ROCKY FLATS STEWARDSHIP COUNCIL

P.O. Box 17670 (303) 412-1200
Boulder, CO 80308-0670
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
Kim Griffiths

Special COVID-19 Announcement

Board of Directors Meeting
Monday, May 3, 2021, 8:30 – 10:30 AM

Due to COVID-19 social distancing requirements, the Rocky Flats Stewardship Council Board of Directors will meet via WebEx, with an internet/phone link provided by separate notice. The meeting is open to the public. Following the direction of local governments and other public entities throughout Colorado, public engagement is being modified for this virtual meeting.

To ensure the meeting participants are able to hear the information being presented and the members of the Board of Directors are able to engage in conversation, the following meeting-specific protocols have been developed:

1. Public comments during the 8:40 am (approximate time) public comment period are limited to two (2) minutes. Participants must sign up in advance by emailing a request to speak to info@rockyflatssc.org. Requests must be made no later than 5:00 pm (MDT), Thursday, April 29, 2021. Persons submitting requests after this deadline will not be allowed to speak during the public comment period.

2. Public comments following the Climate Adaptation and Resilience Briefing are limited to two (2) minutes per person. Comments sent during or following the meeting are also accepted. Advance registration is not required.

3. All written comments, including those sent during or following the meeting, will be posted on the Stewardship Council website.

4. DOE has agreed to respond in writing to comments offered on that agency's report. Those responses will be posted on the Stewardship Council website.

Please direct any questions to dabelson@rockyflatssc.org

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Board of Directors Meeting – Agenda

Monday, May 3, 2021

8:30 – 10:30 AM

VIA WEBEX

Email info@rockyflatssc.org for WebEx details

8:30 AM Convene/Introductions/Agenda Review/Meeting Protocols

8:40 AM Public Comment: Comments are limited to the Consent Agenda and non-agenda items. See the "Special COVID-19 Announcement" for details.

8:50 AM Business Items (briefing memo attached)

1. Consent Agenda: Approve meeting minutes and checks

2. Executive Director's Report

9:05 AM Briefing/Discussion of Climate Adaptation and Resilience (briefing memos attached)

- The briefing and conversation will be divided into four primary sections. Overlap between the sections is expected.
- Sections:
  - View from DOE Headquarters
  - Grasslands management and adaptation
  - Drought and flood: measuring water quality compliance
  - CERCLA Five-Year Review

Public Comment on Climate Adaptation and Resilience: Public comment must focus on this briefing and conversation. Comments will be limited to two (2) minutes per individual.

10:20 AM Board Roundtable – Big Picture/Additional Questions/Issue Identification

Adjourn

Upcoming Meetings:

June 7, 2021
September 13, 2021
November 1, 2021

Business Items

- February 1, 2021, draft board meeting minutes
- List of Stewardship Council checks

ROCKY FLATS STEWARDSHIP COUNCIL
Monday, February 1, 2021
8:30 – 10:15 AM
Virtual Meeting via WebEx

Board members in attendance: Nancy Ford (Arvada), Sandra McDonald (Alternate, Arvada), Summer Laws (Alternate, Boulder County), Sam Weaver (Director, City of Boulder), Deven Shaff (Director, Broomfield), Heidi Henkel (Alternate, Broomfield), David Allen (Alternate, Broomfield), Jim Dale (Director, Golden), Andy Kerr (Director, Jefferson County), Pat O'Connell (Alternate, Jefferson County), Joyce Downing (Director, Northglenn), Shelley Stanley (Alternate, Northglenn), Sophie Porcelli (Alternate, Northglenn), Mark Lacis (Director, Superior), Jan Kulmann (Director, Thornton), James Boswell (Alternate, Thornton), Kathryn Skulley (Director, Westminster), Rich Seymour (Alternate, Westminster), Trea Nance (Alternate, Westminster), Jeannette Hillery (Director, League of Women Voters), Linda Porter (Alternate, League of Women Voters), Roman Kohler (Rocky Flats Homesteaders), Murph Widdowfield (Rocky Flats Cold War Museum), Kim Griffiths (Director/Citizen)

Stewardship Council staff members and consultants in attendance: David Abelson (Executive Director), Melissa Weakley (Technical Program Manager), Barb Vander Wall (Seter & Vander Wall, P.C)

Attendees: Andy Keim (DOE-LM), Gwen Hooten (DOE-LM), Nicole Lachance (Navarro), Dana Santi (Navarro), John Homer (Navarro), John Boylan (Navarro), George Squibb (Navarro), Jody Nelson (Navarro), Padraic Benson (Navarro), Harry Bolton (Navarro), Ryan Wisniewski (Navarro), Chris Stewart (Navarro), Faith Anderson (Navarro), Lindsey Archibald (CDPHE), Lindsey Masters (CDPHE), Laura Hubbard (Broomfield), Rick Green (RSI Entech), Lesley Cusik (RSI Entech), Shirley Garcia, Lynn Segal, Giselle Herzfeld

Convene/Agenda Review
Joyce Downing convened the meeting at 8:30 am. She noted that the Executive Committee met to discuss today's agenda.

Public Comment: None

Elect Stewardship Council Officers for 2021: The current Board Officers—Joyce Downing as Chair, Jan Kulmann as Vice Chair, and Jeannette Hillery as Secretary Treasurer—all expressed interest in continuing in their positions. David Abelson asked if anyone else was interested in serving in one of these positions. No one responded, so the Board moved to a vote.

Mark Lacis moved to approve Joyce, Jan and Jeannette as Officers. The motion was seconded by Jim Dale. The motion passed 13-0.

2021 Meeting Schedule and Notice Provisions: Each year, the Board adopts a resolution establishing the meeting dates for the year. David noted that the proposed 2021 meeting dates are February 1, May 3, June 7, September 13, and November 1. The Board will continue to meet virtually through at least the June meeting, and will make decisions about future in-person meetings prior to the September meeting.

Nancy Ford moved to approve the 2021 Meeting Schedule and Notice Provisions. The motion was seconded by Deven Shaff. The motion passed 13-0.

Consent Agenda: The consent agenda included approval of the minutes from the October 26, 2020, meeting and the checks written since that meeting.

Roman Kohler moved to approve consent agenda. The motion was seconded by Jeannette Hillery. The motion to accept the minutes and checks passed 13-0.

Executive Director's Report: David Abelson reported on new Board members from member governments -- Andy Kerr (Jefferson County Commissioner), Claire Levy (Boulder County Commissioner), Bill Fisher (City of Golden Councilor), and Trea Nance (City of Westminster staff).

Next, David updated the Board on the status of the Triennial Review. Every three years, the local governments represented on the Board must pass resolutions reaffirming their interest in continuing to serve on the RFSC for another three-year period. All local governments passed resolutions.

DOE Legacy Management has awarded a new five-year support contract for Rocky Flats to RSI Entech. This is the third Legacy Management lead support contractor since the office was created in 2005. David noted that one of the most important factors for the Stewardship Council pertaining to this new support contract will be whether the key personnel at the site will continue in their roles. He will keep the Board updated as more is known about these decisions.

David spoke a bit about how a change the White House administration may affect the situation at Rocky Flats. He said that the good news was that Carmelo Melendez will be continuing as the Director of the Legacy Management office.

Barb Vander Wall noted that her office would be distributing Oaths of Office to the Board members electronically.

Host DOE Quarterly Meeting: DOE was on hand to brief the Board regarding site activities for the third quarter of 2020 (July – September). The full report was posted on https://www.lm.doe.gov/Rocky_Flats/Documents.aspx Activities included surface water monitoring, groundwater monitoring, ecological monitoring, and site operations (inspections, maintenance, etc.).

Surface Water Monitoring – George Squibb

Quarterly reports are required under the Rocky Flats Legacy Management Agreement (RFLMA). The Rocky Flats Site remedy components include:

- Maintain two landfill covers
- Maintain three groundwater treatment systems
- Monitor surface water and groundwater
- Maintain physical controls
    - Signage
    - Access restriction
- Institutional controls

- No occupied building construction
- Excavation and soil-disturbance restrictions
- No surface water consumption or agricultural use
- No groundwater wells, except for monitoring
- Protection of landfill covers and engineered remedy components

George reviewed the surface water monitoring locations at the site.

At the Original Landfill (OLF), routine surface water sampling in Woman Creek, downstream of the OLF (GS59), during the third quarter showed mean concentrations for all analytes below applicable RFLMA water quality standards.

At the Present Landfill Treatment System (PLFTS), the system effluent arsenic concentration was 22 micrograms/liter (µg/L), exceeding the standard of 10 µg/L. According to RFLMA protocols, sampling frequency was increased to monthly. Arsenic was measured at 4.4 µg/L in the subsequent monthly sample (below the standard of 10 µg/L) and the increased sampling frequency was discontinued. Quarterly concentrations for all other analytes were below applicable RFLMA standards.

No Point of Evaluation (POE) or Point of Compliance (POC) analyte concentrations were reportable during the third quarter.

Shelley Stanley asked about the flows at GS59 and possible drought conditions. George noted that flows are down across the site. GS59 was dry for a couple of months over the summer, which is not the norm. The only location that flowed throughout the year was SW093, but this was at a very low rate.

David Abelson asked Board Members to offer the reasons behind the questions they ask as a way to help inform the Board as a whole.

Deven Shaff followed up on Shelley's concerns about drought. He asked what was expected in terms of water quality once more water returns to the site. George said they generally do not see impacts on concentrations due to drought. Uranium mobility might be affected temporarily but would not necessarily result in reportable conditions.

Nancy Ford asked what conditions led to increased arsenic levels at the PLFTS. George said this was groundwater seepage coming out of the Present Landfill. The treatment system was not designed to treat metals. Arsenic is naturally occurring, and levels are variable and predictable within an expected range. Nancy also asked whether drought conditions affect seepage from the landfill. George said groundwater effects of drought take longer to appear, and they have not seen anything yet.

Groundwater Monitoring – John Boylan

John first reviewed the RFLMA monitoring network, which includes:

- 10 Resource Conservation and Recovery Act (RCRA) wells (sampled quarterly to evaluate potential impacts from OLF and PLF)
- 9 Area of Concern (AOC) wells and one Surface Water Support location (sampled semiannually). These are located in drainages downstream of contaminant plumes and are evaluated for plumes discharging to surface water

- 27 Sentinel wells (sampled semiannually). These are downgradient of treatment systems, edges of plumes, and in drainages, and are used to look for plumes migrating to surface water and treatment system problems
- 42 evaluation wells (sampled biennially). These are located within plumes, near source areas, and interior of Central Operable Unit (COU) and are used to evaluate whether monitoring of an area or plume can cease
- 9 treatment system locations (seven are sampled semiannually, and two are quarterly)

To meet RFLMA sampling requirements, 10 RCRA wells were sampled during the quarter. Analytical results were generally consistent with previous data. Data will be evaluated and discussed as part of the 2020 annual report. Extra samples were collected to address specific needs. One confirmatory sample was collected from Evaluation well 33502 to check anomalous results from a second quarter sample. Those results, showing unusually low concentrations, were confirmed.

Treatment System Activities included the following:

- Mound Site Plume Collection System (MSPCS), East Trenches Plume Treatment System (ETPTS), Solar Ponds Plume Treatment System (SPPTS), and PLFTS
    - Routine maintenance at all systems
    - Completed annual inspection of power components at MSPCS and SPPTS
- Continued planning MSPCS transfer line repair project
- Completed solar/battery project at ETPTS
    - Replaced 96 lead-acid batteries with 8 lithium-iron-phosphate batteries
        - Retained 6 lead-acid batteries to power heaters for new batteries
    - Replaced broken glass panes on solar panels
    - Reconfigured wiring and replaced other power components to streamline power facility
- SPPTS
    - Design for passive drain in the earthen-floored “SPIN Vault” nearing completion. Fieldwork scheduled for fourth quarter of 2020.
    - Replaced 2 lead-acid batteries with 2 newer ones removed from ETPTS
- Evaluating groundwater conditions west of the existing SPPTS groundwater collection trench
    - Installed 9 piezometers
    - Data collection began in December 2020

David Allen asked whether there was a risk of the slump damaging the SPPTS. John said that was the main reason that they regraded this area in 2017 and are currently investigating the slump via piezometers, inclinometers and other methods. A geotechnical engineering firm is evaluating the data and reviewing options. David asked if the slump movement was shallower or deeper than the drain. John said that the depth of the slump varies from ground surface to deeper than the drain, but he could get back to David with additional information. Shelley Stanley said she was trying to fully understand the purpose of the new piezometers at the SPPTS. John said when the treatment system was installed, there were infrastructure components that blocked further construction of the collection trench to the west. There is a wetland area off the western end of the trench, so they are looking at whether groundwater in this area should be collected and added to the treatment system. She also asked whether they were sampling for water quality from the piezometers. John said they were sending some samples out for testing. They have found there is elevated nitrate and uranium which are lower than the

treatment system influent but higher than the RFMLA standard. Shelley asked whether the report regarding the slump would be available for public review. John said that because it contains cost and design information, it may not be available.

Site Operations – Jody Nelson

Quarterly sign inspections are a physical control under the RFLMA agreement. Signs were inspected on July 10 and all were found to be in good condition and legible.

Monthly inspections are required at the Original Landfill. These took place July 20, August 18, and September 15. A 2- to 3-inch diameter animal burrow was found on the upgradient side of western Berm 7. The depth could not be determined, but there was no evidence of recent inhabitation and no reappearance in subsequent inspections after filling in the opening.

Settlement monuments were surveyed on August 31. Vertical settling was within design limits. Monument E was removed in the second quarter and reinstalled slightly uphill in the third quarter. A new baseline was established during the third quarter survey. Monument F shifted 0.2 feet as a result of the earthwork and compaction activities in the immediate area. Vertical settling was still within design limits. A new baseline was established for this settlement monument.

Other work at the Original Landfill included the following as part of the stabilization project:

- All 267 anchors installed, tested, locked off
- Anchor, perimeter, and East and West Interceptor trench drains complete
- Temporary dewatering wells no longer required, abandoned
- Berm construction, perimeter channel regrading, and cover placement complete
- Placement of turf reinforcement matting and erosion control blankets complete
- Project was completed, with all equipment and support infrastructure demobilized by September 1
- East Subsurface Drain continues to function as designed

A series of photos of work on the landfill hillside were included in the presentation.

At the Present Landfill, the quarterly inspection was performed on August 11. The Present Landfill is in good condition.

Next discussed were the Former Building Areas 371, 771, 881, and 991. The quarterly inspection of these areas was complete on September 24. The depression located near the southeast corner of former building area 881 (December 2019) increased in depth by approximately 3 inches. The diameter was unchanged (~3.3 ft depth; ~3 ft diameter).

Jody next updated the group on the North Walnut Creek Slump. Data collection from piezometers continued where possible. Slump monitoring points are periodically surveyed. No substantial change was seen in August. Maximum movement was approximately 3.5 feet vertically. The main scarp crack remains open.

Jody reviewed the status of the North Walnut Creek Slump and West SPPTS Investigation – September 2020:

- Additional drilling occurred as part of furthering the geotechnical investigation and stabilization efforts to evaluate the slump on the North Walnut Creek Hillside
    - A total of 3 inclinometers and 1 piezometer were installed on the hillside to provide supplemental data and monitoring of slope movement
        - Inclinometers are located to potentially allow extended monitoring of the hillside
- In conjunction with the slump effort, a series of piezometers were installed west of the SPPTS Collection Trench for assessment of groundwater condition outside of the existing treatment system
    - A total of 8 piezometers were installed to a depth of 30 feet below grade surface

David Allen asked what the cost was to regrade the hillside and install anchors as part of the OLF stabilization project. Jody said he did not know but they would follow up with him. Deven Shaff asked, in terms of the North Walnut Creek slump, whether they were more concerned about the collection trench or the other side of the slump. Jody said most of the concern was about possible damage to the trench. Shelley Stanley asked whether there was any weed management completed during the third quarter. Jody said only a very limited amount.

Ecology – Jody Nelson

Jody reviewed third quarter ecology work at the site. This work included:

- Revegetation monitoring
- Preble's mouse mitigation monitoring
- Wetland monitoring
- Forb nursery monitoring
- Habitat enhancement planting survival counts
- Photopoint monitoring
- Herbicide applications
- Wetland/vegetation/weed mapping
- Prairie dog town surveys/counts – all towns near COU are abandoned

Nancy Ford asked whether Jody knew for sure that a plague had affected the prairie dog towns on the site. Jody said, based on information from the US Fish and Wildlife Service, that appears to be the case. There was a confirmed plague that occurred in 2009, which also travelled through the Westminster open space.

