LA-UR-19-30619

Title:	**Fiscal Year 2019 Mitigation Action Plan Annual Report for the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory**
Preparer:	**Environmental Protection and Compliance Division—Environmental Stewardship Group**

Prepared for:

U.S. Department of Energy National Nuclear Security Administration Los Alamos Field Office and Office of Environmental Management

Table of Contents

List of Tables

This page intentionally left blank

Acronyms and Abbreviations

ASER	Annual Site Environmental Report
DARHT	Dual-Axis Radiographic Hydrodynamic Test
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPC	Environmental Protection and Compliance Division
FONSI	Finding of No Significant Impact
FRS	Flood Retention Structure
FY	fiscal year
LANL	Los Alamos National Laboratory
MAP	Mitigation Action Plan
MAPAR	Mitigation Action Plan Annual Report
N3B	Newport News Nuclear BWXT
NEPA	National Environmental Policy Act
NNSA	U.S. Department of Energy, National Nuclear Security Administration
ROD	Record of Decision
SWEIS	Site-Wide Environmental Impact Statement
TA	technical area
WIPP	Waste Isolation Pilot Plant

Executive Summary

In compliance with the U.S. Department of Energy (DOE)/National Nuclear Security Administration (NNSA) Policy 451.1, the DOE/NNSA Los Alamos Field Office compiled the fiscal year (FY) 2019 (October 1- September 30) Mitigation Action Plan Annual Report (MAPAR) for the 2008 *Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory* (DOE/EIS-0380). This FY 2019 MAPAR includes mitigations identified in the *Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory Mitigation Action Plan* (DOE/EIS-0380-MAP) (SWEIS MAP) and mitigations identified in other National Environmental Policy Act (NEPA) documents that have been rolled into the SWEIS MAP. In FY 2019, the mitigation commitments identified in the 2008 LANL SWEIS and associated NEPA documents have been met, are ongoing, or are on hold until preceding actions are taken.

Introduction

The 2008 *Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory* (2008 SWEIS) identifies potential environmental impacts resulting from the implementation of actions as analyzed, and it defines mitigation measures that the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) could consider for the reduction of such potential adverse effects (DOE 2008a). The SWEIS Mitigation Action Plan (MAP), a management document, describes how the mitigation measures and commitments defined by the 2008 SWEIS and subsequent Records of Decision (RODs) are accomplished (DOE 2008b, c, 2009).

NNSA Policy, NAP-451.1, *National Environmental Policy Act Compliance Program*, requires heads of program offices and heads of field offices to track and annually report progress made in implementing, and the effectiveness of, commitments to minimize environmental impacts identified in NEPA documents. This Mitigation Action Plan Annual Report (MAPAR) fulfills this requirement of documenting the mitigation actions that are identified in the 2008 SWEIS MAP. Subsequent mitigation actions identified in other NEPA documents have been incorporated into the 2008 SWEIS MAP and are tracked annually through this MAPAR. As required by the 2008 SWEIS MAP, a draft MAPAR summarizing the work conducted by LANL and Newport News Nuclear BWXT (N3B) in the previous fiscal year (FY) is submitted for review to the DOE/NNSA Los Alamos Field Office each October. The DOE/NNSA Los Alamos Field Office finalizes and publishes the SWEIS MAPAR, which also includes subsequent MAP's from other NEPA documents (Section 2.0).

The 2008 SWEIS MAP requires tracking of mitigation actions in a log, with quarterly transmission to the DOE/NNSA Los Alamos Field Office NEPA Compliance Officer. The log includes information regarding the scope, schedule, interim milestones, deliverables, and closures of the mitigation actions and any issues identified each quarter. The annual MAPAR provides a complete tracking log with a summary of the major actions taken in the previous FY (Table 1).

During the preparation of the 2019 MAPAR, the 2008 SWEIS MAP was reviewed to determine whether the mitigation actions remain effective, and if any mitigation actions have been executed and need to be formally closed. Revision of the 2008 SWEIS MAP may be recommended in the MAPAR to address significant changes, new actions, or deficiencies.

