance Activities First Quarter 2016

This report is required in accordance with the Rocky Flats Legacy Management Agreement (RFLMA). The purpose of this report is to inform the regulatory agencies and stakeholders of the remedy-related surveillance, monitoring, and maintenance activities conducted at Rocky Flats during the first quarter (January 1 through March 31) of calendar year 2016. Legacy Management provides periodic communications through several means, such as this report, web-based tools, and public meetings.

George Squibb (Navarro) and John Boylan (Navarro) were on hand to brief on the status of the surface water and groundwater monitoring, operations, and landfill maintenance and monitoring.

Present Landfill (PLF)

The PLF is inspected quarterly in accordance with the RFLMA. The routine PLF inspection for the first quarter of 2016 was performed on February 29, 2016. An additional inspection was also required on March 29, 2016, due to precipitation greater than 1 inch in a 24-hour period. No significant issues (e.g., erosion) were observed during either inspection. The 2015 annual survey of the PLF settlement monuments was performed on December 9, 2015. Survey data indicate that vertical settling at each monument is within the limits specified in the plan. The 2016 annual survey is scheduled to be completed in the fourth quarter of 2016.

Routine maintenance activities continued at the PLF Treatment System through the first quarter of 2016. These activities generally consisted of inspecting the system for potential problems. Cracking was discovered in the grout surrounding the lip of the north and south manhole covers. The grout was used to fill in the transition from the lip of the manhole cover to the concrete structure of the manhole itself (approximately 2 inches vertically). The cracking was minimal and it was determined that the condition did not affect the treatment system. The grout will be inspected in the second quarter to determine if any maintenance actions are needed. No other deficiencies were noted in first quarter of 2016.

Original Landfill (OLF)

The OLF is inspected monthly in accordance with the RFLMA. It was expected that, after the first year, the inspection frequency might be reduced to quarterly for an additional 4 years. However, because of observed localized slumping and seep areas, and because of the investigation and repairs to the OLF cover completed in 2009, no change to the monthly inspection frequency was recommended in the *Third Five-Year Review Report for the Rocky Flats Site.*

Routine OLF inspections during the first quarter of 2016 were performed on January 25, February 16, and March 16, 2016. An additional weather-related inspection was required on March 29, 2016, due to precipitation events producing more than 1 inch of rain in a 24-hour period. This inspection was conducted because the National Renewable Energy Laboratory (NREL), adjacent to the Site, recorded 1.48 inches of precipitation. (NREL uses heated rain gauges, which the Site does not have.) According to the Rocky Flats meteorological tower, the site received 0.41 inch of precipitation during the first quarter of 2016. (NREL reported 4.71 inches of precipitation for the same time period.) No significant issues (e.g., erosion) were

observed during inspections. The areas that experienced movement and were repaired in 2015 did not move in the first quarter of 2016.

Earlier in January, site staff removed snow fencing installed at the top of the OLF hillside in response to a recommendation from a subcontracted geotechnical engineering firm. The fence was removed to eliminate retention of the snow and thereby reduce the amount of water infiltrating the soil and recharging groundwater just up gradient of the OLF.

The OLF settlement monuments were surveyed on March 14, 2016. Survey data indicate that vertical settling at each monument is within the limits specified in the plan. All inclinometer monitoring at the OLF has been discontinued. As discussed in the quarterly report for the second quarter of 2009, seven inclinometers were installed in boreholes at the OLF in 2008 as part of the geotechnical investigation of localized areas of instability. Since then, movement of the inclinometers was monitored approximately monthly until the majority of inclinometers were broken. Inclinometers are deflected by lateral movement of the ground in which they are located, and if the deflection is enough to break the inclinometer tubes, then the inclinometer is no longer monitored.

Seeps at the OLF were evaluated during the monthly inspections. Individual seep location flow rate estimates can be found in the monthly inspection reports for the OLF.

Groundwater

Four groundwater treatment systems are monitored, operated, and maintained in accordance with requirements defined in the RFLMA and Site Operations Guide. Three of these systems (the Mound Site Plume Treatment System [MSPTS], the East Trenches Plume Treatment System [ETPTS], and the Solar Ponds Plume Treatment System [SPPTS]) include a groundwater intercept trench (collection trench), which is similar to a French drain with an impermeable membrane on the downgradient side. The fourth system, the PLF Treatment System (PLFTS), passively treats water from the northern and southern components of the Groundwater Intercept System and water that flows from the PLF seep.

The MSPTS was installed in 1998 to treat groundwater contaminated with low concentrations of volatile organic compounds (VOCs). Groundwater that is intercepted by the collection trench is routed to treatment cells that are filled with zero-valent iron (ZVI). Dissolved VOCs are treated by the ZVI in these cells, and the water then flows to an effluent manhole and subsequently is discharged to the subsurface. In 2011 a small air stripper, designed and built by site staff, was installed within this effluent manhole. This solar/battery-powered air stripper has been revised and optimized in the years since then to more effectively polish the effluent from the ZVI-filled treatment cells, further reducing residual concentrations of VOCs. Routine maintenance activities continued at the MSPTS through the first quarter of 2016. These activities included checking and adjusting flows, inspecting and flushing piping, monitoring water levels in the two treatment cells, and servicing the air stripper. In addition, accumulated snow was brushed off the solar panels as necessary. The air stripper operated throughout the quarter except for one instance in early February when snow covering the panels led to insufficient power. The snow was brushed off and power was restored. (Snow covering the photovoltaic panels affects operation of the air stripper but not the ZVI-filled treatment cells.) Air-stripper maintenance mainly consisted of

monitoring the water pressures and nozzle spray patterns, maintaining the fan assembly that provides powered ventilation, and cleaning the pump, lines, and nozzles as warranted.

The ETPTS was installed in 1999 to treat groundwater contaminated with low concentrations of VOCs, and was based on the design of the MSPTS. In its original configuration, groundwater that was intercepted by the ETPTS collection trench was routed to treatment cells filled with ZVI. Dissolved VOCs were treated by the ZVI in these cells, and the treated effluent then flowed to an effluent manhole and was subsequently discharged to the subsurface. Following tests at the MSPTS that started in 2011, a small air stripper was installed in the influent manhole in 2013. This component pre-treated (i.e., removed a portion of the VOCs from) water that was then routed to the ZVI-filled treatment cells. A reconfiguration project was undertaken in 2014–2015, and since that project was completed the ETPTS no longer relies on ZVI for treatment. Instead, a full-scale, commercial air stripper using only solar/battery power treats the VOCs in collected groundwater. No changes were made to the groundwater intercept trench, effluent manhole, or discharge gallery. Reconfiguration of the ETPTS was completed in January 2015. Routine maintenance at the ETPTS in the first quarter of 2016 included checking the batteries and other power components, clearing accumulated snow off the solar panels, and adjusting valves and settings to maintain air stripper operation. A generator was plugged into the power facility occasionally to assist in charging the batteries. (An electrical outlet was installed as a part of the reconfiguration project to allow for a generator to be used as a backup to the solar panels.) Other maintenance activities included greasing the blower motor and cleaning bird droppings and dust off the solar panels.

The SPPTS was installed in 1999 to treat groundwater contaminated with nitrate and uranium, and it is based on the design of the MSPTS and ETPTS. In its original configuration, groundwater that was intercepted by the SPPTS collection trench was routed to a larger treatment cell filled with sawdust and a small percentage of ZVI, and thence to a smaller treatment cell filled with gravel and ZVI. Nitrate was treated in the first cell and uranium in the second. Effluent from the treatment cells is routed to an effluent manhole, from which it is piped to a subsurface discharge gallery. Several upgrades to the SPPTS have been installed and modified over the years, and numerous treatability studies have been conducted to improve its effectiveness. The SPPTS now incorporates additional treatment cells as well as pilot-scale nitrate treatment using a lagoon approach. Routine maintenance activities at the SPPTS through the first quarter of 2016 focused primarily on the Phase III pilot-scale lagoons, as the system was being prepared for an upcoming interim reconfiguration project scheduled to mobilize in the second quarter of 2016. This project will include removing the contents of the original treatment cell structure (Cells 1 and 2 within what is informally referred to as the Big Box) and the Phase II Cell, and converting the Big Box to a full-scale test lagoon. Because this test lagoon will be populated with denitrifying bacteria from the pilot-scale lagoons, maintaining the health of these bacteria was important. In addition, staff performed inspections of the solar/battery systems that power the pumps, the operation of the pumps, and influent and effluent flow conditions. Snow was brushed off the solar panels as warranted. The vaults continued to be inspected frequently for accumulations of groundwater, which was pumped out as necessary. Also, in preparation for the interim reconfiguration project, the water pooled across the surface of the overburden in the Big Box was drained.

Sign Inspection

"U.S. Department of Energy – No Trespassing" signs are required to be posted at defined

intervals around the perimeter of the COU to notify persons that they are at the boundary of the COU. Signs listing the institutional controls and providing contact information are also required to be posted at access points to the COU. The signs are required by the remedy as physical controls, are inspected quarterly, and are maintained by repairing or replacing them as needed. Physical controls protect the engineered components of the remedy, including landfill covers, groundwater treatment systems, and monitoring equipment, which are also inspected routinely during monitoring and maintenance activities. The signs were inspected on February 11, 2016, and they met the requirements.

David Allen asked a question about the PLF vinyl chloride exceedance. He asked if the PLF has ever had a full year with no vinyl chloride exceedance. George Squibb stated that there were a couple years since the inception of monitoring, but he couldn't name what or how many years off the top of his head. He said he would get David the information about the consistency of the exceedance. George did note there was no exceedance downstream.

Shelly Stanley asked how they are treating groundwater for uranium contamination. George explained there is a vault the water runs through that monitors for toxins. Shelly also asked if the top will be insulated. George said yes. Another Board member asked for clarification on how the treatment facility is powered (solar) and if there is a possibility of it failing. George said yes a failure is a possibility, but the chance of failure is remote. They also have an outlet at the power facility so a generator can be used in case of solar power failure. The current treatment facility does not continuously run in its current operation. Ann Fenerty asked if they measure during flooding conditions outside of the normal sampling parameters. George said yes, they collected samples after the 2013 flood. She asked again if they go out especially if a weather event has occurred. He said no they do not sample out of the schedule. A citizen asked if they would start doing soil sampling because of public concern, to which George responded no. That same citizen reiterated that they should. Gayle Biggs asked why the airborne emissions are not continuously monitored. George explained that monitoring was done for a few years after closure in 2005, but no air emissions appeared to be present, so the DOE determined there is no need to continue to monitor. Gayle pointed out that the monitoring that was done initially was very limited. George asked Gayle to bring up his concerns at the next meeting as their will be an engineer attending to explaining air emissions.

Gorge Squibb also wanted on the record the notes from their ecologist Jody. Jody's notes stated that no prairie dog towns were found on Rocky Flats, and that 184 acres have been sprayed for contaminate weeds.

Review of the 2017 work plan

Mission Statement

The first item the Board discussed was the wording of the Stewardship Council's mission statement as presented in the draft work plan. David Abelson talked about the term "oversight" and how that suggests authority, and that it may create ambiguity with what the role of the

Stewardship Council really is. He said a more accurate word is "engagement." Mark McGoff stated that the proposed change of "oversight" to "engagement" does not read properly, and that the Board needs to spend more time thinking about the wording of the mission statement. Mark also noted the last sentence referencing the ongoing needs of Rocky Flats that need to be conveyed to later generations may need to be revised. He would like some small edits to the whole statement to be considered.

David Abelson asked the Board members to clarify the use of the term "engagement" as the proper term for how the Board views its role. Mark McGoff noted that he believes engagement is an accurate term to describe the Board's role at Rocky Flats. His issue is more a question of language. Deb Gardner volunteered Mark to work on changes to the mission statement. Mike Shelton also stated he has issues with how the mission statement is put together. David Abelson suggested all the Board members should ask themselves what exactly is the scope of the Stewardship Council's involvement beyond Board meetings, etc. when looking at the language of the mission statement. Mark McGoff mentioned that the 2017 work plan does outline some participation by the Board with the public. Mike Shelton stated the importance of the mission statement language, but noted that any changes to the mission statement probably will not change anything about the work plan. He suggested that the mission statement not be changed at all, and focus on the role of the Stewardship Council. Mike says he understands the public's frustration with the Board's limited role at Rocky Flats, but as long as the Board meetings stay public there is no need to re-word the mission statement.

Laura Weinberg states that the forum has changed throughout the years and noted the increased public participation in the meetings. She thinks the mission statement language needs to be modified to encompass more of what the Board does, and thinks some language could be removed, such as advocating for former Rocky Flats employees. Emily Hunt mentioned she only had an issue with the word "oversight" but the rest of the language encompasses all other duties of the Board. She does not think they whole mission statement needs to be rewritten, just change "oversight." Sue Vaughan said her only concern is what is missing from the mission statement, like the educational engagement (i.e. the DOE quarterly reports). David Abelson mentioned that if the mission is the macro statement, then the work plan is the outline of what is done by the board throughout the year. The work plan usually does not have many changes from year to year. He says the Board may need to reevaluate the work plan language to help the mission statement be clearer. David concluded he and Mark McGoff will work together on the language of the mission statement.

A citizen commented on the importance of discussions about the language of the mission statement, but she feels these meetings are just a demonstration of governmental bureaucracy that does not actually get anything done.

Draft 2017 Work Plan

Mark McGoff commented that he does not understand the language about potentially breaching the terminal ponds. David Abelson explained that in 2017 DOE will likely render a decision on whether to breach the terminal ponds, or close the valves and manage the ponds in a batch-and-release manner. The technical basis for that decision is the result of the adaptive management

plan. That data will underpin DOE's decision. For that reason, David wanted the work plan to be clear regarding the options for the breaching of the ponds or closing the valves.

Mark McGoff was also confused by the language about "forward[ing] the workers concerns, as necessary." Mark asked who those concerns will be forwarded to. David Abelson explained that this statement was included because he just wanted something more broad than the previous statement.

Mark McGoff then asked if the Stewardship Council needs to be more specific regarding the two terms on page 5, "Stewardship Council" and "Stewardship Council Member." He asked about the intended difference with those two terms. David Abelson explained that he was trying to make a distinction between the members of the board as individuals and the Board as a whole. Deb Gardner suggested "Stewardship Council Entities" instead of "members." Barb Vander Wall mentioned there are members of the Board who do not represent entities. Laura Weinberg suggested "may be involved" instead of "will be involved," or alternatively, to take out "Stewardship Council" completely from that statement.

Joe Cirelli mentioned he would like to know when USFWS will initiate public engagement activities and the role of the Stewardship Council in that effort. Joyce Downing mentioned that USFWS has started to attend the Stewardship Council meetings.

A citizen asked if there is an advisory entity that the public can confer with in regards to Rocky Flats. David Abelson explained that the Stewardship Council engages public discussions, but does not serve as an advisory board to DOE. The citizen said the board engagement seems "an exercise in futility."

Marion Whitney asked what the status of additional testing was and if the municipalities on the Board would be using taxpayer money on issues pertaining to Rocky Flats. David explained that testing is not a responsibility of or a project of the Stewardship Council, and that she should talk to Dave Lucas, manager of Rocky Flats Wildlife Refuge, about the status of testing.

Deb Gardner asked about the changes on page 4 under "Outreach." Under the overview, when talking about the Colorado delegation, she was not sure what the language means and what changes were made. David Abelson explained he wanted the language to be clearer regarding the mission. Deb reads it as the expectation that the delegation will be asking the Board questions, and David noted that this is correct. Deb and David discussed the use of the word "public" as it relates to outreach. David stated that the word "public" may be limiting; he noted that these are all merely proposed changes which are subject to review, and do not have to be implemented. Laura Weinberg stated that the Board meetings are considered open to the public. Deb suggested that "public" be put back in so that the public will know that they have a right to comment and engage in the meetings.

David will make changes to the work plan and include a revised red-line version in the October meeting packet.

Review of the Stewardship Council Draft 2017 Budget

David Abelson referred to the draft 2017 budget included in the meeting materials. He noted that the budget document is self-explanatory. There were no comments from the Board.

Public Comment

Jon Lipsky wanted to address the memo regarding the Rocky Flats Downwinders report that was discussed at the previous meeting. He read an email from Carol Jensen explaining that there has never been a health study on citizens living downwind from Rocky Flats. The state- sponsored study was based on theoretical amounts of radiation as levels of radiation could not be detected at the time of the state study. Jon talked about the April meeting and asked Joyce for a Board apology because of how that meeting was conducted. He said he would like comments from the Board to be evidence-based and that he does not think the Board handled the Downwinders report well.

Alesya Casse spoke next. She is part of the organization Rocky Flats Downwinders. She asked about the inclinometers at the Original Landfill (OLF) that were broken and wondered what the outcome of the study done on the broken inclinometers concluded. David Abelson directed her to past meeting minutes for an explanation of ongoing monitoring and studying of the OLF inclinometers. She also stated she thinks it is a bit confusing to see statements being put out by the Board, but then the Board says they cannot advocate for or against the opening of the Rocky Flats National Wildlife Refuge. David explained how the terms of the federal grant outline the Board's capacity at Rocky Flats. Mike Shelton clarified that the Board's statement pertaining to the prescribed burn, which is what Alesya was referring to, was more of a recommendation to the public, and was not a recommendation to the DOE. David Abelson noted it is a bit complicated and confusing. He distinguished the Stewardship Council in its LSO & non-LSO duties. Aleysa asked if the Stewardship Council has any influence on the DOE over the DOE's managed site. David explained that the Board can be used as a point of contact between the public and the DOE, but the Stewardship Council cannot serve as an advisory board. Since Aleysa is part of the Downwinders organization and this meeting was her first, David told her that his comments about the Downwinders' study are being misconstrued. He stated, as he had done previously, that there was a multi-year effort lead by the Colorado health department, and that any additional health impact studies could be beneficial provided that the methodology is statistically-valid and scientifically-sound.

Ann Fenerty then spoke up about wanting to clarify Jon Lipsky's previous statement about David Abelson releasing any correspondence from DOE, CDPHE, etc. to the public. She reiterated she thought the role of the Board was to work as a go-between with the public and the DOE/CDPHE. She wants to see any problems be made public before meetings so the public has an opportunity to respond. David stated he needed some clarification from the DOE as to who they are sending their reports to and if/how they get posted to the public. David stated he would try and coordinate with the DOE to make access to reports and correspondence easier for the public to find.

Another citizen requested clarification about how the Board's recommendation about the prescribed fire was any different than a recommendation given about soil samples. David

explained that the only reason soil sampling has become an issue is because of the Greenway Trail wanting to go through Rocky Flats; the local governments' engagement in the planning process put the trail project on the Board's radar. The Board has no role in the Greenway Trail project.

Big Picture Review

October 31, 2016

Potential Business Items

- Approve 2017 budget
- Approve 2017 work plan

Potential Briefing Items

- DOE quarterly update
- Actinide Migration

February 6, 2016

Potential Business Items

- Elect 2017 officers
- Adopt resolution re: 2017 meeting dates

Potential Briefing Items

- DOE quarterly update
- Original Landfill – path forward
- CERCLA Five Year Review

Issues to watch:

- Uranium exceedances
- Plutonium levels at SW027
- Groundwater treatment systems
- Plutonium movement in soil column

EXECUTIVE SESSION

At 10:49 a.m. Joyce Downing made a motion to move into Executive Session for the purpose of discussing Stewardship Council personnel contracts for 2017, authorized pursuant to Section 24-6-402(4)(e) & (b), C.R.S., to determine positions relative to matters that may be subject to negotiation, and conferencing with the attorney on such matters. Mike Shelton seconded the motion. The motion passed 11-0.

The Board reconvened from Executive Session at 11:50 a.m. and affirmed that no actions had been taken during Executive Session.

Mike Shelton asked the protocol used with fact checking of public comment and distribution of the public comments to Board members. David Abelson explained that he prioritizes what he thinks the Board members need to know immediately, and what he can wait until the next meeting or monthly update.

David Allen commented on the DOE contact records. He pointed out that the Board, as well as the public, does not get to comment on the issues contained in those records prior to approval.

Mark McGoff asked if one of the booklet that was distributed by a citizen during the public comments portion was accurate information; he also noted he did not know who authored the handout. David Abelson did not know who authored the handout booklet, and could not vouch for the contents as he had not seen it prior to the meeting.

David pointed out the cover memo accompanying the minutes from the June meeting. He noted he worked with Barb Vander Wall to make sure that the minutes reflected the conversation at the meeting, but stressed the importance of correcting inaccurate or misleading information. David and Barb decided the best option was to include the cover memo, and to paste that memo to the minutes when posted on the Stewardship Council's website. The Board did not object to this approach, and reiterated its support for making sure information posted on the Stewardship Council website is accurate.

Joyce Downing asked if there was any additional discussion about moving the Board meetings to Westminster. David said it was his understanding that the Board opted to not pursue moving the meetings, and to keep them at the current location.

Rik Getty said he got an informal email from George Squibb stating there are elevated levels of plutonium and americium currently detected at SW093 Rocky Flats, and that the split sample was being analyzed. DOE will ask for expedited results on those findings so they can be presented at the October meeting.

Open session meeting adjourned at 12:01 p.m.

Respectfully submitted by Chelsie Gonzalez, Seter & Vander Wall

Rocky Flats Stewardship Council
Check Detail
August 23 through October 4, 2016

Type	Num	Date	Name	Account	Paid Amount	Original Amount
Check		**08/25/2016**		**CASH-Wells Fargo-Operati...**		**-3.50**
				Admin Services-Misc Services	-3.50	3.50
TOTAL					-3.50	3.50
Check	**1817**	**09/05/2016**	**Century Link**	**CASH-Wells Fargo-Operati...**		**-26.07**
				Telecommunications	-26.07	26.07
TOTAL					-26.07	26.07
Bill Pmt -Che...	**1818**	**09/05/2016**	**Crescent Strategies, LLC**	**CASH-Wells Fargo-Operati...**		**-7,957.36**
Bill	8/31/16 Billing	08/31/2016		Personnel - Contract	-7,150.00	7,150.00
				Telecommunications	-130.59	130.59
				TRAVEL-Local	-14.58	14.58
				Postage	-15.99	15.99
				TRAVEL-Out of State	-646.20	646.20
TOTAL					-7,957.36	7,957.36
Bill Pmt -Che...	**1819**	**09/05/2016**	**Erin Rogers**	**CASH-Wells Fargo-Operati...**		**-675.00**
Bill	8/10/2016	07/01/2016		Personnel - Contract	-675.00	675.00
TOTAL					-675.00	675.00
Bill Pmt -Che...	**1820**	**09/05/2016**	**Jennifer A. Bohn**	**CASH-Wells Fargo-Operati...**		**-218.50**
Bill	16-53	08/31/2016		Accounting Fees	-218.50	218.50
TOTAL					-218.50	218.50
Bill Pmt -Che...	**1821**	**09/05/2016**	**Seter & Vander Wall, P.C.**	**CASH-Wells Fargo-Operati...**		**-77.20**
Bill	73447	07/31/2016		Attorney Fees	-77.20	77.20
TOTAL					-77.20	77.20
Bill Pmt -Che...	**1822**	**10/02/2016**	**Blue Sky Bistro**	**CASH-Wells Fargo-Operati...**		**-290.00**
Bill	2431	09/30/2016		Misc Expense-Local Govern...	-290.00	290.00
TOTAL					-290.00	290.00
Bill Pmt -Che...	**1823**	**10/02/2016**	**Crescent Strategies, LLC**	**CASH-Wells Fargo-Operati...**		**-8,170.96**
Bill	9/30/16 Billing	09/30/2016		Personnel - Contract	-7,150.00	7,150.00
				Telecommunications	-130.59	130.59
				TRAVEL-Local	-85.32	85.32
				Postage	-15.99	15.99
				TRAVEL-Out of State	-779.06	779.06
				Supplies	-10.00	10.00
TOTAL					-8,170.96	8,170.96
Bill Pmt -Che...	**1824**	**10/02/2016**	**Jennifer A. Bohn**	**CASH-Wells Fargo-Operati...**		**-95.00**
Bill	16-59	09/30/2016		Accounting Fees	-95.00	95.00
TOTAL					-95.00	95.00
Bill Pmt -Che...	**1825**	**10/02/2016**	**Seter & Vander Wall, P.C.**	**CASH-Wells Fargo-Operati...**		**-690.00**
Bill	73590	08/31/2016		Attorney Fees	-690.00	690.00
TOTAL					-690.00	690.00
Check	**1826**	**10/02/2016**	**Century Link**	**CASH-Wells Fargo-Operati...**		**-28.89**
				Telecommunications	-28.89	28.89
TOTAL					-28.89	28.89

2017 Work Plan

- Cover memo
- Draft work plan

2017 Budget

- Cover memo
- Draft budget
- Budget Resolution and Notice

ROCKY FLATS STEWARDSHIP COUNCIL

P.O. Box 17670 (303) 412-1200
Boulder, CO 80308-0670 (303) 600-7773 (f)
www.rockyflatssc.org

MEMORANDUM

TO: Board
FROM: David Abelson & Rik Getty
SUBJECT: Approval of 2017 work plan
DATE: October 17, 2016

At this meeting the Board will review, modify as necessary, and approve the 2017 work plan (the modified draft plan is attached). The three changes to the draft that was reviewed at the September meeting are noted using track changes.

Please let us know what questions you have.

Action Item: Approve 2017 Work Plan

ROCKY FLATS STEWARDSHIP COUNCIL

P.O. Box 17670 (303) 412-1200
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Jefferson County -- Boulder County -- City and County of Broomfield -- City of Arvada -- City of Boulder
City of Golden -- City of Northglenn -- City of Thornton -- City of Westminster -- Town of Superior
League of Women Voters -- Rocky Flats Cold War Museum -- Rocky Flats Homesteaders
Steven Franks

2017 Work Plan

DRAFT #2, October 31, 2016

Mission:

The mission of the Rocky Flats Stewardship Council is to provide continuing local oversight of activities at the Rocky Flats site and to ensure local government and community interests are met with regards to long-term stewardship of residual contamination and refuge management. The mission also includes providing a forum to track issues related to former site employees and to provide an ongoing mechanism to maintain public knowledge of Rocky Flats, including educating successive generations of ongoing needs and responsibilities regarding contaminant management and refuge management.

Background:

The Stewardship Council occupies two roles: (1) serving as the Local Stakeholder Organization (LSO) for Rocky Flats, and (2) engaging USFWS on the management of the Rocky Flats National Wildlife Refuge. To help ensure the Board and public understand when the Stewardship Council acts in its capacity as the Rocky Flats LSO and when it engages on issues beyond its scope as the LSO, the plan includes headers indicating "LSO" and "Non-LSO" activities.

Local Stakeholder Organization (LSO)

Legacy Management approved the LSO Plan for Rocky Flats on December 21, 2005. That Plan identifies how the main responsibilities Congress identified in the legislation authorizing the creation of LSO (Section 3120 of the Fiscal Year 2005 Defense Authorization bill) are to be carried out at Rocky Flats. These responsibilities are summarized as follows:

- Solicit and encourage public participation in appropriate activities relating to the closure and post-closure operations of the site.
- Disseminate information on the closure and post-closure operations of the site to the State and local and Tribal governments in the vicinity of the site, and persons and entities having a stake in the closure or post-closure operations of the site.
- Transmit to appropriate officers and employees of DOE questions and concerns of governments, persons, and entities referred to in the preceding bullet.

In fulfilling these responsibilities, the Stewardship Council has been tasked with helping DOE meet its public involvement obligations identified in the Legacy Management Public Involvement Plan (LMPIP) for Rocky Flats.

Rocky Flats National Wildlife Refuge (non-LSO activity)
"The Rocky Flats National Wildlife Refuge Act of 2001" established that Rocky Flats shall become a national wildlife refuge following EPA certification that the site has been cleaned to the agreed-upon regulatory standards. In July 2007 DOE conveyed jurisdictional responsibility over nearly 4000 acres to the Department of the Interior for the Rocky Flats National Wildlife Refuge. Additional lands were conveyed in 2014.

In April 2005, USFWS published the Rocky Flats Comprehensive Conservation Plan (CCP), the conservation plan for the Rocky Flats National Wildlife Refuge. The CCP describes the desired future conditions of the Refuge and provides long-range guidance and management direction. Per the CCP, in the coming years USFWS anticipates developing the following "step-down" management plans, which provide specific guidance for achieving the objectives established in the CCP:

1. Vegetation and Wildlife Management Plan
2. Integrated Pest Management Plan
3. Fire Management Plan (completed)
4. Visitors Services Plan
5. Health and Safety Plan
6. Historic Preservation Plan

In 2015, the USFWS began opening the Rocky Flats National Wildlife Refuge for guided tours. The agency will further open the Refuge in 2017 as it completes building the trail system.

Work Plan Elements

The Work Plan is divided into the following five sections:

1. DOE Management Responsibilities (LSO activity)
2. Former Rocky Flats Workforce (LSO activity)
3. Outreach (LSO activity with two exceptions noted)
4. Rocky Flats National Wildlife Refuge (non-LSO activity)
5. Business Operations (LSO activity)

DOE Management Responsibilities

LSO Activity

Overview:
One of the key roles of the Stewardship Council continues to be to understand and engage the various issues regarding the cleanup and post-closure management of Rocky Flats, and to provide a forum to foster discussions among DOE, the regulatory agencies, and community members.

2017 Activities:

1. Review information regarding the long-term stewardship and management of the Rocky Flats site, including but not limited to the results of the operational and performance monitoring data of site operations and DOE status reports.
2. Continue to identify key questions about the cleanup and ongoing management, and evaluate for remedy effectiveness and impacts to human and ecological receptors.
3. Track the progress made in treating contaminated groundwater at the groundwater treatment systems. Attention to the significant changes to the Mound Site and Solar Ponds groundwater plume treatment systems will be a focus during 2017 to ensure that the systems are effectively removing contaminants from groundwater.
4. Track the ongoing investigation into the source(s) of elevated actinide levels found in surface water. Of particular note are the cyclic uranium levels in North Walnut Creek at point of compliance WALPOC, elevated levels of actinides at point of evaluation GS10 on South Walnut Creek, and elevated plutonium levels at point of evaluation SW027 in the Woman Creek drainage.
5. Track the geotechnical progress made in addressing surface slumping at the Original Landfill (OLF).
6. Track issues related to additional sampling off-site and in the Rocky Flats Refuge. (Note: while the analysis might be conducted by local governments and USFWS, the issue is an LSO issue as it goes to the historic use of Rocky Flats as a weapons plant and associated residual contamination.)
7. Continue to participate in Adaptive Management Plan (AMP) meetings, including technical evaluations of data; track implementation of AMP results, which could include breaching the terminal ponds on Woman and Walnut Creeks.
8. Continue participating in DOE, CDPHE and/or EPA assessment(s) of remedy operations and effectiveness, including the CERCLA five-year review.
9. Work with DOE on implementing its Legacy Management Closure Public Involvement Plan (LMPIP), including the meetings DOE identified in the LMPIP.
10. Review DOE budgets for implementation of DOE responsibilities.
11. As needed, evaluate legal and regulatory issues regarding implementation of RFLMA and related site documents, and provide information to the Stewardship Council and to the community.
12. Work with DOE and the regulators to understand technical data regarding implementation and effectiveness of cleanup remedies and long-term controls, and provide information to the Stewardship Council and to the community.
13. Transmit to appropriate officers and employees of the DOE questions and concerns of governments, persons and entities regarding Rocky Flats.
14. Continue to work with DOE on the development of the visitor center.
15. Support the Rocky Flats Cold War Museum to educate successive generations about the history of Rocky Flats, particularly about residual contamination and continued need for long-term stewardship.
16. Track the development of Jefferson County Parkway as it relates to Rocky Flats.

Former Rocky Flats Workforce

LSO Activity

Overview:

One of DOE's primary post-closure responsibilities is to manage the health and pension benefits of former site workers. Many of these workers are the constituents of the Stewardship Council governments. Further, the Rocky Flats Homesteaders, which represents more than 1800 former site workers, sits on the Board of the Stewardship Council. For these and other reasons, as noted in the Stewardship Council's IGA, worker issues will continue to be an important focus of the Stewardship Council.

2017 Activities:

1. Track issues related to the implementation of the Energy Employee Occupational Illness Compensation Program Act (EEOICPA). Respond as needed.
2. Forward worker concerns, as necessary.

Outreach

LSO Activity with two exceptions noted

Overview:

As the LSO for Rocky Flats, a core responsibility for the Stewardship Council is providing a forum to educate people about Rocky Flats and the ongoing management needs. As part of this mission it remains essential that the Stewardship Council maintain close communications with DOE, EPA, CDPHE, and Congress.

The local communities have developed over the period of many years a very good working relationship with the two primary regulatory agencies that oversee the site, EPA and CDPHE. It is imperative that the Stewardship Council continue this tradition of partnership with these agencies.

The Colorado congressional delegation likewise plays a critical role in addressing Rocky Flats issues. The Stewardship Council shall remain an important mechanism for addressing questions and concerns of the delegation, and for providing ongoing interface with the delegation on the numerous site-specific issues and concerns.

2017 Activities:

1. Hold quarterly Board meetings and provide opportunity for comment and dialogue.
2. Communicate with other local officials, DOE, state and federal regulators, the Colorado congressional delegation, and other stakeholders about the Stewardship Council's mission and activities, as appropriate.
3. Seek public input and involvement on issues related to DOE and USFWS responsibilities at Rocky Flats. (Note: Any work on this item involving DOE is an LSO activity; all other work on this item is a non-LSO activity.)
4. Evaluate Congressional action affecting DOE and USFWS and administrative action that could affect Rocky Flats. (Note: Any work on this item involving DOE is an LSO activity; all other work on this item is a non-LSO activity.)