Kim Griffiths asked what the elk herd count was and whether collaring and tracking has occurred. Jody said that USFWS had done the collaring and tracking. Jody said he had not seen the data. He said he had heard from USFWS that the herd generally stays onsite. Jody said he had counted roughly 250-260 elk at one time.

David Abelson read a question from the chat. Someone asked how they knew that the prairie dog deaths were not related to radiation. Jody said that the lifespan of the prairie dogs was only a few years,

and any effects of radiation would likely take much longer to develop. Giselle from the audience added a follow up on her question that David just read. She wanted to know if there had been any extensive studies on human exposure to radiation at Rocky Flats. David Abelson asked her to email her question and he would forward it to DOE. He added that there have been extensive studies done on high dose exposure on humans, but there was less information on low dose exposures. Standards at Rocky Flats were based on the linear no threshold methodology to account for lower dose effects. David said more recent studies on nuclear bomb survivors in Japan who received lower doses showed them to have longer lifespans than the general population. David said the theory explaining this ('hormesis') is that humans have adapted to low levels of radiation.

Nancy Ford asked whether the studies David mentioned had looked at other variables than the level of exposure which could explain the longer lifespans, and whether the population near Chernobyl had been looked at. She said she would be skeptical of using one study as a reference. David said that's why the site continues to use the more conservative model.

Shelley Stanley asked whether the elk herd was approaching the site's carrying capacity. Jody said he did not know, but that the USFWS was looking at this question.

Board Roundtable: Deven Shaff requested that the Stewardship Council continue to try to get briefings from USFWS. He also requested information be presented from DOE regarding how they are planning for climate change related to their efforts at Rocky Flats. David Abelson clarified that the reason USFWS has not been involved in Stewardship Council meetings is due to a lawsuit from the Town of Superior against USFWS. The Justice Department has prohibited the USFWS from briefing if representatives from Superior will be in attendance. David said he would check in and see whether anything has changed with the new administration.

Nancy Ford said she had been waiting since the end of September to get answers from CDPHE regarding studies from June 2020. She said this was troubling. She also posed the question of whether it would be better to use goats to remove debris from the site rather than controlled burns. She wondered whether this had been considered and whether the Board could look into this. David noted that this had in fact been discussed. He said the use of prescribed fire was one of the most controversial issues at the site, though a few members of the public also question the use of goats, saying they spread contamination and that plutonium uptake is harmful for the goats. He recommended that if the Board wanted to discuss this topic, it must be handled very carefully, with opportunities for community members to appeal directly to their governments prior to any discussion at the Stewardship Council.

Nancy referred to an article addressing some of the future long-term funding challenges within DOE due to cleanup obligations at so many nuclear sites. David asked Nancy to pass along that article. He noted that there are no significant short-term concerns regarding the Rocky Flats budget. However, he went on to address long-term concerns regarding management of hazardous sites in general. He said keeping Rocky Flats open to the public keeps the memory of its history alive. It is very important to maintain focus on sites like this in order to ensure that the government continues to provide necessary funding into the future.

Big Picture/Additional Questions/Issue Identification

May 3, 2021

Potential Briefing Items

- Climate Impacts, Adaptation and Resilience

June 7, 2021

Potential Business Items

- Accept 2020 Financial Audit

Potential Briefing Items

- DOE Quarterly Update

Issues to watch:

- Changes at SPPTS
- North Walnut Creek slump
- Status of OLF
- Uranium exceedances in surface water
- Trichloroethylene (TCE) exceedances in groundwater

The meeting was adjourned at 10:15 am.

Respectfully submitted by Erin Rogers.

Rocky Flats Stewardship Council
Check Detail 2021
January 12 through April 8, 2021

Type	Num	Date	Name	Account	Paid Amount	Original Amount
Check		**01/31/2021**		**CASH-Wells Fargo-Operating**		**-3.50**
				Admin Services-Misc Services	-3.50	3.50
TOTAL					-3.50	3.50
Check		**02/28/2021**		**CASH-Wells Fargo-Operating**		**-3.50**
				Admin Services-Misc Services	-3.50	3.50
TOTAL					-3.50	3.50
Check		**03/31/2021**		**CASH-Wells Fargo-Operating**		**-3.50**
				Admin Services-Misc Services	-3.50	3.50
TOTAL					-3.50	3.50
Bill Pmt -Check	**2076**	**02/02/2021**	**Crescent Strategies, LLC**	**CASH-Wells Fargo-Operating**		**-7,895.91**
Bill	1/31/21 Billing	01/31/2021		Personnel - Contract	-7,750.00	7,750.00
				TRAVEL-Local	-17.92	17.92
				Postage	-17.99	17.99
				Telecommunications	-110.00	110.00
TOTAL					-7,895.91	7,895.91
Bill Pmt -Check	**2077**	**02/02/2021**	**Jennifer A. Bohn**	**CASH-Wells Fargo-Operating**		**-580.00**
Bill	21-08	01/31/2021		Accounting Fees	-580.00	580.00
TOTAL					-580.00	580.00
Bill Pmt -Check	**2078**	**02/02/2021**	**Seter & Vander Wall, P.C.**	**CASH-Wells Fargo-Operating**		**-319.00**
Bill	81706	12/31/2020		Attorney Fees	-319.00	319.00
TOTAL					-319.00	319.00
Check	**2079**	**02/02/2021**	**Century Link**	**CASH-Wells Fargo-Operating**		**-30.04**
				Telecommunications	-30.04	30.04
TOTAL					-30.04	30.04
Check	**2080**	**03/09/2021**	**Century Link**	**CASH-Wells Fargo-Operating**		**-30.10**
				Telecommunications	-30.10	30.10
TOTAL					-30.10	30.10
Bill Pmt -Check	**2081**	**03/09/2021**	**Crescent Strategies, LLC**	**CASH-Wells Fargo-Operating**		**-8,051.85**
Bill	2/28/21 Billing	02/28/2021		Personnel - Contract	-7,750.00	7,750.00
				TRAVEL-Local	-17.92	17.92
				Postage	-17.99	17.99
				Telecommunications	-110.00	110.00
				Website	-155.94	155.94
TOTAL					-8,051.85	8,051.85
Bill Pmt -Check	**2082**	**03/09/2021**	**Jennifer A. Bohn**	**CASH-Wells Fargo-Operating**		**-230.00**
Bill	21-10	02/28/2021		Accounting Fees	-230.00	230.00
TOTAL					-230.00	230.00
Bill Pmt -Check	**2083**	**03/09/2021**	**Seter & Vander Wall, P.C.**	**CASH-Wells Fargo-Operating**		**-1,287.65**
Bill	81865	01/31/2021		Attorney Fees	-1,287.65	1,287.65
TOTAL					-1,287.65	1,287.65
Check	**2084**	**04/07/2021**	**Century Link**	**CASH-Wells Fargo-Operating**		**-29.31**
				Telecommunications	-29.31	29.31
TOTAL					-29.31	29.31
Bill Pmt -Check	**2085**	**04/08/2021**	**Crescent Strategies, LLC**	**CASH-Wells Fargo-Operating**		**-7,895.91**

Rocky Flats Stewardship Council
Check Detail 2021
January 12 through April 8, 2021

Type	Num	Date	Name	Account	Paid Amount	Original Amount
Bill	3/31/21 Billing	03/31/2021		Personnel - Contract	-7,750.00	7,750.00
				TRAVEL-Local	-17.92	17.92
				Postage	-17.99	17.99
				Telecommunications	-110.00	110.00
TOTAL					-7,895.91	7,895.91
Bill Pmt -Check	**2086**	**04/08/2021**	**Jennifer A. Bohn**	**CASH-Wells Fargo-Operating**		**-320.00**
Bill	21-18	03/31/2021		Accounting Fees	-320.00	320.00
TOTAL					-320.00	320.00
Bill Pmt -Check	**2087**	**04/08/2021**	**Seter & Vander Wall, P.C.**	**CASH-Wells Fargo-Operating**		**0.00**
TOTAL					0.00	0.00
Bill Pmt -Check	**2088**	**04/08/2021**	**Seter & Vander Wall, P.C.**	**CASH-Wells Fargo-Operating**		**0.00**
TOTAL					0.00	0.00
Bill Pmt -Check	**2089**	**04/08/2021**	**Seter & Vander Wall, P.C.**	**CASH-Wells Fargo-Operating**		**-2,142.50**
Bill	81914	02/28/2021		Attorney Fees	-1,722.50	1,722.50
Bill	82072	03/31/2021		Attorney Fees	-420.00	420.00
TOTAL					-2,142.50	2,142.50

Climate Adaptation and Resilience

- Briefing memos
- May 2020 GAO Report

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MEMORANDUM

TO: Board of Directors
FROM: David Abelson
SUBJECT: Climate Adaptation and Resilience
DATE: April 19, 2021

The briefing and conversation will be divided into four primary sections.

1. View from Department of Energy (DOE) Headquarters
2. Grasslands management and adaptation
3. Drought and flood: measuring water quality compliance
4. CERCLA Five-Year Review

This memo covers items #1 and #4; the attached memo from Melissa covers items #2 and #3.

View from DOE Headquarters

Addressing climate change and the resulting impacts is a priority for the Biden Administration. DOE aims to tackle the suite of challenges from a variety of angles. At this meeting, the conversation will start with a high-level overview of DOE's role in designing and implementing the Administration's strategy, and then discuss how DOE's Office of Legacy Management (LM) might address the issues. LM is the program office that manages Rocky Flats, among other sites in the long-term monitoring phase.

Following Melissa's memo is a May 2020 report from the General Accountability Office (GAO) on challenges LM faces in managing sites that have been remediated. Rocky Flats is among the sites discussed.

The following is the executive summary from that report:

> **What GAO Found**: The environmental liability of the Department of Energy's (DOE) Office of Legacy Management (LM) was estimated at $7.35 billion in fiscal year 2019 and, according to LM officials, is expected to grow as LM acquires more sites…. Long-term surveillance and maintenance activities associated with radioactive and hazardous waste, such as treating residual groundwater contamination, account for about 40 percent of the costs. LM's environmental liability has generally remained stable over the past 5 years. As of September 2019, LM is scheduled to receive 52 additional sites by 2050, and officials expect LM's environmental liability to grow as a result. Officials said

LM is taking steps to reduce its environmental liability at its current sites, such as exploring alternative approaches for reducing residual contamination.

LM officials identified challenges in providing long-term surveillance and maintenance of sites related to: (1) the performance of remedies that contain or reduce contamination, (2) environmental conditions, and (3) new regulatory requirements. LM is taking some actions to address these challenges. For example, at its Rocky Flats, Colorado, site, LM is repairing an aging landfill that was damaged by extreme rainfall events. However, LM has not yet planned for how to address challenges at some sites that may require new cleanup work that is not in the scope of LM's expertise and resources. By developing agreements and procedures with the entities that would be responsible for conducting this new cleanup work, LM can help mitigate risks to human health and the environment. In addition, LM has not made plans to assess the effects of climate change on its sites or to mitigate those effects, as called for in its strategic plan. By developing plans to assess the effect of climate change on its sites and to mitigate any significant impacts, LM could better ensure that its remedies will protect human health and the environment in the long term.

The full report can be found at: https://www.gao.gov/assets/gao-20-373.pdf

CERCLA Five-Year Review

Under CERCLA Superfund regulations, the U.S. Environmental Protection Agency (EPA) is required to periodically review the protectiveness of remedies at Superfund sites where hazardous substances remain above levels that allow for unlimited use and unrestricted exposure. The DOE-retained lands at Rocky Flats have residual contamination at levels that result in use restrictions, so a periodic review is required by CERCLA. EPA rules require that reviews must be conducted at least every five years (and more frequently if necessary). The last review was conducted and approved by EPA in 2017; the next review must be approved in 2022.

CERCLA Five-Year Reviews are EPA's responsibility. At Rocky Flats, DOE, CPDHE and EPA will conduct the review and produce the draft report, with formal approval by EPA. This collaborative approach mirrors the approach these three agencies adopted during prior reviews.

For the upcoming review, CDPHE will press for the inclusion of an analysis of the potential climate change impacts on the site remedy. While the details of what that part of the review might entail are not yet defined, at this meeting CDPHE will provide an overview of what it might introduce during the review.

ROCKY FLATS STEWARDSHIP COUNCIL

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Jefferson County ~ Boulder County ~ City and County of Broomfield ~ City of Arvada ~ City of Boulder
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League of Women Voters ~ Rocky Flats Cold War Museum ~ Rocky Flats Homesteaders
Kim Griffiths

MEMORANDUM

TO: Stewardship Council Board of Directors
FROM: Melissa Weakley
SUBJECT: Vegetation Management and Water Quality Compliance Briefing
DATE: April 19, 2021

Jody Nelson, the lead ecologist at Rocky Flats, will brief on adaptive vegetation management strategies at Rocky Flats. This briefing will explore how fostering diverse and healthy plant communities remains vital to reducing actinide (i.e., plutonium, americium, and uranium) migration and ensuring the long-term viability of the site remedy.

George Squibb and John Boylan, the current surface water and groundwater leads at Rocky Flats respectively, will discuss water quality compliance during normal precipitation years, as well as during and following extreme weather events, including drought and flood. This briefing will explore the impacts of weather events on water quality compliance.

Background on Actinide Movement
Actinides, or radioactive elements, of concern at Rocky Flats include uranium (U), plutonium (Pu), and americium (Am). These three actinides were either used during production or were by-products of the production process.

As site cleanup began in earnest in the mid-1990s, DOE established the Actinide Migration Evaluation (AME)[1] panel to examine actinide movement in the Rocky Flats environment. By understanding how actinides move, the agencies were able to focus remediation on minimizing such movement. The AME panel assessed four transport pathways—air, surface water, groundwater, and biota. The panel concluded that transport by air and surface water were the dominant transport pathways for these three actinides. Transport of actinides through the air occurs largely by wind erosion of actinide-containing particulate matter from soil and vegetation surfaces. Transport of actinides in surface water occurs by two main processes: insoluble actinides (mainly Pu and Am) sorb to soil or sediment particles that are eroded and transported by water; and soluble actinides (primarily U) move as dissolved-phase contaminants in the water itself.

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[1] This independent panel was made up of geologists, chemists, biologists, and other scientists from around the country. The culmination of the AME panel's work over six years was the AME Pathway Analysis Report, completed in April 2002 (http://www.lm.doe.gov/cercla/documents/rockyflats_docs/SW/SW-A-004544.PDF).

Accordingly, reducing soil erosion caused by wind and water remains a high priority post-closure, particularly in areas with residual actinide activity. The type of ground cover in a given area greatly impacts the amount of actinide contamination introduced into the watersheds.

Rocky Flats management activities are guided by the Rocky Flats Legacy Management Agreement (RFLMA). Consistent with the AME panel's recommendation, reducing soil erosion with a robust vegetation cover and monitoring onsite surface water and groundwater are critical parts of ensuring the long-term protectiveness of the site remedy.

Adaptive Vegetation Management

Following cleanup, approximately 650 acres of land retained by DOE required revegetation. Jody Nelson, DOE's ecologist, developed site-specific seed mixtures consisting predominantly of native grasses, which are well adapted to that climate. The seed mixtures are tailored to address both drought and increased moisture, which is a critical ingredient of the adaptive management approach used at the site.

DOE and its contractors now conduct regular inspections of the site vegetation to assess the success of revegetation efforts and identify areas where vegetation may be sparse or struggling. Erosion-control inspections are also routinely performed to identify potential areas where erosion controls need to be improved or added. At the meeting, Jody will provide an overview of plants species at the site, along with DOE's adaptive response to changing site conditions.

Water Quality Compliance

Water at Rocky Flats is distributed among surface water, shallow groundwater, and deep groundwater. Shallow groundwater refers to water within the alluvium and weathered bedrock underneath the site and is found to a depth of 30 meters. Water from the surface filters downward, recharging the shallow groundwater. Beneath the alluvium is highly impermeable, bedrock that inhibits vertical flow. Shallow groundwater therefore flows laterally (rather than vertically into the deep groundwater zone) and either discharges into onsite streams or emerges as hillside springs and seeps. All shallow groundwater from the site daylights as surface water inside DOE's management boundary. The deep groundwater aquifer is hydrologically isolated from the Rocky Flats surface and shallow groundwater and thus from site-related actinide contaminants. As a result, Rocky Flats does not impact any offsite drinking water groundwater wells.