This FY 2019 MAPAR is the eleventh MAPAR to the 2008 SWEIS. It reports on the status of mitigation commitments and all executed actions for those commitments which have taken place in the FY. In the 2008 SWEIS MAP, all associated mitigation actions were anticipated to be complete by the end of calendar year 2018, however, many of the remaining actions are anticipated to continue until 2022 which was reported in the 2018 Supplement Analysis to the 2008 SWEIS or until otherwise directed by the DOE/NNSA Los Alamos Field Office (DOE 2018).

Background

In May 2008, the 2008 LANL SWEIS was published, since then there have been two associated RODs published. The first ROD was published in September 2008, and the second ROD was published in June 2009 (DOE 2008a, b, 2009). In January 2009, the 2008 SWEIS MAP (DOE 2008c) was finalized. In November 2010, the 2008 SWEIS MAP was revised (DOE 2010a) to incorporate the MAP associated with the *Final Environmental Assessment for the Expansion of the Sanitary Effluent Reclamation Facility and Environmental Restoration of Reach S-2 of Sandia Canyon at Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2010b). Following this revision, the 2008 SWEIS MAP has been revised several more times in FYs 2014 and 2016 (DOE 2014, 2016) to close out completed mitigations and to add new mitigations identified in other NEPA documents, such as environmental assessments.

In FY 2019, with the issuance of the *Final Supplemental Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory* and Finding of No Significant Impact (FONSI), it was determined that new mitigations would be required to be incorporated into the 2008 SWEIS MAP. This determination will require a revision in FY 2020 of the 2008 SWEIS MAP to incorporate these newly identified mitigations (DOE 2019a, b). In addition to the FY 2020 revisions to the 2008 SWEIS MAP, these same mitigations will be incorporated into the FY 2020 SWEIS MAP quarterly and annual updates.

In FY 2019, the *Final Environmental Assessment for the Proposed Construction and Operation of a Solar Photovoltaic Array at Los Alamos National Laboratory, Los Alamos, New Mexico* and associated FONSI were published (DOE 2019c). The MAP associated with this environmental assessment will also be incorporated into the FY 2020 revisions of the 2008 SWEIS MAP and the mitigations will be tracked in quarterly and annual reports.

The *Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility Final Environmental Impact Statement (EIS) Mitigation Action Plan* (DOE 1996) requires a DARHT MAPAR to be prepared every year as part of implementing the Dual-Axis Radiographic Hydrodynamic Test (DARHT) MAP. The annual DARHT MAPAR is one fiscal year behind the annual SWEIS MAPAR, because results from media sampling are not available until the second quarter of each year. The DARHT MAPAR provides a status of specific DARHT Facility operation-related mitigation actions that have been implemented to fulfill DOE commitments under the DARHT EIS ROD (DOE 1995).

The FY 2018 DARHT MAPAR, included in Appendix A, provides details to the progress of the mitigation action commitments. In addition, the FY 2018 DARHT MAPAR is summarized in Table 1.

Mitigation Action Commitments

Mitigation actions identified in Table 1 are based on mitigation measures and commitments that were previously incorporated in the 2008 LANL SWEIS alternatives, and it summarizes other mitigation measures and commitments from previous NEPA decisions.

Mitigation action commitments are grouped into three categories (1) those identified and incorporated into the 2008 SWEIS MAP from other specific NEPA documents, (2) those identified for specific projects listed in the 2008 LANL SWEIS, and (3) those of other mitigation commitments that have been made to State and/or Tribal entities. Those actions and recommendations that address each commitment are also described in Table 1.

Table 1. 2008 SWEIS MAPAR Tracking Log for FY 2019

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
Incorporated LANL NEPA mitigation commitments into the 2008 SWEIS MAP						
2.1 Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility MAP [See Appendix A for additional and detailed information]	Monitor contaminants by sampling soils, plants, mammals, birds, and road kills at the DARHT Facility and surrounding areas and at a control site away from the facility (Appendix A).	MAP for DARHT Environmental Impact Statement (EIS) (DOE 1996)	All samples collected from soil, sediment, birds, and small mammals from around the DARHT Facility and in front of the firing site in 2018 were compiled, analyzed, and reported in the 2018 Annual Site Environmental Report (ASER). All samples collected were either similar to the baseline statistical reference level or below screening levels protective of biota (LANL 2019). In May 2019, samples collected from soil and sediment from four areas around the DARHT Facility, in front of the firing site were analyzed and will be reported in the 2019 ASER. Three new beehives for environmental monitoring purposes were established,	Annual requirement complete	Continue annual sampling	NNSA LANL Field Office/LANL Environmental Protection and Compliance Division (EPC) Group

[1] Green is an annual completed action; yellow is an ongoing action; red is a closed or on-hold mitigation.