5. Maintain communication with federal and state legislators, as appropriate, and track federal and state legislation as needed.
6. Provide opportunities at meetings and in between meetings for education and feedback.
7. Work with DOE to disseminate information on the cleanup and post-closure operations of Rocky Flats.
8. Participate in local, regional and national forums.
9. Implement mechanisms for the Stewardship Council and the general public to be informed of the results of the monitoring data and other relevant information, recognizing that not all communication between DOE and Rocky Flats constituencies will flow through the Stewardship Council. Options include:
    - Periodic reports
    - Email updates
    - White papers
    - Letters

Rocky Flats National Wildlife Refuge

Non-LSO Activity

Overview:

One of the Stewardship Council's roles is to engage on issues related to the development and management of the future Rocky Flats National Wildlife Refuge. In 2015, USFWS began taking steps to open the Rocky Flats National Wildlife Refuge. Activities were limited to 2-3 guided tours during spring/summer 2015 (birds of Rocky Flats, wildflower walk, photography, etc.). Public access will increase in 2017.

In addition, USFWS and DOE are working in partnership to develop a visitor's center. That center will be sited on refuge lands, with USFWS taking lead on the public engagement process. As the LSO for Rocky Flats, the Stewardship Council will work with DOE on that agency's role in developing the visitor center. (That work with DOE is an LSO activity.) USFWS will take lead on public engagement; Stewardship Council members may be involved in that process.

Deleted: will

The items identified in this part of the work plan only concern USFWS.

2017 Activities:

1. Track agency and Congressional action affecting funding for USFWS and Rocky Flats National Wildlife Refuge. Engage as needed.
2. Track issues related to the development of the Rocky Flats visitor center.[1] Engage as needed.
3. Be apprised of the Rocky Flats National Wildlife Refuge site conservation plan, with an emphasis on the proposed trail plan.
4. Forward information regarding the Rocky Flats National Wildlife Refuge to the Stewardship Council Board of Directors and the public, as appropriate.

[1] As noted above, as the LSO for Rocky Flats, the Stewardship Council will work with DOE on that agency's role in developing the visitor center. The item identified in this part of the work plan only concerns USFWS' role.

5. Track issues related to the development of a trail network connecting Rocky Flats National Wildlife Refuge, Rocky Mountain Arsenal National Wildlife Refuge, Two Ponds National Wildlife Refuge, and Rocky Mountain National Park.

Business Operations

LSO Activity

Overview:

Business Operations refers to organizational management responsibilities – conducting the annual audit, submitting financial reports to DOE, adopting annual Work Plan and annual budget, etc.

2017 Activities:

1. Work with DOE to ensure the Stewardship Council continues to meet the needs as the LSO for Rocky Flats.
2. Operate Stewardship Council in compliance with state and federal regulations.
3. Conduct financial audit.
4. Prepare and adopt the annual work plan and the annual budget.
5. Submit financial reports to DOE.
6. Review and renew as necessary consulting agreements.
7. Provide annual report on activities.
8. Appoint community members for 2018-2019.

ROCKY FLATS STEWARDSHIP COUNCIL

P.O. Box 17670 (303) 412-1200
Boulder, CO 80308-0670 (303) 600-7773 (f)
www.rockyflatssc.org

Jefferson County -- Boulder County -- City and County of Broomfield -- City of Arvada -- City of Boulder
City of Golden -- City of Northglenn -- City of Thornton -- City of Westminster -- Town of Superior
League of Women Voters -- Rocky Flats Cold War Museum -- Rocky Flats Homesteaders
Steven Franks

MEMORANDUM

TO: Board
FROM: David Abelson
SUBJECT: Fiscal Year 2017 Budget Hearing
DATE: October 17, 2016

The Board will hold a budget hearing on the fiscal year 2017 Stewardship Council budget, and approve a budget resolution adopting the budget. As a unit of local government under the Colorado Constitution, the Stewardship Council must hold this hearing prior to adopting a final budget.

The budget I am presenting is the same one the Board reviewed at the September meeting. The "2017 Anticipated Expenditures" for 2017 have been updated to include the contract amendment. The hearing notice and budget resolution that will be submitted to the State of Colorado are also attached. Notice will be published in the Denver Post.

Please let me know what questions you have.

Action Item: Hold fiscal year 2017 budget hearing and approve resolution adopting the budget

ROCKY FLATS STEWARDSHIP COUNCIL

2017 Budget -- DRAFT #2 October 31, 2016

			2017 Budget Amounts	2017 Anticipated Expenditures	2016 Budget	2016 Actual/ Projected Expenses*	2016 Budget vs. 2016 Projected Expenses	Actual 2015 Expenses
A.	**Personnel**		**$ 93,000.00**	$ 93,000.00	$ 93,000.00	$ 85,800.00	$ (7,200.00)	$ 84,300.00
	Executive Director and Technical Advisor ($7750/month)							
B.	**Fringe Benefits**		**$ -**	$ -	$ -	$ -	$ -	$ -
	Staff are contractors							
C.	**Travel**		**$ 6,700.00**					
	Out of State National DOE-related trips	$ 5,500.00		$ 5,000.00	$ 5,500.00	$ 3,966.67	$ (1,533.33)	$ 6,255.70
	Local Travel $100/month for 12 months	$ 1,200.00		$ 1,000.00	$ 1,200.00	$ 720.12	$ (479.88)	$ 987.32
D.	**Computer Equipment**		**$ 500.00**	$ -	$ 500.00	$ -	$ (500.00)	$ -
	Purchase misc. hardware, software							
E.	**Supplies**		**$ 1,200.00**	$ 700.00	$ 1,200.00	$ 284.58	$ (915.42)	$ 569.00
	Supplies ($100/month)							
F.	**Contractual**		**$ 40,100.00**					
	Attorney & Accounting Services							
	Legal Services ($1400/ month)	$ 16,800.00		$ 16,000.00	$ 16,800.00	$ 15,778.96	$ (1,021.04)	$ 25,101.01
	Accounting ($850/month)	$ 10,200.00		$ 5,800.00	$ 10,200.00	$ 4,920.25	$ (5,279.75)	$ 5,044.50
	Audit Report	$ 6,500.00		$ 4,200.00	$ 6,500.00	$ 4,010.35	$ (2,489.65)	$ 4,000.48
	Admin. Services							

	Misc. Services: bank fees, etc.	$	1,000.00		$	100.00	$	1,000.00	$	1,061.48	$	61.48	$	986.92
	Minutes Preparation (6 meetings) (also includes web site management)	$	3,600.00		$	3,300.00	$	3,600.00	$	3,450.00	$	(150.00)	$	3,250.00
	Local Government Expenses Miscellaneous expenses not covered by DOE funds (includes meeting expenses and non-LSO activities)	$	2,000.00		$	1,500.00	$	2,000.00	$	1,384.13	$	(615.87)	$	1,440.00
G.	**Construction**			**$ -**	$	-	$	-	$	-	$	-	$	-
	None													
H.	**Other**			**$ 14,600.00**										
	Printing & Copy	$	2,000.00		$	250.00	$	2,000.00	$	-	$	(2,000.00)	$	1,386.29
	Postage $125/month for 12 months	$	1,500.00		$	250.00	$	1,500.00	$	247.18	$	(1,252.82)	$	1,179.88
	Liability Insurance													
	Property Contents/General Liability	$	500.00		$	500.00	$	500.00	$	500.00	$	-	$	500.00
	Board Members	$	3,500.00		$	3,500.00	$	3,500.00	$	3,385.61	$	(114.39)	$	3,204.33
	Telephone, email, etc.	$	2,700.00		$	2,100.00	$	2,700.00	$	1,986.69	$	(713.31)	$	1,927.10
	Website													
	Hosting	$	500.00		$	-	$	500.00	$	-	$	(500.00)	$	-
	Web master	$	1,500.00		$	-	$	1,500.00	$	-	$	(1,500.00)	$	-
	Subscriptions/Memberships													
	ECA membership	$	950.00		$	950.00	$	950.00	$	950.00	$	-	$	950.00
	Conference registration fees	$	800.00		$	400.00	$	800.00			$	(800.00)	$	-
	Newspapers	$	650.00		$	450.00	$	650.00	$	488.80	$	(161.20)	$	462.80
J.	**Indirect Costs**			**$ -**			$	-	$	-	$	-	$	-
	N/A													
TOTAL PROPOSED BUDGET				**$ 156,100.00**	**$**	**139,000.00**	**$**	**156,100.00**	**$**	**128,934.82**	**$**	**(27,165.18)**	**$**	**141,545.33**

REVENUE FOR 2016

Local government contributions	$ 10,000.00
Department of Energy grant	$ 139,000.00
RFCLOG carry-over	$ 7,100.00
TOTAL	$ 156,100.00

*2016 Actual/Projected Expenses = actual January through September; projected October through December

STATE OF COLORADO

ROCKY FLATS STEWARDSHIP COUNCIL

The Board of Directors of the Rocky Flats Stewardship Council ("Stewardship Council"), State of Colorado, held a meeting at the Rocky Mountain Metropolitan Airport (formerly Jefferson County Airport), Mt. Evans Room, 11755 Airport Way, in Broomfield, Colorado 80021, on October 31, 2016, at the hour of 8:30 A.M., at which a quorum of the Board of Directors was present.

The Executive Director reported that prior to the meeting he had notified each of the Directors of the date, time and place of this meeting and the purpose for which it was called. He further reported that Notice of the Board Meeting has been posted in accordance with the Bylaws of the Stewardship Council and, to the best of his knowledge, remains posted to the date of this meeting.

Thereupon, Director _____, introduced and moved the adoption of the following Resolution:

RESOLUTION

A RESOLUTION SUMMARIZING EXPENDITURES AND REVENUES FOR THE GENERAL FUND AND ADOPTING A BUDGET AND APPROPRIATING SUMS OF MONEY TO THE GENERAL FUND IN THE AMOUNTS AND FOR THE PURPOSES SET FORTH HEREIN FOR THE ROCKY FLATS STEWARDSHIP COUNCIL, STATE OF COLORADO, FOR THE CALENDAR YEAR BEGINNING ON THE 1ST DAY OF JANUARY, 2017, AND ENDING ON THE LAST DAY OF DECEMBER, 2017.

WHEREAS, the proposed budget has been submitted to the Board of Directors of the Stewardship Council for its consideration; and

WHEREAS, upon due and proper notice, published in accordance with law as attached as Exhibit A, said proposed budget was open for inspection by the public at a designated place, a public hearing was held on October 31, 2016, and interested electors were given the opportunity to file or register any objections to said proposed budget; and

WHEREAS, the budget being adopted by the Board has been prepared based on the best information available to the Board regarding the effects of Article X, Section 20 of the Colorado Constitution; and

WHEREAS, whatever increases may have been made in the expenditures, like increases were added to the revenues so that the budget remains in balance, as required by law.

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF DIRECTORS OF THE ROCKY FLATS STEWARDSHIP COUNCIL, STATE OF COLORADO:

Section 1. Summary of 2017 Revenues and 2017 Expenditures. That the estimated revenues and expenditures for the general fund for fiscal year 2017, as more specifically set forth in the budget attached hereto, are accepted and approved.

Section 2. Adoption of Budget. That the budget as submitted, amended, attached hereto and incorporated herein, is approved and adopted as the budget of the Rocky Flats Stewardship Council for fiscal year 2017.

Section 3. Appropriations. That the amounts set forth as expenditures and balances remaining, as specifically allocated in the budget, attached hereto, are hereby appropriated from the revenue of the general fund, to the general fund, for the purposes stated and no other.

Section 4. Budget Certification. That the budget shall be certified by Lisa Morzel, Chair of the Board, and made a part of the public records of the Rocky Flats Stewardship Council.

The foregoing Resolution was seconded by Director _____.

RESOLUTION APPROVED AND ADOPTED THIS 31st DAY OF OCTOBER, 2016.

[Remainder of Page Intentionally Left Blank]

Signature Page to Rocky Flats Stewardship Council
2017 Budget Resolution

ROCKY FLATS STEWARDSHIP COUNCIL

By: _____
Lisa Morzel, Chair

ATTEST:

By: _____
Secretary

STATE OF COLORADO

ROCKY FLATS STEWARDSHIP COUNCIL

I, Lisa Morzel, hereby certify that I am a Director and qualified Chair of the Rocky Flats Stewardship Council, and that the foregoing constitutes a true and correct copy of the record of proceedings of the Board of Directors of said Stewardship Council, adopted at a meeting of the Board of Directors of the Rocky Flats Stewardship Council held on October 31, 2016, at the Rocky Mountain Metropolitan Airport (formerly Jefferson County Airport), Mt. Evans Room, 11755 Airport Way, in Broomfield, Colorado, as recorded in the official record of the proceedings of the Stewardship Council, insofar as said proceedings relate to the budget hearing for fiscal year 2017; that said proceedings were duly had and taken; that the meeting was duly held; and that the persons were present at the meeting as therein shown.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed the official seal of the Stewardship Council this 31st day of October, 2016.

_____

Lisa Morzel, Chair

EXHIBIT A

NOTICE AS TO PROPOSED 2017 BUDGET

NOTICE IS HEREBY GIVEN that a proposed budget has been submitted to the **ROCKY FLATS STEWARDSHIP COUNCIL** for the fiscal year 2017. A copy of such proposed budget has been filed in the office Seter & Vander Wall, P.C. 7400 East Orchard Road, Suite 3300, Greenwood Village, Colorado, where same is open for public inspection. Such proposed budget will be considered at a meeting of the Rocky Flats Stewardship Council to be held at 8:30 A.M. on Monday, October 31, 2016. The meeting will be held at 11755 Airport Way, Mt. Evans Room, in Broomfield, Colorado. Any interested party may inspect the proposed budget and file or register any objections at any time prior to the final adoption of the 2017 budget.

BY ORDER OF THE EXECUTIVE COMMITTEE:
ROCKY FLATS STEWARDSHIP COUNCIL

By: /s/ SETER & VANDER WALL, P.C.
Attorneys for the District

Publish in: The Denver Post
Publish on: Saturday, October 22, 2016

ROCKY FLATS STEWARDSHIP COUNCIL
2017 BUDGET MESSAGE

SUMMARY OF SIGNIFICANT ASSUMPTIONS

Services Provided

The purpose of the Rocky Flats Stewardship Council, consistent with public health, safety and welfare, is to provide an effective mechanism for local governments in the vicinity of Rocky Flats and their citizens to work together on issues of mutual concern relating to the future use and long-term protection of Rocky Flats, and to serve as a focal point for local government communication and advocacy with state and federal agencies regarding Rocky Flats issues.

Revenue

The Stewardship Council receives its revenues from the Department of Energy; Rocky Flats Coalition of Local Governments; and Local Government contributions (Boulder County, Jefferson County, City and County of Broomfield, Cities of Arvada, Boulder, Golden, Northglenn, Thornton, and Westminster and Town of Superior).

Expenditures

The funds are used for G&A, overhead expenses, as well as costs incurred with buffer zone and stewardship planning processes.

The Stewardship Council prepares its budget on the modified accrual basis of accounting.

DOE Quarterly Report

- Cover memo
- Selection of quarterly report

Actinide Migration

- Cover memo
- AME Report
- June 4, 2012, minutes (Actinide Migration section only)

ROCKY FLATS STEWARDSHIP COUNCIL

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League of Women Voters ~ Rocky Flats Cold War Museum ~ Rocky Flats Homesteaders
Steven Franks

MEMORANDUM

TO: Stewardship Council Board
FROM: Rik Getty
SUBJECT: Quarterly Report Briefing
DATE: October 14, 2016

We have scheduled one hour for DOE to present its quarterly update for the second quarter of 2016 (April - June). The report, minus the figures, tables and appendices, is attached. The full report can be found by clicking this link (4th bullet):
http://www.lm.doe.gov/Rocky_Flats/Documents.aspx

This report addresses remedy-related surveillance, monitoring, and operations and maintenance activities. Those activities include:

- Annual site inspection
- Maintenance and inspection of the Original Landfill (OLF) and the Present Landfill (PLF)
- Maintenance and inspection of the four groundwater treatment systems
- Inspection of signs posted at the perimeter of the central operable unit
- Erosion control and revegetation activities
- Routine water monitoring

Executive Summary – The following are highlights from the quarter:

- The annual inspection did not reveal any significant issues.
- Original Landfill (OLF) – The cover showed signs of movement in approximately the same locations that were repaired in 2015. The primary area of slumping and cracking was in the southeast corner below the eastern end of Berm 6. Additionally, some areas on the eastern edge moved, but less than what was observed in 2015. The majority of movement observed during the quarter remained well outside of the waste footprint.
- Mound Site Plume Treatment System – Air-stripper maintenance consisted mostly of monitoring water pressure and nozzle spray patterns, maintaining the fan assembly that provides powered ventilation, and cleaning the pump, lines, and nozzles, as warranted.

- East Trenches Plume Treatment System – Maintenance included checking the batteries and other power components, adjusting valves and settings to maintain air stripper operation, greasing the blower motor, cleaning floats, and cleaning the air stripper trays and window. A generator was plugged into the power facility during some periods of no sun to assist charging the batteries.
- Solar Ponds Plume Treatment System (SPPTS) – The Big Box was emptied of overburden and media, the plumbing was revised to support the new design, and a new "Sidecar" vault was installed on the east side of the Big Box.
- Water Monitoring – Monitoring met the targeted objectives[1].
  - All RFLMA POC analyte evaluation concentrations remained below the applicable water-quality standards throughout the quarter.
  - Reportable conditions for plutonium and americium were observed at RFLMA POE SW027 (Woman Creek drainage near terminal pond C2 located in the south interceptor ditch) starting in 2015 and extending into the second quarter of 2016. As of June 30, 2016, the 12-month rolling average for plutonium at SW027 remained reportable at 0.18 picocuries per liter (pCi/L); americium is no longer reportable.
  - All analyte evaluation concentrations at RFLMA POE locations GS10 (South Walnut Creek, upstream of former pond B1) and SW093 (North Walnut Creek, slightly downstream of the SPPTS) remained below the applicable water-quality standards throughout the quarter.

Please let me know if you have any questions.

[1] The RFLMA network consists of eight automated surface water gaging stations, 11 surface water grab-sampling locations, eight treatment-system locations, and 88 monitoring wells. Additional locations are occasionally sampled in support of investigations in response to reportable conditions. During the quarter, 42 flow-paced composite samples, 21 surface water grab samples, 14 treatment system samples, and 91 groundwater samples were collected and submitted for analysis.

LMS/RFS/S14793

Rocky Flats Site, Colorado, Quarterly Report of Site Surveillance and Maintenance Activities Second Quarter Calendar Year 2016

October 2016

U.S. DEPARTMENT OF ENERGY | Legacy Management

Contents

Figures

Tables

Appendixes

Abbreviations

AOC	Area of Concern
CAD/ROD	Corrective Action Decision/Record of Decision
CDPHE	Colorado Department of Public Health and Environment
COU	Central Operable Unit
CR	Contact Record
CY	calendar year
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ETPTS	East Trenches Plume Treatment System
ICs	institutional controls
LM	Office of Legacy Management
M&M	monitoring and maintenance
µg/L	micrograms per liter (sometimes expressed as ug/L)
mg/L	milligrams per liter
MSPTS	Mound Site Plume Treatment System
NREL	National Renewable Energy Laboratory
OLF	Original Landfill
OLF M&M Plan	*Rocky Flats Site Original Landfill Monitoring and Maintenance Plan*
pCi/L	picocuries per liter
PLF	Present Landfill
PLF M&M Plan	*Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan*
PLFTS	Present Landfill Treatment System
POC	Point of Compliance
POE	Point of Evaluation
RCRA	Resource Conservation and Recovery Act
RFLMA	*Rocky Flats Legacy Management Agreement*
RFSOG	Rocky Flats Site Operations Guide
SID	South Interceptor Ditch
Site	Rocky Flats Site
SPPTS	Solar Ponds Plume Treatment System
TCE	trichloroethene
VOCs	volatile organic compounds
ZVI	zero-valent iron

1.0 Introduction

The U.S. Department of Energy (DOE) Office of Legacy Management (LM) is responsible for implementing the final response action selected in the *Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit* (CAD/ROD) (DOE, EPA, and CDPHE 2006), issued on September 29, 2006, and amended on September 21, 2011 (DOE, EPA, and CDPHE 2011), for the Rocky Flats Site, Colorado (the Site). DOE, the U.S. Environmental Protection Agency (EPA), and the Colorado Department of Public Health and Environment (CDPHE) are implementing the monitoring and maintenance (M&M) requirements of the CAD/ROD as described in the *Rocky Flats Legacy Management Agreement* (RFLMA). Attachment 2 of the RFLMA (DOE 2012a) defines the surveillance and maintenance requirements of the Central Operable Unit (COU) remedy, the frequency for each required activity, and the M&M locations. The requirements include environmental monitoring; maintenance of the erosion controls, access controls (signs), landfill covers, and groundwater treatment systems; and operation of the groundwater treatment systems. The RFLMA also requires that the institutional controls (ICs), in the form of use restrictions as established in the CAD/ROD, be maintained.

This report is required in accordance with Section 7.0, "Periodic Reporting Requirements," of RFLMA Attachment 2. The purpose of this report is to inform the regulatory agencies and stakeholders of the remedy-related surveillance, monitoring, and maintenance activities conducted at the Site during the second quarter (April 1 through June 30) of calendar year (CY) 2016. LM provides periodic communications through several means, such as this report, web-based tools, and public meetings.

LM prepared the Rocky Flats Site Operations Guide (RFSOG) (DOE 2013) to serve as the primary internal document to guide work to satisfy the requirements of the RFLMA and to implement best management practices at the Site.

Several other site-specific documents provide additional detail regarding the requirements described in RFLMA Attachment 2, including all aspects of surveillance, monitoring, and maintenance activities, as well as data evaluation protocols.

Monitoring data and summaries of surveillance and maintenance activities for past quarters are available in the quarterly reports. Extensive discussion and evaluation of surveillance, monitoring, and maintenance activities are presented each calendar year in the annual report of Site surveillance and maintenance activities.

This report addresses remedy-related surveillance, monitoring, and operations and maintenance activities conducted at the Site during the second quarter of CY 2016. This report summarizes the following activities:

- Maintenance and inspection of the Original Landfill (OLF) and the Present Landfill (PLF)
- Maintenance and inspection of the four groundwater treatment systems
- Inspection of signs posted at the perimeter of the COU as physical controls
- Erosion control and revegetation activities
- Routine water monitoring (in accordance with the RFLMA and the RFSOG)

2.0 Site Operations and Maintenance

2.1 Annual Site Inspection

Annual inspection and monitoring of evidence of significant erosion and violation of ICs is required in accordance with RFLMA Attachment 2, Sections 5.3.4 and 5.3.6. The inspection was conducted on April 13, 2016.

The items listed below were monitored during the inspection:

- Evidence of significant erosion in the COU, and the proximity of any erosion to the subsurface features identified in RFLMA Attachment 2, Figure 3 and Figure 4. This monitoring included observation for precursor evidence of significant erosion, such as cracks, rills, slumping, subsidence, and sediment deposition.
- The effectiveness of ICs as determined by evidence of violation of the controls.
- Evidence of adverse biological conditions, such as unexpected morbidity or mortality.

As part of the IC inspection, annual verification that the Environmental Covenant remains in the Administrative Record and on file in Jefferson County records is required. In addition, it was verified that physical controls (i.e., signs placed along the COU fence) were in place.

The annual inspection was scheduled so that surface features could be observed after snow cover had melted, once the surface was dry, and before vegetation growth could obscure land surface features.

To conduct this work, knowledgeable DOE, CDPHE, EPA, and Navarro Research and Engineering, Inc. staff members (the inspection team) walked down the COU surface to observe the conditions. These areas were designated as Areas A through E and are shown on the maps included in Appendix A. These areas generally coincide with the location of the subsurface features in RFLMA Attachment 2, Figure 3 and Figure 4, or they afforded adequate viewing of the surface at these locations (e.g., sloping areas). Areas F and G were inspected as a best management practice (Appendix A). Inspection team members were given maps and assigned areas to inspect. Reference points, such as monitoring wells and roads, were used to orient the inspection team members within designated inspection areas.

Appendix A of this report also includes the completed inspection checklists.

Team members used marker flags to identify areas where conditions showed evidence of the three categories listed above to make their location available for follow-up by site subject matter experts. Areas that required evaluation were documented in the Site Observation Log for evaluation and follow-up.

Debris or trash on the surface was either picked up during the inspection or subsequently removed. Several areas showed minor depressions around former building areas. Site field operations subject matter experts evaluated those areas and none appeared to be significant.

No evidence of violations of institutional or physical controls was observed.

On March 28, 2016, an inspection team member verified that the Environmental Covenant for the COU remains in the Administrative Record and on file with the Jefferson County land records, which are used by the Planning and Zoning Department.

No adverse biological conditions were noted during the inspection.

2.2 Landfills

2.2.1 Present Landfill

The PLF is inspected quarterly in accordance with the requirements of the *Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan* (PLF M&M Plan) (DOE 2014) and Attachment 2 of the RFLMA (DOE 2012a). Settlement monuments are surveyed annually in December and results are reported in the annual report.

2.2.1.1 Inspection Results

The routine PLF inspection for the second quarter of CY 2016 was performed on June 21, 2016. An additional weather-related inspection was required on April 20, 2016, because there was precipitation of more than 1 inch in a 24-hour period. The National Renewable Energy Laboratory (NREL), adjacent to the Site, recorded 1.45 inches of precipitation. (NREL uses heated rain gauges, which the Site does not have.) No significant issues (e.g., erosion) were observed during either inspection. Copies of the landfill inspection forms are presented in Appendix A.

2.2.1.2 Settlement Monuments

The 2015 annual survey of the PLF settlement monuments was performed on December 9, 2015. Survey data indicate that vertical settling at each monument is within the limits specified in the PLF M&M Plan (DOE 2014). The 2016 annual survey is scheduled for completion in the fourth quarter of CY 2016.

2.2.2 Original Landfill

The OLF is inspected monthly in accordance with the requirements in the *Rocky Flats Site Original Landfill Monitoring and Maintenance Plan* (OLF M&M Plan) (DOE 2009a) and the RFLMA. It was expected that after the first year, the inspection frequency might be reduced to quarterly for an additional 4 years. However, because localized slumping and seep areas have been observed, and because of the investigation of, and subsequent repairs to, the OLF cover that were completed in 2009, no change to the frequency of inspections was recommended in the *Third Five-Year Review Report for the Rocky Flats Site, Jefferson and Boulder Counties, Colorado* (DOE 2012b).

2.2.2.1 Inspection Results

Routine OLF inspections during the second quarter of CY 2016 were performed on April 20, May 18, and June 21, 2016. As discussed in Section 2.2.1.1, the weather-related inspection on April 20, 2016, was due to precipitation events producing more than 1 inch of rain in a 24-hour

period. This weather-related inspection was combined with the routine monthly inspection for April.

NREL reported 5.85 inches of precipitation for the second quarter of 2016. The OLF cover showed signs of movement in approximately the same locations that were repaired in 2015. The primary area of slumping and cracking was in the southeast corner below the eastern end of Berm 6. While some areas of the cover on the eastern edge of the landfill did move in the second quarter, the magnitude of movement was much less than what was observed in 2015. In addition, the majority of movement observed in the second quarter remained well outside of the waste footprint. The completed inspection forms are presented in Appendix A.

2.2.2.2 Settlement Monuments

The OLF settlement monuments were surveyed on March 14, 2016. Survey data indicate that vertical settling at each monument is within the limits specified in the OLF M&M Plan (DOE 2009a). The survey results are presented in Appendix A.

2.2.2.3 Inclinometers

All inclinometer monitoring at the OLF has been discontinued.

As discussed in the quarterly report for the second quarter of CY 2009 (DOE 2009b), seven inclinometers were installed in boreholes at the OLF in 2008 as part of the geotechnical investigation of localized areas of instability. Since then, movement of the inclinometers was monitored approximately monthly until the majority of inclinometers were broken. (Inclinometers are deflected by lateral movement of the ground in which they are located, and if the deflection is enough to break the inclinometer tubes, then the inclinometer is no longer monitored. As stated in Section 3.3.1, "Monitoring Locations and Procedures," in the OLF M&M Plan: "Once an inclinometer tube breaks, it will no longer be monitored.")

2.2.2.4 Seeps

Seeps at the OLF were evaluated during the monthly inspections. Estimates for individual seep flow rates are given in the monthly OLF inspection reports.

2.3 Subsidence Observed Near Former Buildings

Former building areas, including those for Buildings 371, 771, 881, and 991, are routinely inspected (i.e., quarterly and during weather-related inspections) for evidence of subsidence. After a significant precipitation event in April, additional subsidence was noted in the former Building 881 area at a location where subsidence had been previously filled. The new subsidence was approximately 4 feet in diameter and 3 to 4 feet deep. The subsidence area was filled with soil.

2.4 Site Road Maintenance

Routine maintenance on the site roads occurred in June 2016. A dust suppressant was applied on the primary routes to aid in dust control.

The slump identified in the North Walnut Creek drainage and reported in the 2015 Annual Report experienced additional slumping due to precipitation during the second quarter of CY 2016. This slump is encroaching on a dirt road used to access valley-bottom components of the Solar Ponds Plume Treatment System (SPPTS) (e.g., the Discharge Gallery).

2.5 Groundwater Treatment Systems

Four groundwater treatment systems are monitored, operated, and maintained in accordance with requirements defined in the RFLMA and the RFSOG. Three of these systems (the Mound Site Plume Treatment System [MSPTS], the East Trenches Plume Treatment System [ETPTS], and the SPPTS) include a groundwater intercept trench (collection trench), which is similar to a French drain with an impermeable membrane on the downgradient side. The fourth system, the PLF Treatment System (PLFTS), passively treats water from the northern and southern components of the Groundwater Intercept System and water that flows from the PLF seep.

2.5.1 Mound Site Plume Treatment System

The MSPTS was installed in 1998 to treat groundwater contaminated with low concentrations of volatile organic compounds (VOCs). Groundwater that is intercepted by the collection trench is routed to treatment cells that are filled with zero-valent iron (ZVI). Dissolved VOCs are treated by the ZVI in these cells. The water then flows to an effluent manhole and is subsequently discharged to the subsurface. In 2011, a small air stripper, designed and built by site staff, was installed within this effluent manhole. This solar/battery-powered air stripper has been revised and optimized in the years since to more effectively polish the effluent from the ZVI-filled treatment cells, further reducing residual concentrations of VOCs. Refer to recent annual reports for more information on this treatment system, including the air stripper.

Routine maintenance activities continued at the MSPTS through most of the second quarter of CY 2016. These activities included checking and adjusting flows, inspecting and flushing piping, monitoring water levels in the two treatment cells, and servicing the air stripper. Air-stripper maintenance mainly consisted of monitoring water pressure and nozzle spray patterns, maintaining the fan assembly that provides powered ventilation, and cleaning the pump, lines, and nozzles, as warranted.

On June 27, 2016, flow to the MSPTS treatment cells (and the air stripper in the MSPTS effluent manhole) was shut off in preparation for the reconfiguration project that will begin early in the third quarter.

Refer to Section 3.1.9.1 for information on water-quality monitoring.

2.5.2 East Trenches Plume Treatment System

The ETPTS was installed in 1999 to treat groundwater contaminated with low concentrations of VOCs, and was based on the design of the MSPTS. In its original configuration, groundwater that was intercepted by the ETPTS collection trench was routed to treatment cells filled with ZVI. Dissolved VOCs were treated by the ZVI in these cells and the treated effluent then flowed to an effluent manhole and was subsequently discharged to the subsurface. Following tests at the MSPTS that began in 2011, a small air stripper designed and built by site staff was installed in

the influent manhole in 2013. This pre-treated water (i.e., the water from which some of the VOCs were removed) was then routed to the ZVI-filled treatment cells. A reconfiguration project was undertaken in 2014–2015, and since that project was completed, the ETPTS no longer relies on ZVI for treatment. Instead, a full-scale, commercial air stripper using only solar/battery power treats the VOCs in collected groundwater. This reconfiguration project made no changes to the groundwater intercept trench, effluent manhole, or discharge gallery. Reconfiguration of the ETPTS was completed in January 2015. Refer to the annual reports for 2014 and 2015 (DOE 2015a; DOE 2016, respectively) and the first-quarter 2015 report (DOE 2015b) for more information on the reconfiguration project.

Routine maintenance at the ETPTS in the second quarter of 2016 included checking the batteries and other power components, adjusting valves and settings to maintain air stripper operation, greasing the blower motor, cleaning floats, and cleaning the air stripper trays and window. A generator was plugged into the power facility occasionally to assist charging the batteries. A portable sump pump was used periodically to boost the rate of discharge of treated effluent from the effluent tank, given the relatively higher volumes of treated influent during spring months. (As a part of the upcoming MSPTS reconfiguration project, the ETPTS effluent pump will be replaced with a higher-volume pump that should reduce or eliminate the need for seasonal use of a portable pump.)

Refer to Section 3.1.9.2 for information on water-quality monitoring.

2.5.3 Solar Ponds Plume Treatment System

The SPPTS was installed in 1999 to treat groundwater contaminated with nitrate and uranium, and is based on the design of the MSPTS and ETPTS. In its original configuration, groundwater that was intercepted by the SPPTS collection trench was routed to a larger treatment cell filled with sawdust and a small percentage of ZVI, and then to a smaller treatment cell filled with gravel and ZVI. Nitrate was treated in the first cell and uranium in the second. Effluent from the treatment cells is routed to an effluent manhole, from which it is piped to a subsurface discharge gallery. Several upgrades to the SPPTS have been installed and modified over the years, and numerous treatability studies have been conducted to improve its effectiveness. The SPPTS now incorporates additional treatment cells as well as pilot-scale nitrate treatment using a lagoon approach. Refer to recent annual reports for additional information on this treatment system and the upgrades and studies conducted here.