The site remedy is largely focused on protecting surface water. Because surface water and groundwater are intertwined as the site, surface water monitoring, groundwater remediation, and groundwater monitoring are used to ensure remedy compliance. Groundwater treatment and monitoring ensures that groundwater, when it surfaces, is protective of surface water quality. Surface water monitoring ensures that water leaving the site meets all standards. (Of note, all water leaving Rocky Flats since completion of the remedial actions in October 2005 has met the stringent water quality standards for the site, even after extreme precipitation events.)

Heavy Precipitation Impacts

Heavy precipitation events at Rocky Flats result in increased amounts of surface water available to recharge the shallow aquifer below. Additional shallow groundwater can result in higher volumes of groundwater emerging as seepage and/or discharging into streams. For soluble contaminants, such as uranium and trichloroethylene (TCE), higher-than-normal precipitation events can result in increased concentrations in groundwater and/or surface water.

For example, as discussed in the 2017 Five-Year Review Report for Rocky Flats (https://semspub.epa.gov/work/08/1885612.pdf), a predictable relationship between precipitation and uranium concentrations in surface water is emerging. Specifically, heavy precipitation events (1) increase the mobility of U in soil, which allows increased migration of U to groundwater; and (2) increase U concentrations in surface water as a result of increased groundwater discharging to surface water. In particular, Walnut Creek water quality data show that significant precipitation events, such as those in 2013 and 2015, result in an initial lowering of U concentrations in surface water due to increased runoff, followed by an increase in U concentrations over a prolonged period due to increased mobilization of U via geochemical mechanisms and increased volumes of groundwater reaching surface water.

George Squibb and John Boylan will brief the Board on water quality trends under wet conditions and strategies to address these trends.

Dry Year Impacts
Prolonged periods of reduced precipitation can cause groundwater monitoring wells to go dry and surface water runoff to decrease. As a result, there is less water to monitor, which raises questions about how DOE can measure actinide movement and therefore show remedy compliance if there is no water (particularly surface water) to monitor.

George and John will brief the Board on how compliance is monitored under such conditions.

United States Government Accountability Office

Report to the Committee on Armed Services, U.S. Senate

May 2020

ENVIRONMENTAL LIABILITIES

DOE Needs to Better Plan for Post-Cleanup Challenges Facing Sites

GAO-20-373

GAO Highlights

Highlights of GAO-20-373, a report to the Committee on Armed Services, U.S. Senate

May 2020

ENVIRONMENTAL LIABILITIES

DOE Needs to Better Plan for Post-Cleanup Challenges Facing Sites

Why GAO Did This Study

After over 70 years of nuclear weapons production and energy research at hundreds of sites across the country, DOE faces over $500 billion in environmental liabilities associated with cleanup of hazardous contamination and long-term management of these sites. LM is responsible for the portion of these liabilities associated with long-term management of sites after active cleanup has been completed. LM oversees 100 sites across the country. Depending on the sites' clean-up standards and intended reuse, LM will likely be managing some sites for centuries.

Senate Report 116-48 accompanying the National Defense Authorization Act for fiscal year 2020 includes a provision for GAO to review LM's operations, including the nature of its environmental liability. This report examines (1) LM's environmental liability, and (2) any challenges LM faces in managing its sites and how it is addressing those challenges. GAO analyzed data on LM's environmental liability; interviewed officials at LM headquarters and those responsible for the nine sites requiring the most intensive level of management; and reviewed relevant policies, procedures, and guidance.

What GAO Recommends

GAO is making three recommendations, including that DOE develop agreements and procedures for circumstances that require new cleanup work and that it develop plans to assess and to mitigate the effects of climate change on its sites. DOE agreed with all three recommendations.

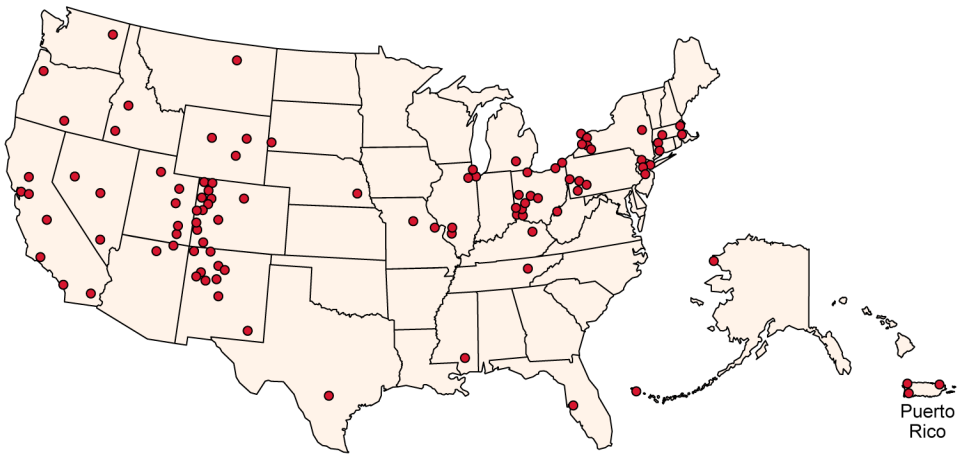
View GAO-20-373. For more information, contact David C. Trimble at (202) 512-3841 or trimbled@gao.gov.

What GAO Found

The environmental liability of the Department of Energy's (DOE) Office of Legacy Management (LM) was estimated at $7.35 billion in fiscal year 2019 and, according to LM officials, is expected to grow as LM acquires more sites (see figure for LM's current sites). Long-term surveillance and maintenance activities associated with radioactive and hazardous waste, such as treating residual groundwater contamination, account for about 40 percent of the costs. LM's environmental liability has generally remained stable over the past 5 years. As of September 2019, LM is scheduled to receive 52 additional sites by 2050, and officials expect LM's environmental liability to grow as a result. Officials said LM is taking steps to reduce its environmental liability at its current sites, such as exploring alternative approaches for reducing residual contamination.

LM officials identified challenges in providing long-term surveillance and maintenance of sites related to: (1) the performance of remedies that contain or reduce contamination, (2) environmental conditions, and (3) new regulatory requirements. LM is taking some actions to address these challenges. For example, at its Rocky Flats, Colorado, site, LM is repairing an aging landfill that was damaged by extreme rainfall events. However, LM has not yet planned for how to address challenges at some sites that may require new cleanup work that is not in the scope of LM's expertise and resources. By developing agreements and procedures with the entities that would be responsible for conducting this new cleanup work, LM can help mitigate risks to human health and the environment. In addition, LM has not made plans to assess the effects of climate change on its sites or to mitigate those effects, as called for in its strategic plan. By developing plans to assess the effect of climate change on its sites and to mitigate any significant impacts, LM could better ensure that its remedies will protect human health and the environment in the long term.

Figure: Map of 100 Sites Managed by DOE Office of Legacy Management (as of September 2019)



Sources: Department of Energy (DOE) (site locations); Map Resources (map). | GAO-20-373

Contents

Figures

Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	Department of Energy
EM	Office of Environmental Management
EPA	Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
LM	Office of Legacy Management
NRC	Nuclear Regulatory Commission
RCRA	Resource Conservation and Recovery Act
UMTRCA	Uranium Mill Tailings Radiation Control Act
USACE	U.S. Army Corps of Engineers

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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May 13, 2020

The Honorable James M. Inhofe
Chairman
The Honorable Jack Reed
Ranking Member
Committee on Armed Services
United States Senate

Over seventy years of nuclear weapons production and energy research by the federal government has generated large amounts of radioactive and hazardous waste, spent nuclear fuel, uranium mill tailings,[1] and contaminated soil and groundwater at hundreds of sites across the country. Even after active environmental remediation of these sites is completed, few sites will be cleaned up to the point that they can be released for unrestricted human access. Rather, many sites will require surveillance and maintenance to ensure the continued protection of human health and the environment for as long as contamination remains—in many cases, hundreds or thousands of years into the future. The Department of Energy (DOE) is responsible for such surveillance and maintenance, and in 2003, it created the Office of Legacy Management (LM) to manage those responsibilities. Specifically, LM is charged with providing environmental surveillance, facility and site maintenance, records management, and pension and benefit program oversight for sites where active cleanup has been completed, among other things. For fiscal year 2019, DOE budgeted about $159 million for LM activities.

The estimated future cost of LM's long-term surveillance and maintenance and other activities is known as LM's environmental liability. This cost is part of DOE's overall environmental cleanup and disposal liabilities, which DOE reported as $505.3 billion in fiscal year 2019. DOE is responsible for the largest share of reported federal environmental liabilities—about 85 percent in fiscal year 2019.[2] We have previously reported that the federal government's environmental liabilities have been growing for the past 20 years and are likely to continue to increase. In

[1]Uranium mill tailings are the residue that remains from extracting uranium from uranium ore. The tailings are radioactive and might contain other metals or hazardous substances.

[2]See Department of the Treasury, *Financial Report of the United States Government: FY19* (Washington, D.C.: March 2020).

2017, we designated the federal government's environmental liabilities as a high-risk area because of the large and expanding estimated costs of cleaning up areas where federal activities have contaminated the environment.[3] We have also previously reported on challenges created by fiscal exposures, which are responsibilities, programs, and activities that legally may commit the federal government to future spending or create the expectation for future spending (such as in the case of environmental liabilities).[4]

Senate Report 116-48 accompanying the National Defense Authorization Act for FY 2020 includes a provision for us to review LM's operations, including the nature of its environmental liability. This report examines (1) LM's environmental liability and changes in this liability over time, and (2) any challenges LM faces in providing long-term surveillance and maintenance of sites, and the extent to which LM is addressing those challenges.

To examine LM's environmental liability and changes over time, we reviewed environmental liability data provided by LM for fiscal years 2012 through 2019 (the time period for which comparable data were available), including data for each LM site and activity.[5] To assess the reliability of these data, we reviewed accompanying documentation on LM's sites and its guidance on estimating its environmental liability, interviewed knowledgeable officials from LM and DOE's Office of the Chief Financial Officer about the department's systems for collecting and maintaining the data, and conducted checks for data completeness and other factors. For

[3]GAO, *High-Risk Series: Progress on Many High-Risk Areas, While Substantial Efforts Needed on Others*, GAO-17-317 (Washington, D.C.: Feb. 15, 2017). GAO's high-risk program identifies government operations with greater vulnerabilities to fraud, waste, abuse, and mismanagement or the need for transformation to address economy, efficiency, or effectiveness challenges. In our March 2019 update to this high-risk area, we reported that DOE and the Department of Defense, which also shares responsibility for a large portion of the U.S. government's environmental liabilities, have partially met one out of five criteria for removal from the high-risk list; the other four criteria are not met. See GAO, *High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas,* GAO-19-157SP (Washington, D.C.: Mar. 6, 2019).

[4]GAO, *Fiscal Exposures: Federal Insurance and Other Activities That Transfer Risk or Losses to the Government,* GAO-19-353 (Washington, D.C.: Mar. 27, 2019).

[5]LM reports estimated costs associated with its current sites as well as costs associated with sites that it expects to acquire in the future. LM also reports other program-wide costs that are not site-specific, such as costs associated with exploring new technologies and operating a laboratory.

example, we confirmed the completeness of the data by verifying that the number and types of sites represented in LM's data align with documentation listing its current sites as of fiscal year 2019. We found these data to be sufficiently reliable for the purposes of our performance audit, that is, to describe what the environmental liability estimate is and how it has changed over time.

To examine any challenges facing LM in providing long-term surveillance and maintenance of sites and the extent to which LM is addressing those challenges, we reviewed relevant DOE and LM policies, procedures, and guidance documents related to LM's management of its sites. The control activities component of internal control—the policies, procedures, actions, or information systems that management designs or implements—was significant to this objective, along with the related principle that management should design control activities to achieve objectives and respond to risks.[6] We reviewed DOE documentation on policies and procedures for providing long-term surveillance and maintenance and compared this documentation with internal control criteria to identify any gaps.

For both objectives, we interviewed LM headquarters officials and site-level officials responsible for the nine sites that require the most intensive level of management, which LM refers to as category 3 sites. Appendix I provides information about these sites. We interviewed officials from these sites to obtain their perspectives on any trends in LM's environmental liability in recent years and any projected future changes, as well any challenges facing LM in providing long-term surveillance and maintenance of its sites and any actions or plans to address those challenges. To develop interview questions for site-level officials, we analyzed relevant reports from the National Academies of Science, Engineering, and Medicine on DOE's long-term management of post-cleanup sites.[7] We categorized major areas of challenges identified in these reports and used these categories to develop questions for site-

[6]GAO, *Standards for Internal Control in the Federal Government,* GAO-14-704G (Washington, D.C.: September 2014).

[7]National Research Council of the National Academies, Committee on the Remediation of Buried and Tank Waste, *Long-Term Institutional Management of U.S. Department of Energy Legacy Waste Sites* (Washington, D.C.: The National Academies Press, 2000) and National Research Council of the National Academies, Committee on Long-Term Institutional Management of DOE Legacy Waste Sites: Phase 2, *Long-Term Stewardship of DOE Legacy Waste Sites—A Status Report* (Washington, D.C.: The National Academies Press, 2003).

level officials about potential challenges facing LM in providing long-term surveillance and maintenance of sites. In developing these questions, we also drew on challenges identified by LM headquarters officials. We visited and toured one of LM's category 3 sites—the Rocky Flats site in Colorado. We selected this site to visit because, in the portion of LM's fiscal year 2019 environmental liability estimate that is broken down by site, this site accounts for the largest amount.

We conducted this performance audit from August 2019 to May 2020, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

In 1999, DOE issued a report stating that, based on experience from a decade of planning and conducting cleanup work at the sites for which it is responsible, complete restoration to levels acceptable for unrestricted use could not be accomplished at many of its sites.[8] According to the report, a variety of hazards would remain at many DOE sites after these sites had been cleaned up in accordance with applicable requirements. These hazards include long-lived radionuclides left in place in soils or contained in on-site disposal cells and residual contaminants in surface water and groundwater.[9] The report cited technical challenges—such as lack of existing technology for completely removing some types of waste—and economic limitations—such as prohibitive costs to employ available technology—as reasons why these hazards would remain.[10] As a result, DOE reported that long-term management would be needed at these sites to ensure that the cleanup remedies—i.e., the actions, systems, or other measures put in place to clean up a site—would protect

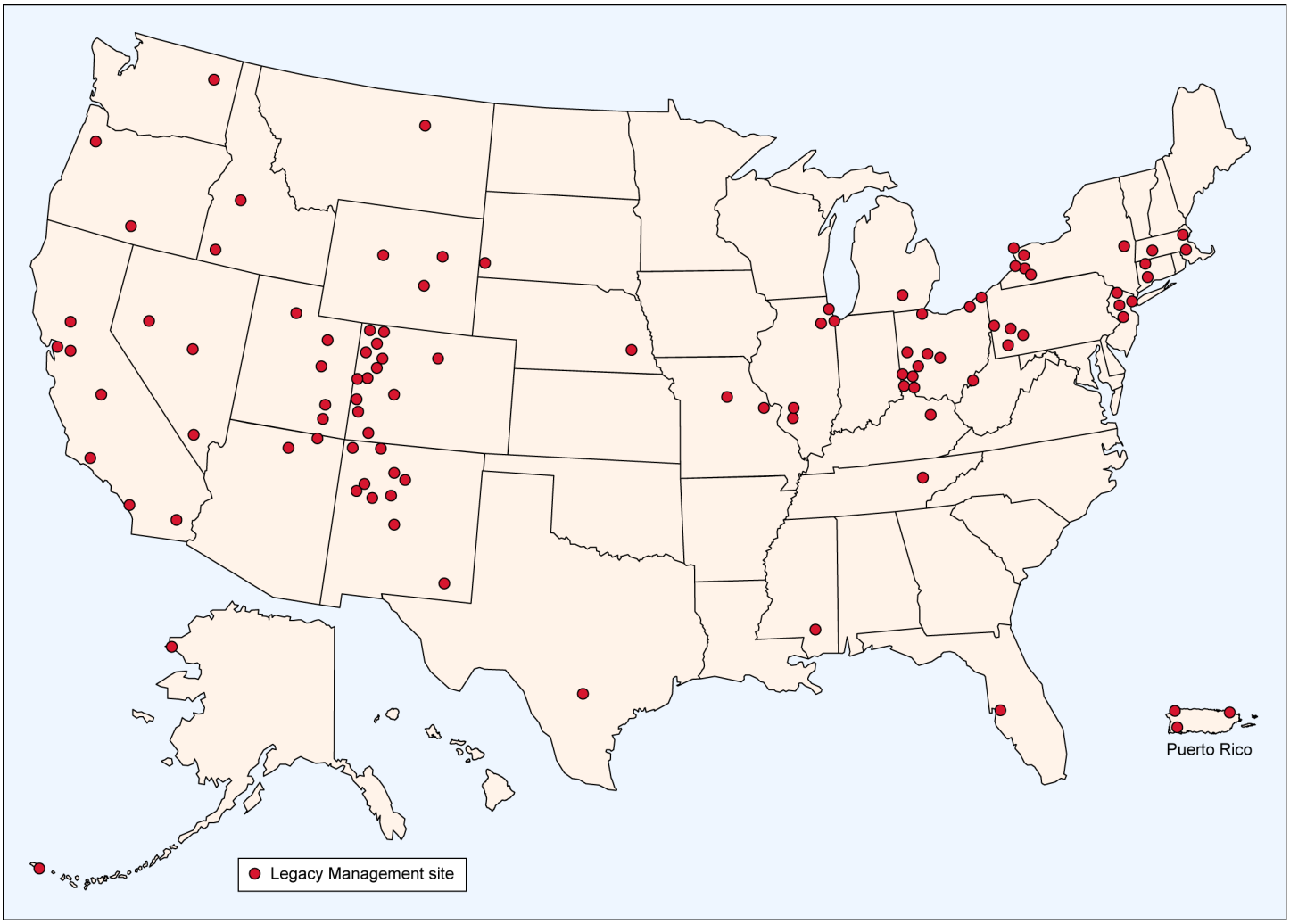
[8]Department of Energy, Office of Environmental Management, *From Cleanup to Stewardship,* DOE/EM-0466 (Washington, D.C.: October 1999).

[9]For example, according to a DOE document, radionuclides (radioactive forms of elements) left onsite after cleanup continue to pose some degree of risk to human health and the environment indefinitely. This is due to radionuclides' long half-lives, or fixed amounts of time required for one half of a given amount of a radionuclide to decay. Depending on the radionuclide, radioactive decay products may persist in the environment for hundreds of thousands of years before decaying into a stable, nonradioactive element.

[10]In addition, DOE officials told us that, due to technical and financial impracticability, consistent with current applicable cleanup requirements, some residual contamination remains after cleanup is completed.

human health and the environment from these hazards into the future. Several DOE organizations, including the Office of Environmental Management (EM), were responsible for long-term management of post-cleanup sites until the department established LM in 2003. As of the end of fiscal year 2019, LM had assumed responsibility for 100 sites across the United States, including sites in Alaska and Puerto Rico (see fig. 1).

Figure 1: Map of 100 Sites Managed by DOE Office of Legacy Management (as of September 2019)



Sources: Department of Energy (DOE) (site locations); Map Resources (map). | GAO-20-373

Roles and Responsibilities for Cleanup of Sites

Several different entities conducted cleanup of sites before LM assumed responsibility for the sites. These different entities conducted cleanup under a variety of authorities:

- **EM.** Established in 1989, DOE's EM is responsible for the cleanup of legacy waste that resulted from the development and production of nuclear weapons and government-sponsored nuclear energy research dating back to World War II and the Cold War. Such waste includes radioactive waste, spent nuclear fuel and nuclear material, and contaminated soil and water, among other things. EM cleaned up 83 of the 100 sites that are now within LM's portfolio. Key laws that governed EM's cleanup of these sites include the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 as amended (CERCLA); the Resource Conservation and Recovery Act of 1976 as amended (RCRA); and Title I of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). Title I of UMTRCA authorizes a cleanup program for uranium mill tailings sites—which produced uranium for nuclear weapons and other defense purposes—that were no longer operational as of 1978, the year of the law's enactment.[11] DOE is generally responsible for financing the cleanup of these sites. EM also cleaned up sites that are now within LM's portfolio under the Formerly Utilized Sites Remedial Action Program (FUSRAP). This program was established in 1974 to identify, investigate, and clean up sites where radioactive contamination remained from Manhattan Project and early Atomic Energy Commission operations. EM was responsible for cleaning up FUSRAP sites until 1997, when Congress directed the U.S. Army Corps of Engineers (USACE) to assume responsibility for the cleanup work of the remaining designated FUSRAP sites.[12]
- **USACE.** USACE cleaned up 10 FUSRAP sites that are now within LM's portfolio. Under a memorandum of understanding signed by DOE and USACE in 1999, DOE is responsible for the long-term management of FUSRAP sites after USACE completes cleanup. Key requirements that govern USACE's cleanup of FUSRAP sites include

[11]Specifically, UMTRCA was enacted in part to address the environmental and public health risks associated with residual radioactive material produced at inactive uranium mill sites.

[12]DOE assessed more than 600 candidate sites for eligibility under FUSRAP and determined that 46 would be eligible for cleanup. DOE remediated 25 of the 46 sites from 1974 to 1997, when Congress transferred cleanup responsibility for the remaining sites to USACE.

CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan.

- **Private licensees.** LM's portfolio includes seven sites cleaned up by private licensees, i.e., commercial operators who were permitted to operate uranium mills or other facilities under a license from the Nuclear Regulatory Commission (NRC). In all except one case, private licensees cleaned up these sites under Title II of UMTRCA, which assigned responsibility to the licensee for reclamation of uranium mill sites operating on or after the law's enactment in 1978.[13] When a private licensee has completed all cleanup requirements, NRC approves transfer of a site to LM for long-term management.

Cleanup activities conducted by these entities included decontaminating, decommissioning, and demolishing buildings; containing and disposing of a variety of hazardous and radioactive wastes; excavating and stabilizing contaminated soil; constructing engineered disposal cells for contaminated materials; containing and treating contaminated surface water and groundwater; and preparing the land for future public, industrial, or commercial use. Depending on the legal and regulatory framework governing cleanup, other agencies or groups may have played a role in setting cleanup standards and helping to select a site's cleanup remedy. For example, sites cleaned up under Title I of UMTRCA must meet regulatory cleanup standards established by the Environmental Protection Agency (EPA). For certain sites cleaned up under CERCLA and RCRA, DOE has entered into agreements with EPA and the relevant state regulator regarding the necessary cleanup actions, and EPA and the state have provided input in selecting the cleanup remedy.

As cleanup of a site nears completion, LM works with the entity responsible for cleanup to prepare the site for transition into LM's portfolio. The transition process for a given site may take up to 5 years, during which time LM and the cleanup entity develop a long-term surveillance and maintenance plan. Depending on the authority under which a site has undergone cleanup, this plan may require approval by regulators such as EPA or NRC. Other transition responsibilities include identifying and preserving records and checking that administrative

[13]The exception is one site (the Parkersburg Disposal Site in West Virginia), cleaned up by a private licensee under Section 151 of the Nuclear Waste Policy Act, which authorizes DOE to take title to certain privately owned low level radioactive waste disposal sites at no cost to the federal government if, among other things, NRC determines that the private owner has successfully cleaned up the site.

institutional controls and other real property instruments are in place.[14] DOE considers site cleanup to be complete when, among other things, short-term cleanup activities have been completed and long-term cleanup measures, such as groundwater treatment, are in place. According to a DOE document, ongoing groundwater remediation continues at many sites after the official completion of cleanup because of the long timeframes required to capture and remediate contaminated groundwater.

Scope of LM's Mission and Activities

Once LM acquires a site, it places each site into one of three categories based on the actual or anticipated long-term surveillance and maintenance activities associated with the site.

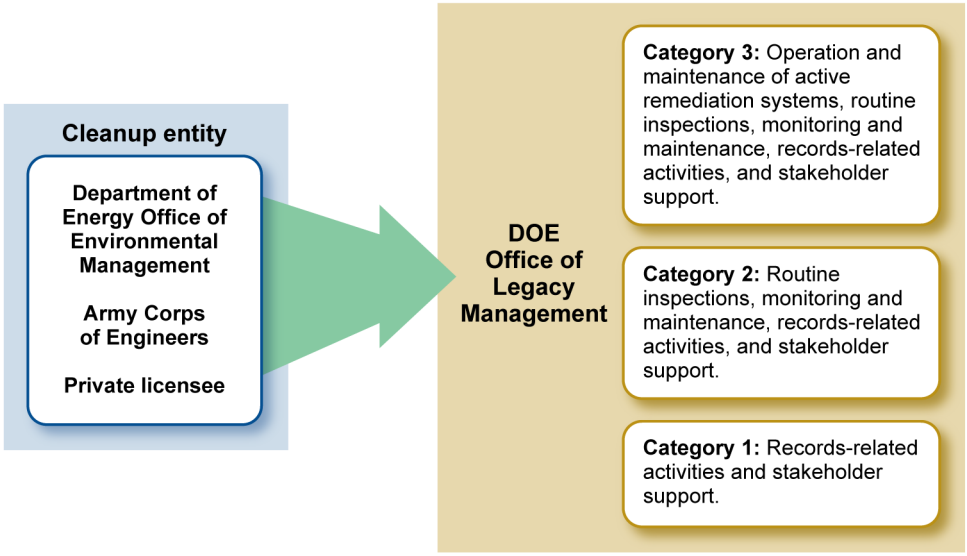
- LM has nine "category 3" sites, which require the most intensive surveillance and maintenance due to the extent of residual contamination, according to LM officials. These sites typically have an ongoing remediation system—such as a groundwater treatment system, according to officials—that LM must monitor and maintain.
- LM has 49 "category 2" sites, which require routine inspection, monitoring, and maintenance.
- LM has 42 "category 1" sites, which require management of records or stakeholder requests for information.

LM also maintains a list of 52 sites that, as of September 2019, are expected to transition into its portfolio over the next three decades. Figure 2 illustrates sites' transition from cleanup entities and their categorization. Appendix II provides additional details about the current sites in LM's portfolio as of fiscal year 2019, and appendix III provides details about sites that, as of September 2019, are scheduled to transition to LM by 2050.[15] According to LM officials, LM does not have a schedule or process for retiring sites from its portfolio. Depending on the sites' clean-up standards and intended reuse, LM will likely be managing some sites for centuries.

[14]Institutional controls include administrative and legal controls that minimize the potential for human exposure, for example, by limiting land use or providing information to guide behavior at the site, such as through zoning restrictions. Institutional controls are a subset of land use control, which can include physical measures such as fencing.

[15]In its technical comments on our draft report, DOE revised the planned transition dates for five sites, including revising the transition date for one site (the Paducah site) from 2047 to "beyond 2050." For consistency with the data we used to examine LM's environmental liability, we continue to report on the sites that, as of the time we drafted our report, LM expected to transition into its portfolio by 2050.

Figure 2: Transition of Contaminated Sites from Cleanup Entity to DOE Office of Legacy Management



Source: GAO summary of Department of Energy (DOE) documents. | GAO-20-373

Note: According to DOE Office of Legacy Management (LM) officials, LM's goal is to move sites into lower categories over time as site conditions allow. LM officials said that LM does not have a schedule for moving sites down in category and told us that many sites will remain in category 2 for the foreseeable future. LM may also move sites to a higher category if new surveillance and maintenance of active remediation systems is needed, according to officials.

LM's budget includes funding for other activities that are not directly associated with its 100 sites. These activities include conducting an inventory of abandoned defense-related uranium mines, overseeing pensions and post-retirement benefits for former contractor workers at closed DOE sites, and leading and coordinating DOE's environmental justice activities. As of fiscal year 2019, LM's overall budget was about $159 million.

DOE's Environmental Liabilities

Federal accounting standards require agencies that are responsible for cleaning up contamination to estimate future cleanup and waste disposal costs and to report such costs in their annual financial statements as environmental liabilities.[16] According to these standards, environmental liability estimates are to include probable and reasonably estimable costs of cleanup work. Environmental liability estimates do not include cost

[16]Federal Accounting Standards Advisory Board, *FASAB Handbook of Federal Accounting Standards and Other Pronouncements, as Amended* (Washington, D.C.: June 30, 2017).

estimates for work for which reasonable estimates cannot currently be generated, such as cleanup costs at sites where no feasible remedy exists, according to the standards.

In fiscal year 2019, DOE reported $505 billion in environmental cleanup and disposal liabilities, of which about $64 billion are categorized by DOE as "other legacy environment" costs. LM's environmental liability is part of this category, along with several other types of environmental liability costs.[17]

LM's Environmental Liability Was Estimated at $7.35 Billion in Fiscal Year 2019 and Will Likely Grow as LM Acquires Additional Sites

LM estimated its environmental liability in fiscal year 2019 at $7.35 billion, an amount that has been relatively stable over the last 5 years. However, LM expects its environmental liability to increase as it acquires additional sites, according to LM officials.

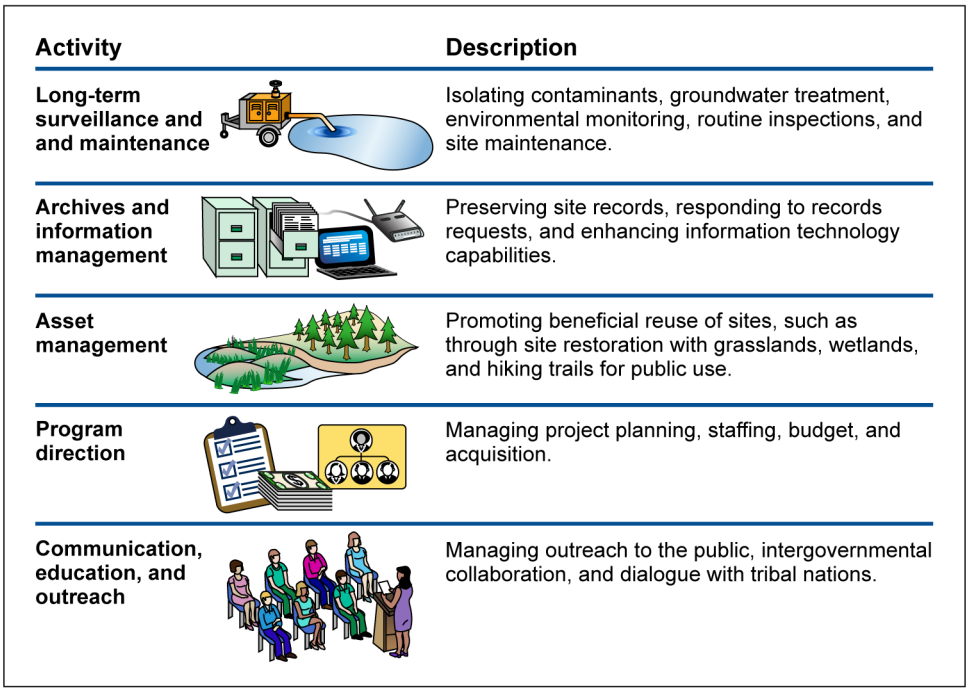
LM's Environmental Liability Largely Reflects the Costs of Long-Term Surveillance and Maintenance of Its Sites

According to LM financial data, LM's environmental liability estimate in fiscal year 2019 was $7.35 billion. LM's guidance defines its environmental liability as an estimate of life-cycle costs associated with five main activities—determined by DOE—occurring over 75 years (see

[17]In fiscal year 2019, DOE reported an estimated $64 billion in "other legacy environment" environmental cleanup and disposal liabilities. According to data provided by DOE, this estimate includes LM's long-term management of sites ($8.1 billion) as well as costs not directly managed by LM, including: costs associated with DOE disposal of surplus plutonium ($15.1 billion); disposal of high-level waste and spent nuclear fuel currently at EM sites into a geologic repository under the Nuclear Waste Policy Act of 1982 ($20.3 billion); long-term management of EM sites after cleanup is complete ($13.4 billion); and liability held by other offices within DOE ($7.2 billion). According to officials from DOE's Office of the Chief Financial Officer, the department estimated LM's fiscal year 2019 environmental liability to be $8.1 billion rather than $7.35 billion (as reported to us by LM), because the department added an additional $700 million in contingency to LM's estimate to account for uncertainty.

fig. 3).[18] LM develops guidance on how its site managers should estimate their sites' environmental liability. In accordance with this guidance, site managers are to develop estimates of the direct costs over the upcoming 75-year period. They are also to determine a certain amount of contingency to account for potential changes in LM's project scope because of unknown and unpredictable events over the upcoming 75-year period.[19]

Figure 3: Activities that Account for the DOE Office of Legacy Management's Environmental Liability



Source: GAO Summary of Department of Energy (DOE) documents. | GAO-20-373

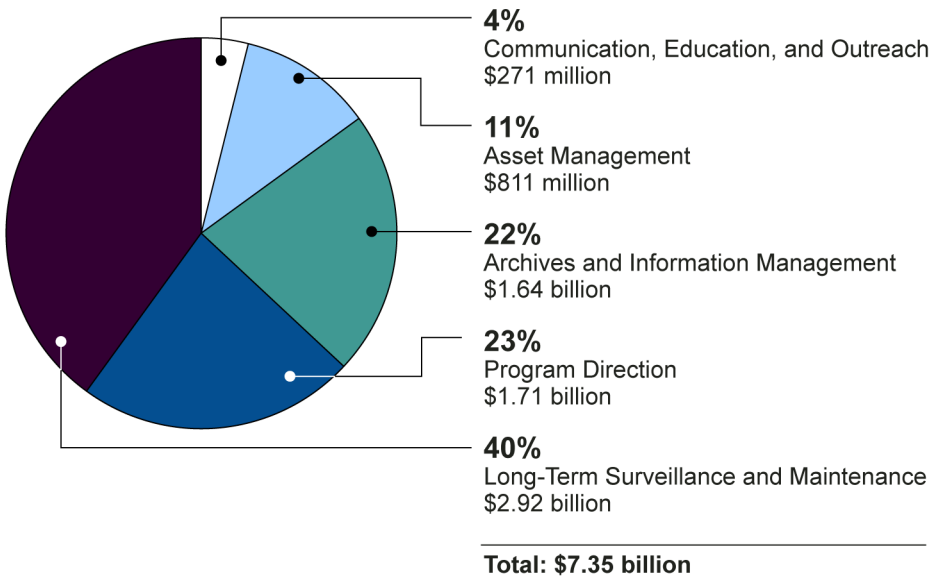
[18]Although these estimates assume a 75-year timeframe, LM officials told us that some sites will not complete their long-term surveillance and maintenance activities within that period. As a result, the 75-year cost estimates may underestimate LM's full lifecycle costs for managing all of its sites.