The pilot-scale approach to nitrate treatment using denitrifying bacteria in a lagoon was identified as the most promising approach of those tested over the past several years at the SPPTS. As a result, the system was scheduled for reconfiguration to a full-scale, test lagoon beginning in the second quarter of 2016. This interim reconfiguration project was approved in RFLMA Contact Records (CRs) 2015-08 and 2015-09.

With the exception of checking the solar/battery systems and pumping out accumulated water from the vaults, what had been routine maintenance at the SPPTS was no longer appropriate beginning early in the second quarter of CY 2016. Flow to the original treatment cells and associated concrete structure, informally referred to as the “Big Box,” was halted on April 11, 2016, and water was allowed to passively drain out. On April 19, field activities began. The Big Box was emptied of overburden and media, the plumbing was revised to support the new design, and a new “Sidecar” vault was installed on the east side of the Big Box. Tests of

uranium-treating microcells will be conducted in this vault. The Phase II Cell was also emptied of its ZVI/gravel media.

By the end of the second quarter CY 2016, the new configuration of the Big Box was nearing completion. However, in late June, there was evidence that a pipe outside the northern wall of the Big Box at a depth of about 12 feet was broken or leaking. As the quarter ended, plans were being finalized to excavate and replace the external plumbing on that side of the Big Box.

Throughout the second quarter and the performance of the reconfiguration project, the pilot-scale lagoons were maintained via routine pulses of nutrient-dosed water. The objective of this was to keep the denitrifying bacteria healthy, because the contents of these small-scale lagoons will be used to populate the full-scale interim test lagoon.

Refer to Section 3.1.9.3 for information on water-quality monitoring.

2.5.4 Present Landfill Treatment System

Routine maintenance activities continued at the PLFTS through the second quarter of CY 2016. These activities generally consisted of inspecting the system for potential problems. Cracking in the grout surrounding the lip of the north and south manhole covers, observed during the first quarter, was still evident. The cracking was minimal and did not affect the treatment system. The grout will be repaired during the third quarter of 2016. No other deficiencies were noted in second quarter of 2016.

Refer to Section 3.1.9.4 for information on water-quality monitoring.

2.6 Sign Inspection

It is required that "U.S. Department of Energy – No Trespassing" signs be posted at defined intervals around the perimeter of the COU to notify persons that they are at the boundary of the COU. It is also required that signs listing the ICs and providing contact information be posted at access points to the COU. The signs are required by the remedy as physical controls, are inspected quarterly, and are maintained through repair or replacement as needed. Physical controls protect the engineered components of the remedy, including landfill covers, groundwater treatment systems, and monitoring equipment, which are also inspected routinely during M&M activities.

The signs were inspected on May 2, 2016, and they met the requirements.

2.7 Erosion Control and Revegetation

Minor maintenance of the site erosion-control features was performed in the second quarter of CY 2016. Erosion controls were installed and maintained for the various projects that were ongoing during the second quarter of CY 2016.

3.0 Environmental Monitoring

This section summarizes the environmental monitoring conducted in accordance with RFLMA Attachment 2. RFLMA Attachment 2, Table 1, "Surface Water Standards," establishes the concentrations that determine reportable conditions in accordance with RFLMA Attachment 2, Section 6.0, "Action Determinations." Reportable conditions require DOE to consult with CDHPE and EPA to determine the appropriate actions.

3.1 Water Monitoring

This section includes:

- A discussion of analytical results for the Point of Compliance (POC), Point of Evaluation (POE), PLF, and OLF surface-water monitoring objectives.
- Summaries of groundwater monitoring at the Area of Concern (AOC) wells, the Sentinel wells, the Evaluation wells, and the Resource Conservation and Recovery Act (RCRA) wells; treatment-system monitoring; and Surface Water Support monitoring at the Site.

RFLMA Attachment 2 and the RFSOG offer details about the monitoring locations, sampling criteria, and evaluation protocols for the water monitoring objectives mentioned in the following sections. Appendix B provides analytical water-quality data for the second quarter of CY 2016. The annual report for CY 2016 will provide a more detailed interpretation and discussion.

3.1.1 Water Monitoring Highlights

During the second quarter of CY 2016, the water monitoring met the targeted monitoring objectives required by the RFLMA and was in conformance with RFSOG implementation guidance. The routine RFLMA network consists of 8 automated gaging stations, 11 surface-water grab-sampling locations, 8 treatment-system locations, and 88 monitoring wells (DOE 2015a). Additional locations are occasionally sampled in support of investigations in response to reportable conditions. During the quarter, 42 flow-paced composite samples, 21 surface-water grab samples, 14 treatment-system samples, and 91 groundwater samples were collected (in accordance with RFLMA protocols) and submitted for analysis.[1]

Groundwater monitoring results will be evaluated as part of the annual report for CY 2016.

All RFLMA POC analyte evaluation concentrations remained below the applicable water-quality standards throughout the second quarter of CY 2016.

Reportable conditions for plutonium and americium were observed at RFLMA POE SW027 starting in CY 2015 and extending into the second quarter of CY 2016. As of June 30, 2016, the 12-month rolling average for plutonium at SW027 remained reportable at 0.18 picocuries per liter (pCi/L) and americium is no longer reportable. SW027 data are presented and discussed

[1] Composite samples consist of multiple aliquots ("grabs") of identical volume. Each grab is delivered by the automatic sampler to the composite container at each predetermined flow volume or time interval. During the second quarter of CY 2016, the 42 flow-paced composites comprised 2,070 individual grabs.

further in Section 3.1.3.2. All other analytes were not reportable through the second quarter of CY 2016.

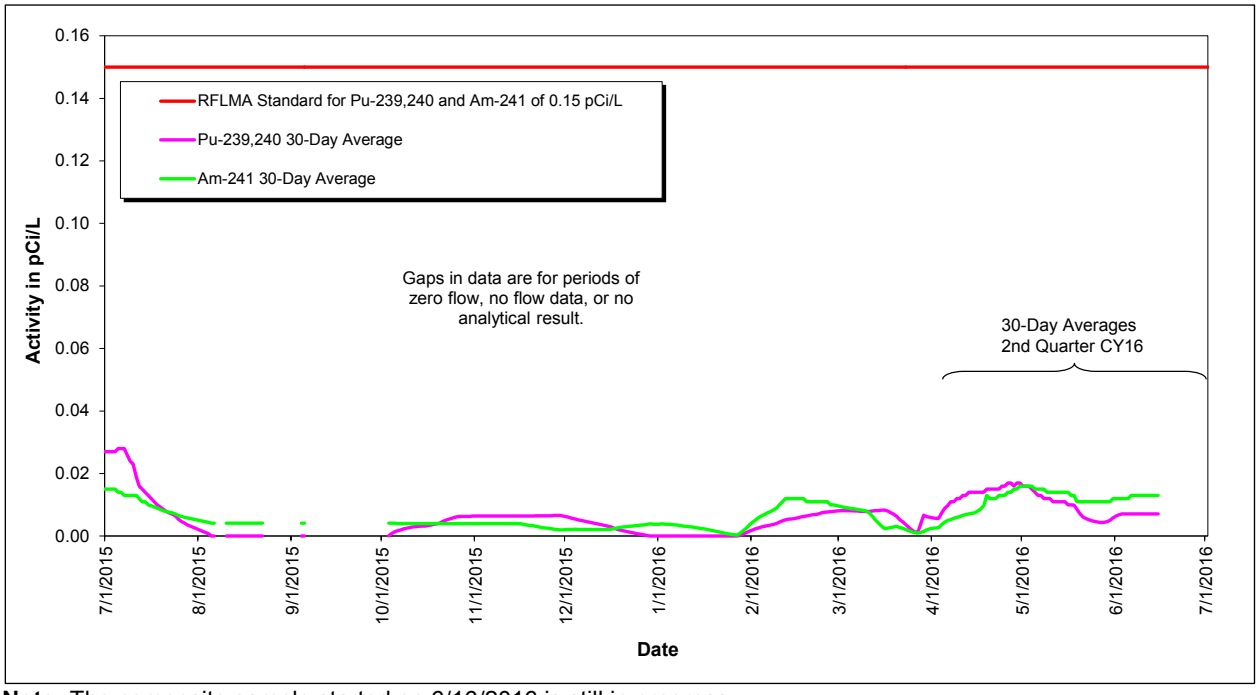
All analyte evaluation concentrations at RFLMA POE locations GS10 and SW093 remained below the applicable water-quality standards throughout the second quarter of CY 2016.

3.1.2 POC Monitoring

The following sections include summary tables and plots showing the applicable 30-day and 12-month rolling averages for the POC analytes.

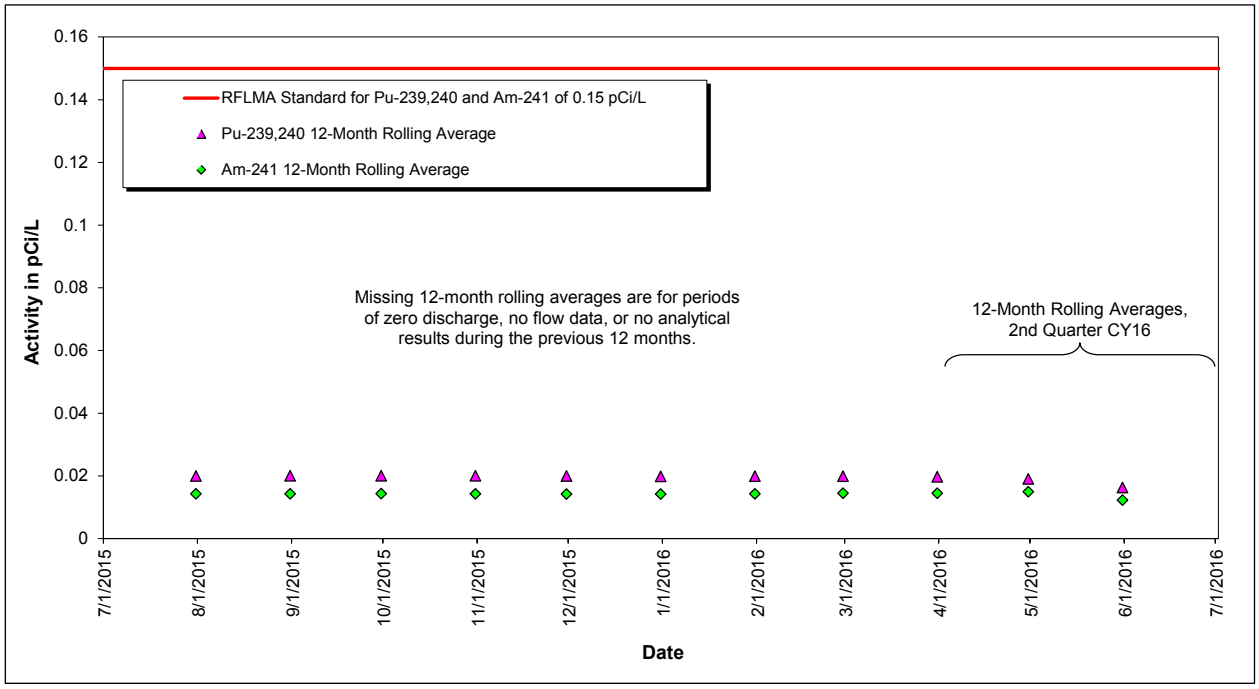
3.1.2.1 Monitoring Location WALPOC

Monitoring location WALPOC is on Walnut Creek at the eastern COU boundary. Figure 1 through Figure 4 show no occurrences of reportable 12-month rolling or 30-day averages during the quarter for plutonium and americium (in pCi/L) or nitrate + nitrite as nitrogen (in milligrams per liter [mg/L]). The methods for calculating the 30-day and 12-month rolling averages are detailed in the annual report.



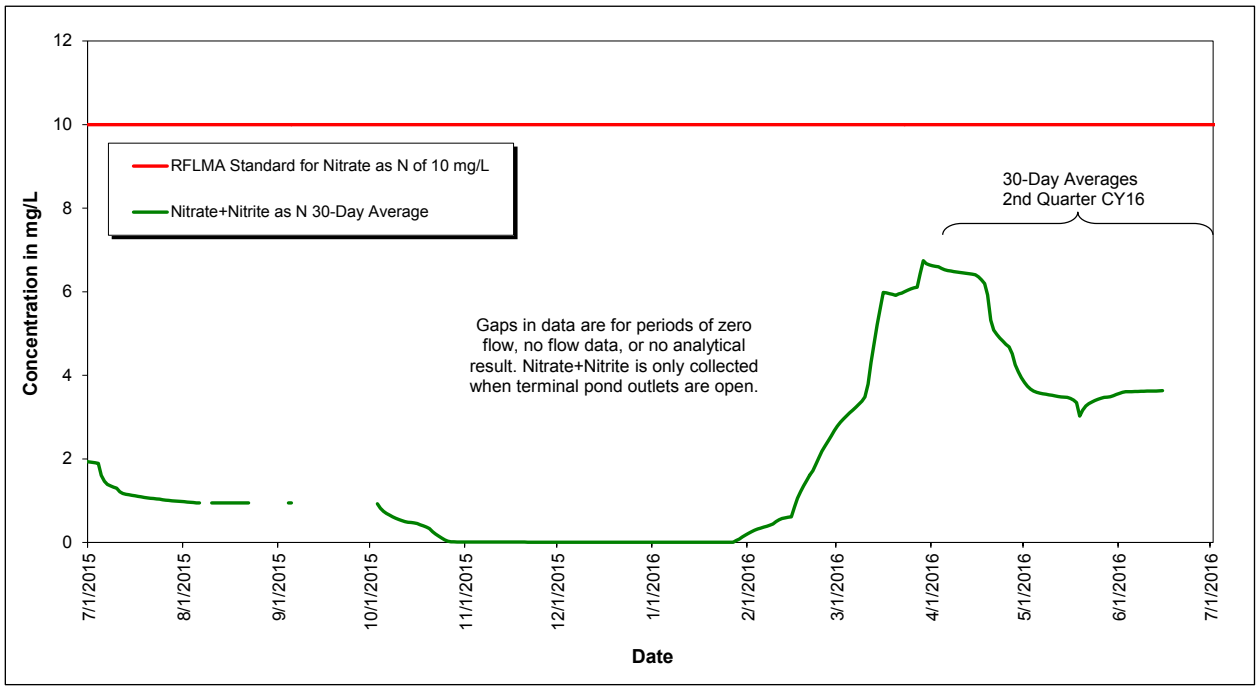
Note: The composite sample started on 6/16/2016 is still in progress.

Figure 1. Volume-Weighted 30-Day Average Plutonium and Americium Activities at WALPOC: Year Ending Second Quarter CY 2016



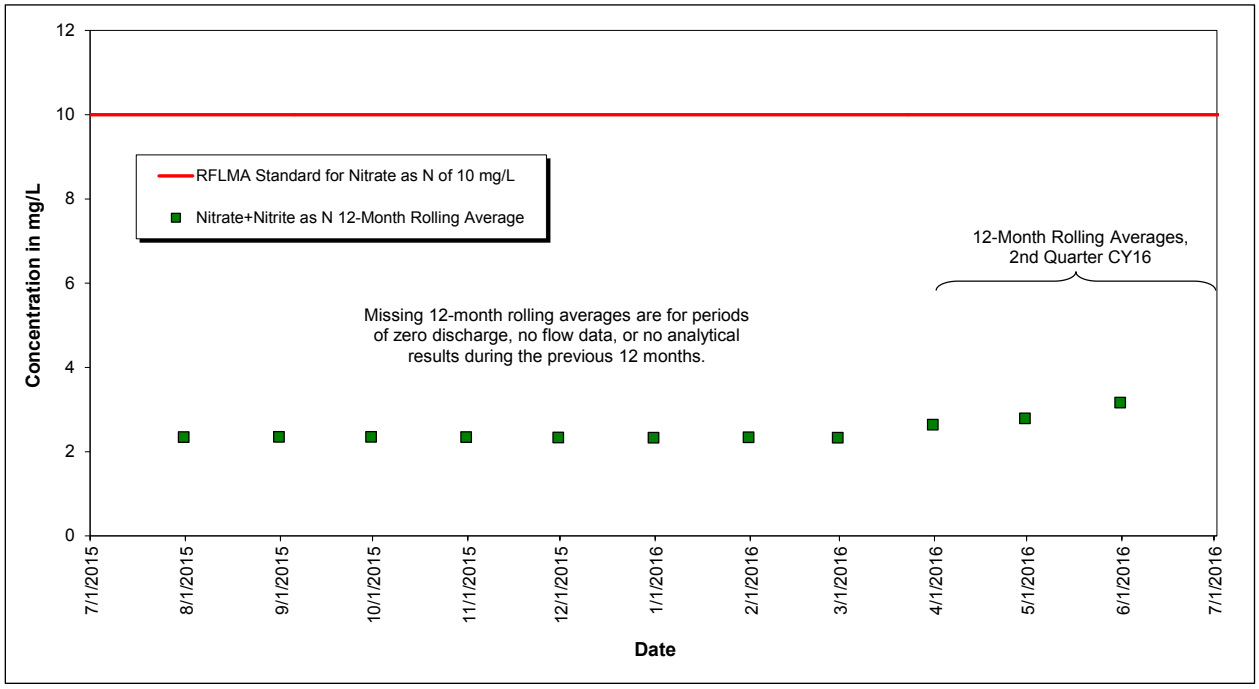
Note: The composite sample started on 6/16/2016 is still in progress.

Figure 2. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at WALPOC: Year Ending Second Quarter CY 2016



Note: The composite sample started on 6/16/2016 is still in progress.

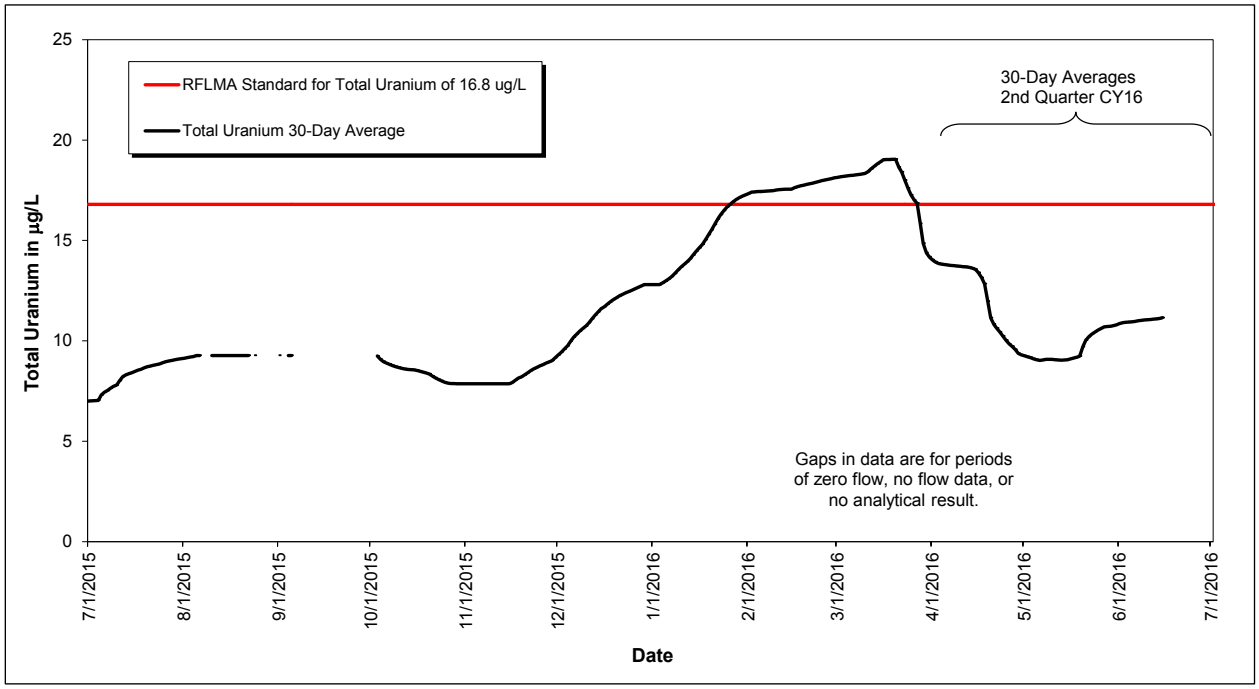
Figure 3. Volume-Weighted 30-Day Average Nitrate + Nitrite as Nitrogen Concentrations at WALPOC: Year Ending Second Quarter CY 2016



Notes: Nitrate + nitrite as nitrogen 12-month averages are conservatively compared to the nitrate standard only. The composite sample started on 6/16/2016 is still in progress.

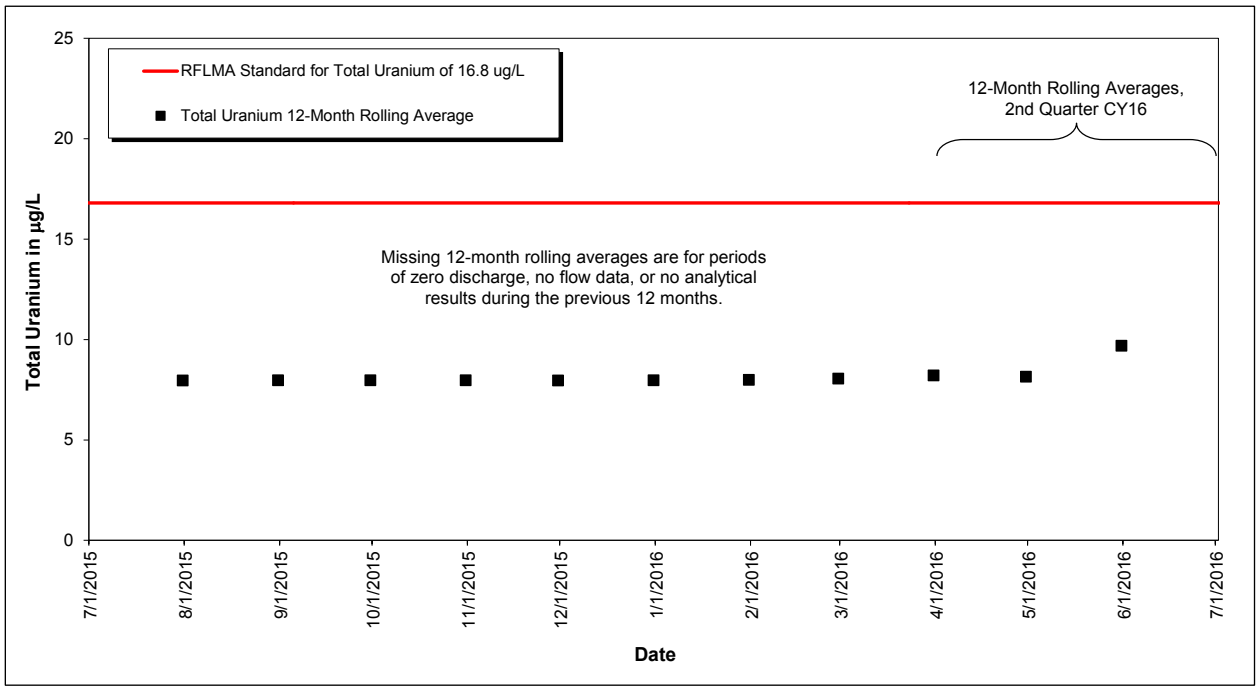
Figure 4. Volume-Weighted 12-Month Rolling Average Nitrate + Nitrite as Nitrogen Concentrations at WALPOC: Year Ending Second Quarter CY 2016

Figure 5 shows that the 30-day average for uranium exceeded the RFLMA standard of 16.8 micrograms per liter (µg/L) during the first quarter, triggering a Reportable Condition under the RFLMA. For details on this Reportable Condition see the first quarter CY 2016 report. As of March 28, 2016, the 30-day average for uranium at WALPOC is no longer reportable. The 12-month rolling average remains well below the RFLMA water-quality standard for uranium (Figure 6).



Note: The composite sample started on 6/16/2016 is still in progress.

Figure 5. Volume-Weighted 30-Day Average Total Uranium Concentrations at WALPOC: Year Ending Second Quarter CY 2016

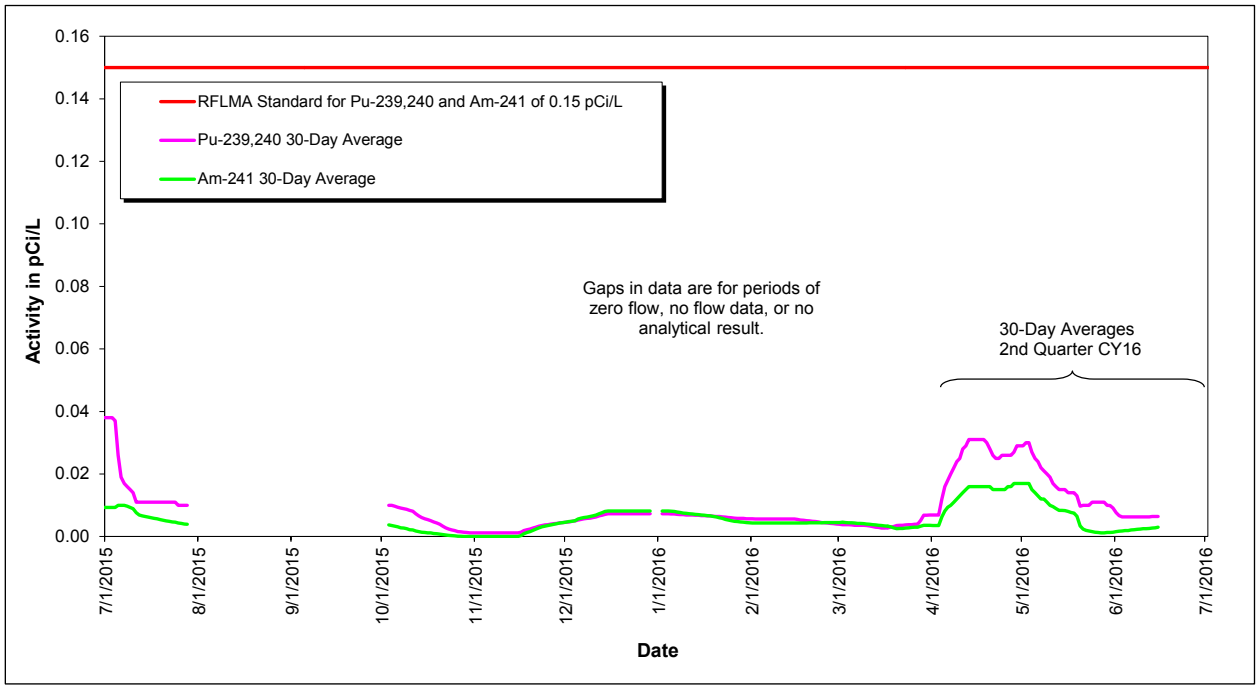


Note: The composite sample started on 6/16/2016 is still in progress.

Figure 6. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at WALPOC: Year Ending Second Quarter CY 2016

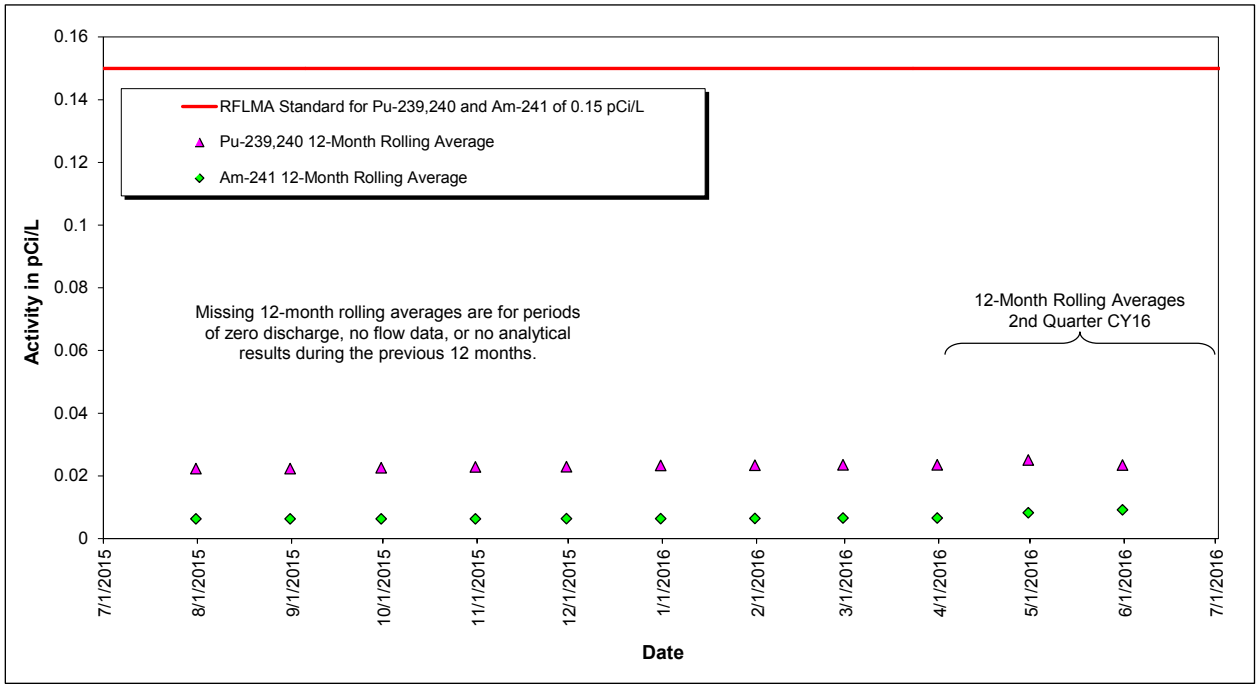
3.1.2.2 Monitoring Location WOMPOC

Monitoring location WOMPOC is on Woman Creek at the eastern COU boundary. Figure 7 through Figure 10 show no occurrences of reportable 12-month rolling or 30-day averages for the quarter. The methods for calculating the 30-day and 12-month rolling averages are detailed in the annual report.



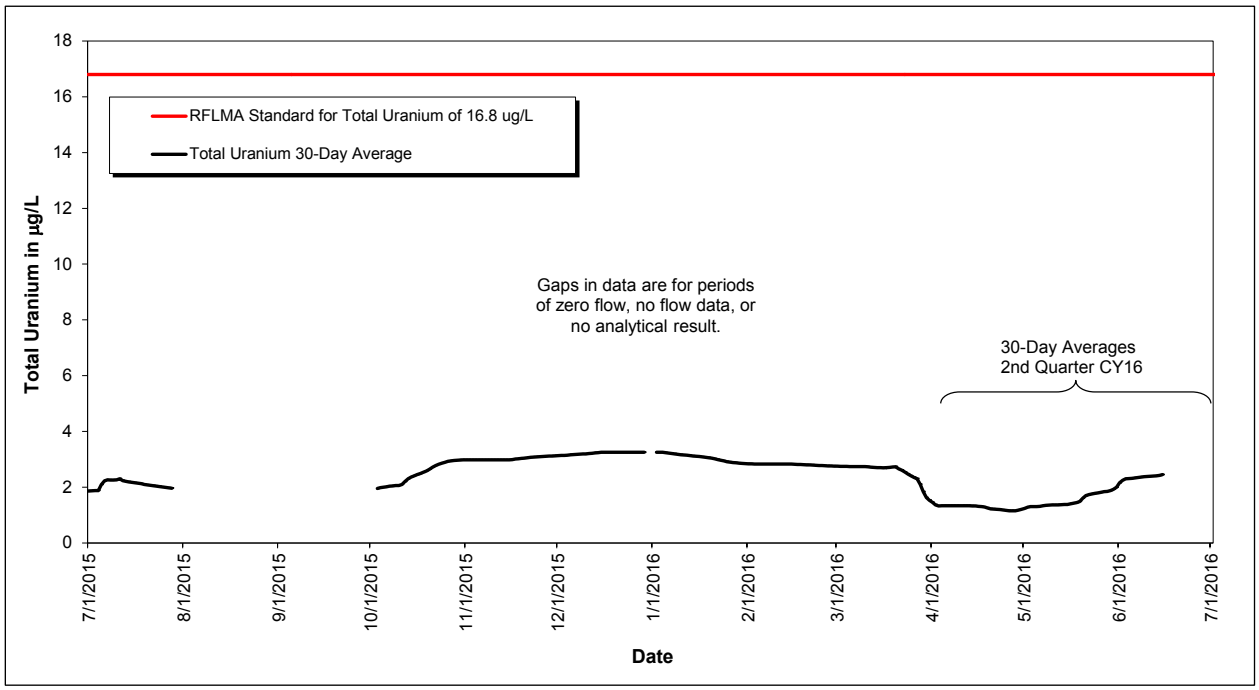
Note: The composite sample started on 6/16/2016 is still in progress.