[19]In particular, in developing its estimates, LM makes assumptions to account for uncertainty about factors that could influence costs in the future, such as those related to site conditions, regulatory requirements, technology, and cleanup standards, according to LM guidance. Further, these estimates are to reflect the most likely, rather than worst-case, scenarios at sites, meaning the actual costs could be either higher or lower than LM's estimates.

As shown in figure 4, LM activities related to long-term surveillance and maintenance of its sites accounted for about $3 billion—or 40 percent—of its fiscal year 2019 environmental liability.[20] LM activities related to program direction and to archives and information management each accounted for about 23 percent and 22 percent, respectively, of LM's fiscal year 2019 environmental liability, and activities related to asset management and to communication, education, and outreach combined for about 15 percent.

[20]This approximately $3 billion includes the costs of providing long-term surveillance and maintenance for the 100 sites currently in LM's portfolio, as well as costs associated with transitioning an additional 51 sites into its portfolio by 2050. Although, as of September 2019, LM expects to transition a total of 52 sites by 2050, at this point LM has not reported any environmental liability associated with one of these sites (the Elemental Mercury Storage Facility site), because LM is not yet sure about the scope of long-term surveillance and maintenance activities needed at that site, according to LM officials. Regarding these 51 sites, LM's environmental liability estimate includes transition costs associated with each of these sites, such as costs to develop site transition plans. The estimate also includes long-term surveillance and maintenance costs for a portion of these 51 sites—specifically, the portion of sites that is scheduled to transition to LM from USACE and private licensees by 2050. The estimate does not include long-term surveillance and maintenance costs for sites that will transition to LM from EM, according to LM officials. As mentioned previously, part of DOE's other legacy environment liability includes about $13 billion associated with long-term surveillance and maintenance of sites currently managed by EM. DOE Chief Financial Officer officials told us that although many of these sites will likely transfer to LM in the future, LM cannot fully assess the scope of long-term surveillance and maintenance activities (and thereby determine the associated cost) until the sites' transitioning periods, which are typically five years prior to the transition date. According to LM officials, EM's decisions regarding the final remedies and subsequent long-term surveillance and maintenance requirements for sites are complex and subject to negotiation with regulators. LM officials told us that since LM is not involved in such decisions, it would be difficult for LM to estimate long-term surveillance and maintenance costs for these sites.

Figure 4: DOE Office of Legacy Management Estimated Environmental Liability by Activity (Fiscal Year 2019)

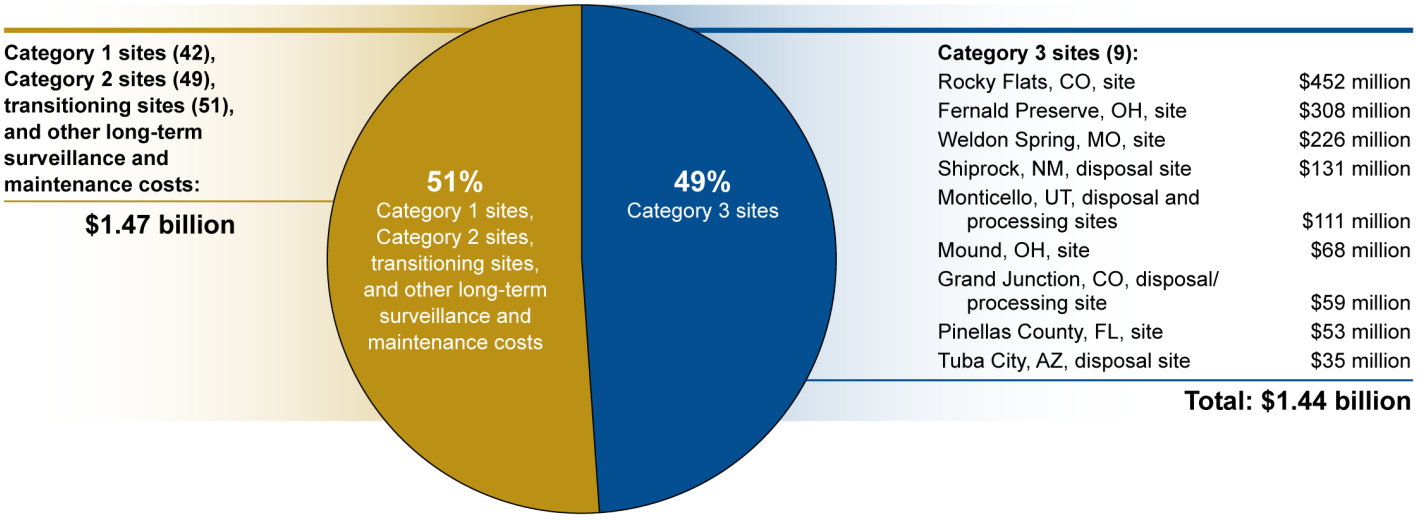


Source: GAO analysis of Department of Energy (DOE) data. | GAO-20-373

Note: According to Office of Legacy Management (LM) officials, aside from long-term surveillance and maintenance, the other four activities that make up LM's environmental liability estimate are not broken down by site because they are primarily programmatic in scope and not site-specific. For example, as part of its archives and information management activities, LM maintains information technology capabilities that are primarily operated and maintained at LM's office locations, rather than at individual sites.

Of LM's approximately $3 billion in costs for long-term surveillance and maintenance, LM's category 3 sites—the nine sites that require the most intensive level of management—accounted for almost half of these estimated costs (see fig. 5). The Rocky Flats site in Colorado accounted for the largest share of this portion of the liability (about $452 million), and the Fernald Preserve site in Ohio accounted for the second-largest share (about $308 million). Long-term surveillance and maintenance responsibilities for category 1 and category 2 sites, transition costs associated with sites that LM will acquire in future years, and other program-wide activities—such as exploring new technologies and operating a laboratory—accounted for the remaining share (about $1.5 billion) of LM's environmental liability related to long-term surveillance and maintenance.

Figure 5: DOE Office of Legacy Management Estimated Environmental Liability Related to Long-Term Surveillance and Maintenance Activities, by Site Category (Fiscal Year 2019)



Source: GAO analysis of Department of Energy (DOE) data. | GAO-20-373

Note: The Office of Legacy Management's (LM) environmental liability includes the costs associated with providing long-term surveillance and maintenance for the 100 sites currently in LM's portfolio, as well as estimated costs associated with transitioning 51 sites into its portfolio by 2050. Although, as of September 2019, LM expects to transition a total of 52 sites by 2050, at this point LM has not reported any environmental liability associated with one of these sites (the Elemental Mercury Storage Facility site), because LM is not yet sure about the scope of long-term surveillance and maintenance activities needed at that site, according to LM officials.

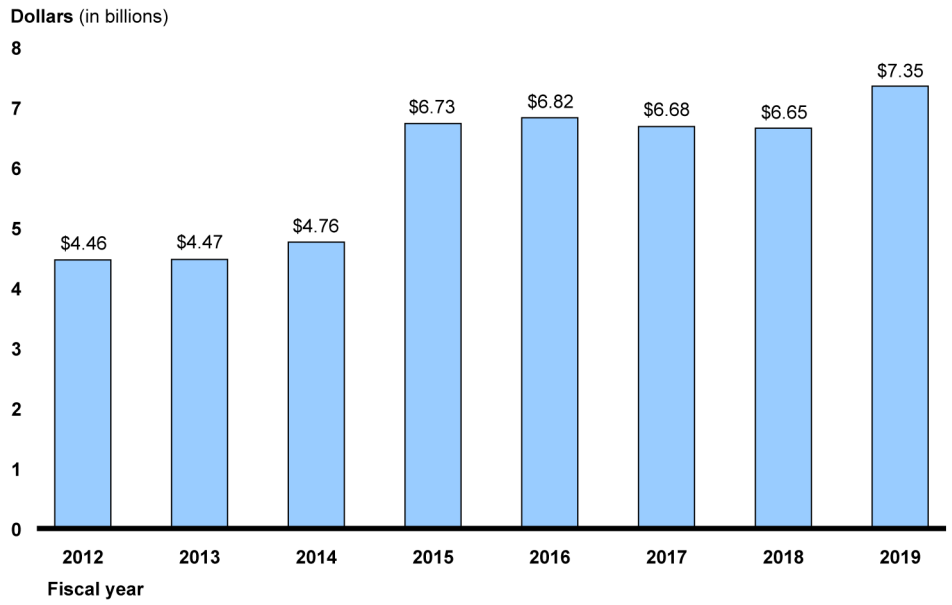
LM's Environmental Liability Has Generally Remained Stable in Recent Years, with Some Notable Fluctuations at Individual Sites

LM's total environmental liability has generally remained stable in recent years, although there have been some notable fluctuations at individual sites. In fiscal years 2015 through 2018, LM's total environmental liability remained between $6 billion and $7 billion per year, and increased to slightly over $7 billion in fiscal year 2019 (see fig. 6). Most notably, LM's total environmental liability increased by about $2 billion (about 41 percent) between fiscal years 2014 and 2015. LM officials attributed this increase to adopting a more thorough approach for estimating future costs associated with sites scheduled to be transferred from USACE under FUSRAP. LM officials said that, before fiscal year 2015, LM had used a standard cost estimate for all of USACE's sites, which resulted in an underestimate of the associated liability.[21] According to LM officials, in

[21]Although the entity in charge of cleanup may estimate the environmental liability associated with providing long-term management of a site post-cleanup, LM reassesses this estimate upon acquiring a site, according to DOE officials.

fiscal year 2015 LM began estimating costs based on individual sites' specific conditions, which allowed LM to capture more potential costs.

Figure 6: DOE Office of Legacy Management Estimated Environmental Liability by Fiscal Year



Source: GAO analysis of Department of Energy (DOE) data. | GAO-20-373

Similar to LM's overall environmental liability, the long-term surveillance and maintenance portion of LM's environmental liability has generally remained stable in recent years, though individual sites have seen some notable changes. From fiscal year 2015 through 2018, LM's environmental liability related to long-term surveillance and maintenance remained between about $3 billion and $3.5 billion. Similar to LM's overall environmental liability, the long-term surveillance and maintenance portion of LM's liability saw a more significant increase between fiscal years 2014 and 2015, from about $2.2 billion to about $3.4 billion. At the site level, of LM's nine category 3 sites, the Fernald Preserve and Mound sites in Ohio are examples of sites that have had mostly steady decreases from fiscal year 2014 to 2019, which LM officials attributed in part to adjustments to groundwater treatment strategies at Fernald Preserve as well as transferring ownership of most of the Mound site to another party. In contrast, several other sites (including Rocky Flats and Grand Junction in Colorado and Weldon Spring in Missouri) saw overall decreases from fiscal year 2014 to 2016 followed by steady increases from fiscal year 2016 to 2019, which LM officials generally attributed to

costs of site maintenance at Rocky Flats, construction at Weldon Spring, and planning activities for the potential closure of the disposal cell at Grand Junction. LM officials provided additional details on specific factors driving sites' changes in environmental liability. For example:

- At the Fernald Preserve site, the long-term surveillance and maintenance liability has decreased overall from about $367 million in fiscal year 2014 to about $308 million in fiscal year 2019 (about a 16 percent decrease). The site manager for Fernald attributed this decrease to improvements in the site's groundwater treatment strategy. In 2014, LM made changes to optimize the site's "pump-and-treat" system (which brings contaminated water above ground so that it can be treated and contaminants removed) by increasing pumping from the wells in the portion of the site with the most contamination, according to the site manager. Further, the site manager said that this change increased the amount of water coming from the more contaminated areas, making the water treatment more efficient and cost-effective in the long-term.
- At the Mound site, the long-term surveillance and maintenance liability has decreased from about $124 million in fiscal year 2014 to about $68 million in fiscal year 2019 (about a 45 percent decrease). According to LM officials, this decrease is in part due to a transfer in ownership. Specifically, LM transferred ownership of the majority of the site to the Mound Development Corporation to sell or lease parcels of the land to third parties for commercial use. Transferring ownership meant that LM gave up some of its responsibilities and their associated costs (such as maintenance and repairs at buildings that are now privately owned), although it continues to fulfill ongoing groundwater treatment and records management responsibilities.
- At the Rocky Flats site, the long-term surveillance and maintenance liability has increased substantially since fiscal year 2016, from about $269 million to about $452 million in fiscal year 2019 (about a 68 percent increase). According to the site manager for Rocky Flats, this increase can be attributed to additional costs needed to repair aging infrastructure. Specifically, a landfill on the site, which was constructed in the 1950s, has been damaged by erosion in recent years, and LM is currently undertaking a large-scale project to repair and stabilize it after previous repairs failed to provide a long-term fix. This project, which is due to be completed in the summer of 2020, includes installing about 260 steel anchors of up to 95 feet in length into the soil around the landfill. These anchors are intended to keep the soil intact while drains route groundwater away from the areas of the landfill that are particularly vulnerable to erosion.

LM's Environmental Liability Is Likely to Grow as LM Acquires More Sites in Future Years

LM's environmental liability is likely to grow as it acquires more sites in future years, even as LM takes steps to reduce the environmental liability associated with its current sites, according to LM officials. According to an LM document, as of September 2019, LM is scheduled to acquire 52 additional sites by 2050, including six category 3 sites, 45 category 2 sites, and one category 1 site.[22] Since LM does not account for the environmental liability related to long-term surveillance and maintenance for a portion of its sites until it acquires them, LM officials could not tell us by how much its total environmental liability will increase as a result of acquiring these sites.[23] However, officials said that some sites transitioning to LM in the future will be increasingly complex, which will likely mean increased long-term surveillance and maintenance costs. In particular, one official told us that the FUSRAP sites LM is set to acquire from USACE will be larger and have more extensive residual contamination than FUSRAP sites that LM had previously acquired. As a result, these sites will likely require LM to undertake more extensive and costly long-term surveillance and maintenance activities, according to this official.

At the same time, LM officials said they are taking steps to help reduce the environmental liability at LM's current sites, such as exploring ways to improve the cost-effectiveness of managing residual groundwater contamination. For example:

- At the Shiprock site in New Mexico, LM has initiated an environmental assessment to evaluate the impacts of removing an evaporation pond into which contaminated groundwater is being pumped, according to the site manager. The site manager also told us that removing this pond could mean reducing the scope of the site's water pumping activities and ultimately adopting a different groundwater treatment strategy that could prove to be more efficient. Further, the site manager said that this removal would result in reduced long-term

[22]The category 3 sites (which require the most intensive level of management) and their projected fiscal year of transfer to LM include: Elemental Mercury Storage Facility site (2022); Hazelwood, MO, site (2023); St. Louis, MO, site (2026); Moab, UT, Disposal/Processing site (2035); Berkeley, MO, site (2038); and Berkeley, MO, Site Vicinity Properties (2038).