Figure 7. Volume-Weighted 30-Day Average Plutonium and Americium Activities at WOMPOC: Year Ending Second Quarter CY 2016



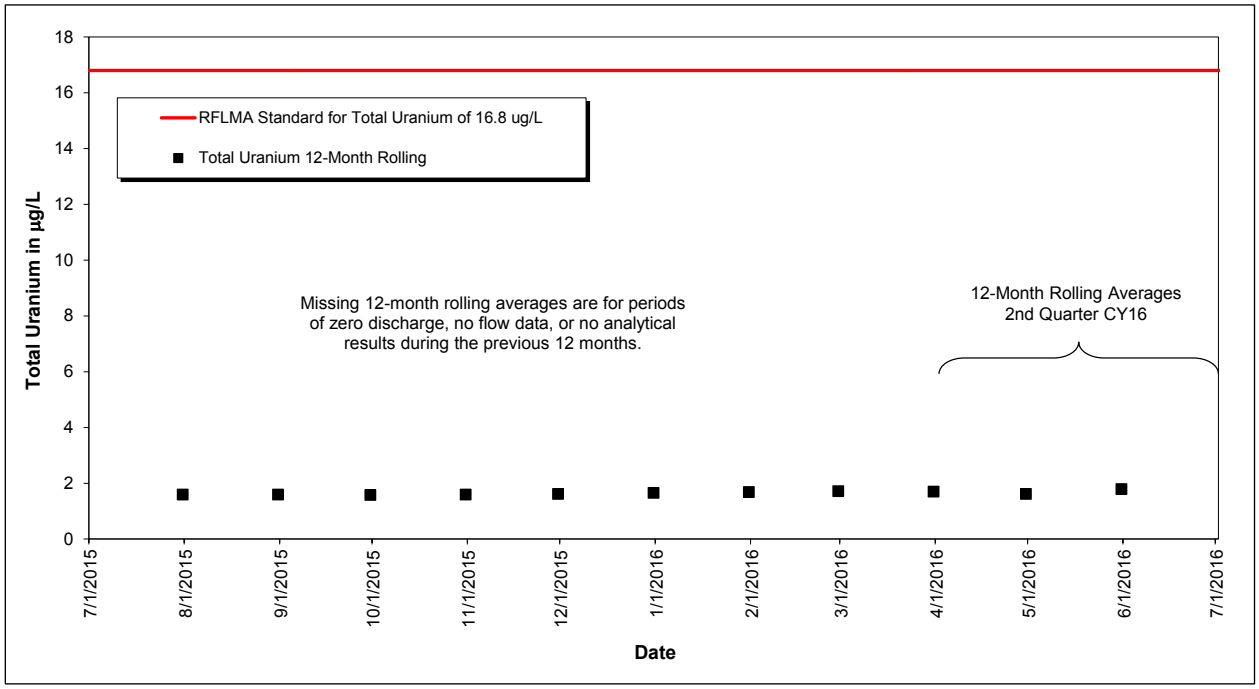
Note: The composite sample started on 6/16/2016 is still in progress.

Figure 8. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at WOMPOC: Year Ending Second Quarter CY 2016



Note: The composite sample started on 6/16/2016 is still in progress.

Figure 9. Volume-Weighted 30-Day Average Total Uranium Concentrations at WOMPOC: Year Ending Second Quarter CY 2016



Note: The composite sample started on 6/16/2016 is still in progress.

Figure 10. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at WOMPOC: Year Ending Second Quarter CY 2016

3.1.3 POE Monitoring

The following sections include summary plots showing the applicable 12-month rolling averages for the POE analytes.

3.1.3.1 Monitoring Location GS10

Monitoring location GS10 is on South Walnut Creek just upstream of the B-Series ponds. Figure 11 and Figure 13 show no occurrences of reportable 12-month rolling averages for plutonium, americium, or total uranium values during the quarter. Figure 12 and Figure 14 show sampling data from CY 2005 through the second quarter of CY 2016. The method for calculating the 12-month rolling averages is detailed in the annual report.

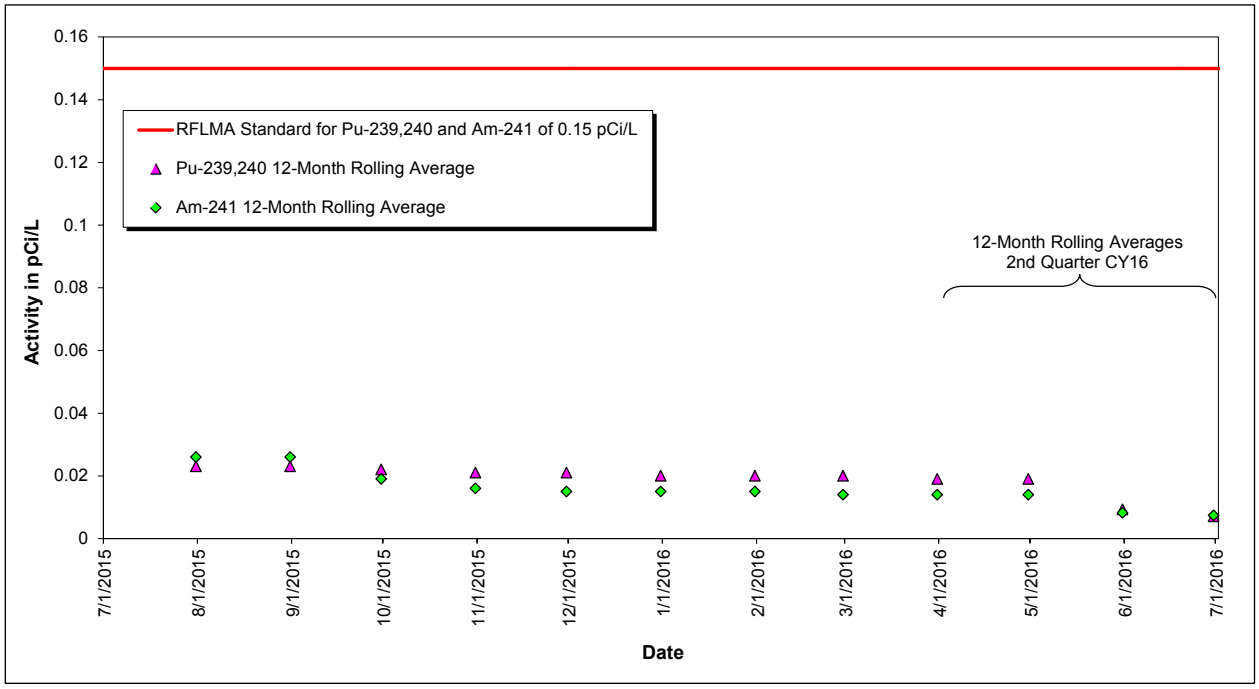


Figure 11. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at GS10: Year Ending Second Quarter CY 2016

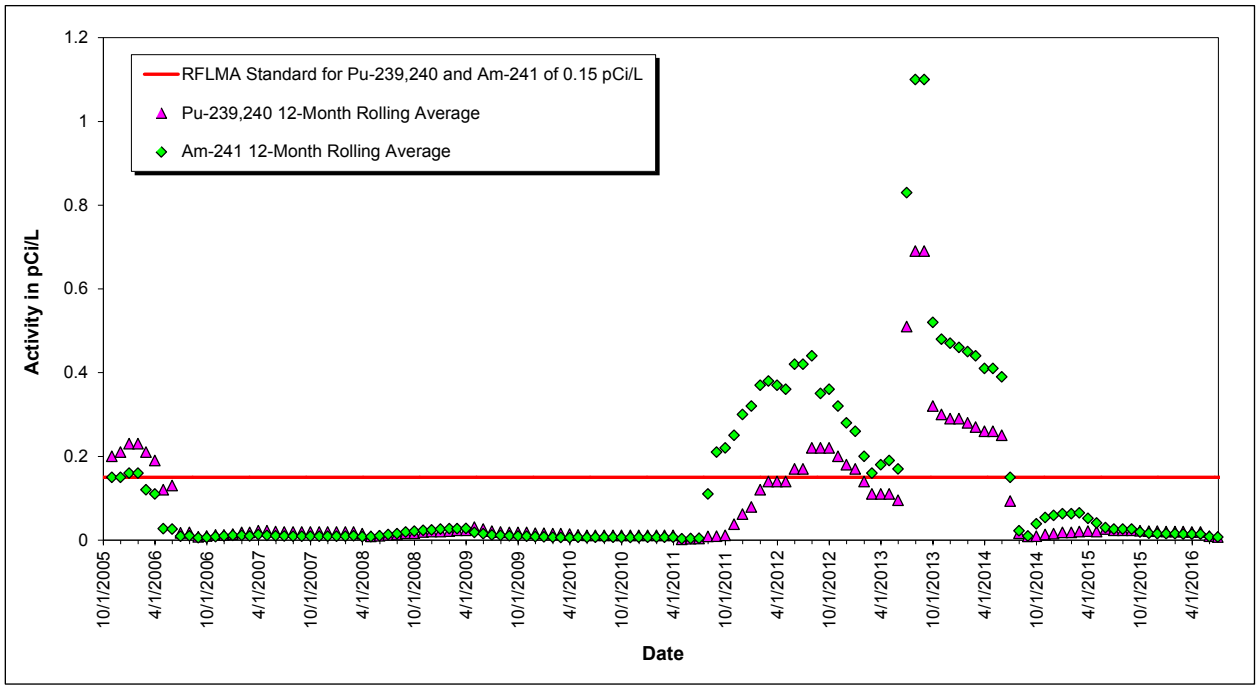


Figure 12. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at GS10: Post-Closure Period Ending Second Quarter CY 2016

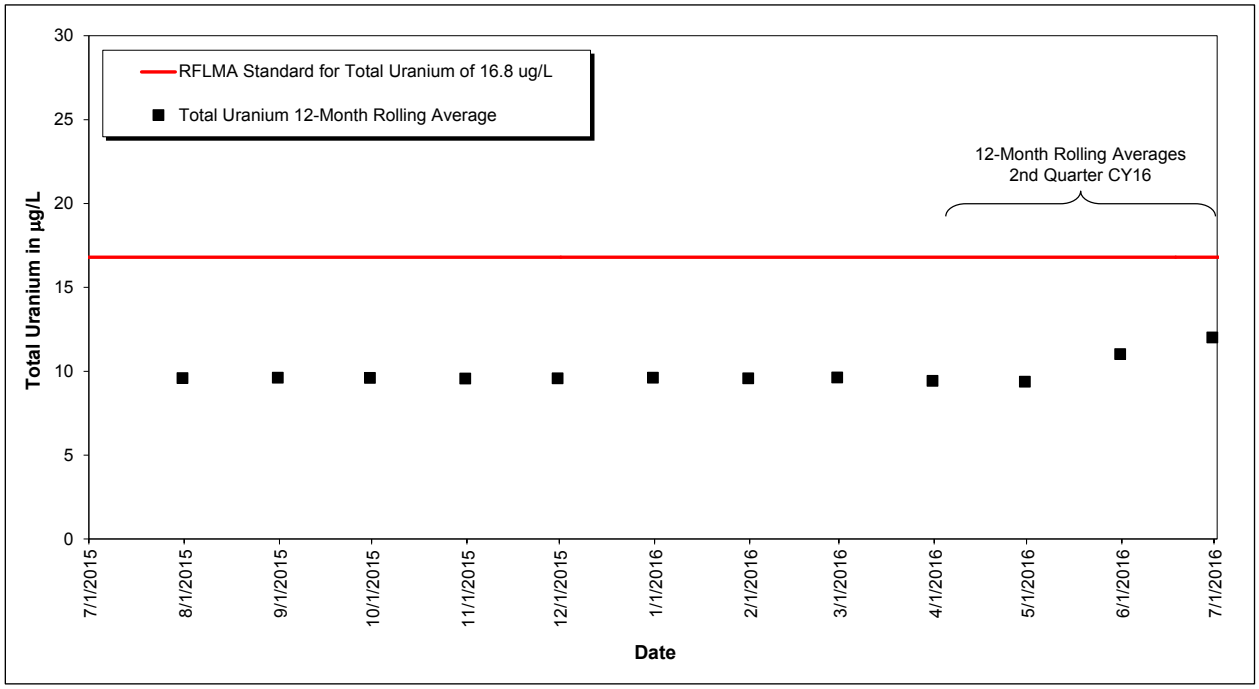


Figure 13. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at GS10: Year Ending Second Quarter CY 2016

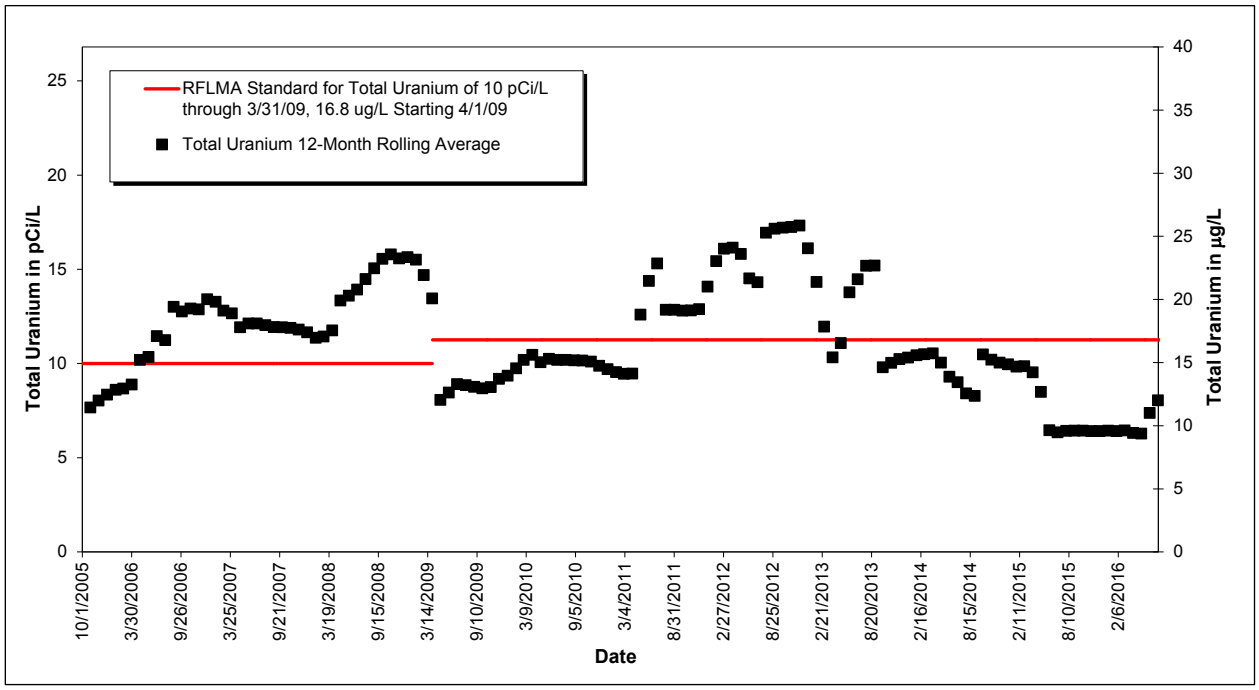


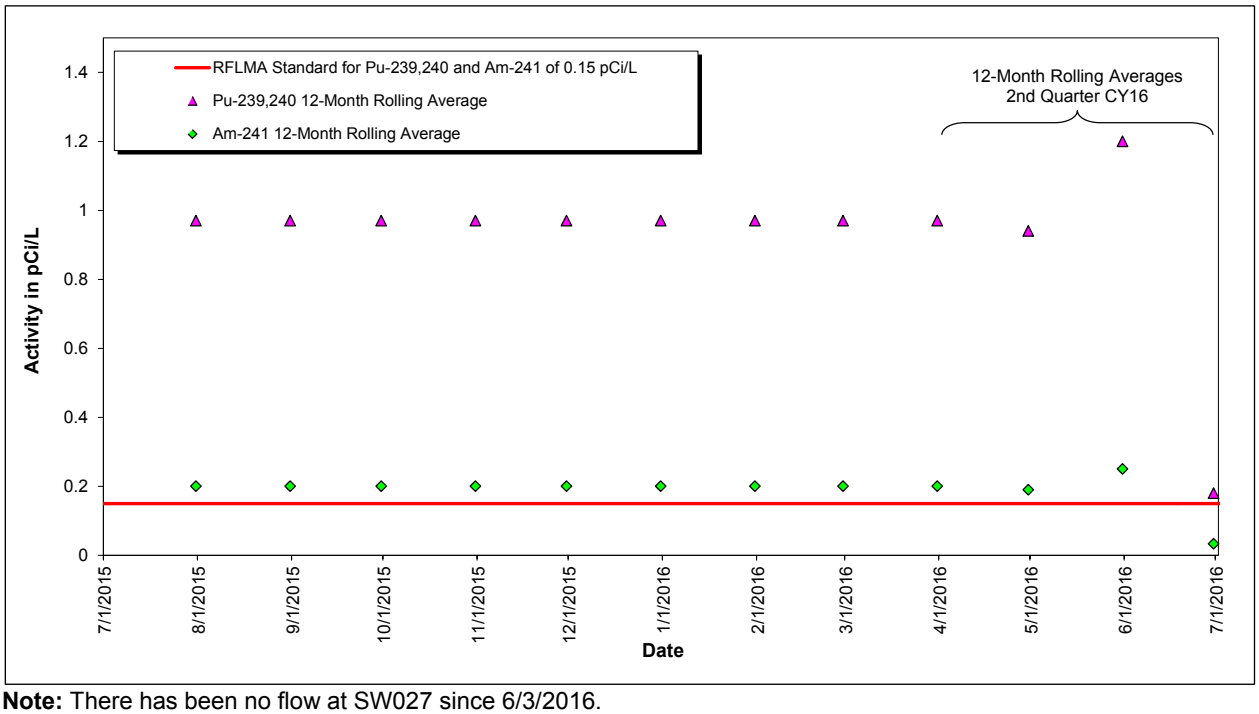
Figure 14. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at GS10: Post-Closure Period Ending Second Quarter CY 2016

3.1.3.2 Monitoring Location SW027

Monitoring location SW027 is at the end of the South Interceptor Ditch (SID) at the inlet to Pond C-2. Figure 15 and Figure 17 show the 12-month rolling averages for plutonium, americium, and total uranium values during the quarter. Figure 16 and Figure 18 show water-quality data for plutonium, americium, and uranium from CY 2005 through the second quarter of CY 2016. The method for calculating the 12-month rolling averages is detailed in the annual report.

Figure 15 shows that the 12-month rolling average for plutonium and americium exceeded the RFLMA standard of 0.15 pCi/L, starting with the April 30 and June 30, 2015, evaluations. Due to the relatively small volumes of water monitored at SW027 in 2016 compared to 2015, the 12-month rolling averages have not changed significantly, even though 2016 concentrations are measurably lower than 2015 concentrations. As of June 30, 2016, the 12-month rolling average for plutonium remained reportable at 0.18 pCi/L and americium was no longer reportable. All other analytes were not reportable through the second quarter of CY 2016.

Table 1 lists the americium, plutonium, and uranium results for composite samples collected during CY 2015 and 2016.



Note: There has been no flow at SW027 since 6/3/2016.

Figure 15. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at SW027: Year Ending Second Quarter CY 2016

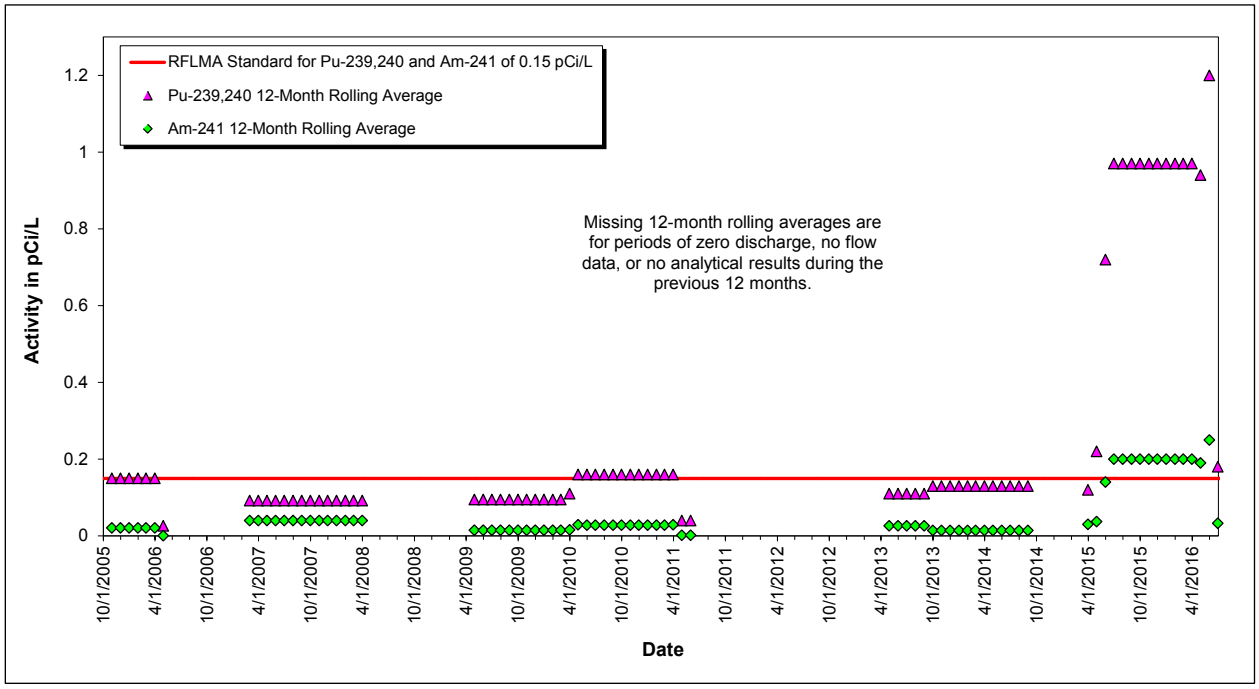
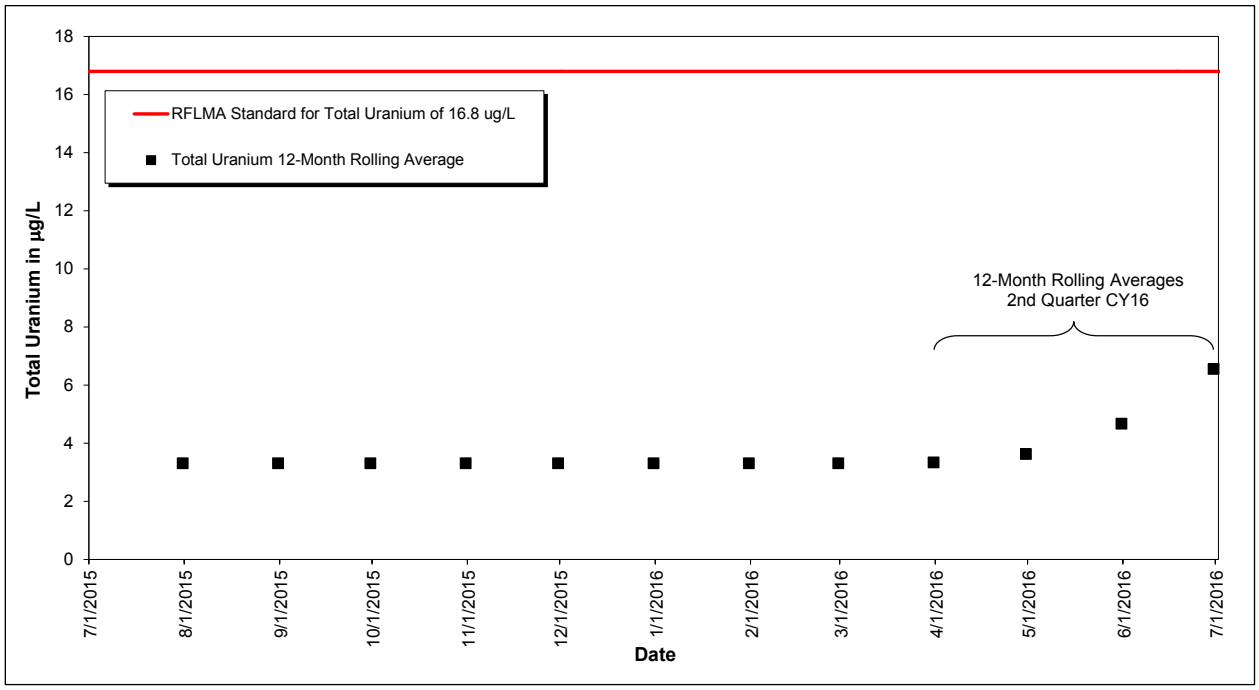


Figure 16. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at SW027: Post-Closure Period Ending Second Quarter CY 2016



Note: There has been no flow at SW027 since 6/3/2016.

Figure 17. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at SW027: Year Ending Second Quarter CY 2016

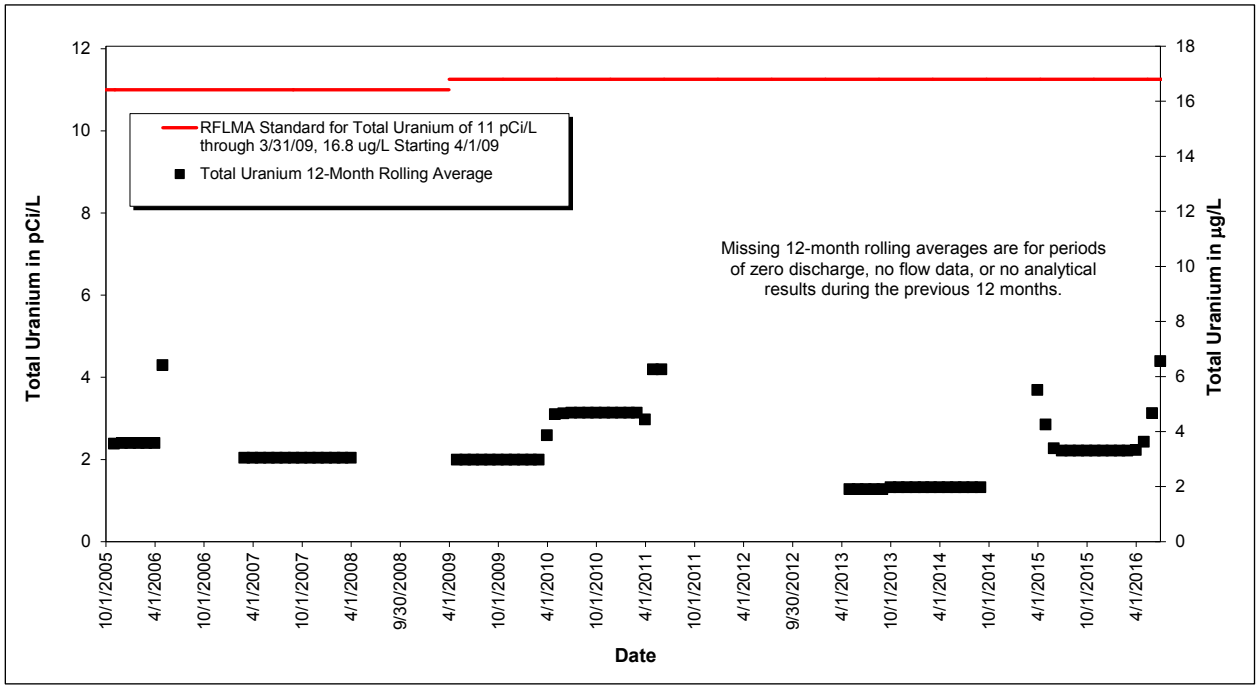


Figure 18. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at SW027: Post-Closure Period Ending Second Quarter CY 2016

Table 1. CY 2015–2016 Composite Sampling Results at SW027

Start Date and Time	End Date and Time	Am-241 Result (pCi/L)	Pu-239, 240 Result (pCi/L)	Uranium Result (µg/L)
3/6/2014 11:59	3/9/2015 13:00	NSQ	NSQ	NSQ
3/9/2015 13:00	3/11/2015 12:57	0.030	0.116	5.92
3/11/2015 12:57	4/17/2015 17:50	0.030	0.139	4.04
4/17/2015 17:50	5/6/2015 12:42	0.040	0.251	3.78
5/6/2015 12:42	5/9/2015 12:43	0.169	0.887	3.45
5/9/2015 12:43	5/14/2015 9:56	0.034	0.306	3.07
5/14/2015 9:56	5/19/2015 14:13	0.068	0.432	3.17
5/19/2015 14:13	5/26/2015 16:32	0.109	0.501	3.55
5/26/2015 16:32	6/5/2015 10:37	1.260	5.590	2.19
6/5/2015 10:37	6/12/2015 14:51	0.321	1.520	3.05
6/12/2015 14:51	1/5/2016 12:40	NSQ	NSQ	NSQ
1/5/2016 12:40	3/30/2016 11:30	0.007	0.041	7.24
3/30/2016 11:30	4/20/2016 11:30	0.027	0.161	5.61
4/20/2016 11:30	4/21/2016 12:36	0.072	0.393	5.27
4/21/2016 12:36	6/3/2016 11:00	0.012	0.061	9.21
6/3/2016 11:00	In progress	[a]	[a]	[a]

Note:
[a] Sample in progress

Abbreviation:
NSQ = nonsufficient quantity for analysis

CR 2015-05 describes the plan and schedule for addressing the reportable conditions of plutonium and americium. 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 that the 12-month rolling average for plutonium would exceed the standard at SW027 as reported in CR 2010-06, "Monitoring Results at Surface Water Point of Evaluation (POE) SW027." This includes a review of "Status 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, Site personnel walked the SID drainage area and identified opportunities to enhance the revegetation and erosion controls previously implemented in 2010 and 2011 (Figure 1 of CR 2015-05). Also during that June 2015 inspection, limited areas in the SID showed evidence of local erosion and sediment deposition. Based on these general observations, a geotechnical engineer was scheduled to inspect the areas and provide recommendations.
- During the June 17, 2015, inspection, locations were identified for immediate installation of new wattles (Figure 2 of CR 2015-05); installation was completed on June 22, 2015.
- On June 29, 2015, geotechnical engineers, CDPHE, and Site personnel walked down the SID to evaluate the potential for using water and sediment management devices or structures. The geotechnical engineers provided several recommendations for water and sediment management in the SID, most of which will be implemented in the longer term as appropriate. Recent implementation of recommendations include the following:
  - Additional erosion control methods were implemented in the SW027 drainage, predominantly on the hillside above GS51. These measures included adding matting, wattles, GeoRidge berms, and organic mulch. Several areas in the SID also received erosion matting. This work was completed on August 20, 2015. These erosion control measures are periodically inspected to confirm adequate performance.
  - Additional erosion control matting was installed at various locations in the SID on March 10, 2016.
- Sampling will continue as currently scheduled when surface-water runoff is available.
- The status of the items above will be reported in quarterly or annual reports, depending on when the activities occur.

Downstream of SW027, monitoring at WOMPOC continues to show plutonium and americium concentrations that are not reportable, as explained in Section 3.1.2.2. Recent analytical results from WOMPOC are given in Table 2.