[23]As mentioned previously, LM estimates long-term surveillance and maintenance costs associated with sites transitioning to LM from USACE and private licensees by 2050, but LM's estimates do not include long-term surveillance and maintenance costs associated with sites transitioning to LM from EM, according to LM officials.

surveillance and maintenance costs associated with ongoing repairs to the pond.

At the Tuba City site in Arizona, LM is conducting an environmental assessment to weigh options for a new groundwater treatment strategy. According to the site manager, the current strategy, which involves injecting clean water into the site's contaminated aquifer to flush out contamination, does not cost-effectively address the root cause of the groundwater contamination. Among other options, LM may use its assessment to seek alternate concentration limits accompanied by restrictions to grazing and water use, which LM officials said could be a cost-effective way to manage residual contamination.[24]

LM Faces Several Challenges and Has Not Planned for Those That Require New Cleanup Work or Address Climate Change Risks

LM officials we interviewed identified a number of challenges that LM faces in providing long-term surveillance and maintenance of sites. In particular, officials identified challenges related to three main areas: (1) the performance of remedies on its sites, (2) environmental conditions, and (3) new requirements and regulations. LM is taking some actions to address the challenges that officials identified. However, it has not planned for how to address challenges with remedies at some sites that may require additional cleanup work outside the scope of its expertise and resources, and it has not developed plans to assess and mitigate challenging environmental conditions that may become more frequent or intense because of climate change.

Challenges with the Performance of Remedies Could Require New Cleanup Work

According to LM officials, LM faces challenges with cleanup remedies not performing as predicted or intended at some sites. For example:

- At the L-Bar site in New Mexico, officials told us that the disposal cell, which was constructed by a private licensee under UMTRCA Title II and holds about 2.1 million tons of radioactive mill tailings, began experiencing erosion problems shortly after NRC transferred the site to LM in 2004. This erosion is threatening to undermine the disposal cell, according to LM officials (see fig. 7).

[24]Alternate concentration limits can be set if groundwater cannot be restored to background levels. NRC will establish a site-specific alternate concentration limit for a hazardous constituent if it finds that the proposed limit is as low as reasonably achievable, after considering practicable corrective actions, and that the constituent will not pose a substantial present or potential hazard to human health or the environment as long as the alternate concentration limit is not exceeded. 10 C.F.R. pt. 40 app. A, criterion 5B(6).

- At the Monticello site in Utah, monitored natural attenuation[25]—the groundwater treatment remedy originally agreed to by DOE, EPA, and the Utah state regulator—proved ineffective in meeting cleanup goals within a few years of being implemented and of the site being transferred to LM. As a result, in 2015, LM implemented a pump-and-treat approach that reduced contamination; however, officials told us that the efficacy of this approach has declined over time, and LM is again seeking to change the remedy.

Figure 7: Damage from Erosion at the DOE Office of Legacy Management's L-Bar Site in New Mexico

Source: Department of Energy (DOE) Office of Legacy Management. | GAO-20-373

To address challenges related to the performance of remedies, LM is currently undertaking a risk analysis effort to rank sites according to several types of risks, including the risk that a site will not attain compliance with cleanup goals or that compliance will not be maintained into the future. According to LM officials, LM plans to use the results of the risk analysis to inform decisions about where to focus resources, to identify systemic technical challenges, and to identify possible opportunities for reducing LM's environmental liability, such as through technology development.

LM is also addressing challenges related to remedy performance by updating some sites' remedies. For example, LM has implemented an erosion monitoring program for the L-Bar site and, at the Monticello site, is collecting data that could allow it to seek regulatory approval for a new

[25]Natural attenuation relies on natural processes to decrease or "attenuate" concentrations of contaminants in soil and groundwater. Scientists monitor these conditions to make sure natural attenuation is working. The entire process is called monitored natural attenuation. The groundwater remedy at the Monticello site also included implementation and enforcement of institutional controls to prohibit use of contaminated groundwater for domestic purposes.

groundwater compliance strategy, according to LM officials. LM officials said that, in general, they consider such updates to be routine and to fall within LM's mission to provide long-term surveillance and maintenance of these sites.

Nonetheless, LM officials told us that as LM acquires additional sites and as remedies age, future challenges related to remedy performance could result in the need for more extensive work, including active cleanup work that is outside the scope of LM's mission, capabilities, and resources. We found that LM has developed agreements and procedures for addressing such challenges at sites cleaned up by USACE, but has not developed such agreements and procedures for sites cleaned up by EM or by private licensees under Title II of UMTRCA. Specifically, regarding sites cleaned up by USACE under FUSRAP, under the 1999 memorandum of understanding between DOE and USACE, USACE is responsible for carrying out additional cleanup actions when it determines such actions are necessary. In addition, LM guidance related to transition and transfer of FUSRAP sites includes examples of situations in which LM would return a site to USACE for additional cleanup, such as situations in which routine monitoring identifies new areas of contamination. Conversely, for sites where EM was responsible for active cleanup, a 2005 memorandum co-signed by the leadership of LM and EM includes a brief statement about the need for LM and EM to coordinate in instances of "significant remedy failures." LM officials told us that structural or engineering damage could signify evidence of a "significant remedy failure," but said that such criteria have not been documented. They also said that LM has not defined a process by which such failures would be addressed. Finally, LM officials said that there is no mechanism in place under UMTRCA for LM to return a site to NRC or to seek recovery of costs from a private licensee for any additional cleanup that needs to be done.

According to agency officials, LM has not developed agreements or procedures for addressing challenges that require active cleanup work at sites cleaned up by EM because LM has not yet encountered such instances at any of its sites. They also noted that LM has been more focused on long-term surveillance and maintenance and the process of transitioning sites into its portfolio from EM and private licensees, rather than a process for moving sites back to these entities if a cleanup remedy fails. However, under federal internal control standards, management is to design control activities to achieve objectives and respond to risks, such as by clearly documenting internal control in management

directives, administrative policies, or operating manuals.[26] By working with EM and NRC to develop agreements and procedures for identifying and addressing circumstances at LM sites that require new cleanup work beyond the scope of LM's mission, capabilities, and resources, LM can help ensure mitigation by the most appropriate entity of the risks to human health and the environment that such instances would present.

Challenging Environmental Conditions May Become More Frequent or Intense

LM faces challenges with environmental conditions at the sites—some of which may become more frequent or intense—and, according to its mission, LM must react to these challenges to ensure the sites remain protective of human health and the environment. For example:

- At the Rocky Flats site in Colorado, officials told us that extreme rainfall events over the past few years have caused soils covering an on-site landfill to "slump," or slip downhill. In particular, rainfall during 2015—the site's wettest year on record, according to LM officials—caused a 20-foot slump in the landfill.
- The Boiling Nuclear Superheater site in Puerto Rico and the Pinellas County site in Florida were both in the path of Hurricane Irma in 2017, though neither site sustained substantial damage.
- At the Weldon Spring site in Missouri, the site manager said that tornadoes pose a risk to the site's infrastructure, and that a strong tornado in 2013 damaged the site's interpretive center.[27]

To address challenges related to environmental conditions, LM has been repairing damages caused by extreme weather events. For example, at the Rocky Flats site, LM is undertaking a major project to repair and stabilize its aging landfill, as discussed earlier. At the Weldon Spring site, LM installed a tornado shelter in 2014 and is currently building a new interpretive center. In addition, according to the 2020 LM Site Sustainability Plan, LM has taken a number of steps to implement

[26]GAO-14-704G.

[27]Per the long-term surveillance and maintenance plan for the Weldon Spring site, DOE is to maintain and operate an interpretive center at the site to inform the public of the site's history, cleanup activities, and final conditions. DOE may not discontinue operations of the interpretive center without the approval of EPA in consultation with the Missouri state regulator.

emergency and security measures, such as completing emergency drills and tabletop exercises.[28]

The U.S. Global Change Research Program—which coordinates and integrates the activities of 13 federal agencies that research changes in the global environment and their implications for society—reported in its November 2018 Fourth National Climate Assessment that climate change is playing a role in the increasing frequency of some types of extreme weather, such as extremely heavy rainfall and hurricanes; these are environmental conditions that have presented challenges at LM sites.[29] The assessment reported that climate models are consistent with temperature and precipitation extremes becoming more frequent, more intense, or longer in duration, which may make certain natural disasters more frequent or more intense. As a result of the significant risks posed by climate change and the nation's fiscal condition, in February 2013, we added *Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks* to our list of areas at high risk for fraud, waste, abuse, and mismanagement, or most in need of transformation.[30] In our March 2019 update to this high-risk area, we reported that the federal government needs to improve the resilience of facilities it owns and operates, and land it manages, against the effects of climate change.[31] In addition, in October 2019, we found that EPA needs to improve management of risks from climate change at Superfund sites where remedies may need to be operational indefinitely (see sidebar).

[28]U.S. Department of Energy Legacy Management, *2020 LM Site Sustainability Plan*, LMS/S07225 (December 2019).

[29]D.R. Reidmiller, C.W. Avery, D. R. Easterling, K. E. Kunkel, K. L. M. Lewis, T. K. Maycock, and B. C. Stewart (eds.), *2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* (Washington, D.C.: U.S. Global Change Research Program, November 2018). Under the Global Change Research Act of 1990 (Pub. L. No. 101-606, § 103 (1990)), the U.S. Global Change Research Program is to periodically prepare a scientific assessment—known as the National Climate Assessment—which is an important resource for understanding and communicating climate change science and impacts in the United States. The Office of Science and Technology Policy within the Executive Office of the President oversees the U.S. Global Change Research Program.

[30]GAO, *High-Risk Series: An Update,* GAO-13-283 (Washington, D.C.: Feb. 14, 2013).

[31]GAO-19-157SP.

We Found That EPA Should Take Additional Actions to Manage Risks from Climate Change

Superfund is the federal government's principal program to address sites with hazardous substances. It was established by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and is administered by the Environmental Protection Agency (EPA). EPA lists some of the most seriously contaminated sites on the National Priorities List (NPL) and has recorded over 500 contaminants at those sites. Some NPL sites are located at federal facilities, where departments such as the Department of Energy are responsible for cleanup. However, most NPL sites are nonfederal, where EPA generally carries out or oversees the cleanup conducted by one or more potentially responsible parties.

In October 2019, we reported that available federal data on flooding, storm surge, wildfires, and sea level rise suggest that about 60 percent of all nonfederal NPL sites are located in areas that may be impacted by these potential climate change effects. According to EPA officials, remedies at nonfederal NPL sites may have to be operational indefinitely, during which time the potential effects of climate change may become more extreme. We found that EPA has taken some actions to manage risks from the potential impacts of climate change effects at nonfederal NPL sites, but that its actions did not fully align with essential elements of enterprise risk management. For example, we found that EPA officials do not always have direction to ensure that they consistently integrate climate change information into site-level risk assessments and risk response decisions, according to EPA officials. Without providing such direction, EPA cannot ensure that remedies at nonfederal NPL sites will protect human health and the environment in the long-term.

We made four recommendations to EPA, including that it provide direction on how to integrate information on the potential impacts of climate change effects into risk assessments and risk response decisions at nonfederal NPL sites. EPA agreed with one recommendation and disagreed with the other three. We continue to believe that all four are warranted.

Source: GAO, *Superfund: EPA Should Take Additional Actions to Manage Risks from Climate Change* (GAO-20-73). | GAO-20-373

LM's 2016-2025 *Strategic Plan* acknowledges the challenges posed by climate change.[32] To support the objective of improving the long-term sustainability of environmental remedies, the plan includes a strategy to "assess the effect of climate change on environmental remedies and develop plans to mitigate significant impacts." However, LM provided minimal information about ongoing or planned efforts to carry out this strategy. Specifically, the *2020 LM Site Sustainability Plan*, which officials said provides information about LM's future plans to adapt to changing climate conditions, includes the term "climate change" one time, in reference to sustainable buildings—not to remedies. The plan describes one pilot project conducted at the Monticello site to evaluate the site's main climate stressors and capacity to adapt to those stressors, but it does not describe whether or how LM intends to use the results of the pilot project, such as any specific plans to roll out the project to other sites.[33] Aside from the *2020 LM Site Sustainability Plan*, LM officials said they have a goal to review sites' conceptual models, which predict how remedies should perform under different conditions, with the aim of updating the assumptions in the models to better account for real-world conditions. However, LM did not provide details about how it intends to meet this goal, such as a schedule for implementing this review across its sites.

According to LM officials, LM has not developed a plan or schedule for reviewing sites' conceptual models because of competing priorities. In addition, LM officials told us they have not assessed the effects of climate change or developed plans to mitigate those effects because of a lack of concern about the risks posed by climate change. Specifically, site managers in charge of several of LM's category 3 sites—including Rocky Flats, which has the highest environmental liability of LM's 100 sites and is currently implementing the large-scale project described above to address erosion caused by extreme precipitation—told us that

[32]U.S. Department of Energy Legacy Management, *2016-2025 Strategic Plan*, DOE/LM-1477 (May 2016).

[33]LM headquarters officials told us that site managers conduct separate assessments of current climate trends to determine the climate resilience of cleanup remedies at their sites, but said that these assessments are not part of an overall plan to assess the effects of climate change or to mitigate those effects. LM provided documentation of one such assessment for the Monticello site, but officials said that LM has not applied the assessment to other sites.

they have not assessed the potential effects of climate change on their sites because they do not believe climate change is a concern.

Recognizing the federal government's significant role in managing climate-related disaster impacts, GAO's *Disaster Resilience Framework* provides three broad principles that those who oversee or manage federal efforts can consider when analyzing opportunities to enhance their contribution to national disaster resilience.[34] For instance, under the information principle, the framework states that accessing authoritative, understandable information can help decision makers to identify current and future risk and the impact of risk-reduction strategies. In addition, the integration principle states that integrated analysis and planning can help decision makers take coherent and coordinated resilience actions. By developing plans to assess the effect of climate change on LM's sites and to mitigate any significant impacts and, as part of these plans, incorporating principles from GAO's *Disaster Resilience Framework*, as appropriate, LM could better ensure that its remedies will protect human health and the environment in the long term.

Regulators Update or Adopt New Requirements, Making Remedies No Longer Compliant With Standards

According to LM officials, LM faces challenges when regulators update or adopt new requirements and regulations for contaminants, meaning that remedies in place when LM received a site may no longer meet standards. For example:

- At several sites, such as the Fernald Preserve and Mound sites in Ohio and the Rocky Flats site in Colorado, LM officials told us they are investigating for per- and polyfluoroalkyl substances (PFAS) or vapor-forming chemicals, which are emerging contaminants that EM

[34]The principles are (1) information, which is about giving federal and nonfederal decision makers authoritative and understandable information to help identify current and future risks, as well as the impact of risk-reduction strategies; (2) integration, which is about enabling decision makers to take coherent and coordinated actions; and (3) incentives, which is about making long-term, forward-looking, risk-reduction investments more viable and attractive among competing priorities. See GAO, *Disaster Resilience Framework: Principles for Analyzing Federal Efforts to Facilitate and Promote Resilience to Natural Disasters,* GAO-20-100SP (Washington, D.C.: Oct. 2019).

was not required to address when cleaning up these sites.[35] EPA has published information regarding potential impacts to human health and the environment from these and other emerging contaminants. Federal regulatory standards issued by EPA in the future could affect LM sites.

- At the Bluewater site in New Mexico, LM officials said that the state recently adopted an updated, more stringent uranium drinking water standard. Under the new standard, the area of groundwater that is considered contaminated is much larger than the area of groundwater considered contaminated under the standard in place when NRC approved transfer of the site to LM, according to officials.

To address challenges related to new requirements and regulations, LM is monitoring changes to federal and state standards. For example, LM participates in interagency working groups, such as a PFAS working group led by DOE's Office of Environment, Health, Safety, and Security. Participation in the working groups helps LM monitor the evolution of a federal PFAS regulatory standard, according to LM officials. In addition, LM officials told us that they routinely review state and federal regulatory changes, with the aim of providing sites time to prepare for any changes. LM also evaluates its surveillance and maintenance practices against current regulatory and best management requirements to identify any gaps. For instance, in 2018, the contractor that provides support services to LM reviewed site management practices listed in UMTRCA Title I and II sites' site management plans against current regulatory requirements. The review identified a number of discrepancies between practices and requirements. For example, the review found that some site management plans were developed many years ago and had not been updated to reflect changes in remedy requirements. LM indicated it planned to take steps to address the discrepancies identified by this review. For example, LM is planning to update its site management plans to include the most current remedy requirements for each site.