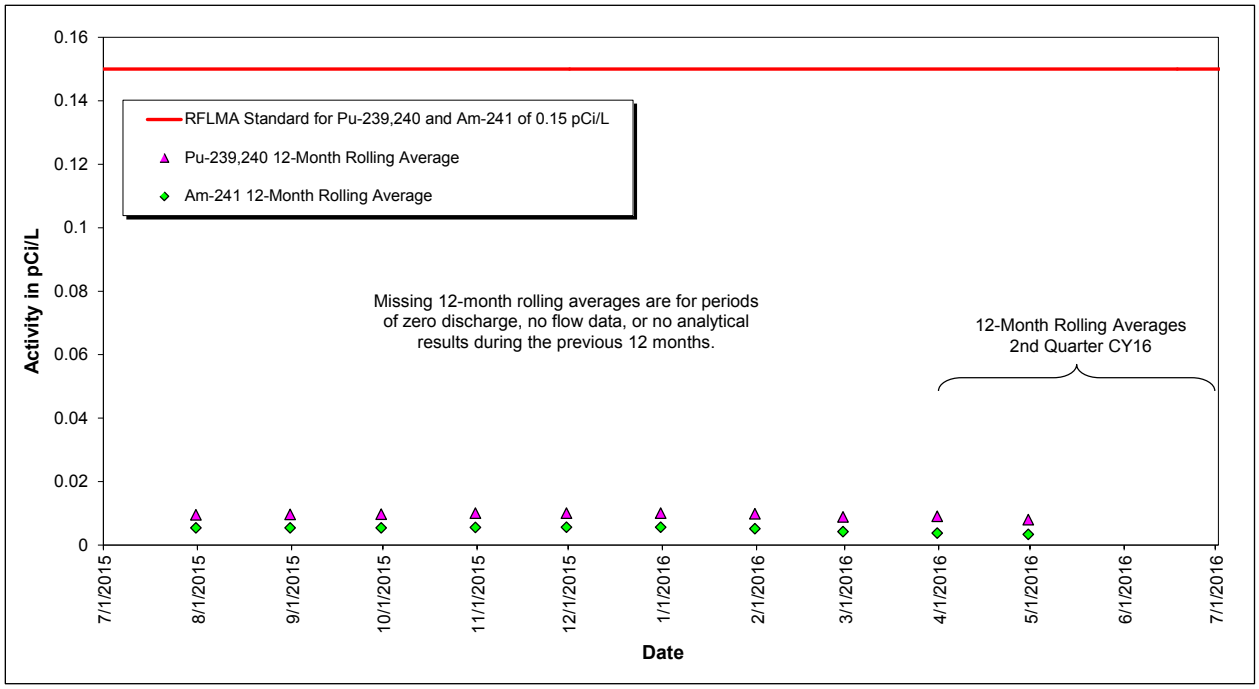
Table 2. CY 2015–2016 Composite Sampling Results at WOMPOC

Start Date and Time	End Date and Time	Am-241 Result (pCi/L)	Pu-239, 240 Result (pCi/L)	Uranium Result (µg/L)
3/9/2015 15:47	3/11/2015 13:28	0.003	0.006	1.30
3/11/2015 13:28	3/18/2015 12:44	0.002	0.006	1.58
3/18/2015 12:44	4/1/2015 10:53	0.002	0.005	2.28
4/1/2015 10:53	4/13/2015 13:13	0.005	0.007	2.72
4/13/2015 13:13	4/17/2015 13:22	0.005	0.005	1.75
4/17/2015 13:22	4/20/2015 11:08	0.011	0.030	1.55
4/20/2015 11:08	4/27/2015 11:12	0.006	0.011	1.30
4/27/2015 11:12	5/5/2015 10:25	0.006	0.010	1.62
5/5/2015 10:25	5/8/2015 13:22	0.003	0.016	1.37
5/8/2015 13:22	5/9/2015 16:04	0.017	0.084	1.23
5/9/2015 16:04	5/18/2015 16:25	0.006	0.015	1.28
5/18/2015 16:25	5/26/2015 16:49	0.003	0.018	1.65
5/26/2015 16:49	6/8/2015 15:22	0.008	0.057	1.50
6/8/2015 15:22	6/12/2015 16:52	0.021	0.045	1.85
6/12/2015 16:52	7/7/2015 14:41	0.008	0.011	2.36
7/7/2015 14:41	8/20/2015 11:58	0.003	0.010	1.85
8/20/2015 11:58	11/16/2015 14:02	0.000	0.001	2.98
11/16/2015 14:02	1/5/2016 13:11	0.008	0.007	3.25
1/5/2016 13:11	2/16/2016 13:27	0.004	0.006	2.83
2/16/2016 13:27	3/3/2016 11:47	0.005	0.001	2.63
3/3/2016 11:47	3/21/2016 11:30	0.000	0.006	2.84
3/21/2016 11:30	3/28/2016 13:51	0.004	0.003	2.01
3/28/2016 13:51	3/30/2016 11:48	0.005	0.011	1.24
3/30/2016 11:48	4/4/2016 14:32	0.003	0.007	0.89
4/4/2016 14:32	4/14/2016 10:14	0.085	0.165	1.73
4/14/2016 10:14	4/21/2016 12:17	0.015	0.022	1.16
4/21/2016 12:17	4/28/2016 10:04	0.008	0.007	1.21
4/28/2016 10:04	5/5/2016 16:09	0.001	0.015	1.49
5/5/2016 16:09	5/26/2016 12:43	0.001	0.006	2.21
5/26/2016 12:43	6/16/2016 12:17	0.006	0.007	2.78
6/16/2016 12:17	In progress	[a]	[a]	[a]

Note:
[a] Sample in progress

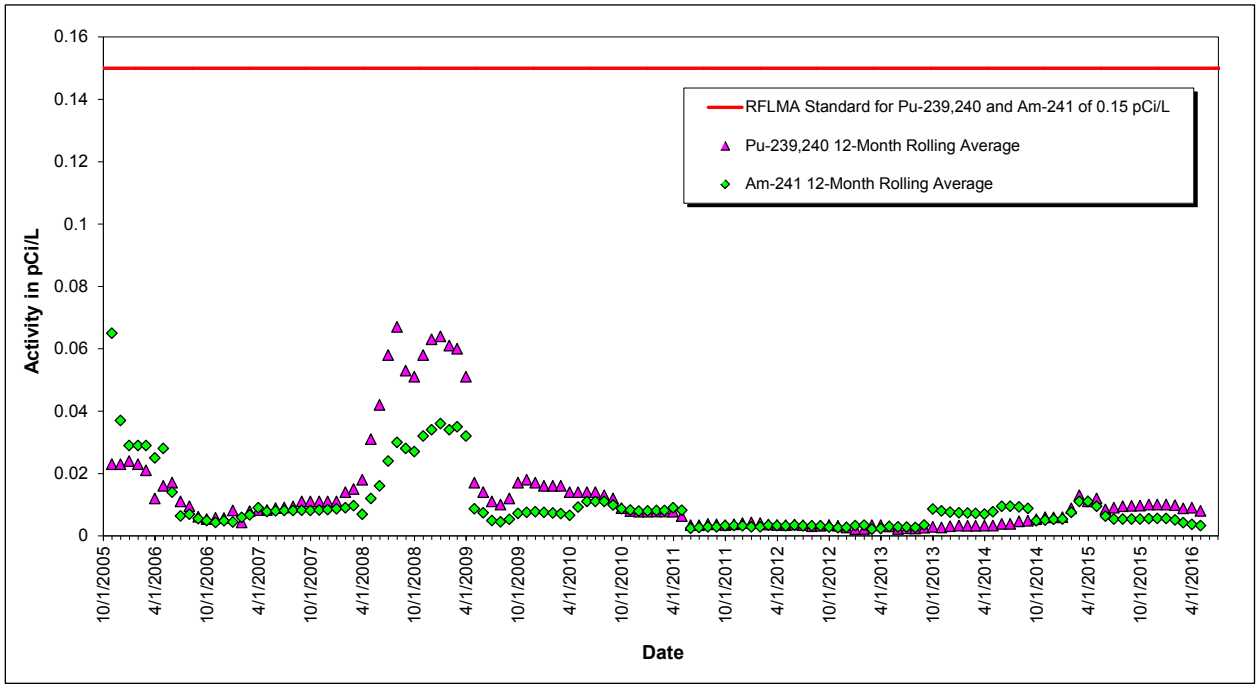
3.1.3.3 Monitoring Location SW093

Monitoring location SW093 is on North Walnut Creek, 1300 feet upstream of former Pond A-1. Figure 19 and Figure 21 show no occurrences of reportable 12-month rolling averages for plutonium, americium, or total uranium values during the quarter. Figure 20 and Figure 22 show sampling data from 2005 through the second quarter of CY 2016. The method for calculating the 12-month rolling averages is detailed in the annual report.



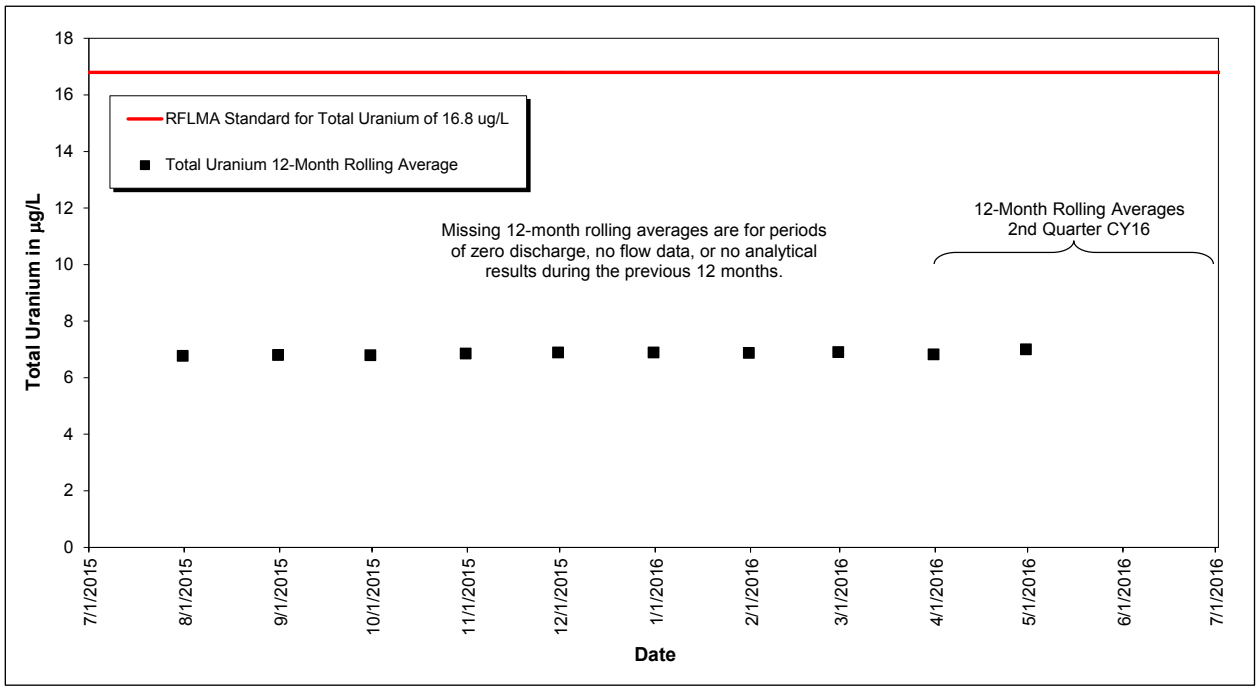
Note: Results for the composite sample started on 5/26/2016 are pending.

Figure 19. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at SW093: Year Ending Second Quarter CY 2016



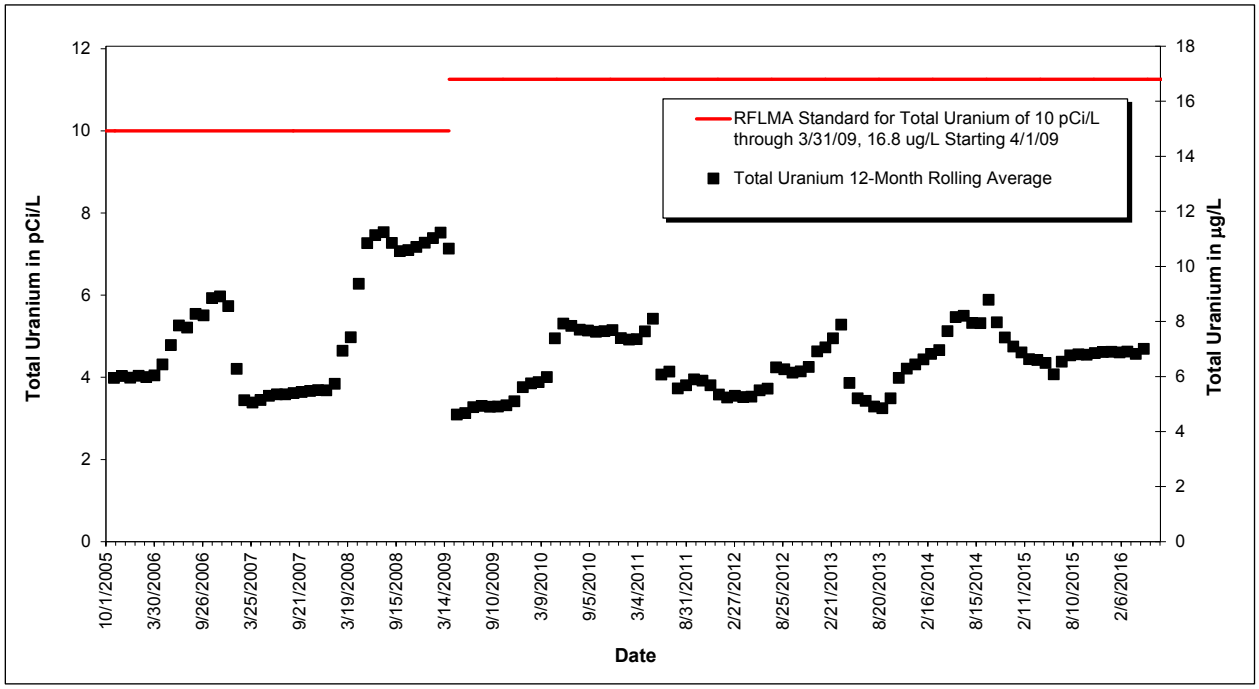
Note: Results for the composite sample started on 5/26/2016 are pending.

Figure 20. Volume-Weighted 12-Month Rolling Average Plutonium and Americium Activities at SW093: Post-Closure Period Ending Second Quarter CY 2016



Note: Results for the composite sample started on 5/26/2016 are pending.

Figure 21. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at SW093: Year Ending Second Quarter CY 2016



Note: Results for the composite sample started on 5/26/2016 are pending.

Figure 22. Volume-Weighted 12-Month Rolling Average Total Uranium Concentrations at SW093: Post-Closure Period Ending Second Quarter CY 2016

3.1.4 AOC Wells and Surface Water Support Location SW018

All AOC wells and the Surface Water Support location SW018 were scheduled for RFLMA monitoring in the second quarter of CY 2016. Analytical results (Appendix B) were generally consistent with those of past samples, with one main exception.

AOC well 10304, located between Woman Creek and the 903 Pad/Ryan's Pit Plume source areas, produced a sample in which the concentration of trichloroethene (TCE) was reported above the associated RFLMA level. (Refer to the annual report for 2015, DOE 2016, for discussion of results obtained that year and the pre-closure predictions concerning VOCs and TCE specifically in this area.) The concentration of TCE in the sample collected on May 24, 2016 was 49 µg/L, above the 2.5 µg/L RFLMA standard. In accordance with CR 2015-10, surface water location SW10200 on Woman Creek was also sampled. TCE was not detected in the surface water sample. SW10200 will be sampled whenever AOC well 10304 is sampled until AOC well 10304 is no longer reportable for TCE.

Additional detail and discussion will be provided in the annual report for 2016.

3.1.5 Sentinel Wells

All of the Sentinel wells were scheduled for RFLMA monitoring in the second quarter of CY 2016. Analytical results (Appendix B) were generally consistent with those of past samples and will be discussed and statistically evaluated as part of the annual report for CY 2016.

3.1.6 Evaluation Wells

All of the Evaluation wells were scheduled for RFLMA monitoring in the second quarter of CY 2016. Analytical results (Appendix B) were generally consistent with those of past samples and will be discussed and statistically evaluated as part of the annual report for CY 2016.

3.1.7 PLF Monitoring

All RCRA groundwater monitoring wells at the PLF were sampled during the second quarter of CY 2016. Analytical results (Appendix B) were generally consistent with those of past samples and will be discussed and statistically evaluated as part of the annual report for CY 2016. Section 3.1.9.4 discusses monitoring the PLFTS.

3.1.8 OLF Monitoring

All RCRA groundwater monitoring wells at the OLF were sampled during the second quarter of CY 2016. Analytical results (Appendix B) were generally consistent with those of past samples and will be discussed and statistically evaluated as part of the annual report for CY 2016.

During the second quarter of CY 2016, when routine surface-water sampling was performed in Woman Creek downstream of the OLF (GS59), the mean concentrations for all analytes were below the applicable surface-water standards.

3.1.9 Groundwater Treatment System Monitoring

As described in Section 2.5, contaminated groundwater is intercepted and treated in four areas of the Site. The MSPTS, ETPTS, and SPPTS have a groundwater intercept trench. At the MSPTS and SPPTS, groundwater is collected in the trenches, routed through a pipe and into one or more treatment cells, where it is treated and then discharged to the subsurface; at the recently reconfigured ETPTS, the water is pumped through an air stripper for treatment and then discharged to the subsurface. (As discussed in Section 2.5, reconfiguration projects began at both the MSPTS and SPPTS during or immediately after the second quarter of CY 2016.) The PLFTS treats water from the northern and southern components of the Groundwater Intercept System and water that flows from the PLF seep.

3.1.9.1 Mound Site Plume Treatment System

The MSPTS monitoring locations were scheduled for routine RFLMA sampling in the second quarter of CY 2016. Results (Appendix B) showed the combined effects of relatively older, more-oxidized ZVI media and higher flow rates that lead to shorter residence times in the media. The samples collected from system effluent contained several VOCs at concentrations above RFLMA levels, and surface water performance location GS10 produced a sample in which the concentration of TCE exceeded the RFLMA standard (4.4 µg/L versus the standard of 2.5 µg/L). The reconfiguration of this treatment system, begun at the end of the second quarter and scheduled for completion before the end of the third quarter of CY 2016, will result in substantial improvement in the treatment of VOCs in the MSPTS influent. This project and its effects on treatment of MSPTS groundwater will be discussed in greater detail in the annual report for 2016.

3.1.9.2 East Trenches Plume Treatment System

The ETPTS monitoring locations were scheduled for routine RFLMA sampling in the second quarter of CY 2016. Results (Appendix B) continue to show much better treatment effectiveness than was achieved before the system reconfiguration (when the treatment method relied on ZVI). However, the concentration of TCE in system effluent was slightly higher than the RFLMA standard (3.1 µg/L versus 2.5 µg/L, respectively; the influent concentration is in the range of 6000 µg/L). Another sample was collected for confirmatory purposes and it was also above the standard at 2.9 µg/L. VOCs were not detected in the surface water performance location, POM2.

In response to these TCE results, adjustments to the air stripper were made. Later (third quarter) samples confirmed treatment of TCE to below the RFLMA standard.

The annual report for 2016 will provide more detailed discussion of water quality at the ETPTS.

3.1.9.3 Solar Ponds Plume Treatment System

The SPPTS monitoring locations were scheduled for routine RFLMA sampling in the second quarter of CY 2016, just before the SPPTS reconfiguration project began. Nonroutine samples were also collected, many to support the Adaptive Management Plan (DOE 2015c). The associated results were generally consistent with recent data and will be discussed in the annual report for 2016, together with additional information regarding the reconfiguration project.

3.1.9.4 PLF Treatment System

Breaching of the PLF dam was completed in June 2012, and since then any PLFTS effluent flows through the remaining wetland area. This flow configuration is now essentially equivalent to the historical open valve configuration.

During collection of the April 5, 2016, sample at the system influent (monitoring location PLFSEEPINF), the flow rate was 1.59 gallons per minute. The routine quarterly effluent sample of the PLFTS (monitoring location PLFSYSEFF) collected on April 5, 2016, showed results for vinyl chloride that were above the applicable surface-water standard from RFLMA Attachment 2, Table 1, "Surface Water Standards." The individual result was as follows:

- The vinyl chloride concentration was 0.27 µg/L, exceeding the practical quantitation limit of 0.2 µg/L

In accordance with RFLMA evaluation protocols, the vinyl chloride result triggered an increase in sampling frequency from quarterly to monthly. Vinyl chloride was not detected in the subsequent sample and, in accordance with the RFLMA data evaluation protocols, sampling frequency returned to monthly.

All other analyte concentrations were below the RFLMA standards for the quarter.

3.1.10 Predischarge Monitoring

Predischarge samples are collected prior to opening the valves to initiate a discharge period at Ponds A-4, B-5, and C-2 on North Walnut Creek, South Walnut Creek, and Woman Creek, respectively.

No predischarge samples were collected at Ponds A-4, B-5, or C-2 during the second quarter of CY 2016. All three ponds have been operated in a flow-through configuration since September 2011.

4.0 Adverse Biological Conditions

No evidence of adverse biological conditions (e.g., unexpected mortality or morbidity) was observed during M&M activities in the second quarter of CY 2016.

5.0 Ecological Monitoring

During the second quarter of CY 2016, ecological monitoring consisted of weed mapping, nest box surveys, prairie dog surveys, wetland water-level surveys, and wetland weed surveys. Preparations were also underway for revegetation monitoring, monitoring the Preble's meadow jumping mouse, and wetland mitigation monitoring surveys that are scheduled to take place during the third quarter of CY 2016. One hundred shrubs (buffalo berry and skunkbush) and fifty Rocky Mountain juniper trees were installed in the COU as a habitat-enhancement project. An irrigation system was installed, and the plants are being watered during the first growing season to improve their chances of survival. Approximately 140 acres were sprayed with herbicides to control weeds in the COU during the second quarter. Legacy Management Support contractor personnel conducted additional spot control to control individual noxious weeds at several locations.

6.0 References

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

DOE (U.S. Department of Energy), 2009b. *Rocky Flats Site Quarterly Report of Site Surveillance and Maintenance Activities, Second Quarter Calendar Year 2009*, LMS/RFS/S05823, Office of Legacy Management, October.

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

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DOE (U.S. Department of Energy), 2015b. *Rocky Flats, Colorado, Site Quarterly Report of Site Surveillance and Maintenance Activities, First Quarter Calendar Year 2015*, LMS/RFS/S13091, Office of Legacy Management, July.

DOE (U.S. Department of Energy), 2015c. *Surface Water Configuration Adaptive Management Plan for the Rocky Flats, Colorado, Site,* LMS/RFS/S07698, Office of Legacy Management, May.

DOE (U.S. Department of Energy), 2016. *Annual Report of Site Surveillance and Maintenance Activities at the Rocky Flats, Colorado, Site, Calendar Year 2015*, LMS/RFS/S13696, 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), 2006. *Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit*, EPA/541/R-06/197, September 29.

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,* September 21.

ROCKY FLATS STEWARDSHIP COUNCIL

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MEMORANDUM

TO: Stewardship Council Board
FROM: David Abelson & Rik Getty
SUBJECT: Actinide Migration Evaluation in the Rocky Flats Environment
DATE: October 17, 2016

We have scheduled seventy-five minutes for DOE to brief on the Actinide Migration Evaluation (AME) study at Rocky Flats. Understanding how actinides move through the Rocky Flats environment, and taking appropriate actions to mitigate such movement, were central to the cleanup. Actinide migration likewise remains foundational to post-closure management. The AME study was pivotal to these efforts.

The Board was briefed on actinide migration and the AME study at the June 2012 meeting. Attached to this memo are the section of the minutes from the June 2012 meeting, and the AME summary report.

Attachments

1. AME study summary report
2. June 2012 RFSC meeting minutes (section on AME briefing)

Executive Summary

1. Actinides at Rocky Flats are plutonium, americium and uranium.
2. The oxidation state determines the chemical properties; the chemical properties determine mobility. The two important chemical properties are solubility and sorption (when something adheres). A high oxidation state means high solubility, and less sorption; a low oxidation state means lower solubility and greater sorption.
3. Potential pathways at Rocky Flats:
    a. Air – Sorption is important because actinides can attach to soils and move via wind. With the wind pathway, solubility is not applicable.
    b. Surface water – Both solubility and sorption are important. Uranium is soluble; plutonium and americium adhere to sediments and eroding solids.
    c. Groundwater – Solubility is important, while sorption is not.
    d. Biological – This pathway is a minor transport mechanism for all actinides at Rocky Flats.

4. Plutonium and Americium – At Rocky Flats,
    a. Plutonium and americium have low solubility and high sorption rates. Thus, these constituents move by air and surface water.
    b. Movement via groundwater is not a concern.
    c. Due to air and surface water migration pathways, cleanup of plutonium and americium focused on the surface soils.
    d. The amount of plutonium and americium carried offsite via air transport is roughly 40 times greater than the amount carried offsite by surface water.
5. Uranium – At Rocky Flats
    a. Two oxidation states exist. As a result, all transport pathways are available.
    b. Treatment of uranium contaminated groundwater is required. Treatment occurs at the Solar Ponds Plume Treatment System, a known source of uranium contamination.
    c. The amount of uranium carried offsite via air transport is roughly 10 times greater than the amount carried offsite by surface water.

Background

Actinides are a class of elements with an atomic number 89 through 103. As noted in the AME summary report, "Actinides are among the heaviest known elements and all are radioactive. Only thorium and uranium can be found naturally in abundance. Plutonium and americium are man-made. Actinides of concern at Rocky Flats…are uranium (atomic number 92), plutonium (atomic number 94) and americium (atomic number 95)." Plutonium, americium and uranium were either used in products manufactured at the site or were process by-products.

As cleanup began in earnest in the mid-1990s, understanding how actinides moved in the environment at Rocky Flats was critically important. The AME program was initiated in 1996. The AME panel included geologists, chemists, biologists, and other scientists from around the country. The culmination of the AME panel's work was the AME Pathway Analysis Report, completed in April 2002. We have attached the summary report. It can also be found at: http://www.lm.doe.gov/cercla/documents/rockyflats_docs/SW/SW-A-004544.PDF

For this study, the AME panel used actinide concentrations measured at Rocky Flats to estimate the average amount of uranium, plutonium, and americium that migrates off-site annually under then-current conditions. Four major transport pathways were considered and compared—air, surface water, groundwater and biota. Extreme events (e.g. storms, high winds, and fires) were also modeled to assess whether extreme conditions modify the relative importance of different migration pathways when compared with non-extreme conditions.

This study did not attempt to assess actinide-related health or ecological impacts. It did, however, provide recommendations based on the study results for long-term protection of the environment during and after site closure, with an emphasis on surface water quality protection.

Actinide Solubility

Of importance when examining the transport of actinides is the relative solubility in water. Plutonium and americium are much less soluble than uranium. Plutonium and americium are more likely to be transported by physical processes on the surface, such as erosion of

contaminated particles by wind and water, than by chemical processes in the subsurface, such as dissolution in groundwater. In contrast, uranium is more soluble and can be transported in significant amounts by both physical and chemical processes.

AME Pathway Analysis Results

As discussed below, data presented in the AME Pathway Analysis Report show that transport by air and surface water are the dominant transport pathways for the three actinides studied. Data also indicate groundwater is a significant pathway for uranium. The biological pathway is a minor transport mechanism at Rocky Flats.

Air Transport Pathway

According to the AME study results, transport of actinides through the air occurs largely by wind erosion of actinide-containing particulate matter from soil and dust-laden vegetation. The amount of plutonium and americium carried offsite via air transport is roughly 40 times greater than the amount carried offsite by surface water. The amount of uranium carried offsite via air transport is roughly 10 times greater than the amount carried offsite by surface water.

Accordingly, during cleanup activities, DOE and CDPHE employed a robust air monitoring network. That effort showed that as a result of remediation activities, little contamination was leaving the site via the air transport pathway. Accordingly, a few years following completion of closure activities, DOE and CDPHE ceased air monitoring.

Surface Water Transport Pathway

The AME study indicated that the type of groundcover contributes significantly to the amount of actinide contamination introduced into the watersheds. For instance, the study showed the former Industrial Area, which contained all of the buildings, parking lots, etc., contributed the most plutonium to any body of water, although not in the area with the highest plutonium concentrations in surface soil. This fact suggests that the impervious asphalt cover in the Industrial Area facilitated runoff and thus erosion of contaminated soils into surface water. On the other hand, the 903 Pad area, which had the highest known levels of plutonium activity in soil, was in a well-vegetated basin and therefore generated less runoff and contributed less actinide contamination to surface water. Thus, reduction of the impervious cover (asphalt, sidewalks, etc.) in the Industrial Area is likely contributing to significant reductions in actinide loads to surface water by decreasing the potential for soil erosion into the watershed.

Data also indicate that the ponds on North and South Walnut Creeks (A- and B-series ponds) settled particles, and generally removed 80 to 90 percent of the amount of plutonium and americium that flowed into the ponds. Sampling of the sediments in the ponds led DOE to remediate the soils underlying ponds B-1, B-2, and B-3. At these ponds, large amounts of sediment containing low levels of actinides were removed and shipped off-site for disposal. The other ponds did not require sediment remediation based on characterization sampling of the sediments.

The report noted that uranium concentrations in surface water are relatively uniform across the site. As a result, the amount of uranium transported offsite in a given watershed, the panel concluded, is largely proportional to the amount of water in the watershed. This generalization,

however, did not prove accurate. As the Board learned from the uranium in water briefing at the June 2015 Board meeting, uranium concentrations in surface water can vary depending on a number of factors. The extensive geochemical investigation of North Walnut Creek, performed by Wright Water Engineers in 2014, revealed that dissolved oxygen levels (contributing to higher or lower oxidation potential) and nitrate concentrations can affect uranium solubility in surface water.

Groundwater Transport Pathway
AME study results showed plutonium and americium are relatively immobile in the soil and groundwater because of their low solubility and tendency to be sorbed onto soil. The AME panel estimated the amount of plutonium and americium transported to surface water via groundwater is approximately one percent of the total amount transported in surface water.

AME data show uranium is the dominant actinide found in shallow groundwater at Rocky Flats because of its natural abundance. Nevertheless, as with plutonium and americium, the amount of uranium transported to surface water via groundwater is approximately one percent of the total amount transported in surface water.

Biological Transport Pathway
Studies performed at Rocky Flats by Dr. Ward Whicker (Professor Emeritus at CSU) and others indicate that plutonium has low bioavailability due to its insolubility. Consequently, uptake into plant and animal tissues is minor. There is little accumulation of plutonium in the tissues of insects, small mammals, snakes, or mule deer. The estimated amount of plutonium and americium transported offsite via biota is approximately 1/100,000 the amount transported offsite via surface water. For uranium, the ratio becomes 1/10,000,000.

Implication to Cleanup and Closure
The AME study also includes recommendations for long-term protection of the environment during and after closure. Below is a summary of some of the recommendations for near-term remediation activities and post-closure site management. (As you read this material, bear in mind that the report was issued in 2002, so we have 14 years of data since then.)

Near-Term Remediation Activities
Because particulate transport via air is a major transport pathway for plutonium and americium, the AME study concluded that soil disturbance will likely increase the potential for soil erosion, and thus plutonium and americium transport at Rocky Flats. This knowledge reinforced the importance of implementing soil erosion controls, such as protecting soil stockpiles and limiting excavation on windy days, to minimize airborne actinide transport during remedial activities.

Similarly, soil erosion into surface water is another major potential pathway for plutonium and americium movement. To address this issue, the AME panel recommended implementing erosion control measures during site remediation, including techniques such as minimizing vegetation disturbance and redirecting runoff away from excavations, in addition to maintaining the detention pond system during active site remediation.

Post Closure Site Management

The AME panel asserted that minimizing wind and water erosion should remain a high priority post-closure, particularly in areas with residual actinide activity. Planning for the long-term effectiveness of erosion control measures, such as limiting soil disturbance and maintaining stable slopes, should be of utmost importance. Since site closure in October 2005, DOE and its contractors have made erosion control one of their most important duties. Inspections are done routinely looking for areas where erosion control needs to be improved or added.

Please contact us with any questions.

TABLE OF CONTENTS

ACTINIDE MIGRATION EVALUATION PATHWAY ANALYSIS SUMMARY REPORT

‘Actinides are those **14 elements** with atomic numbers 90 to 103 that follow the element actinium in the **Periodic Table of Elements.’**

ACTINIDE MIGRATION EVALUATION ADVISORY GROUP

The Actinide Migration Evaluation (AME) has an advisory group that provides scientific expertise in the fields of actinide chemistry, geochemistry, erosional transport, hydrogeology and microbiology. The AME is privileged to have the dedicated support of the following scientists:

- **Sumner J. Barr, Ph.D., (AME tenure: 2000 - present)**
  Consultant to Los Alamos National Laboratory (retired) -
  Air Transport of Radionuclides

- **Gregory R. Choppin, Ph.D., (AME tenure: 1998 - present)**
  Professor Emeritus, Dept. of Chemistry, Florida State University -
  Actinide Chemistry

- **David L. Clark, Ph.D., (AME tenure: 1996 - present)**
  Seaborg Institute Director and Fellow, Los Alamos National Laboratory -
  Actinide Chemistry

- **Arokiasamy J. (A.J.) Francis, Ph.D., (AME tenure: 2000 - present)**
  Brookhaven National Laboratory - Microbiological Processes and Actinide Mobility

- **Bruce D. Honeyman, Ph.D., (AME tenure: 1996 - 1999)**
  Colorado School of Mines - Radionuclide Geochemistry, Actinide Phase Speciation

- **David R. Janecky, Ph.D., (AME tenure: 1996 - present)**
  Environmental Science and Technology Program Office, Los Alamos National Laboratory - Actinide Geochemistry

- **Annie B. Kersting, Ph.D., (AME tenure: 2000 - present)**
  Analytical Nuclear Chemistry Division, Lawrence Livermore National Laboratory -
  Geochemistry and Colloidal Transport of Actinides

- **Leonard J. Lane, Ph.D., (AME tenure: 1999 - present)**
  Hydrology and Water Resources, Agricultural Research Service (retired) -
  Erosion and Sediment Transport, Actinide Fate and Transport

- **D. Kirk Nordstrom, Ph.D., (AME tenure: 1996 - 2000)**
  U.S. Geological Survey - Geochemistry, Actinide Fate and Transport

- **Peter H. Santschi, Ph.D., (AME tenure: 1996 - present)**
  Texas A&M University at Galveston - Radionuclide Geochemistry,
  Actinide Phase Speciation

INTRODUCTION AND RFETS HISTORY

THE ACTINIDE ELEMENTS

INTRODUCTION The Rocky Flats Environmental Technology Site (RFETS or Site), located near Denver, Colo., and owned by the United States Department of Energy (DOE), was formerly a manufacturing facility in the nation's Nuclear Weapons Complex. The Site is currently undergoing cleanup, closure and conversion to a National Wildlife Refuge. An important question was identified early in the closure planning – how do radioactive elements move in the environment?

The Actinide Migration Evaluation (AME) Program was initiated in 1996 to address this question. Specifically, the AME focuses on issues of actinide behavior and mobility in surface water, groundwater, air, soil and biota at RFETS. For the purposes of this study, an actinide refers to the radioactive element uranium (U), plutonium (Pu) or americium (Am).

To address issues of actinide migration, the AME Program has brought together personnel with a broad range of relevant expertise in technical investigations, project management and external advisory roles. This effort, funded by DOE, involves identification of research investigations and approaches that can be used to solve short- and long-term issues related to actinide migration at the Site. Knowledge garnered through the AME Program is being used to characterize current RFETS environmental conditions and to recommend a path forward for long-term protection of surface water quality during closure and long-term stewardship of the Site.

In the early 1950s, Rocky Flats was built as part of the nation's Nuclear Weapons Complex. In 1989, following decades of expansion, production operations were halted. Current cleanup efforts are scheduled for completion by 2006. The Site will then become a National Wildlife Refuge.

WHAT ARE ACTINIDES?

Actinides are those 14 elements with atomic numbers 90 to 103 that follow the element actinium in the Periodic Table of Elements. Actinides are among the heaviest known elements and all are radioactive. Only thorium and uranium can be found naturally in abundance. Plutonium and americium are man-made. Actinides of concern at RFETS addressed in this report are uranium (atomic number 92), plutonium (atomic number 94) and americium (atomic number 95).

Effective cleanup of the Site requires a thorough understanding of how actinides move in the environment.

Throughout the AME Program, there has been extensive public discussion and participation in the scientific process and review of findings. Discussion of actinide migration technical issues with stakeholders, regulators, administrators and staff has been valuable as a means of focusing efforts on critical questions.

Data presented in this Report show that air and surface water are the major transport pathways for all actinides. This is particularly true for plutonium and americium, which are largely insoluble and are transported when wind and water erosion move the soil and sediment particles to which the plutonium and americium are bound. Groundwater is a significant pathway for uranium, which is more soluble than plutonium or americium. The biological pathway is a minor transport mechanism for all actinides.

This Summary Report is a condensed review of the study's major topics and findings. Detailed discussions, calculations and literature references to support subjects discussed in this document are included in the companion Technical Appendix.

PURPOSE The purpose of the AME Pathway Analysis Report is to provide a summary of the quantitative analyses that have been performed to examine the many processes that impact movement of actinides in the environment at RFETS. Evaluation of alternatives for remediating actinide contamination at RFETS must consider migration and mobility along all available environmental pathways. The ultimate objective of the pathway study is to compare and quantitatively rank the various pathways in terms of total actinide loads transported off site for a given time period. Major transport pathways addressed in this study include: air, surface water, groundwater and biota.

This study is limited to quantifying actinide movement and does not assess actinide-related human health impacts. However, references to pertinent risk-based health standards are made to provide perspective.

SITE HISTORY RFETS is located 16 miles northwest of downtown Denver. It was built as a production plant to manufacture triggers for nuclear weapons and purify plutonium recovered from retired weapons. These operations involved fabricating components out of plutonium, enriched and depleted uranium, beryllium and stainless steel. Nearly 40 years of weapons production left a legacy of radiological waste at the Site, including contaminated facilities, process waste lines and buried wastes. Plutonium dispersal from fires in production buildings and leakage of waste oil stored outdoors caused contamination of the immediate environment.

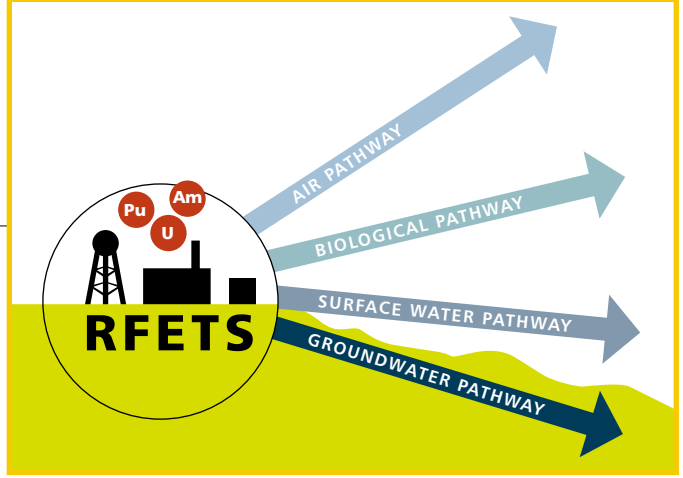
CLOSURE AND CLEANUP In 1992, the Site mission changed from production to one of closure and cleanup of the 385-acre Industrial Area and the surrounding 6,165-acre Buffer Zone. Today, RFETS is in the process of deactivating, decontaminating, decommissioning and demolishing all of the weapons production facilities and support buildings in the Industrial Area. The objective of the final closure phase is remediation of the environmental legacy of nuclear weapons production and transition to long-term stewardship as a National Wildlife Refuge.

CONCEPTUAL MODEL

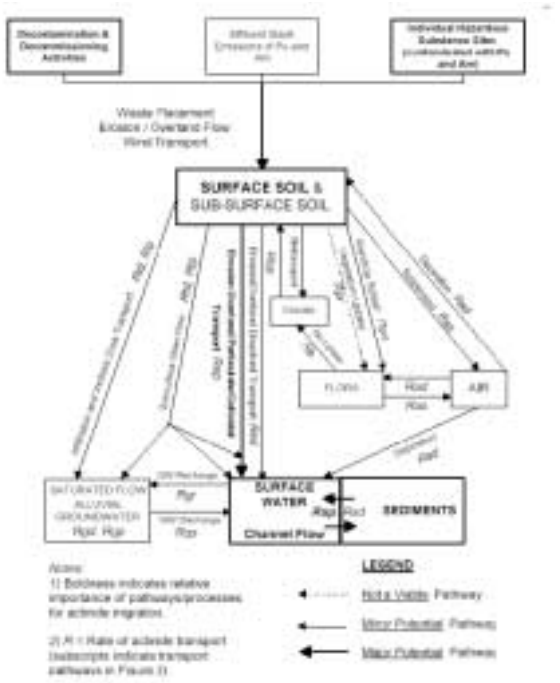
CONCEPTUAL MODEL In 1998, a document entitled "Conceptual Model for Actinide Migration Studies at the Rocky Flats Environmental Technology Site" was developed as an initial effort to provide a qualitative description of the relationships among potential actinide sources and transport pathways at RFETS (Kaiser-Hill, 1998).

The transport of actinide elements in the environment involves complex chemical and physical processes. These processes depend on the type and source of the actinide as well as the influence of the surrounding environmental media. To facilitate understanding of the potential routes for actinide transport in the RFETS environment, schematic models of actinide transport pathways were developed. One conceptual model was developed specifically for plutonium and americium, because they have similar geochemical and transport properties. A separate model was developed for uranium because of its different properties. These models formed the basis for quantitative analyses described in the Pathway Analysis Report. Development of the Pathway Analysis Report used both existing data from the literature and site-specific analyses. Field, laboratory and modeling studies were conducted to provide quantitative estimates of actinide migration.

CONCEPTUAL PATHWAY DIAGRAM



ORIGINAL CONCEPTUAL MODEL



INITIAL CONCEPTUAL MODEL DIAGRAM

This chart was the first effort by the AME group to diagram how plutonium and americium move in the environment at RFETS. It was a familiar tool at public meetings and has evolved into the chart on the following page.

CONCEPTUAL MODEL LEGEND

not a viable pathway

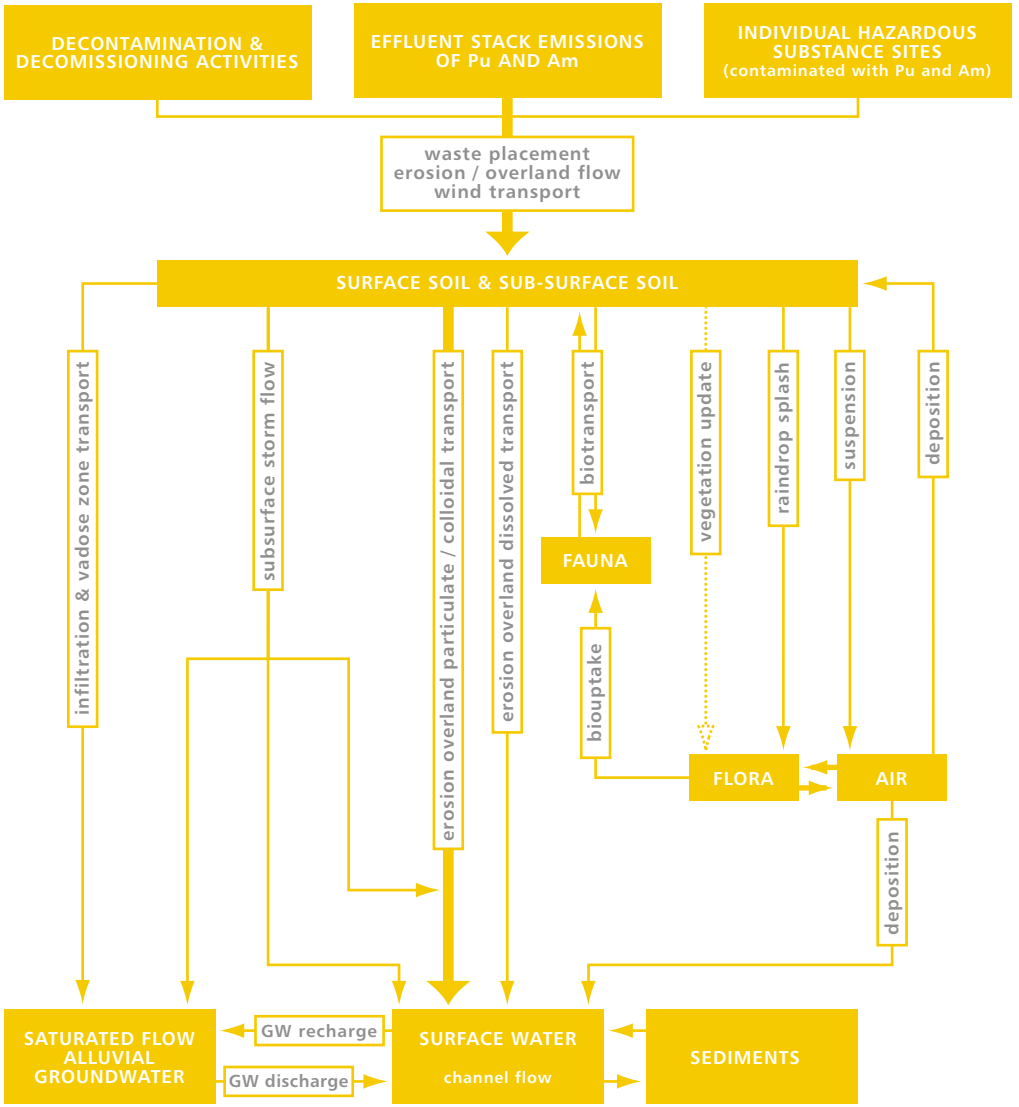
minor potential pathway

major potential pathway

ACTINIDE MIGRATION CONCEPTUAL MODEL

This flowchart, developed from the conceptual model, is a qualitative diagram of potential plutonium and americium movement pathways at RFETS. The Pathway Analysis Report quantifies potential pathways to determine their relative importance in RFETS actinide migration. Since the geochemical behavior of uranium is different from that of plutonium and americium, a separate conceptual model flowchart developed for uranium is in the Technical Appendix.

REVISED CONCEPTUAL MODEL DIAGRAM



ACTINIDE SOURCES

These drums leaked contaminated waste oil in the 1960s. The 903 Pad area is the Site's primary known source of plutonium and americium in the environment and is scheduled for cleanup in 2002.

LEAKING DRUMS RELEASED CONTAMINATION

A major release of plutonium to the environment occurred when plutonium-contaminated waste oil leaked from approximately 3,750 drums stored outside from 1958 to 1968. Although the drums were removed after leakage was detected, plutonium-contaminated soil was dispersed into the air during remediation activities and deposited east of the drum storage area. In 1969, the area was covered with gravel fill and an asphalt layer to prevent further wind dispersal. The remaining contamination in this area, known as the 903 Pad, continues to be one of the major sources of plutonium and americium contamination at the Site. Further remediation will remove the source material and reduce airborne transport of plutonium and americium.

ACTINIDES IN THE ENVIRONMENT Actinide elements occur in the environment at RFETS as both "background" material and as material released during operations at the Site. For plutonium and americium, background concentrations exist because of global fallout from historic atmospheric nuclear testing.

With uranium, background quantities occur naturally in the soil and underlying geologic material. A significant amount of naturally occurring uranium exists at RFETS as well as in the surrounding vicinity, as evidenced by the presence of the Schwartzwalder uranium ore mine within 16 kilometers (10 miles) of the Site. Differentiation between natural and man-made uranium contributions can be accomplished by examining characteristic differences in the mixtures of uranium isotopes. Such isotopic analyses have detected low levels of man-made uranium in shallow groundwater at locations somewhat removed from contaminant sources. However, in general, beyond the immediate vicinity of man-made uranium sources, the observed uranium concentrations are difficult to distinguish from natural background uranium.

SPATIAL DISTRIBUTION Plutonium and americium generally exhibit the same spatial distribution in surface soils, with wide variations in activities occurring throughout the Site. The highest concentrations are found at the 903 Pad and areas to the east of the Pad. Nearly all the plutonium and americium in RFETS soils is confined to the top 20 centimeters (8 inches) of soil and approximately 90 percent is located in the top 12 centimeters (5 inches) (Webb, et al., 1993; Litaor, et al., 1994).

BACKGROUND LEVELS OF ACTINIDES

Plutonium and Americium – Global Fallout from Nuclear Tests There were 541 acknowledged atmospheric nuclear tests conducted around the world, primarily from 1945 through 1963, prior to the Limited Test Ban Treaty. These tests resulted in the global dispersal of approximately 4,000 kilograms (360,000 curies) of plutonium and 95 kilograms of americium. Most of this fallout was distributed across the temperate regions of the Northern Hemisphere, resulting in background plutonium levels that generally range from approximately 0.003 to 0.03 picocuries per gram (pCi/gram) of surface soil. The background plutonium level found in Front Range soils is approximately 0.04 pCi/gram.

Uranium – Naturally Occurring in the Earth's Crust Uranium is found naturally in the earth's crust with an approximate average concentration of 1.6 pCi/gram. This amount varies depending on local geology, with natural uranium activity in Colorado soils ranging from approximately 0.5 to 3.0 pCi/g. Three isotopes compose natural uranium. The percent occurrences by mass are: uranium-238 (99.275 %), uranium-235 (0.719 %) and uranium-234 (0.0057 %). Each of these isotopes has different amounts of activity per unit mass, which explains why the activity in soil emitted from uranium-234 approximately equals the activity from uranium-238, even though there is much less uranium-234 by mass (see "Radioactivity per Unit Mass," Page 8).

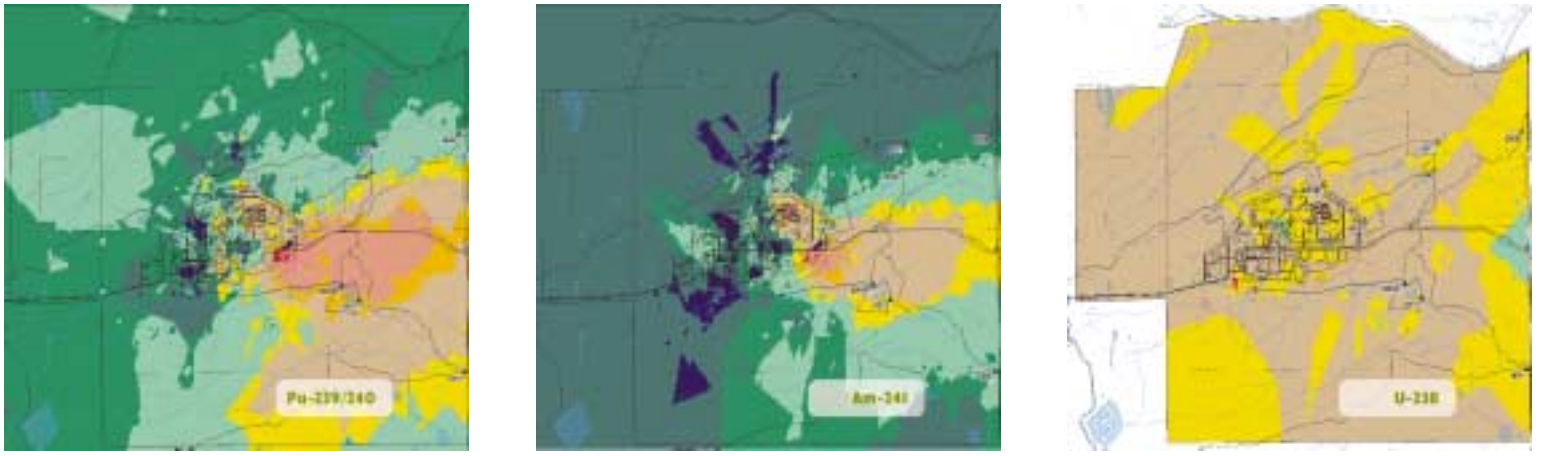
Uranium does not have the same spatial distribution observed for plutonium and americium in surface soils. Uranium is observed at varying levels of natural background activity across the Site, which complicates identifying uranium from man-made, versus natural, sources.

DATA GAPS The "Historical Release Report" identifies 215 total locations that are potentially contaminated by actinides. Acceptable data, as defined in the Technical Appendix, exist for surface or sub-surface soil contamination for plutonium, americium and uranium at 95 locations. Additional sampling is needed to more fully characterize actinide contamination at RFETS.

STATISTICAL METHODS USED WITH SOIL DATA

Although an extensive program exists to sample RFETS surface soils for actinides, it is not feasible to collect soil samples from every location at the Site. Therefore, to estimate actinide concentrations in soil at locations that have not been sampled, it is necessary to use data from adjacent locations that have been sampled. Various computerized estimation techniques have been developed for this purpose.

A geostatistical technique known as kriging was applied to the plutonium, americium and uranium surface soil sample data at RFETS to estimate concentrations of these actinides in the surface soil and generate the maps shown below.

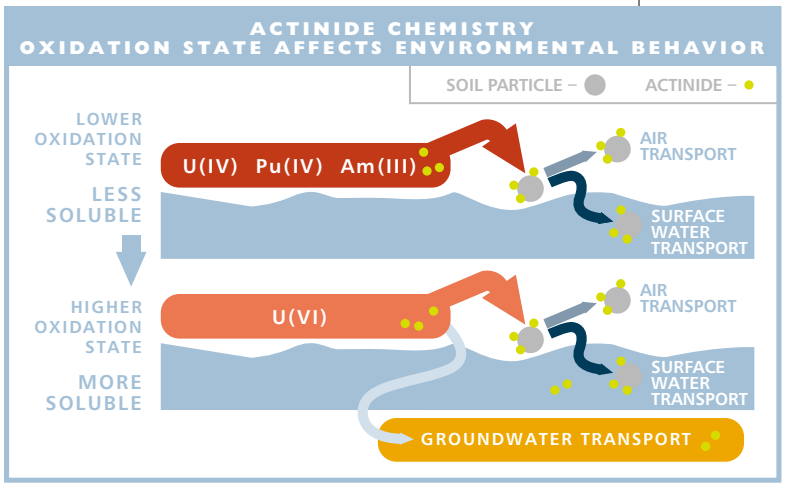


ACTINIDE SURFACE SOIL MAPS **Surface soil data for plutonium (left) and americium (center) display a similar pattern of wind-driven dispersal to the east of the primary source area – the 903 Pad. In contrast, uranium (right) exists at natural background levels across most of the Site except for small areas of higher activity located near contamination sources. In these maps of kriged data, red indicates highest contamination activity and green indicates areas with lowest activity. Larger versions of these maps are in the Technical Appendix.**

ENVIRONMENTAL CHEMISTRY Pu, Am AND U

TRANSPORT Scientific literature and RFETS-specific studies indicate that the chemical and physical characteristics of plutonium, americium and uranium control how they are transported and where they eventually reside in the environment.

OXIDATION STATES The oxidation state of an actinide is determined by the number of electrons lost when the actinide combines with oxygen. The oxidation state is a function of the unique chemical characteristics of each actinide element as well as the geochemical conditions in the surrounding soil and water. In environmental conditions, plutonium and americium tend to exist in low oxidation states III (Am) and IV (Pu) that are relatively insoluble. In contrast, uranium is stable in both oxidation states IV and VI, with VI dominant in surface and near-surface oxidizing conditions. Because U (VI) forms compounds of greater solubility than Pu (IV) or Am (III), uranium exhibits a greater tendency to exist in chemical forms that are more soluble than plutonium or americium.



COLLOIDS AND ACTINIDE TRANSPORT

Colloids are naturally occurring particles, defined as ranging in size from 0.1 to 0.001 micrometers. Colloids are found in nearly all surface water and groundwater and are formed as a result of the weathering of rocks, soils and decomposing plant materials. Due to their small size, colloids can remain suspended and are readily transported with groundwater. Suspended colloids are of interest as a transport mechanism for contaminants that strongly attach to mineral or organic surfaces, such as plutonium and americium (i.e., contaminants that do not readily dissolve in groundwater). The hydrology, water chemistry and geology of the surrounding environment influence the importance of colloids in facilitating transport of insoluble contaminants. Though colloid-facilitated transport of actinides has been observed at the Nevada Test Site, it is important to recognize that plutonium there was deposited during an underground nuclear test in fractured volcanic rock below the groundwater table. Geologic conditions at RFETS are significantly different than at the Nevada Test Site, but colloidal transport of actinides is a mechanism that still warrants consideration in the RFETS pathway analysis.

PLUTONIUM AND AMERICIUM GEOCHEMISTRY Because of the extremely low solubilities of plutonium and americium, these elements are predominantly associated with solids. They are either strongly sorbed, or attached, to soil and sediment particles or precipitated as oxides and hydroxides. The concentrations found in solution under the oxidizing environmental conditions common at RFETS are very low, around 1 x 10^{-15} moles/liter (also represented herein as 1E-15 moles/liter). Evidence indicates that reducing conditions which may exist in the treatment ponds or in landfill locations do not influence plutonium solubility at RFETS.

Studies performed to date and measurements at RFETS indicate that groundwater transport of plutonium and americium should be very low. Measured plutonium and americium concentrations in shallow groundwater below the Industrial Area range from the analytical detection limit (about 0.02 picocuries/liter [pCi/L]) to about 0.1 pCi/L. At present, it is not clear whether detections of plutonium and americium in shallow groundwater arise from surface contamination carried downward by well-drilling activities, from contamination during sampling and analysis, from sub-surface transport of actinide-bearing colloids or from a combination of these processes. These possibilities are currently being studied with a series of wells drilled and sampled under conditions that minimize the possibility of extraneous contamination.

Surface soil (0 to 15 centimeters [0 to 6 inches] below original grade), in contrast to the low levels observed in groundwater, has plutonium activities that range between 0 to 152,000 picocuries/gram [pCi/g]. Measurements of plutonium and americium movement show that the mobility of these actinides is largely controlled by erosion of surface soil by wind and water.

Since the data amassed indicate that plutonium and americium are present as insoluble forms and migration occurs via colloidal and particulate transport, contaminant transport modeling calculations must take these facts into account. Contaminant transport models that assume soluble forms and the existence of equilibrium conditions between soil and solution phases of plutonium and americium are of limited value for assessing the risk of exposure at RFETS. For plutonium and americium, models based on particulate transport processes are more appropriate and have been developed for use at the Site.

URANIUM GEOCHEMISTRY In contrast to plutonium and americium, uranium is most stable in the oxidation states IV and VI, with VI dominating in surface and near-surface oxidizing conditions. Because U (VI) forms compounds of much greater solubility than those formed by Pu (IV) or Am (III), uranium exhibits a greater tendency to exist in dissolved forms. Uranium is predominantly transported as dissolved chemical species, although transport can also occur in particulate form. Models used to estimate uranium transport must account for these processes and, accordingly, might suitably include a solubility and sorption-controlled mobility component.

RADIOACTIVITY PER UNIT MASS

Specific activity is used to quantify the amount of radioactivity emitted per unit of mass. The specific activity for each isotope of a given element is related to its radioactive half-life. The half-life is the time it takes for half of the atoms to decay. Specific activities for isotopes of interest are listed below. Note how the amount of activity per unit mass can vary by several orders of magnitude from one actinide isotope to another.

RADIONUCLIDE	HALF-LIFE (years)	SPECIFIC ACTIVITY (Ci/gram)
americium-241	4.32×10^{2}	3.53×10^{0}
plutonium-239	2.42×10^{4}	8.48×10^{-2}
plutonium-240	6.57×10^{3}	3.10×10^{-2}
uranium-234	2.47×10^{5}	6.25×10^{-3}
uranium-235	7.04×10^{8}	2.14×10^{-6}
uranium-236	2.34×10^{7}	8.85×10^{-6}
uranium-238	4.51×10^{9}	3.33×10^{-7}

An example of the importance of specific activity is demonstrated by examining the natural occurrence of uranium. Three uranium isotopes are found naturally in the environment. By mass, uranium-238 accounts for nearly all (99.275 %) of the naturally-occurring uranium, while uranium-235 (0.719 %) and uranium-234 (0.0057 %) account for the remaining mass. However, in terms of radioactivity, the amount of activity emitted from naturally-occurring uranium-234 and uranium-238 is roughly equal, despite the overwhelming abundance of uranium-238 atoms in a given sample.

MEASURING RADIOACTIVITY

What is a curie? The curie (Ci) is a unit of measure for radioactivity. The nuclei of the heaviest elements in the periodic table are unstable and emit radiation when their nuclei break up. An element that emits radiation is called radioactive and the emission process is often referred to as radioactive decay. The Ci was established as a unit of measure based on the radioactivity emitted by 1 gram of radium-226. The Ci is defined as 3.7×10^{10} nuclear decays per second. The activity emitted by a gram of an isotope of a radioactive element may vary greatly from the activity emitted by a gram of a different element or a different isotope and is related to its rate of radioactive decay (the half-life). Therefore, it is more meaningful to use a measure of radioactivity like the Ci, versus using mass or volume units, when discussing actinides and their radioactivity.

What is a picocurie? A picocurie (pCi) is one trillionth of a Ci (1×10^{-12} Ci). For studying actinides in the environment at RFETS, the Ci is often too large a unit of radioactivity in the same way that a fraction of a mile would be an awkward way to describe the thickness of a human hair. Therefore, activity in the environment at RFETS is frequently presented in units of pCi.

AIR PATHWAY

INTRODUCTION Transport of actinides through the air at RFETS occurs largely by wind erosion of actinide-containing particulate matter from soil and vegetation surfaces. RFETS-specific research suggests that dust-laden vegetation is the primary source for resuspended airborne plutonium under most conditions (Langer, 1991). Resuspension of actinides directly from soil surfaces is thought to be a lesser source except during high wind events or after soil has been disturbed and made more erosion-prone. Building stack and vent emissions are, to a much lesser extent, also sources of airborne actinides, though these sources will be eliminated as buildings are removed.

Data collected from air-monitoring stations like this one, near the 903 Pad, are used to quantify actinide movement by the wind. Air is a major transport pathway.

Overall, the general direction of airborne actinide transport at the Site follows the prevailing winds, from the north and west to the south and east. More importantly, Site data show that higher wind speeds occur almost exclusively from the northwest quadrant. This is significant because the amounts of soil resuspended are much higher during high-wind events than during periods with lower winds. Higher winds are also more effective at transporting particles further downwind from source areas before being redeposited.

Although the first few minutes of high winds may result in significant airborne particle transport, the emission rate decreases rapidly with time as the available inventory of erosion-prone particles is depleted. Sustained windy periods do not result in significantly greater emissions until the inventory is replenished by deposition or by other factors that increase soil erosion potential, such as freeze/thaw cycles, wet/dry cycles, rangeland fires, animal activities, rainsplash effects or other processes that disturb the soil. Following disturbances, erosion protection is restored by crusting of the soil, regrowth of vegetation and regeneration of a litter layer.

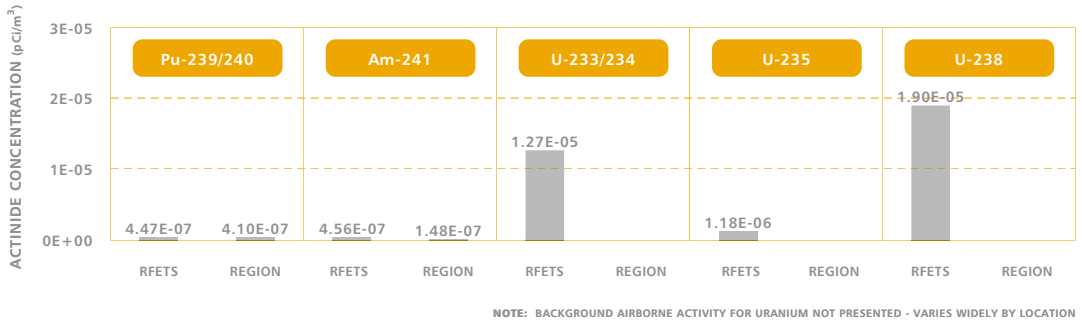
METHODOLOGY FOR QUANTIFYING ACTINIDE TRANSPORT Two different methods were used to quantify actinide transport via the air pathway. The first method is more closely linked to measured site data. It uses airborne average actinide concentration data from 1997 through 1999, collected at site perimeter monitoring stations, coupled with on-site wind data.

The second method involves a wind erosion emission estimation method and dispersion / deposition model developed for the Site. Off-site airborne transport was calculated for plutonium and americium as the difference between annual wind erosion emissions from the Site and deposition of actinides back onto the Site. Though this approach does not account for possible contributions from project or building emissions, wind erosion of actinides from soil and vegetation has been determined to represent the majority of air emissions from the Site during recent years.

Although the first method is a more "data-driven" estimation approach, it has uncertainty associated with wind speed data and airborne actinide data collected in different time steps, 15-minute and monthly intervals, respectively. The dispersion modeling approach, though not tied as closely to measured air actinide concentrations, provides the advantage that hypothetical off-normal events can also be investigated. Results from both methods, for normal conditions, provide a range of results for estimated annual quantities of airborne actinides transported off site.

CHART 1

AIRBORNE ACTINIDE CONCENTRATIONS –
MEDIAN MEASURED ACTIVITIES AT SITE PERIMETER COMPARED WITH REGIONAL BACKGROUND ACTIVITIES



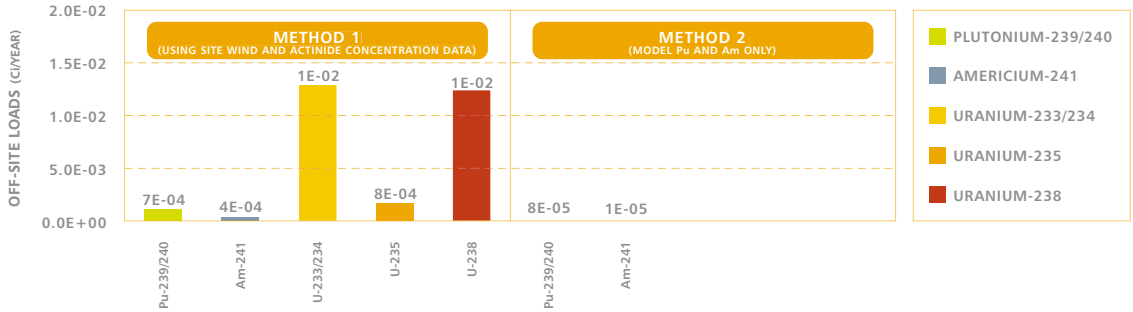
NOTE: BACKGROUND AIRBORNE ACTIVITY FOR URANIUM NOT PRESENTED - VARIES WIDELY BY LOCATION

ACTINIDE CONCENTRATIONS IN AIR

Chart 1 presents airborne actinide concentrations measured at the RFETS boundary. Units of measurement are pCi per cubic meter of air. Regional background activities are provided for plutonium and americium for comparison. Background concentrations of airborne plutonium and americium exist, as discussed earlier, because they were globally dispersed from historic weapons testing. Resuspension by the wind of the residual plutonium and americium causes a background level of these actinides in the air. Airborne uranium measured at the Site is similar to background because of its natural abundance in the soil. In Chart 1, the concentration presented for each actinide is the median of annual average concentrations measured at the RFETS perimeter monitoring locations from 1997 through 1999.

CHART 2

AIRBORNE ACTINIDES – TOTAL AVERAGE ANNUAL ACTIVITY TRANSPORTED OFF SITE –
RESULTS FOR TWO ESTIMATION METHODS



TOTAL ACTIVITY IN AIR

Estimated annual off-site airborne actinide loads are shown in Chart 2. Results are presented for two modeling methods described previously.

AIR PATHWAY

DISCUSSION: AIRBORNE PLUTONIUM AND AMERICIUM Model estimates for average annual off-site transport of plutonium range from 8×10^{-5} Ci to 7×10^{-4} Ci and for americium range from 1×10^{-5} Ci to 4×10^{-4} Ci. For both plutonium and americium, the estimation method based on measured Site wind and airborne actinide concentration data yielded higher predicted off-site transport than the model estimation method. The primary source of plutonium and americium in airborne loads at RFETS is from contaminated surface soil, or soil on vegetation surfaces, in the area near and east of the 903 Pad. Additional minor sources are building stack and vent emissions as well as background plutonium and americium in surface soil from global atmospheric nuclear fallout that gets resuspended by the wind.

Modeling results are consistent with the observed pattern of plutonium and americium surface soil contamination, originating in the 903 Pad area and migrating eastward as a result of prevailing winds from the west and northwest. Reconstruction of events associated with the 903 Pad contamination in the late 1960s suggests that much of the contamination was likely dispersed during a few high-wind events that followed closely after the contaminated soil had been disturbed by grading or weed control efforts (Meyer et al., 1996). Such activities can break up the surface crust, crush aggregated soil particles and remove vegetative cover, thereby renewing and increasing the reservoir of particles available for erosion. The resulting dispersion and deposition pattern indicates that substantial quantities of material can be moved through the air pathway by the sporadic events.