[35]PFAS are a group of man-made chemicals that have been manufactured and used in a variety of industries around the globe, including in the United States. They can be used in some food packaging and are also used in firefighting foams and in a wide range of manufacturing practices. PFOA and PFOS—two specific PFAS chemicals—have been the most extensively produced and studied of these chemicals. Both are very persistent in the environment and in the human body. Exposure to certain PFAS can lead to adverse human health effects. EPA has issued a non-enforceable drinking water advisory and is evaluating whether to issue drinking water standards for PFAS under the Safe Drinking Water Act. These standards could affect LM sites.

Conclusions

At many sites contaminated from nuclear weapons production and nuclear energy research dating back to World War II and the Cold War, completely eliminating risks to human health and the environment is unlikely. LM is responsible for protecting human health and the environment from the risks that remain after other entities have cleaned up these sites, and its mission is long-term—LM sites will require surveillance and maintenance for hundreds or even thousands of years. Over this period, the likelihood that cleanup remedies will experience performance challenges is high, and these challenges may exceed the scope of LM's mission, capabilities, and resources. LM acquires sites from several cleanup entities, but has not developed agreements or procedures with EM or NRC for addressing challenges that require new, active cleanup work. By working with EM and NRC to develop agreements and procedures for identifying and addressing circumstances at LM sites that require new cleanup work beyond the scope of LM's mission, capabilities, and resources, LM can help ensure mitigation by the most appropriate entity of the risks to human health and the environment that such instances would present.

Environmental conditions also present challenges to LM's sites, and some of these conditions may become more frequent or intense in the future, according to the 13-agency U.S. Global Change Research Program. To ensure the long-term protectiveness of remedies, it is important for LM to understand how climate change may affect its sites. LM's strategic plan includes a strategy to assess the effects of climate change on its sites, but the agency provided minimal information about how it plans to carry out this strategy. GAO's *Disaster Resilience Framework* outlines a set of principles that those who oversee or manage federal efforts can consider when analyzing opportunities to enhance their contribution to national disaster resilience. By developing plans to assess the effect of climate change on LM's sites and to mitigate any significant impacts, and, as part of these plans, incorporating principles from GAO's *Disaster Resilience Framework*, as appropriate, LM could better ensure that its remedies will protect human health and the environment in the long term.

Recommendations for Executive Action

We are making three recommendations to DOE:

The Secretary of Energy should direct the Director of LM and the Assistant Secretary of the Office of Environmental Management to develop agreements and procedures for identifying and addressing circumstances at LM sites that require new cleanup work beyond the scope of LM's mission, capabilities, and resources. (Recommendation 1)

The Secretary of Energy should direct the Director of LM to work with the Nuclear Regulatory Commission to develop agreements and procedures for identifying and addressing circumstances at LM sites that require new cleanup work beyond the scope of LM's mission, capabilities, and resources. (Recommendation 2)

The Secretary of Energy should direct the Director of LM to, as called for in LM's strategic plan, develop plans to assess the effect of climate change on LM's sites and to mitigate any significant impacts. These plans should incorporate principles from GAO's *Disaster Resilience Framework*, as appropriate. (Recommendation 3)

Agency Comments and Our Evaluation

We provided a draft of this report to DOE for comment. In its comments, reproduced in appendix IV, DOE agreed with our three recommendations. In its letter, DOE officials stated that in response to our first two recommendations, it plans to work with DOE's Office of Environmental Management and the Nuclear Regulatory Commission to develop agreements and procedures for identifying and addressing new cleanup work beyond LM's mission scope of long-term stewardship. DOE officials also stated that in response to our third recommendation, LM will develop site assessment and mitigation plans, taking into account any significant effects of climate change and incorporating principles from GAO's *Disaster Resilience Framework*, as appropriate. DOE also provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committee, the Secretary of Energy, and other interested parties. In addition, the report is available at no charge on the GAO website at https://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or trimbled@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix V.

David C. Trimble
Director, Natural Resources and Environment

Appendix I: DOE Office of Legacy Management's Nine Category 3 Sites as of Fiscal Year 2019

Table 1: Category 3 Sites Managed by DOE Office of Legacy Management (LM) as of Fiscal Year 2019

Category 3 sites require the most intensive surveillance and maintenance, typically including an ongoing groundwater remediation system because of the long timeframes required to capture and remediate groundwater.

LM site name (state)	Site history and contamination	Fiscal year of transfer to LM
Fernald Preserve site (Ohio)	• Former site of a uranium processing facility, which from 1951 to 1989 produced high-purity uranium metal products as the first step in the nuclear weapons production cycle • Facility operations contaminated the soil, groundwater, and surface water with uranium	2008
Grand Junction Disposal/Processing site (Colorado)	• Former site of a uranium and vanadium mill that operated from 1950 to 1970 • A disposal cell at the site holds contaminated materials, and part of it remains open to receive additional low-level radioactive material	1999
Monticello Disposal and Processing sites (Utah)	• Former site of a uranium and vanadium mill that operated from the early 1940s to 1960 • Properties in the city of Monticello and near the mill were contaminated by windblown uranium mill tailings, tailings carried by surface water, and tailings that were used for construction-related purposes[a]	2002
Mound site (Ohio)	• Former site of a DOE research, development, and production facility that operated from 1948 to 2003 and supported weapons, energy, and space missions • Facility operations resulted in low-level radioactivity in the soil and volatile organic compounds in the groundwater	2012
Pinellas County site (Florida)	• Site of a facility that developed and manufactured nuclear weapons components from 1957 to 1994 • Waste disposal practices contaminated portions of the underlying aquifer with organic solvents and metals	2004
Rocky Flats site (Colorado)	• Site of the Rocky Flats Plant, which from 1952 to 1994 produced nuclear and nonnuclear weapons components, including the plutonium pit, or "trigger," for nuclear weapons • Plant operations caused substantial contamination from plutonium, beryllium, and other hazardous substances	2008
Shiprock Disposal site (New Mexico)	• Site of a uranium- and vanadium-ore processing facility within the Navajo Nation that operated from 1954 to 1968 • Milling operations created radioactive tailings and contaminated the groundwater with uranium and other contaminants	1996
Tuba City Disposal site (Arizona)	• Site of a uranium mill within the Navajo Nation that operated from 1956 to 1966 • Milling operations created radioactive tailings and contaminated the groundwater with uranium	1996
Weldon Spring site (Missouri)	• Site of a chemical plant and quarry that operated from the early 1940s to the late 1960s and produced explosives and processed uranium • Site operations contaminated soil and ground and surface water	2003

Source: GAO analysis of Department of Energy (DOE) documents. | GAO-20-373

Note: DOE's Office of Environmental Management was responsible for cleanup of these sites. LM acquired these sites from the Office of Environmental Management once cleanup was completed.

DOE considers site cleanup to be complete when, among other things, short-term cleanup activities have been completed and long-term cleanup measures, such and groundwater treatment, are in place.

[a]Uranium mill tailings are the residue that remains from extracting uranium from uranium ore. The tailings are radioactive and might contain other metals or hazardous substances.

Appendix II: List of DOE Office of Legacy Management's 100 Sites as of Fiscal Year 2019

Table 2: List of Sites Managed by DOE Office of Legacy Management (LM) as of Fiscal Year 2019, by Category

LM site name	State	Cleanup entity	Fiscal year of transfer to LM
Category 3 sites (9)			
Fernald Preserve site	Ohio	DOE Office of Environmental Management (EM)	2008
Grand Junction Disposal/Processing site	Colorado	EM	1999
Monticello Disposal and Processing sites	Utah	EM	2002
Mound site	Ohio	EM	2012
Pinellas County site	Florida	EM	2004
Rocky Flats site	Colorado	EM	2008
Shiprock Disposal site	New Mexico	EM	1996
Tuba City Disposal site	Arizona	EM	1996
Weldon Spring site	Missouri	EM	2003
Category 2 sites (49)			
Ambrosia Lake Disposal site	New Mexico	EM	1998
Amchitka site	Alaska	EM	2008
Attleboro site	Massachusetts	U.S. Army Corps of Engineers (USACE)	2019
Bayo Canyon site	New Mexico	EM	1984/2019[a]
Bluewater Disposal site	New Mexico	private licensee	1997
Boiling Nuclear Superheater Decommissioned Reactor site	Puerto Rico	EM	2004
Bronco site	Colorado	EM	2019
Burrell Disposal site	Pennsylvania	EM	1994
Burris Park site	California	EM	2015
Canonsburg Disposal site	Pennsylvania	EM	1996
Central Nevada Test Area	Nevada	EM	2008
Colonie site	New York	USACE	2019
Durango Disposal/Processing site	Colorado	EM	1996
Edgemont Disposal site	South Dakota	private licensee	1996
Falls City Disposal site	Texas	EM	1997
Gasbuggy site	New Mexico	EM	2008
Gnome-Coach site	New Mexico	EM	2008
Grand Junction site	Colorado	EM	2002
Green River Disposal site	Utah	EM	1998
Gunnison Disposal/Processing site	Colorado	EM	1997

LM site name	State	Cleanup entity	Fiscal year of transfer to LM
Hallam Decommissioned Reactor site	Nebraska	EM	1998
Laboratory for Energy-Related Health Research site	California	EM	2006
Lakeview Disposal/Processing site	Oregon	EM	1995
L-Bar Disposal site	New Mexico	private licensee	2004
Lowman Disposal site	Idaho	EM	1994
Maybell Disposal site	Colorado	EM	1999
Maybell West Disposal site	Colorado	private licensee	2010
Mexican Hat Disposal site	Utah	EM	1997
Monument Valley Processing site	Arizona	EM	1997
Naturita Disposal/Processing site	Colorado	EM	1999
New Brunswick site	New Jersey	EM	2001
Painesville site	Ohio	USACE	2016
Parkersburg Disposal site	West Virginia	private licensee	1994
Piqua Decommissioned Reactor site	Ohio	EM	1998
Pre-Gondola and Trencher site	Montana	EM	2019
Rifle Disposal/Processing site	Colorado	EM	1998
Rio Blanco site	Colorado	EM	2008
Riverton Processing site	Wyoming	EM	1991
Rulison site	Colorado	EM	2008
Salmon site	Mississippi	EM	2008
Salt Lake City Disposal/Processing site	Utah	EM	1997
Sherwood Disposal site	Washington	private licensee	2001
Shirley Basin South Disposal site	Wyoming	private licensee	2005
Shoal site	Nevada	EM	2008
Site A / Plot M Decommissioned Reactor site	Illinois	EM	1998
Slick Rock Disposal/Processing site	Colorado	EM	1998
Spook Disposal site	Wyoming	EM	1993
Tonawanda site	New York	USACE	2017
Utah site	Utah	EM	2019
Category 1 sites (42)			
Acid/Pueblo Canyon site	New Mexico	EM	1985
Adrian site	Michigan	EM	1996
Albany site	Oregon	EM	1993
Aliquippa site	Pennsylvania	EM	1997
Ashtabula site	Ohio	EM	2010

LM site name	State	Cleanup entity	Fiscal year of transfer to LM
Berkeley site	California	EM	1985
Beverly site	Massachusetts	EM	2004
Buffalo site	New York	USACE	2002
Center for Energy and Environmental Research site	Puerto Rico	EM	2006
Chariot site	Alaska	EM	2005
Chicago North site	Illinois	EM	1989
Chicago South site	Illinois	EM	1989
Chupadera Mesa site	New Mexico	EM	1986
Columbus East site	Ohio	EM	2001
Columbus site	Ohio	EM	2008
El Verde site	Puerto Rico	EM	2006
Fairfield site	Ohio	EM	1996
General Atomics Hot Cell Facility site	California	EM	2005
Geothermal Test Facility site	California	EM	2005
Granite City site	Illinois	EM	1994
Hamilton site	Ohio	EM	1997
Indian Orchard site	Massachusetts	EM	2004
Inhalation Toxicology Laboratory site	New Mexico	EM	2012
Jersey City site	New Jersey	EM	1983
Madison site	Illinois	USACE	2002
Maxey Flats Disposal site	Kentucky	EM	2004
Missouri University Research Reactor site	Missouri	EM	2005
New York site	New York	EM	1996
Niagara Falls Storage Site Vicinity Properties site	New York	EM	1992
Oak Ridge Warehouses site	Tennessee	EM	1994
Oxford site	Ohio	EM	1997
Oxnard site	California	EM	2008
Plowshare/Vela Uniform sites, Records Only	Nevada	EM	2019
Pre-Schooner II site	Idaho	EM	2019
Seymour site	Connecticut	EM	1995
Springdale site	Pennsylvania	EM	1996
Toledo site	Ohio	EM	2001
Tonawanda North site Unit 1	New York	USACE	2009
Tonawanda North site Unit 2	New York	USACE	2009

LM site name	State	Cleanup entity	Fiscal year of transfer to LM
Vallecitos Nuclear Center site	California	EM	2013
Wayne site	New Jersey	USACE	2007
Windsor site	Connecticut	USACE	2019

Source: GAO analysis of Department of Energy (DOE) documents. | GAO-20-373

Note: LM places each of its sites into one of three categories based on the actual or anticipated long-term surveillance and maintenance activities associated with the site: "category 3" sites require the most intensive surveillance and maintenance, which typically includes maintaining an ongoing remediation system; "category 2" sites require routine inspection, monitoring, and maintenance; and "category 1" sites require management of records or stakeholder requests for information.

[a]The Bayo Canyon Site was formerly two separate sites, both of which were cleaned up by EM. One was transferred to LM in 1984, while the other was transferred to LM in 2019.

Appendix III: List of 52 Sites Transferring to the DOE Office of Legacy Management by Fiscal Year 2050, as of September 2019

Table 3: List of Sites Transferring to DOE Office of Legacy Management (LM) by Fiscal Year (FY)

LM site name	State	Cleanup entity	Anticipated site category
Planned transfer in FY 2020			
Tonopah Test Range site	Nevada	DOE Office of Environmental Management (EM)	2
Planned transfer in FY 2022			
Durita Disposal site	Colorado	private licensee	2
East Tennessee Technology Park site[a]	Tennessee	EM	2
Elemental Mercury Storage Facility	Texas	EM	3
Gas Hills East Disposal site	Wyoming	private licensee	2
Gas Hills North Disposal site	Wyoming	private licensee	2
Panna Maria Disposal site	Texas	private licensee	2
Ray Point Disposal site	Texas	private licensee	2
Split Rock Disposal site	Wyoming	private licensee	2
Planned transfer in FY 2023			
Bear Creek Disposal site	Wyoming	private licensee	2
Hazelwood site	Missouri	U.S. Army Corps of Engineers (USACE)	3
Planned transfer in FY 2024			
Curtis Bay site	Maryland	USACE	2
Deepwater site	New Jersey	USACE	2
Highland Disposal site	Wyoming	private licensee	2
Lisbon Valley Disposal site	Utah	private licensee	2
Middlesex South site	New Jersey	USACE	2
Middletown site	Iowa	USACE	2
Tonawanda Landfill site	New York	USACE	2
Planned transfer in FY 2025			
Ambrosia Lake West Disposal site	New Mexico	private licensee	2
Conquista Disposal site	Texas	private licensee	2
Gas Hills West Disposal site	Wyoming	private licensee	2
Sequoyah County Disposal site	Oklahoma	private licensee	2
Uravan Disposal site	Colorado	private licensee	2
Planned transfer in FY 2026			
Ford Disposal site	Washington	private licensee	2
Maywood site	New Jersey	USACE	2
St. Louis site	Missouri	USACE	3
Planned transfer in FY 2027			

LM site name	State	Cleanup entity	Anticipated site category
Church Rock Disposal site	New Mexico	private licensee	2
Grants Disposal site	New Mexico	private licensee	2
Planned transfer in FY 2031			
Tonawanda North Site Unit 3	New York	USACE	2
Planned transfer in FY 2032			
Energy Technology Engineering Center site[b]	California	EM	1
Planned transfer in FY 2033			
Luckey site	Ohio	USACE	2
Planned transfer in FY 2035			
Moab Disposal/Processing site	Utah	EM	3
Planned transfer in FY 2038[c]			
Berkeley site	Missouri	USACE	3
Berkeley Site Vicinity Properties	Missouri	USACE	3
Carnegie site	Pennsylvania	USACE	2
Cleveland site	Ohio	USACE	2
Ft. Wayne site	Indiana	USACE	2
Hicksville site	New York	USACE	2
Lockport site	New York	USACE	2
Middlesex North site	New Jersey	USACE	2
Niagara Falls Storage site	New York	USACE	2
Parks Township site	Pennsylvania	USACE	2
Planned transfer in FY 2040			
West Valley site[d]	New York	EM	2
Planned transfer in FY 2044			
Portsmouth site[e]	Ohio	EM	2
Planned transfer in FY 2047			
Cañon City Disposal site	Colorado	private licensee	2
Paducah site[f]	Kentucky	EM	2
Salt Lake City 11e.(2) Disposal site	Utah	private licensee	2
Shirley Basin North Disposal site	Wyoming	private licensee	2
Shootaring Canyon Disposal site	Utah	private licensee	2
Sweetwater Disposal site	Wyoming	private licensee	2
White Mesa Disposal site	Utah	private licensee	2
Planned transfer in FY 2050			
Andrews 11e.(2) Disposal site	Texas	private licensee	2

Source: GAO analysis of Department of Energy (DOE) document and LM officials. | GAO-20-373

Note: When sites transfer to LM, LM places each site into one of three categories based on the actual or anticipated long-term surveillance and maintenance activities associated with the site: “category 3” sites require the most intensive surveillance and maintenance, which typically includes maintaining an ongoing remediation system; “category 2” sites require routine inspection, monitoring, and maintenance; and “category 1” sites require management of records or stakeholder requests for information.