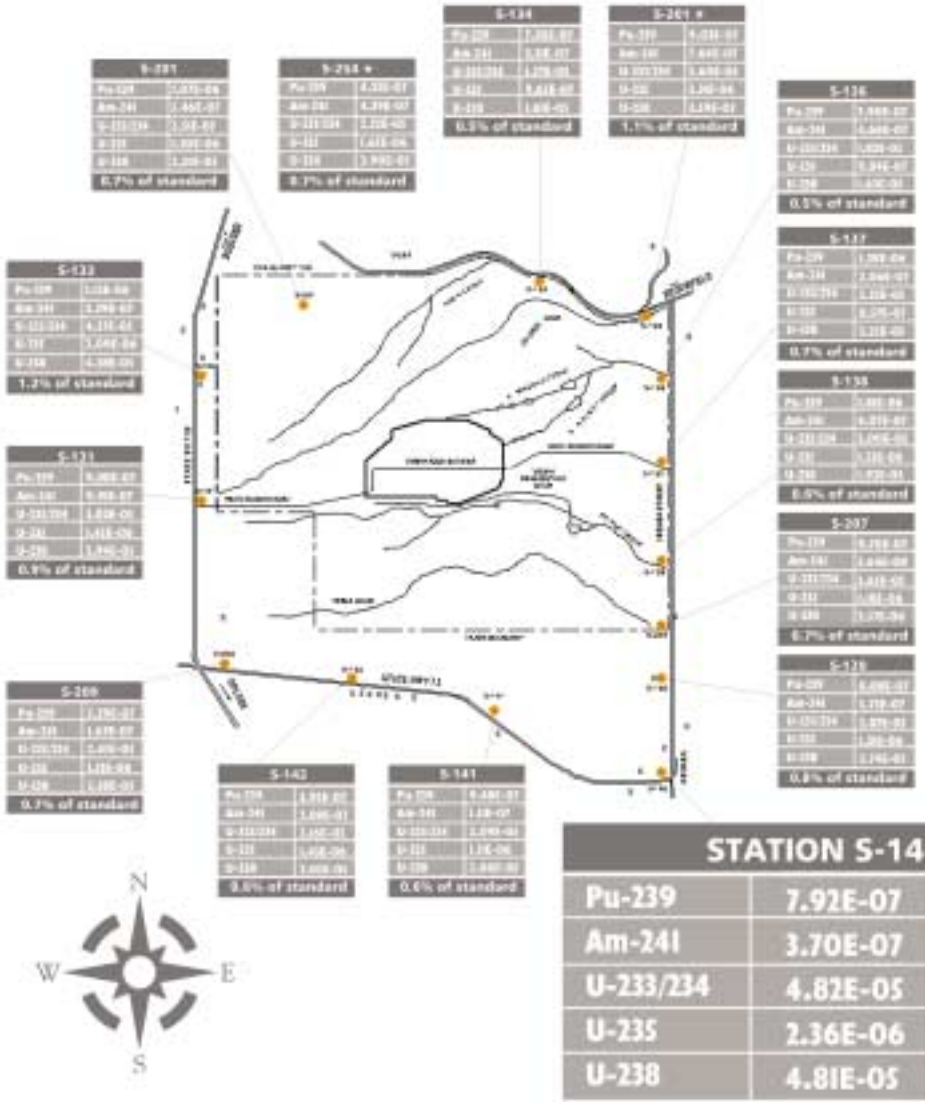
DISCUSSION: AIRBORNE URANIUM Naturally occurring uranium from the soil is the major component of airborne uranium leaving the Site. Based on the relative concentrations of uranium-233/234 and uranium-238, data from the sampling network confirm that almost all airborne uranium is naturally occurring. For comparison, the concentration of airborne uranium-233/234 activity measured at site boundary monitors ranges from 10 to 60 times more than the activity measured for airborne plutonium.

DISCUSSION: EXTREME EVENTS As a hypothetical extreme event, a model simulation was performed to study the effect on airborne actinide transport following a rangeland fire occurring on approximately 40 hectares (100 acres) in a plutonium-contaminated area near the 903 Pad. Modeling results indicate that average airborne plutonium concentrations would increase an estimated 5- to 13-fold in the vicinity of the burned area in the first year following a fire. Such an increase in concentrations would lead to greater off-site transport until the vegetation recovered and soil loss from wind erosion returned to pre-fire levels. The actual increase in actinide transport following a fire would depend on the size of the burned area, the intensity of the fire and the actinide concentrations in the area burned. Other extreme conditions, such as soil disturbance by heavy equipment, can increase airborne particulate emissions by nearly a factor of 20 (EPA, 1995).

AIRBORNE ACTINIDES

The air-monitoring location with the highest total average actinide concentration had a level equal to approximately 1.4 percent of the 10 millirem standard governing airborne radionuclide concentrations leaving DOE facilities. Results are based on data collected from 1997 through 1999.

AIRBORNE ACTINIDE CONCENTRATIONS



STATION S-140		
Pu-239	7.92E-07	pCi/m³
Am-241	3.70E-07	pCi/m³
U-233/234	4.82E-05	pCi/m³
U-235	2.36E-06	pCi/m³
U-238	4.81E-05	pCi/m³
1.4% of standard		

SURFACE WATER PATHWAY

INTRODUCTION Actinides are transported in surface water by two main processes, depending on the actinide's solubility. First, insoluble actinides, such as plutonium, americium or uranium in lower oxidation states, sorb to soil or sediment particles that are eroded by water. The particles thereby transport the attached actinides. The second transport process involves actinides in solution, primarily uranium in the VI oxidation state, that move in surface water. Plutonium and americium are essentially insoluble and are not transported as dissolved species in significant quantities.

Surface water at RFETS flows generally from west to east, with three major drainages traversing the Site (see map at back of report, Page v). Walnut Creek drains the northern portion of the Site, including the majority of the Industrial Area, which runs off to the A- and B-series detention ponds. Woman Creek drains the southern portion of the Site, including southern Industrial Area runoff after it is diverted by the South Interceptor Ditch into Pond C-2. The third major drainage, Rock Creek, does not receive runoff from the Industrial Area or other contaminated areas. This pathway study focuses on the Walnut and Woman Creek drainage basins.

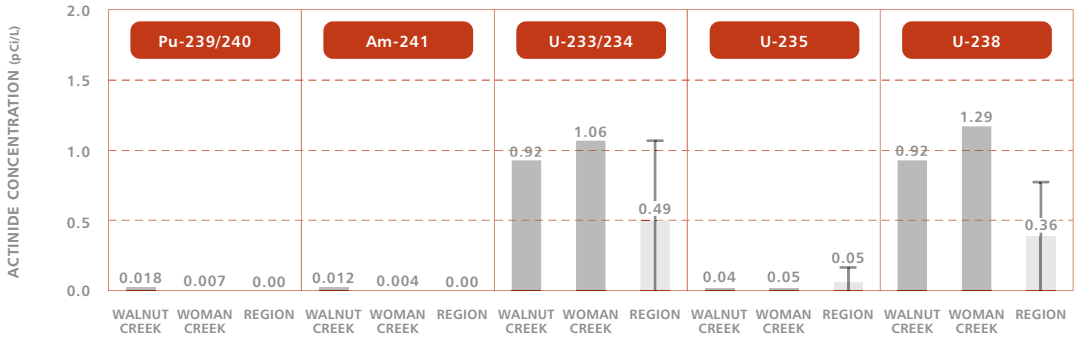
Surface water is monitored throughout the Site at automated stations. When the water flow rate of the water increases, this unit is programmed to increase the number of samples it collects.

METHODOLOGY FOR QUANTIFYING ACTINIDE TRANSPORT The amount of actinide material, or load, transported in surface water past a specific location is a function of both the volume of water that flows past the location and the actinide concentration in the water. This surface water actinide load is calculated using data from automated monitoring stations that continuously measure water flow and periodically collect samples using a "flow-weighted" sampling protocol. This means sample volumes are collected in equal proportion to the volume of water passing the station. Multiple samples are collected and combined, resulting in an accumulated composite sample. The sample is representative of the actinide concentration for an entire volume of water passing the monitoring station. Annual surface water actinide loads were quantified in this study at eight site monitoring locations, using data from water years 1997 through 1999.

In addition to using measured data to quantify surface water actinide loads, models were developed to estimate impacts to surface water from pathways for which measured data is unavailable. Estimates of plutonium and uranium-238 inputs and outputs to surface water were made for: 1) deposition of airborne actinides to surface water, using a Gaussian plume model; 2) hillslope erosion and runoff of actinides to surface water, using the Watershed Erosion Prediction Project (WEPP) model coupled with actinide soil data; and 3) inflow and outflow of actinides to surface water from shallow alluvial sub-surface water, using water balance calculations coupled with monitoring-well data. These mass balance analyses were conducted on three study areas: the Walnut Creek detention ponds, Walnut Creek between the ponds and the site boundary and the South Interceptor Ditch drainage basin.

CHART 3

SURFACE WATER ACTINIDE CONCENTRATIONS – WALNUT AND WOMAN CREEKS COMPARED WITH REGIONAL BACKGROUND CONCENTRATIONS IN SURFACE WATER



NOTE: BOUNDARY URANIUM CONCENTRATIONS ESTIMATED USING VOLUME-WEIGHTED DATA FROM UPSTREAM STATIONS

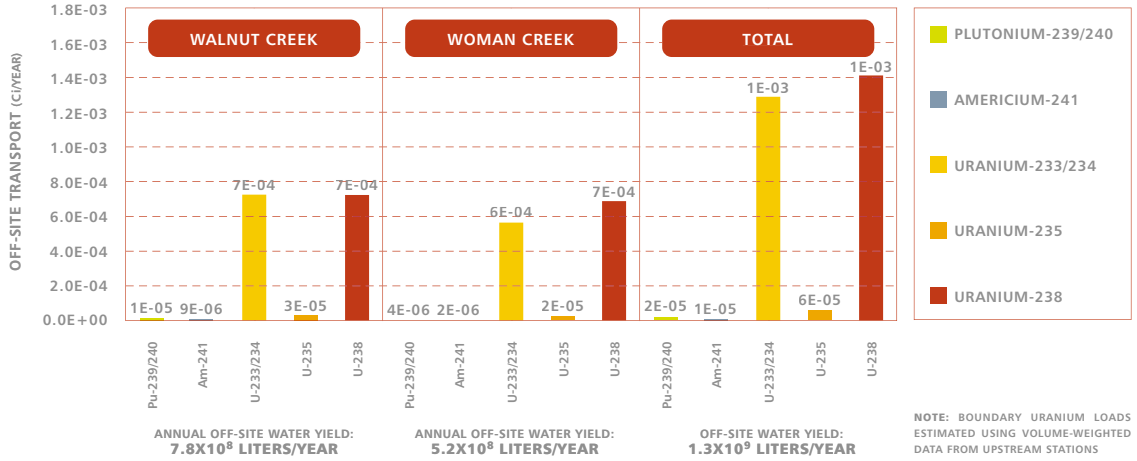
SURFACE WATER CONCENTRATIONS

Average surface water actinide concentrations in Walnut and Woman Creeks at the Site's eastern boundary are presented in Chart 3. Concentrations were calculated using a volume-weighted average based on samples and flow data collected from water years 1997 through 1999. Site measurements are compared with background concentrations of actinides measured in Front Range regional surface water that is not impacted by RFETS.

The actively managed detention ponds on South Walnut Creek (left) and North Walnut Creek (right) settle out 80 to 90 percent of the plutonium and americium loads carried into them from runoff.

CHART 4

SURFACE WATER ACTINIDE LOADS – ESTIMATED OFF-SITE TRANSPORT



ANNUAL OFF-SITE WATER YIELD: $7.8X10^8$ LITERS/YEAR

ANNUAL OFF-SITE WATER YIELD: $5.2X10^8$ LITERS/YEAR

OFF-SITE WATER YIELD: $1.3X10^9$ LITERS/YEAR

NOTE: BOUNDARY URANIUM LOADS ESTIMATED USING VOLUME-WEIGHTED DATA FROM UPSTREAM STATIONS

SURFACE WATER LOADS

Off-site actinide loads in the Walnut and Woman Creek drainage basins, as well as the total load of both basins combined, are summarized in Chart 4. The measured average annual volume of surface water flowing off site is displayed for each basin at the bottom of the chart.

SURFACE WATER PATHWAY

CHART 5

Pu MEASURED INPUTS

INPUT	DESCRIPTION	LOAD (pCi)
SW093	N. WALNUT IN	8.7E+06
GS10	S.WALNUT IN	2.9E+07
SW091	TRIBUTARY	1.7E+05
WWTP	TRIBUTARY	1.1E+06
SUBTOTAL		3.9E+07

Pu MODELED INPUTS

INPUT	DESCRIPTION	LOAD (pCi)
EROSION	DIFFUSE INPUT	8.2E+06
GROUNDWATER	DIFFUSE INPUT	1.2E+05
AIR DEPOSITION	DIFFUSE INPUT	6.5E+06
SUBTOTAL		1.5E+07

TOTAL INPUTS 5.4E+07

A- AND B-SERIES PONDS (study area)

Pu MEASURED OUTPUTS

INPUT	DESCRIPTION	LOAD (pCi)
GS11	N. WALNUT IN	2.5E+06
GS08	S.WALNUT IN	6.9E+06
SUBTOTAL		9.4E+06

TOTAL OUTPUTS 9.4E+06

GAIN (+) OR LOSS (-) OF Pu IN STUDY AREA

VARIABLES	DATA (pCi)	CHANGE FROM INPUT	REMARKS
MEASURED DATA ONLY (OUT - IN)	-2.9E+07	-76%	76% OF INFLOW PU ACCUMULATES
MEASURED + MODELED (OUT - IN)	-4.4E+07	-82%	82% OF INFLOW PU ACCUMULATES

MASS BALANCE ANALYSIS

An example of the detailed mass balance analyses performed on three surface water study areas is shown in Chart 5, which summarizes plutonium input and output loads to the Walnut Creek detention ponds. Results indicate a larger plutonium load flowing into the ponds than flowing out. This accumulation of plutonium in the ponds is attributed to particle settling which removes plutonium from the water column. Contributions of modeled input loads, such as deposition of airborne plutonium to surface water, are also quantified. A similar analysis for uranium-238 was done in the same study area. Those results are tabulated in the Technical Appendix. Other study areas analyzed in the same manner are the South Interceptor Ditch drainage basin and the section of Walnut Creek between the terminal ponds and the site boundary.

DISCUSSION: PLUTONIUM AND AMERICIUM IN SURFACE WATER The South Interceptor Ditch drainage basin, which includes hillslopes near the 903 Pad, has the highest levels of surface soil plutonium contamination at the Site. This basin is characterized by well-vegetated slopes and has only 14 percent impervious surface coverage. In contrast, the highly-developed central Industrial Area drainage basin is covered by approximately 47 percent impervious surfaces. Therefore, the South Interceptor Ditch basin has more water infiltration and less runoff per unit area than the central Industrial Area. Less runoff equates to less soil erosion and less actinide transport. As a result, despite having higher plutonium activities in the soil, the surface water plutonium load discharged per square meter of the South Interceptor Ditch basin (3.8 pCi/m^2/year) is roughly one-tenth of that measured in the central Industrial Area runoff.

Average concentrations of plutonium in surface water vary by a factor of nearly 40 at monitoring stations across the Site. Average plutonium concentrations measured in surface water range from 0.191 pCi/L, for central Industrial Area runoff monitored at station GS10, to 0.005 pCi/L for Woman Creek at station GS01 located near Indiana Street.

The actively managed detention ponds on North and South Walnut Creeks settle out particles and, as a result, remove roughly 80 percent to 90 percent of the plutonium and americium that flows into the ponds. The fraction of plutonium that doesn't settle is at least partially explained by site research which indicates approximately 10 percent of the plutonium and americium in runoff from the central Industrial Area, at station GS10, is attached to sub-micrometer-sized colloid particles (Santschi, 2000). The colloids are not likely to settle in the ponds. An additional important observation regarding

plutonium transport involves the lower section of Walnut Creek, between the terminal detention ponds and the site boundary, where the average annual plutonium load measured at the downstream end is approximately 30 percent greater than the plutonium load measured at the upstream end. Site investigations suggest the plutonium source in this area is diffuse, low-level legacy contamination in watershed soils and channel sediments (RMRS, 1998).

DISCUSSION: URANIUM IN SURFACE WATER Concentrations of uranium, in contrast to plutonium and americium, are relatively uniform in surface water across the Site. As a result, uranium loads in each basin are largely a function of each basin's water yield. Quantifying the fractions of natural versus man-made uranium in surface water requires that samples be analyzed using a high-resolution analytical technique, such as inductively coupled plasma/mass spectrometry (ICP/MS). This type of analysis is planned to permit more accurate detection of man-made uranium in site surface water. Although surface water flowing from RFETS is not utilized for drinking water supplies, comparison with the drinking water standard for uranium provides perspective on water quality. Total uranium concentrations at RFETS Point of Evaluation and Point of Compliance monitoring stations from water years 1997 through 1999 averaged roughly one-tenth of the 30 microgram per liter Maximum Contaminant Level for drinking water.

DISCUSSION: AIR-TO-SURFACE WATER PATHWAY Model estimates were generated to characterize the air-to-surface water pathway for plutonium and uranium-238. These analytes also serve as analogs for the transport behavior of americium and other uranium isotopes. Model estimates indicate the air-to-surface water pathway provides a relatively minor load, less than 1 percent of the total input to surface water, for all actinides and for all areas of the Site, with one exception. For the Walnut Creek detention ponds, model results indicate approximately 12 percent of the total input load is from airborne deposition to surface water. The increased fraction from airborne deposition in this location is a function of the large surface area of the ponds and the close proximity of the 903 Pad, a large surface soil plutonium source.

DISCUSSION: SURFACE WATER INTERACTION WITH SUB-SURFACE WATER For plutonium, flow between surface water and shallow sub-surface alluvial water is a relatively minor transport pathway to and from surface water, comprising 1 percent or less of the total input or output load for any of the areas studied. In contrast, uranium transport in the shallow sub-surface is a relatively major pathway. Model estimates for uranium-238 in shallow sub-surface flow ranged from 7 percent of the output load in lower Walnut Creek to 83 percent of the input load in the South Interceptor Ditch basin.

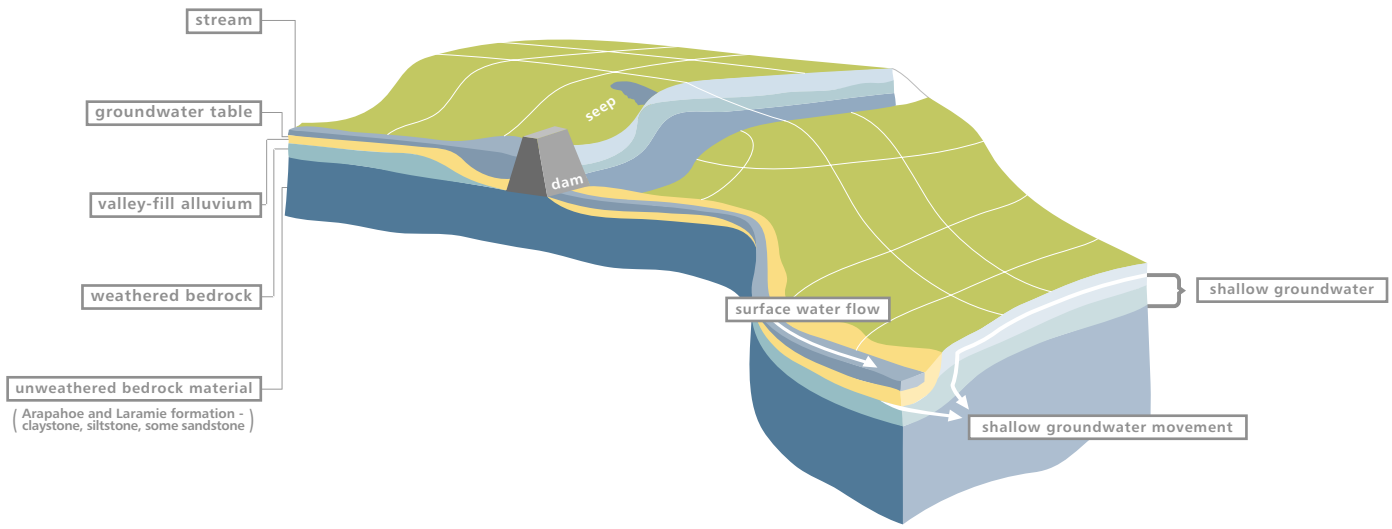
DISCUSSION: EXTREME EVENTS Model estimates of erosion indicate the plutonium load delivered from the South Interceptor Ditch basin is greater relative to other watersheds during extreme events. The plutonium load delivered from the 100-year, 6-hour storm event (97.1 mm) at the downstream end of the South Interceptor Ditch is approximately four times larger than the load delivered off site in Walnut Creek during the same storm. The explanation for the model-predicted impact of large storms is that the highest levels of plutonium contamination on Site are within the South Interceptor Ditch watershed. The hillslopes are well vegetated and have little runoff or erosion and plutonium transport, until an extreme storm event occurs. Remediation of soils within the South Interceptor Ditch watershed will reduce actinide loads transported in extreme events.

GROUNDWATER PATHWAY

INTRODUCTION Flowing beneath the ground surface, groundwater represents another pathway by which actinides can potentially be transported. This study focuses on "shallow" alluvial groundwater because geologic conditions at RFETS limit the depth of groundwater potentially impacted by Site contamination. Shallow groundwater refers to water flowing in the Site's alluvium and weathered bedrock geologic units and is found from just below the ground surface to depths of approximately 30 meters (100 feet), as shown in the figure below.

Shallow groundwater and surface water are inextricably linked. Water from stream channels infiltrates downward, recharging the shallow groundwater. Seeps discharge shallow groundwater to the surface. Therefore, it is not surprising that an actinide's solubility, which controls actinide transport in surface water, also dictates actinide transport in shallow groundwater. Insoluble actinides, such as plutonium, americium and uranium in the IV oxidation state, are relatively immobile in the soil and groundwater environment due to their low aqueous solubility and tendency to strongly sorb on soil media (Cleveland et al., 1976 and Honeyman and Santschi, 1997). However, work at RFETS, as well as studies in the literature, have shown that insoluble actinides can sorb to natural, sub-micrometer-sized colloid particles that can potentially facilitate actinide movement (Santschi, 2000). Another transport process similar to that observed in surface water involves more soluble actinides, such as uranium in the IV oxidation state, that move in solution with the shallow groundwater flow.

SHALLOW GROUNDWATER FLOW MODEL



Beneath areas with shallow groundwater flows in the alluvium and weathered bedrock geologic units, there is a thick, highly-impermeable, unweathered section of bedrock that inhibits downward groundwater flow. Because the shallow groundwater is inhibited from flowing vertically downward, it preferentially moves laterally along the unweathered bedrock surface and generally flows from west to east. The shallow groundwater flow is directed toward streams, where it either discharges as baseflow into the stream, evapotranspires to the atmosphere or continues as shallow groundwater flowing downstream within the more permeable valley-fill alluvium material just below the ground surface. Yet deeper, below the unweathered bedrock unit, is the regional Laramie-Fox Hills aquifer, approximately 200 to 300 meters (650 to 1,000 feet) below the Site. A U.S. Geological Survey study and a separate, peer-reviewed site investigation both indicate this aquifer will not be impacted by site activities because of the intervening unweathered bedrock layer, specifically the Laramie Formation, that has claystones with low hydraulic conductivities (Hurr, 1976; RMRS, 1996).

METHODOLOGY FOR QUANTIFYING ACTINIDE TRANSPORT Calculating actinide quantities transported off site each year in shallow groundwater requires quantifying: 1) the volume of shallow groundwater flowing off site; and 2) concentrations of different actinides in the shallow groundwater.

The volume of shallow groundwater flowing off site, or shallow groundwater flux, was calculated using the site-wide water balance model that uses the "MIKE SHE" computer code. This hydrologic model simulates all of the significant integrated hydrologic flow processes including overland flow, channel flow and sub-surface flow in the saturated and unsaturated zones. Lateral shallow groundwater flow off-site is computed for saturated flow within the unconsolidated alluvial and weathered bedrock material. For actinide transport analysis, off site shallow groundwater flux volumes were estimated for water year 2000 (from October 1999 through September 2000) for the Walnut Creek and Woman Creek groundwater basins. In addition to using model results for a normal precipitation year, shallow groundwater flux was estimated using precipitation data for January through May of 1995. Approximately 340 mm (13.5 in), or twice the average amount, of precipitation fell during this period. These model results provide insight into shallow groundwater flows during wet conditions.

Shallow groundwater actinide measurements, collected from alluvial wells near Walnut and Woman Creeks at the Site's eastern boundary, were used to determine the concentration of actinides in shallow groundwater flowing off site. The estimated annual shallow groundwater flux volumes for the Walnut and Woman Creek basins were multiplied by the average actinide concentrations within each basin to estimate the actinide loads transported off site in shallow groundwater.

DISCUSSION: PLUTONIUM AND AMERICIUM IN SHALLOW GROUNDWATER Determination of plutonium and americium concentrations in shallow groundwater at the Site is complicated by residual surface soil contamination potentially introduced down boreholes during drilling and well installation operations. Shallow groundwater samples collected using traditional bailing techniques may suspend these contaminated drilling-artifact soil materials, thereby producing shallow groundwater samples with artificially high plutonium or americium concentrations. As a result of potential well construction and sampling biases, new clean or "aseptic wells" were drilled and efforts to improve sampling protocols undertaken. This work is currently ongoing. Therefore, plutonium and americium concentrations in shallow groundwater wells used in this analysis may represent a "worst case" scenario. Mean plutonium activities in alluvial wells at the site boundary were 0.035 pCi/L (+/- 0.018 pCi/L) in the Walnut Creek shallow groundwater basin and 0.003 pCi/L (+/- 0.004 pCi/L) in the Woman Creek shallow groundwater basin.

DISCUSSION: URANIUM IN SHALLOW GROUNDWATER Uranium-233/234 and uranium-238 isotopes are the dominant actinides found in groundwater in terms of total activity because of their natural abundance, particularly in the RFETS region. Though the concentration of uranium in groundwater at RFETS is within the natural range, shallow groundwater flowing from the Site can have uranium from man-made sources. Special analytical techniques, such as ICP/MS, must be used to study isotopic ratios in the groundwater and determine whether any of the uranium has origins from man-made sources. For natural uranium, the ratio of uranium-235/uranium-238, by mass, is approximately 0.0072. A ratio less than 0.0072 indicates the presence of man-made uranium-238, or "depleted" uranium, whereas a ratio greater than 0.0072 indicates the presence of man-made uranium-235, or "enriched" uranium. Additionally, ICP/MS analysis can detect the presence of uranium-236, a reactor product that is not found in natural uranium.

Actinide concentrations in groundwater are determined by analyzing samples collected from wells. Most of the uranium found in groundwater at RFETS is from natural sources. Special analytical techniques are used to determine if any fraction comes from man-made uranium sources.

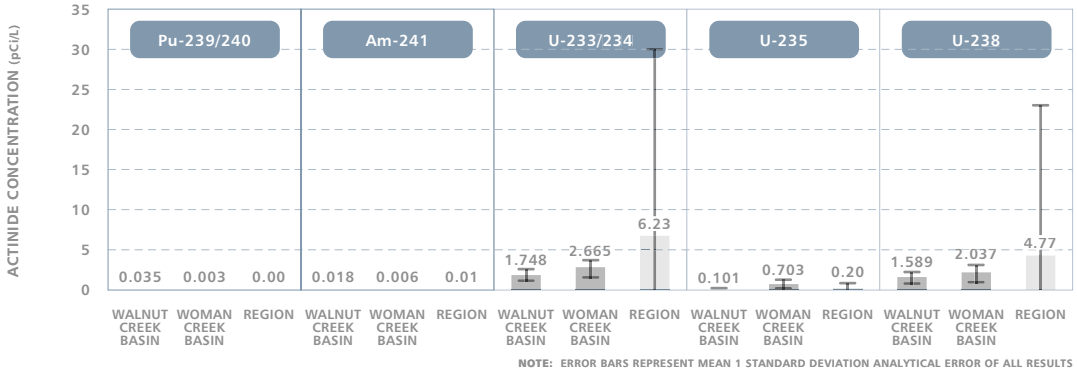
Samples collected at site wells from July 1999 to August 2000 were analyzed using ICP/MS. Most samples indicated uranium from natural sources. However, alluvial groundwater samples collected near the site boundary in both the Walnut and Woman Creek groundwater basins had uranium-235/uranium-238 mass ratios slightly less than the 0.0072 ratio found naturally. The small variation from the natural ratio, though potentially related to analytical uncertainty, indicates the shallow groundwater in these basins may have a small fraction of man-made "depleted uranium" as part of the total uranium concentration. In addition, the same Walnut Creek boundary location had detectable levels of uranium-236, an isotope that comes only from a man-made uranium source (RMRS, 2000).

GROUNDWATER CONCENTRATIONS

Chart 6 displays shallow groundwater actinide concentrations in the RFETS Walnut and Woman Creek groundwater basins. Site measurements are compared with background concentrations of actinides measured in Front Range regional upper hydrostratigraphic unit groundwater, or shallow groundwater, that is not impacted by RFETS.

CHART 6

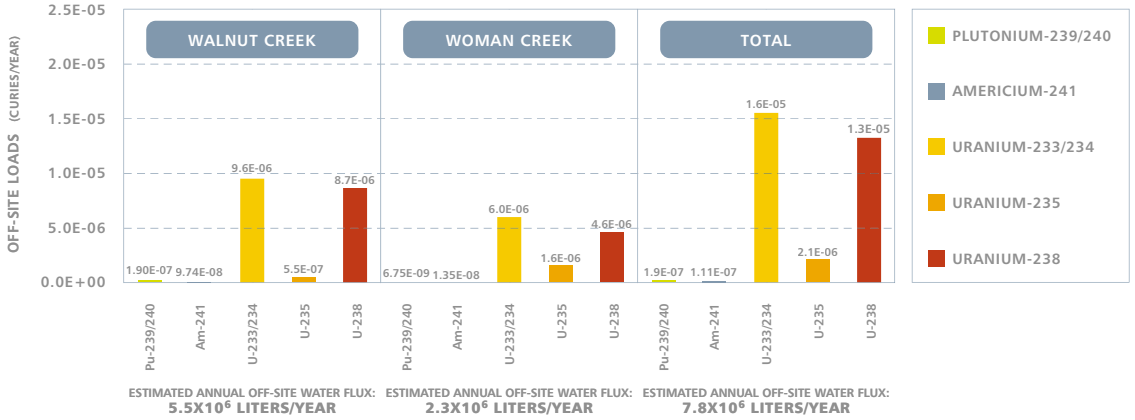
SHALLOW GROUNDWATER ACTINIDE CONCENTRATIONS – WALNUT AND WOMAN CREEK GROUNDWATER BASINS COMPARED WITH REGIONAL BACKGROUND ACTIVITY IN GROUNDWATER



NOTE: ERROR BARS REPRESENT MEAN 1 STANDARD DEVIATION ANALYTICAL ERROR OF ALL RESULTS

CHART 7

SHALLOW GROUNDWATER ACTINIDE LOADS – ESTIMATED ANNUAL OFF-SITE TRANSPORT BASED ON WATER YEAR 2000 PRECIPITATION



ESTIMATED ANNUAL OFF-SITE WATER FLUX: $5.5X10^6$ LITERS/YEAR

ESTIMATED ANNUAL OFF-SITE WATER FLUX: $2.3X10^6$ LITERS/YEAR

ESTIMATED ANNUAL OFF-SITE WATER FLUX: $7.8X10^6$ LITERS/YEAR

GROUNDWATER LOADS

Shallow groundwater actinide loads transported off site in the Walnut and Woman Creek groundwater basins are summarized in Chart 7. The model-estimated average annual volume of shallow groundwater yielded off site is displayed for each basin at the bottom of the chart.

GROUNDWATER FLUX – WET CONDITIONS

Model estimates of increased shallow groundwater flux during extreme precipitation conditions were calculated for May 1995, when 194 mm (7.65 in) of precipitation occurred, or roughly three times the May norm. The estimated flux of shallow groundwater flowing off site increased by approximately 100 percent in the Walnut Creek drainage and approximately 50 percent in the Woman Creek drainage. This provides some basis for estimating the impacts of extreme precipitation events on shallow groundwater flow and related actinide transport.

BIOLOGICAL PATHWAY

INTRODUCTION Movement of actinides via the biological pathway can occur by a variety of mechanisms that range from transport of soil and actinides by insects to actinide transport by deer that have ingested vegetation with actinide-bearing soil on plant surfaces. A large body of scientific literature addresses quantitative estimates of actinide intake and movement by different biological entities. Much of this research was specific to RFETS, including an extensive series of radioecology studies conducted from the 1960s through the 1990s by the Department of Radiology and Radiation Biology at Colorado State University (Whicker, 1979; Little, et. al., 1980; Webb, et al., 1993). These studies generally concentrated on areas contaminated with plutonium and other actinides in various compartments of the RFETS ecosystem and used field measurements and laboratory analyses of actinides in plant and animal tissues.

Site-specific research has been conducted on mule deer as a biological pathway for actinide movement for several reasons, including their mobility, amount of soil intake and their relative abundance, with a herd size of approximately 140 (Kaiser-Hill, 2000). Quantifying the off-site transport of actinides by mule deer provides a reference for comparing the effects of the overall macro-biological transport pathway. Other biological transport pathways and mechanisms, such as vegetation uptake of actinides and biogeochemical processes, are not quantified here but are addressed later in the Discussion section of this text (Page 22).

Mule deer have been the focus of research as the most likely mechanism for biological actinide transport at RFETS.

The Buffer Zone serves as attractive habitat for the Site's approximately 140 mule deer. Tracking data indicate approximately 5 percent of the herd leave the Site each year.