[a]In its technical comments on our draft report, DOE revised the planned transfer date for the East Tennessee Technology Park site to 2021, and said that the K-25 slab at the East Tennessee Technology Park Site will transfer in fiscal year 2021. The remainder of the site will transition in fiscal year 2025, according to LM’s site management guide. However, we previously reported that EM officials stated that 2024 is a more accurate completion timeframe for this site. Further, officials at the Environmental Protection Agency (EPA) and Tennessee regulators told us that based on their understanding of remaining work, cleanup of the site may not be completed until the late 2020s. EPA officials also believe this cleanup could be completed as late as the 2040s. See GAO, *Nuclear Cleanup: Actions Needed to Improve Cleanup Efforts at DOE’s Three Former Gaseous Diffusion Plants*, GAO-20-63 (Washington, D.C.: Dec. 17, 2019).

[b]In its technical comments on our draft report, DOE revised the planned transfer date for the Energy Technology Engineering Center site to 2044.

[c]For all sites except the Berkeley, Missouri sites, the transfer date is assumed to be fiscal year 2038 for planning purposes. The actual date of cleanup action completion has not yet been determined by USACE.

[d]In its technical comments on our draft report, DOE revised the planned transfer date for the West Valley site to 2041.

[e]In its technical comments on our draft report, DOE revised the planned transfer date for the Portsmouth site to 2041.

[f]In its technical comments on our draft report, DOE revised the planned transfer date for the Paducah site to “beyond 2050.”

Appendix IV: Comments from the Department of Energy

Department of Energy
Washington, DC 20585

April 27, 2020

Mr. David Trimble
Director
Natural Resources and Environment
U.S. Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Trimble:

The Department of Energy (DOE) appreciates the opportunity to provide a Departmental response to the Government Accountability Office's (GAO) draft report titled, *Environmental Liabilities: DOE Needs to Better Plan for Post Cleanup Challenges Facing Sites (GAO-20-373).* The draft report contained a total of three recommendation and DOE concurs with each of GAO's recommendations. Also, DOE has included technical comments in the enclosure for GAO's consideration.

GAO should direct any questions to Peter O'Konski, Deputy Director, Office of Legacy Management, at 202-586-4873 or via email at Peter.Okonski@hq.doe.gov.

Sincerely,

Peter O'Konski for

Carmelo Melendez
Director
Office of Legacy Management

Enclosure

Department of Energy
Washington, DC 20585

Management Response

Recommendation 1: The Secretary of Energy should direct the Director of LM and the Assistant Secretary of the Office of Environmental Management to develop agreements and procedures for identifying and addressing circumstances at LM sites that require new cleanup work beyond the scope of LM's mission, capabilities, and resources.

DOE Response: Concur

LM and EM will work together to expand on agreements and procedures for identifying and addressing new cleanup work beyond LM's mission scope of Long-Term Stewardship (LTS).

Estimated Completion Date: September 30, 2021.

Recommendation 2: The Secretary of Energy should direct the Director of LM to work with the Nuclear Regulatory Commission to develop agreements and procedures for identifying and addressing circumstances at LM sites that require new cleanup work beyond the scope of LM's mission, capabilities, and resources.

DOE Response: Concur

LM will work with the Nuclear Regulatory Commission and EM to develop agreements and procedures for identifying and addressing new cleanup work beyond LM's mission scope of Long-Term Stewardship.

Estimated Completion Date: September 30, 2021

Recommendation 3: The Secretary of Energy should direct the Director of LM to, as called for in LM's strategic plan, develop plans to assess the effect of climate change on LM's sites and to mitigate any significant impacts. These plans should incorporate principles from GAO's Disaster Resilience Framework, as appropriate.

DOE Response: Concur

LM currently uses models to project Long-Term Stewardship mission requirements. These model efforts contribute to the evaluation of LM sites' vulnerability and resilience to environmental trends over time. LM will build upon current operations to develop assessment and mitigation plans, taking into account any significant effects of climate change that will incorporate principles from GAO's *Disaster Resilience Framework (GAO-20-100SP)*, as appropriate.

Estimated Completion Date: September 2022.

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

David C. Trimble, (202) 512-3841 or trimbled@gao.gov.

Staff Acknowledgments

In addition to the contact named above, Amanda K. Kolling (Assistant Director), Katherine Killebrew (Analyst in Charge), and Rachel Pittenger made key contributions to this report. Also contributing to this report were Mark Braza, Ellen Fried, Susan J. Irving, Richard Johnson, Keegan Maguigan, Katrina Pekar-Carpenter, Dan Royer, and Doris Yanger.

Appendix

- Acronym List

Rocky Flats Acronym List
Prepared for the Rocky Flats Stewardship Council
Rev. 02/20

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 or one inch of air. Alpha radiation presents its greatest risk when it is inhaled or ingested. Plutonium, the radioactive material of greatest concern at Rocky Flats, produces this type of radiation.
Am	americium	A man-made radioactive element that is a byproduct of plutonium (Pu) production. Am emits gamma radiation, which can penetrate 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 plutonium, americium, and uranium move through the soil and water at Rocky Flats.
AMP	Adaptive Management Plan	Additional water quality sampling and analysis that DOE is conducting, beyond the normal environmental assessments, to inform decisions regarding future breaches of remaining dams.
AOC well	Area of Concern well	A particular type of groundwater well.
B	boron	An inorganic compound that has been found in some surface water and groundwater samples at Rocky Flats.
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 that is more penetrating than alpha (but less penetrating than gamma). Beta particles can be stopped after traveling through 10 feet of air or a thin layer of glass or metal. Some forms of uranium emit beta radiation.
BMP	Best Management Practices	A term used to describe actions taken by DOE that are not required by regulation but warrant action.
BZ	Buffer Zone	The portion of the Rocky Flats site that was added during production to provide a "buffer" between the neighboring communities and the industrial portion of Rocky Flats. The buffer zone covered approximately 6,100 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	The state agency that regulates Rocky Flats.

Acronym or Term	Means	Definition
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act	Federal legislation that governs the Rocky Flats 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 Rocky Flats.
COU	Central Operable Unit	A CERCLA term used to describe the DOE-retained lands (about 1,300 acres) at Rocky Flats. The COU overlays the former Industrial Area (where manufacturing activities took place) and contains all engineered elements of the remedy (two landfills and four groundwater treatment systems) and areas of residual subsurface contamination.
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-Legacy Management (LM) website and the public is notified via email.
Cr	chromium	Potentially toxic metal used at Rocky Flats.
CRA	Comprehensive Risk Assessment	A series of analyses that assess 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	The location where the treated effluent of the Solar Ponds Plume Treatment System (defined below) 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	A study required by NEPA (defined 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	An evaluation that is undertaken by a government agency when it is determined, via the EA, that a proposed action by the agency may have significant impacts to the environment.
EPA	U.S. Environmental Protection Agency	The federal agency that regulates Rocky Flats activities.
EEOICPA	Energy Employees Occupational Illness Compensation Program Act	An act passed by Congress in 2000 to compensate sick nuclear weapons workers and certain survivors.

Acronym or Term	Means	Definition
ETPTS	East Trenches Plume Treatment System	The treatment system near the location of the East Waste Disposal Trenches. This system treats groundwater emanating from the trenches that is contaminated with organic solvents, as well as groundwater routed from the Mound Plume Site Collection System. 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	The federal law that regulates federal advisory boards. The law requires balanced membership and open meetings with published Federal Register meeting dates.
Gamma Radiation		The most penetrating type of radiation at Rocky Flats. Thick, dense shielding is necessary to protect against gamma rays. Americium (Am) is a strong gamma emitter.
GAO	Government Accountability Office	Congressional investigative office that reports to Congress.
g	gram	A metric unit of mass.
gpm	gallons per minute	A volumetric measure of water flow.
GWIS	Groundwater Intercept System	A below-ground system that directs contaminated groundwater toward the Solar Ponds Plume and East Trenches Plume Treatment Systems.
IA	Industrial Area	The central core of Rocky Flats where all manufacturing activities took place. The IA covered 385 of Rocky Flats's 6,500 acres.
IC	Institutional Control	Administrative and legal controls employed to protect the integrity of the remedies in place and minimize the potential for human exposure to residual contamination.
IGA	intergovernmental agreement	A cooperative agreement between local governments that establishes 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 formerly over two hundred IHSSs 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 Plume Treatment System or the East Trenches Plume Treatment System.
L	liter	Metric measure of volume (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	Hydrogeological term for deep unweathered bedrock that is hydraulically isolated from the upper hydrostratigraphic unit (see UHSU). Data show that site COCs have not contaminated the LHSU.

Acronym or Term	Means	Definition
LM	Legacy Management	DOE office responsible for overseeing activities at closed sites.
LMPIP	Legacy Management Public Involvement Plan	A plan that 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).
O&M/OM&M	Operations, monitoring, and maintenance	Term that describes ongoing activities at Rocky Flats.
MOU	Memorandum of Understanding	The formal agreement between EPA and CDPHE specifying that CDPHE is the lead post-closure regulatory agency with EPA providing assistance when needed.
MSPCS	Mound Site Plume Collection System	The system that collects groundwater and routes it to the ETPTS for treatment.
MSPTS	Mound Site Plume Treatment System	The remediation system formerly in place (reconfigured in 2016) to treat groundwater contaminated with organic solvents emanating from the Mound Site (a portion of Rocky Flats where waste barrels were buried).
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 originating from Solar Ponds wastes. Nitrates have been detected in the North Walnut Creek drainage. Nitrates are very soluble in water and move readily through the aquatic environment.
Np	neptunium	A man-made radioactive isotope that is a by-product of nuclear reactors and plutonium production.
NPL	National Priorities List	A list of Superfund sites. The refuge lands were de-listed from the NPL, while the DOE-retained lands are still on the NPL because of residual groundwater contamination and associated remediation activities.
NWCS	North Walnut Creek Slump	Slumping observed on the hillside east of the Solar Ponds Plume Treatment System.
OLF	Original Landfill	Hillside dumping area of about 20 acres that was used from 1951 to 1968. The OLF underwent remediation with the addition of a soil cap and groundwater monitoring locations.
OU	Operable Unit	A distinct area within a cleanup site. These areas may address geographic areas, specific problems, or medium (e.g., groundwater, soil) where a specific action is required.
PCE	perchloroethylene (a.k.a. tetrachloroethylene)	A volatile organic solvent used in past operations at Rocky Flats.
pCi/g	picocuries per gram	A unit of radioactivity in soil.
pCi/L	picocuries per liter	A unit of radioactivity in water. CDPHE's regulatory limit for Pu and Am in surface water at Rocky Flats is 0.15 pCi/L. This standard is 100 times stricter than the EPA's drinking water standard.

Acronym or Term	Means	Definition
PLF	Present Landfill	Landfill constructed in 1968 to replace the OLF. During site remediation, 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 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 monitoring location at Rocky Flats where contaminant concentrations must 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)	A surface water monitoring location at Rocky Flats where water quality is monitored. There are no financial penalties associated with water quality exceedances at these locations, but DOE 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 4,800-acre area surrounding the Central Operable Unit.
Pu	plutonium	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. There are different forms of plutonium, called isotopes. Each isotope is known by a different number, such as plutonium 239 (Pu-239) and plutonium 241 (Pu-241). Pu-239 is the primary radioactive COC at Rocky Flats.
RCRA	Resource Conservation and Recovery Act	Federal law regulating hazardous waste. In Colorado, EPA delegates to CDPHE the authority to regulate hazardous wastes.
RFCA	Rocky Flats Cleanup Agreement	The regulatory agreement that governed cleanup activities. DOE, EPA, and CDPHE were signatories.
RFCAB	Rocky Flats Citizen Advisory Board	The group formed as part of DOE's site-specific advisory board network. The RFCAB provided community feedback to DOE on a wide variety of Rocky Flats issues from 1993 through regulatory closure in 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 Rocky Flats during cleanup years.
RFLMA	Rocky Flats Legacy Management Agreement	The post-cleanup regulatory agreement between DOE, CDPHE, and EPA that governs site activities. The CDPHE has the lead regulatory role, with support from EPA as required.
RFNWR	Rocky Flats National Wildlife Refuge	The 4,000 acres of Rocky Flats where unrestricted use is allowed. This land is now a wildlife refuge.

Acronym or Term	Means	Definition
RFSOG	Rocky Flats Site Operations Guide	The nuts-and-bolt guide for post-closure site activities performed by DOE and its contractors.
RSAL	Radionuclide Soil Action Level	Concentration of radionuclide in soil above which remedial action should be considered so that people are not exposure to radiation doses above permitted levels.
SEP	Solar Evaporation Ponds	An area of Rocky Flats used in the 1950s to hold excess wastewater generated during manufacturing operations. Wastewater that could not be treated in the onsite treatment plant was sent to open-air holding ponds where solar energy was utilized to evaporate and concentrate the waste. The original SEPs were unlined, and substantial quantities of uranium and nitrates made their way into groundwater. As a result, the Solar Ponds Plume Treatment System was constructed to treat contaminated groundwater before it emerged as surface water in North Walnut Creek.
SID	South Interceptor Ditch	A water feature designed to intercept runoff from the southern portion of the COU. The SID flows from west to east into Pond C-2. Woman Creek water does not enter Pond C-2, but is diverted around Pond C-2 through the Woman Creek Diversion Canal.
SPPTS	Solar Ponds Plume Treatment System	Engineered system designed 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. Effluent from the SPPTS flows into North Walnut Creek.
SVOCs	semi-volatile organic compounds	Organic compounds that are not as volatile as solvent-related VOCs. SVOCs are found in many environmental media at Rocky Flats. They are found in materials like oil, coal, asphalt, and tar.
TCE	trichloroethylene	A volatile organic compound used as a solvent in past site operations. TCE is also a degradation product of PCE.
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 and was used in nuclear weapons. The second isotope was U-238, also known as depleted uranium. U-238 has low levels of radioactivity.
ug/L or µg/L	micrograms per liter	A unit of contaminant concentration in water.
UHSU	upper hydrostratigraphic unit	A hydrogeological 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 Rocky Flats is contaminated with site-related COCs, while groundwater in other UHSU areas is not impacted. All groundwater in the UHSU emerges to surface water before it leaves Rocky Flats.

Acronym or Term	Means	Definition
USFWS	United States Fish & Wildlife Service	The 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.
UUUE	unlimited use and unrestricted exposure	A regulatory term used to describe residual risk remaining after a site has been remediated. In 2007, the Peripheral Operable Unit (POU) was found to be suitable for unlimited use and unrestricted exposure (based on risk calculations). EPA removed the POU (now largely the Rocky Flats National Wildlife Refuge) from the EPA's National Priorities List of CERCLA or "Superfund" sites.
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 (TCE), perchloroethylene (PCE), and methylene chloride.
WALPOC	Walnut Creek Point of Compliance	The surface water Point of Compliance on Walnut Creek, at the COU boundary.
WCRA (or “the Authority”)	Woman Creek Reservoir Authority	The group composed the cities of Westminster, Northglenn, and Thornton. These cities use Standley Lake as part of their drinking water supply network. Surface water from Rocky Flats formerly flowed through Woman Creek to Standley Lake, but the Woman Creek Reservoir was constructed to sever that connection. The Authority has an operations agreement with DOE to manage the Woman Creek Reservoir.
WOMPOC	Woman Creek Point of Compliance	The surface water Point of Compliance on Woman Creek, at the COU boundary.
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.
WRW	Wildlife Refuge Worker	User scenario on which exposure risks are calculated.
ZVI	zero valent iron	A type of fine iron particles formerly used to treat VOCs in the ETPTS and MSPTS.