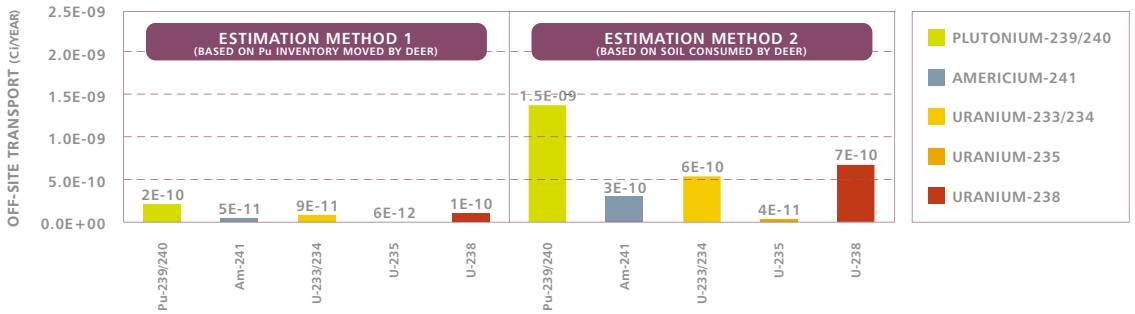
METHODOLOGIES FOR QUANTIFYING ACTINIDE TRANSPORT

Two different methods were used to quantify actinide transport off site via the biological pathway. The first method is based on a site-specific study that estimated less than 1 x 10^{-7} (one ten-millionth) of the plutonium inventory in soil is moved around the Site by mule deer each year and most of this is redeposited on DOE-controlled property (Whicker, 1979). This value, combined with data on the plutonium inventory in soil and average soil activity, provided a basis for calculating the amount of soil moved by mule deer. The second actinide transport estimation method is based on RFETS data quantifying the average amount of soil consumed by mule deer, over the year, to be approximately 16 grams per day (Arthur and Alldredge, 1979).

The estimated soil quantities moved or ingested by mule deer on site were used with additional data to quantify the amount of soil transported off site by mule deer. The other information included telemetry data that indicate approximately 5 percent of the deer herd leave the Site annually (Symonds and Alldredge, 1992). The time for a deer to completely cycle forage before its bowel is empty is approximately 48 hours (Alldredge and Reeder, 1972). This variable is important because most plutonium ingested by deer grazing in contaminated areas passes through the deer's gut, because of plutonium's low solubility and is redeposited to the ground in the form of fecal pellets (Whicker, 1979). Based on the amounts of soil transported off site by mule deer, the quantities of plutonium, americium, uranium-238, uranium-235 and uranium-233/234 transported off site were estimated using area-weighted average soil concentrations of these actinides.

CHART 8

BIOLOGICAL PATHWAY ACTINIDE LOADS – ESTIMATED OFF-SITE TRANSPORT BY MULE DEER



BIOLOGICAL PATHWAY LOADS

Estimates of actinide loads transported off site by mule deer, calculated using two different methods, are summarized in Chart 8.

DISCUSSION Estimates of plutonium activity transported off site by mule deer range from approximately 200 to 1,000 pCi per year. Areas most frequented at RFETS by mule deer are more heavily vegetated hillside grasslands, shrublands and woodlands (Kaiser-Hill, 2000). These areas provide greater erosion protection than sparsely vegetated areas and therefore limit indirect actinide movement caused by deer disturbing the soil. The limited erosion potential in heavily vegetated areas also reduces movement of deer pellets by erosion processes.

BIOLOGICAL PATHWAY

Site studies suggest there is limited redistribution of plutonium by biota in aquatic systems.

DISCUSSION: TERRESTRIAL FAUNA Plutonium is not a biologically essential element, nor does it serve as an analog for any other essential element (Higley and Whicker, 1999). There is little accumulation of plutonium in the tissues of arthropods, small mammals, snakes and mule deer. In general, biota investigations in the 903 Pad area showed that plutonium concentrations in biota were significantly lower than in soils. Arthropods and small mammals showed plutonium concentrations 100 times less than the concentrations in soil, with no significant differences in seven tissue types analyzed. The concentration hierarchy followed a downward trend from dead plant litter to fresh vegetation to animal compartments. Higher values for plant litter are expected since the litter is more closely associated with the surface soil and is prone to the accumulation of soil particulate matter. Generally, actinide sources in the environment have resulted in minor transfer of these elements into food webs, regardless of transport process.

DISCUSSION: OTHER HIGHLY MOBILE SPECIES Several other mobile species undoubtedly transport small quantities of actinides off site. Species such as waterfowl and other birds, coyotes and insects may transport actinides off site. However, data for these species are not available and would be difficult and in some cases logistically nearly impossible to obtain. Redistribution of contaminated soil by burrowing animals such as pocket gophers is a recognized phenomenon but is believed to only have a local effect on actinide redistribution (Whicker, 1979). Using the deer data and normalizing by the deer biomass, it is estimated that off-site transport by other selected terrestrial species is comparable to transport by deer, or possibly lower.

Studies conducted by CSU researchers show little accumulation of plutonium in animal tissues.

DISCUSSION: AQUATIC STUDIES Limited aquatic studies at RFETS indicate a very limited potential for biota to redistribute plutonium in aquatic systems. Paine (1980) found an increase in trophic-level concentration of plutonium does not occur. There appears to be a selective mechanism, which discriminates against plutonium at the phytoplankton to zooplankton level. The highest concentration in crawfish was found in the exoskeleton. Whole fish had detectable activity, but fish flesh showed none. These results indicate low bioavailability of the plutonium because of its low solubility and chemical partitioning to solid particles.

Plant tissues uptake very minor amounts of plutonium because of their insoluble nature.

DISCUSSION: TERRESTRIAL VEGETATION The uptake of plutonium into plant tissues is normally very minor because of its insoluble nature. The majority of plutonium measured in plant material is associated with surficial dust particles (Higley and Whicker, 1999).

DISCUSSION: SOIL MICROBES Microorganisms in soils, sediments and ponds may play a role in the regulation of actinide movement that occurs through surface soil erosion and colloidal transport processes. Potential interactions between indigenous microorganisms and actinides include bioreduction, bioprecipitation, biosorption and solubilization due to production of microbial metabolic products. Site-specific data on the microbial ecology of RFETS, however, do not exist, nor do studies detailing specific microbiological processes on actinide mobility in the surface soils, sub-surface material or surface water at the Site.

PATHWAY COMPARISON

SUMMARY OF ACTINIDE LOADS Estimates of average annual actinide loads transported off site by each of the major pathways addressed in this report are summarized and compared in this section. In cases where more than one method was used to estimate off-site loads for a specific pathway, the method yielding the highest estimated off-site load was used for the comparison. Because quantities of actinides transported off site vary by several orders of magnitude depending on the actinide and transport pathway, a logarithmic scale is used to display the results (Chart 9). Therefore, each horizontal line represents an actinide load that is larger, by a factor of 10, than the line below. Actinide transport pathways are compared by order of magnitude due to the uncertainties associated with analytical measurements and model estimation results.

PATHWAY COMPARISON

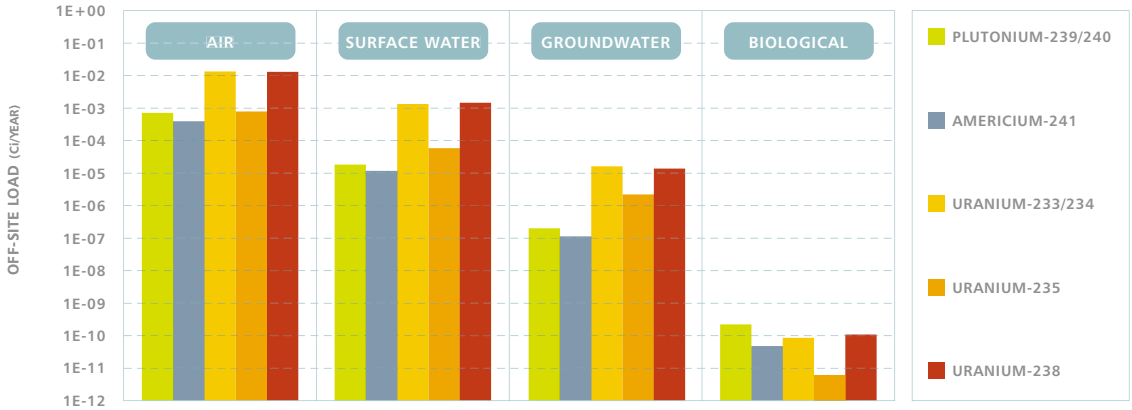
For all actinides, air and surface water are the dominant transport mechanisms. For plutonium, the estimated annual airborne load transported off site exceeds the surface water load by roughly a factor of 40. For americium, the trend of the results is the same, which is logical because both plutonium and americium are transported in a similar manner.

For shallow groundwater, estimated plutonium and americium loads are approximately two orders of magnitude less, or 1/100th, of the load conveyed in surface water. These shallow groundwater loads are, however, potentially biased high because of residual low-level surface soil contamination introduced down boreholes during drilling and well-installation operations. The ratio between surface water and groundwater in transporting loads of plutonium and americium off site is approximately the same as the ratio between volumes of surface water and shallow groundwater flowing off site.

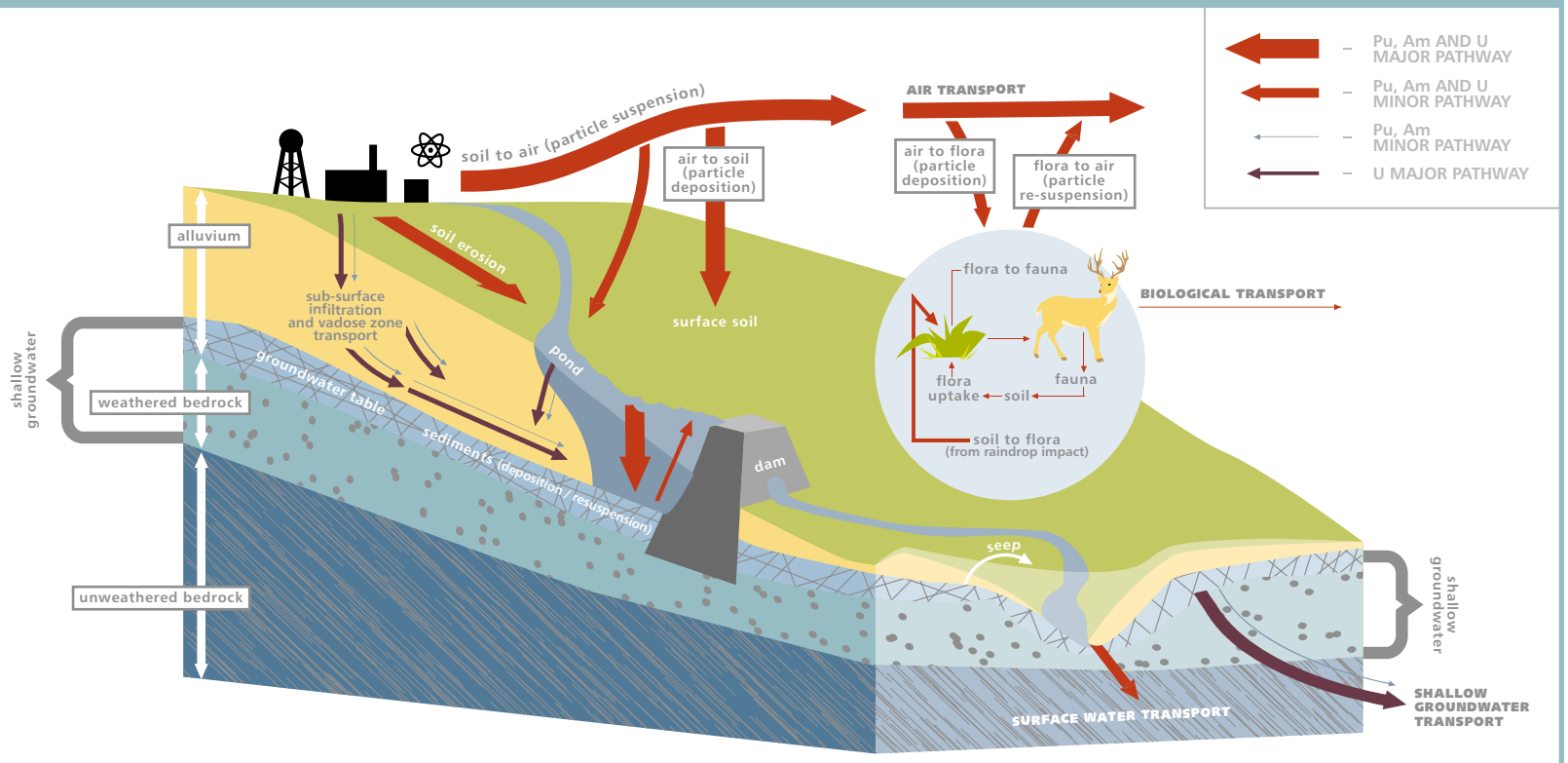
The biological pathway is also minor relative to the air and surface water pathways. It is estimated to transport approximately five orders of magnitude less, or 1/100,000, of the plutonium load compared with the surface-water pathway.

CHART 9

ALL PATHWAYS – ESTIMATED OFF-SITE ANNUAL ACTINIDE LOADS



UPDATED CONCEPTUAL DIAGRAM OF ACTINIDE MIGRATION



TRANSPORT PROCESSES - PLUTONIUM AND AMERICIUM COMPARED WITH URANIUM

Processes that transport plutonium and americium in the environment at RFETS are summarized in the diagram above. Larger arrows indicate more dominant pathways and smaller arrows indicate lesser pathways. The insoluble nature of plutonium and americium causes these actinides to be largely transported as particles attached to soil that is eroded by wind and water. Sub-surface transport of plutonium and americium is a relatively minor pathway, as is transport by biological mechanisms.

Uranium transport processes at RFETS are also shown above. Though not highly soluble, uranium is more soluble than plutonium and americium and is therefore more easily transported in the sub-surface. Hence, the arrows indicating a sub-surface pathway for uranium are larger than those for sub-surface plutonium or americium transport.

PATHWAY SUMMARY & CONCLUSIONS

AIR TRANSPORT PATHWAY Transport of actinides through the air occurs largely by wind erosion of actinide-containing particulate matter from site soil and dust-laden vegetation. The general direction of airborne actinide transport follows the prevailing winds, from the northwest to the southeast. More importantly, higher winds, which transport much larger loads than lower winds, occur almost exclusively from the northwest quadrant.

For perspective on the quantity of airborne actinides measured at the Site, the air monitoring location with the highest total annual airborne actinide concentration from 1997 through 1999 was station S-140 in the southeast corner of the Site. This location had an airborne actinide level equal to approximately 1.4 percent of the 10 millirem regulatory standard governing airborne radionuclide concentrations at DOE facilities.

SURFACE WATER TRANSPORT PATHWAY The central Industrial Area, which drains to South Walnut Creek, yields the largest loads of plutonium and americium in surface water per square meter of drainage area. The Industrial Area has large impervious surfaces that generate large volumes of runoff during storms, which causes erosion and actinide loading in surface water. In contrast, the South Interceptor Ditch drainage has areas near the 903 Pad with the highest known levels of plutonium activity in soil, but the basin is largely well-vegetated and therefore generates less runoff that can cause erosion and transport actinides. The surface water plutonium load discharged per square meter of the South Interceptor Ditch basin (3.8 pCi/m^2/year) is roughly one-tenth of the load per square meter of watershed compared to the central Industrial Area.

However, for extreme conditions, the South Interceptor Ditch may yield proportionately higher actinide loads. Model results indicate a hypothetical 100-year, 6-hour storm event (97.1 mm) would cause significant erosion in the South Interceptor Ditch basin and result in plutonium loads to the channel that are two to three orders of magnitude higher than observed in the Walnut Creek basin. Remediation of soils within the South Interceptor Ditch watershed will reduce actinide loads transported during extreme events.

The detention ponds on North and South Walnut Creeks serve to settle out particles and generally remove 80 to 90 percent of the annual plutonium and americium load that flows into the ponds. This corresponds with site research that demonstrates approximately 10 percent of the plutonium and americium in surface water is sorbed to colloid particles that are not likely to settle in the ponds. Another important observation regarding plutonium transport involves the lower section of Walnut Creek. The average annual plutonium load measured in Walnut Creek near the site boundary is approximately 30 percent greater than the plutonium load measured upstream, below the detention ponds. Site investigations indicate the plutonium source in this area is diffuse legacy contamination in soils and sediments.

Uranium activities are relatively uniform in surface water across the Site. As a result, the uranium load delivered from different basins is largely a function of each basin's water yield. Though surface water across the Site has uranium concentrations below the Maximum Contaminant Level for drinking water, high resolution analytical techniques are planned to determine if uranium from man-made sources is impacting site surface water.

GROUNDWATER TRANSPORT PATHWAY At RFETS, potential groundwater actinide transport involves lateral, shallow groundwater flow in the alluvium and weathered bedrock geologic units. Shallow groundwater at the Site does not percolate down into the regional Laramie-Fox Hills aquifer. A thick, intervening layer of impermeable claystones in the Laramie Formation prevents vertical movement from the shallow groundwater down to the regional aquifer.

Shallow groundwater and surface water are linked. Plutonium and americium are relatively immobile in the soil and groundwater because of their low solubility and tendency to sorb onto soil. However, work at RFETS as well as studies in the literature have shown that insoluble actinides can sorb to natural, sub-micrometer-sized colloid particles that can facilitate actinide movement. In addition to colloidal transport, sub-surface actinide transport can occur when more soluble actinides, such as uranium in the (VI) oxidation state, move in solution.

Low levels of plutonium and americium have been detected in shallow groundwater wells at the eastern site boundary. However, determination of plutonium and americium levels in shallow groundwater is complicated by residual surface soil contamination potentially introduced down boreholes during drilling and well installation. New clean or "aseptic wells" were drilled and efforts to improve sampling protocols are currently ongoing. For this analysis, plutonium and americium activity measured in shallow wells may represent activities higher than what actually exists in the shallow groundwater.

Uranium-233/234 and uranium-238 isotopes are the dominant actinides found in shallow groundwater in terms of total activity because of their natural abundance. Uranium in RFETS shallow groundwater is generally within the range of uranium detected naturally. Data from high-resolution ICP/MS analyses indicate that uranium in most areas of the Site is from natural sources. However, shallow groundwater samples at the site boundary in the Walnut and Woman Creek groundwater basins have a uranium-235/uranium-238 ratio that is slightly less than found naturally. Though potentially related to analytical uncertainty, these results indicate alluvial groundwater in these basins potentially has a signature indicating a small fraction of the uranium is "depleted" uranium.

BIOLOGICAL TRANSPORT PATHWAY RFETS-specific studies and other scientific literature indicate that plutonium has low bioavailability, due to its insolubility. Consequently, uptake into plant and animal tissues is minor. There is little accumulation of plutonium in the tissues of arthropods, small mammals, snakes or mule deer.

Mule deer have been studied as a biological pathway for actinide movement because of their mobility, amount of soil intake and size of the herd. Based on the estimated plutonium inventory in soil and data on deer mobility, the plutonium activity transported off site by deer movement is estimated to be approximately 2×10^{-10} to 1×10^{-9} Ci annually.

CONCLUSIONS Quantified analyses of RFETS actinide pathways generally support the conceptual model which identified soil and sediment transport processes as the primary mechanisms for plutonium and americium transport. Measured and modeled data confirm that wind and water erosion are the dominant plutonium and americium transport pathways, though the magnitude of airborne transport is larger than previously suggested in the qualitative conceptual model study.

Modeled data also support the conceptual model in terms of shallow groundwater transport being a relatively minor pathway for plutonium and americium because of the low solubility and strong soil sorption characteristics of these actinides. Data also support the conceptual model regarding the importance of sub-surface uranium transport, due to its higher solubility. Analyses indicate most of the uranium in shallow groundwater is from natural sources. Uranium loads transported off site in shallow groundwater are small compared to surface water. However, discharges of shallow groundwater to the surface contribute a major fraction of the surface water uranium load in specific stream channels.

IMPLICATIONS FOR SITE CLOSURE

An objective of the Pathway Analysis Report is to provide recommendations for long-term protection of the environment, with emphasis on actinide surface water quality, during and after site closure, as specified in the Rocky Flats Cleanup Agreement. Based on the characterization of current actinide sources and quantitative analysis of actinide transport mechanisms, the following general implications apply to near-term site remediation, final site closure design and long-term site management and stewardship.

NEAR-TERM SITE REMEDIATION Field measurements and modeling analyses indicate air and surface water are the major transport pathways for plutonium and americium. Soil disturbance increases the potential for soil erosion and contaminant transport. For example, Environmental Protection Agency (EPA) emissions factors indicate heavy construction equipment activities can increase airborne particulate emissions by roughly a factor of 20. Plutonium and americium in surface soil east of the 903 Pad is evidence of widespread contamination believed to have been dispersed when disturbed soils were exposed to a few high wind events in the 1960s. Current understanding of transport processes combined with historic lessons reinforce the importance of implementing soil erosion controls, such as protecting soil stockpiles and limiting excavation on windy days, to minimize airborne actinide transport during remedial activities.

Similarly, soil erosion and transport by surface water is a major potential pathway for plutonium and americium movement. Appropriate erosion control measures should be implemented during site remediation, including techniques such as minimizing vegetation disturbance and redirecting runoff away from excavations. A surface water management and detention pond system, with the capacity to settle out plutonium and americium, should be maintained during active site remediation.

Minimizing soil erosion by wind and water is a key concept for controlling actinide movement during short-term remediation activities and for long-term Site management.

Groundwater is not a major pathway for plutonium and americium transport, but operation and maintenance of the existing groundwater treatment systems will protect surface water from potential sub-surface uranium transport. The biological pathway is a minor transport mechanism for actinides and does not require altered management during site remediation other than excluding wildlife from active remediation sites.

FINAL CLOSURE DESIGN When site remediation is complete, surficial actinide sources with the highest activities are likely to have been removed. These remedial actions will reduce the reservoir of available actinides and diminish the magnitude of airborne actinide transport from these areas.

Removal of large impervious surfaces from the Industrial Area will result in reduced surface water runoff with a corresponding reduction in soil erosion and actinide transport. The combination of reduced runoff and diminished actinide sources will reduce the actinide load transported by the surface water pathway. In addition to remediation of localized actinide sources, other diffuse, low-level actinide sources that contribute to surface water contaminant loads, as observed in lower Walnut Creek, should be managed as needed for long-term protection of surface water quality.

Minimizing wind and water erosion should remain as a central theme in the final site closure design, with attention given to the long-term functionality of erosion control features. In addition to general erosion protection measures, such as establishing a vegetation cover resistant to drought or other extreme ecological conditions, location-specific controls for surface water erosion should be considered for the final site configuration. Such measures include: (1) re-contoured or terraced slopes; (2) re-routed runoff; and (3) a surface water detention system with the capacity to entrap and settle particles that transport plutonium and americium.

Groundwater is a minor pathway for plutonium and americium, but can be an important transport pathway for uranium. Remediation of man-made uranium sources that impact surface water should provide long-term protection of surface water quality.

Biological mechanisms also have a minor direct influence on actinide movement, but they can indirectly influence actinide transport by causing soil disturbance that promotes erosion with resulting air and surface water actinide transport. Therefore, the final closure configuration design should minimize potential erosion effects caused by animals burrowing or otherwise disturbing the soil in parts of the Industrial Area with residual contamination.

LONG-TERM MANAGEMENT After final site closure, efforts to reduce soil erosion caused by wind and water should be continued by minimizing soil disturbance and maintaining stable slopes, particularly in areas with residual actinide activity. This approach includes using appropriate controls for managing biological resources and human impacts after the Site is converted into a National Wildlife Refuge. If post-closure monitoring identifies residual actinide activity that impacts surface water quality, the best available technology should be used to appropriately characterize and mitigate the actinide source.

FURTHER READING

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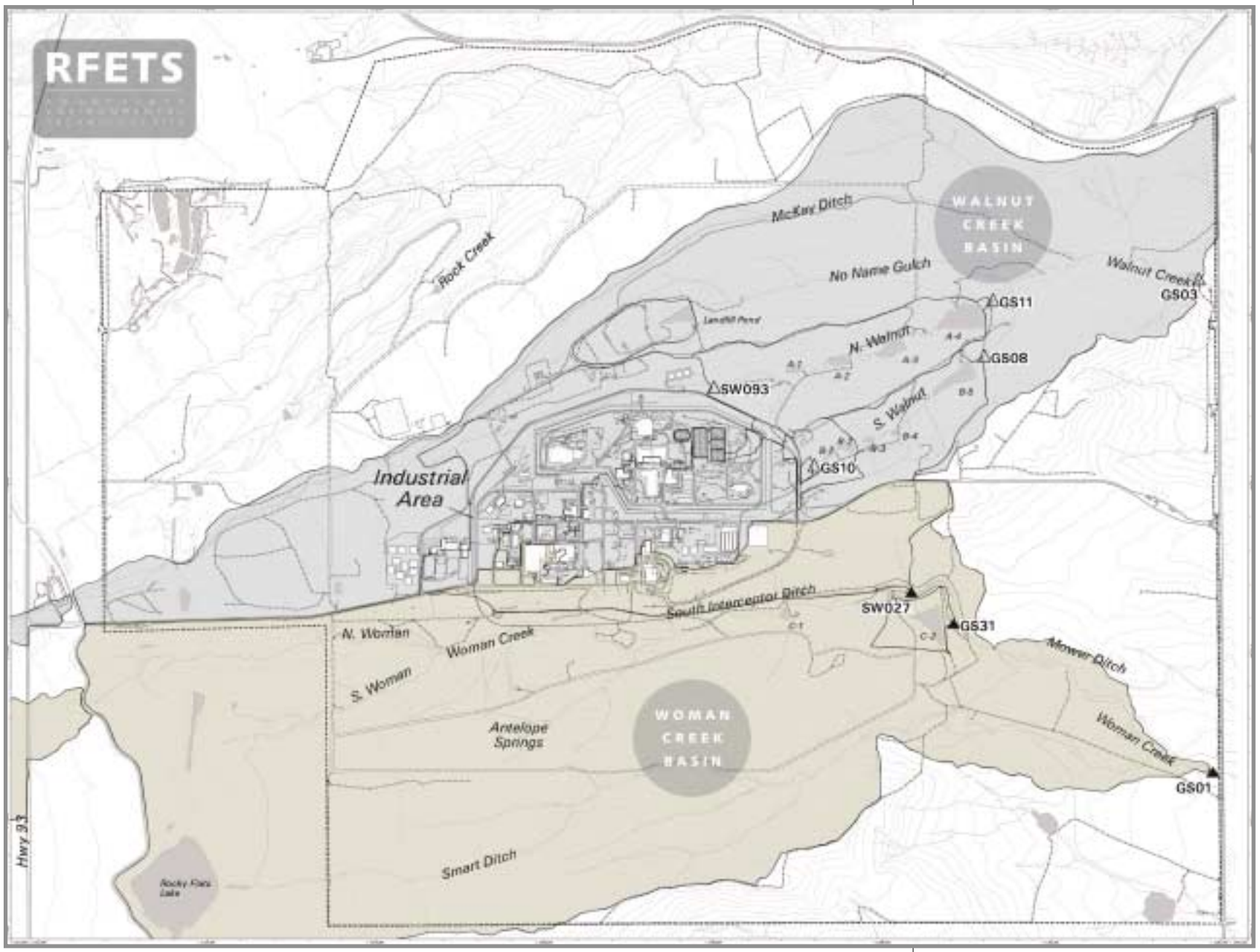
RFETS
WALNUT CREEK BASIN
WOMAN CREEK BASIN
McKay Ditch
Rock Creek
No Name Gulch
Walnut Creek
GS03
GS11
N. Walnut
GS08
SW093
S. Walnut
GS10
Industrial Area
South Interceptor Ditch
SW027
GS31
N. Woman
Woman Creek
S. Woman
Mower Ditch
Antelope Springs
Woman Creek
GS01
Hwy 93
Smart Ditch
Rocky Flats Lake

Selection of Minutes from June 4, 2012 Meeting

Briefing on the Actinide Migration

Since many new members have been added since closure, the Board has been making sure that these members are educated on basic Rocky Flats issues, so they can understand information in context. This briefing was designed provide an overview of the radioactive contaminants at Rocky Flats, the risks that they could pose in the environment.

The Actinide Migration Evaluation (AME) projects were commissioned at Rocky Flats in 1995 to address how actinide elements could potentially move in the local environment. Initially, AME advisors were recruited to evaluate and provide guidance on environmental conditions (including actinide chemistry, geochemistry, migration, and erosion) at Rocky Flats. The charter was expanded to include recommendations of paths forward for long-term protection of surface-water quality as the primary technical and regulatory measure of remedial action quality. Understanding how actinides move in the environment is central to the cleanup and long-term protection strategies.

Ian Paton and Dr. Robert Weiner (retired professor of chemistry), both with Wright Water Engineers and the Actinide Migration Evaluation, were brought in to provide this presentation.

Dr. Weiner began by stating that uranium (U), plutonium (Pu) and Americium (Am) were the main radionuclides of concern at Rocky Flats. Actinide elements (all are radioactive) are close together on the periodic table and have similar properties. Uranium is a naturally-occurring element, and was used in weapons manufacturing. Plutonium is produced artificially when making fissionable materials. Americium is produced by the radioactive decay of plutonium. An element's atomic structure is defined by a different number of electrons around the nucleus. The ratio of neutrons to protons determines the radioactive properties. The number of electrons and their spatial arrangement determines the chemical properties. Chemical properties determine the mobility of an element. Electron arrangement is described by a quantity called the oxidation state, which is essentially the number of electrons in the atom available for reaction with other atoms. Oxidation state values range from I-VIII. The oxidation state determines the chemical properties which in turn determine mobility. The two important chemical properties are solubility and sorption (when something adheres). A high oxidation state means high solubility, and less sorption; while a low oxidation state means lower solubility and greater sorption.

When looking at potential pathways for the movement of actinides, solubility and sorption may or may not apply. With the wind pathway, solubility is not applicable. Sorption is important because actinides can be sorbed on dust particles. In the surface water pathway, solubility is important, but sorption is also important, because of sediments and eroding solids. With the groundwater pathway, solubility is important, while sorption is not.

Plutonium and americium can be found almost everywhere on earth because of nuclear testing. Man-made background concentrations are as follows: Plutonium .04 pCi/g and americium .01 pCi/g. There are different possible oxidation states for actinides. The predominant forms at Rocky Flats had to be measured. They were found to be Pu(IV) and Am(III), which represent a

low oxidation state. These have low solubility and high sorption strengths. Solubility tends to be between 1 -.01 ppb. Pu and Am have similar chemical properties and dispersal mechanisms.

Uranium is also found virtually everywhere. There is a high natural background across the Front Range, as well as a man-made background from nuclear testing. Near Rocky Flats, background levels are about 2.25 pCi/g. Uranium exists in two oxidation states at Rocky Flats – U(VI) is more soluble and U(IV) is less soluble. All transport pathways are possible for uranium.

Dr. Weiner provided a summary of mobility pathways at Rocky Flats:

- Wind - Pu, Am and U
- Surface water - Pu, Am and U (however, only U has significant solubility)
- Groundwater - only U (only with high solubility)

These specific conclusions drove remediation decisions.

Ian Paton explained how these principles and findings apply at Rocky Flats. In 1996, an Actinide Migration Evaluation (AME) group was formed, consisting of independent, internationally-recognized experts with various specialties. This project lasted through closure, which was almost ten years. They held regular meetings with stakeholder groups. One of the first activities was to develop pathway models, as well as more sophisticated models for Pu/Am and uranium. The AME experts worked on these for approximately six years. An example of one of their studies was looking at the 903 Pad, which had the highest Pu concentrations onsite. The AME team collected soil samples under the asphalt which was used to fix the contamination in place. They analyzed the atomic structure and confirmed that it was Pu(IV). This form of Pu is insoluble and only moves in particles in surface water and air. This supported data previously gathered regarding contamination patterns. 90% of the contamination was found to be in the first five inches of soil, and 100% was in first eight inches. Ian was asked about the potential for transport via colloids. He explained that colloids are very small, sub-micron particles and added that studies were done to look into this, but that very limited concentrations were found. He said that while this was potential pathway, it was not a dominant one.

This pathway data was used as a foundation for soil cleanup standards at the site. Because of the lack of mobility in soil, cleanup work was focused on the top three feet. This was intended to be conservative, since almost no contamination was found below eight inches. The bulk of the cleanup took place at and around the 903 Pad. During the cleanup, a tent/weather enclosure was constructed over the area being excavated, and then clean fill dirt was added on top. Once cleanup was confirmed through sampling, erosion 'blankets' were laid on to in order to reduce erosion. This cleanup effort took place over an area of approximately 34 acres. After remediation, the same pathways continue to apply for any residual material left in the soil and the goal is to prevent movement by controlling wind and water erosion. Tim Plass asked what volume of contamination was left onsite. Ian said this has not been quantified, but in the 903 Pad lip area, the average remaining contamination levels were about 13 pCi/g. There is a continuing focus on re-vegetation and erosion control, as well as ongoing monitoring. Lisa Morzel asked how much fill soil was used at the 903 Pad. Scott Surovchak said they replaced the same amount that was removed. She also asked if the site looked at soil column migration. Scott said they did not. Joe Cirelli asked how the extent of the lip area to be remediated was determined. Scott said it was determined prior to cleanup via sampling. He added that after the Actinide Migration

Evaluation report, a more stringent soil standard was instituted, which in turn increased the area to be remediated. Scott said that soil characterization showed plutonium contamination only at 903 Pad and around building foundations, and this was only to a depth of about 6 inches. Mary Fabisiak asked if work done recently that would minimize projected plutonium loads in the South Interceptor Ditch (SID) for a 100-year rain event, as noted in the AME report. Ian pointed out that these calculations were done based on pre-remediation contamination levels on the lip area, and were no longer relevant.