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
DARHT Facility MAP (cont.)		MAP for DARHT Environmental Impact Statement (EIS)	monitored, and inspected on the north side of the DARHT Facility in FY 2019. Honey was collected to be included as a biota sample and will be reported in the 2019 ASER.			NNSA LANL Field Office/LANL EPC Group
	Conduct Tribal tours of Nake'muu Pueblo as requested. Perform annual surveillance and maintenance activities. (Appendix A).		No requests for tribal visits were received in FY 2019, though annual surveillance and maintenance activities were conducted.		Continue visits to Nake'muu Pueblo as requested by the Pueblo de San Ildefonso	
2.2 Trails Management Plan	Implement the Trails Management Plan (LANL 2015, DOE 2016).	DOE/EA-1431 (DOE 2003a) and FONSI (DOE 2003b)	The Trails Management Program continued to address cultural, biological, safety and security issues as required in FY 2019. The Trails Working Group met eight times in FY 2019. A coordinated LANL and Los Alamos County trails master planning effort began in August 2019. Downed hazard trees were removed from various trails near the wellness center. In a coordinated effort with N3B, trails were closed to avoid conflicts with remediation efforts.	Mitigation complete	The 2015 Trails Management Plan, LANL Trails Management Program, and the Trails Working Group have established a process for ongoing sustainable trails management. Recommend closing out mitigation, all mitigations have been incorporated into the Trails Management Plan.	NNSA LANL Field Office/LANL EPC

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
2.3 Special Environmental Analysis Mitigations	Monitor biota and sediment contamination behind the Los Alamos Canyon weir, the Pajarito Canyon Flood Retention Structure (FRS) and report results in the FY 2018 ASER.	DOE/SEA-03 (DOE 2000)	Data collected in May 2018 from vegetation and small mammal samples from behind the Los Alamos Canyon weir and Pajarito Canyon FRS were reported in the 2018 ASER (LANL 2019). Vegetation and small mammal samples submitted for radionuclide and inorganic element analyses from both locations had levels that were either not detected, were below regional statistical reference levels, or were below biota dose screening levels (LANL 2019). Understory vegetation and small mammals from the up-gradient side of both locations were collected in June 2019. All samples were submitted for analysis and results will be published in the 2019 ASER.	Annual requirement complete	Continue annual sampling and analysis	DOE Environmental Management/ LANL EPC and Newport News Nuclear BWXT (N3B)

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
2.3 Special Environmental Analysis (Cont.)	Periodically remove sediment from the Los Alamos Canyon weir.	DOE/SEA-03 (DOE 2000)	No sediment from the Los Alamos Canyon weir was sampled or removed in FY 2019.	Ongoing	Continue maintenance on clean-outs as necessary	DOE Environmental Management/N3B
2.4 Flood and Sediment Retention Structure	Annually monitor the FRS for structural integrity and safe operations until removed.	DOE/EA-1408 (DOE 2002)	The annual inspection of the Pajarito Canyon FRS was conducted on September 28, 2019 (UI RPT-003, R9) and no corrective actions are recommended at this time.	Annual requirement complete	Continue annual inspections of the FRS	NNSA LANL Field Office/LANL Utilities and Institutional Facilities Division

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
2.4 FRS (Cont.)	Remove portions of the FRS in accordance with DOE/EA-1408. Recycle demolition spoils from FRS decontamination, decommissioning, and demolition, as appropriate.	DOE/EA-1408 (DOE 2002)	N/A	Ongoing	Recommend LANL Utilities and Institutional Facilities Division develop a decontamination, decommissioning, and demolition plan for the FRS structure.	NNSA LANL Field Office/LANL Utilities and Institutional Facilities Division

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
2.4 FRS (Cont.)	Consider leaving an aboveground portion of the FRS equivalent to the dimensions of a low-head weir to retain potentially contaminated sediments on LANL land. Remove aboveground portions of the steel diversion wall below the FRS. Re-contour and reseed disturbed areas to protect surface water quality in Pajarito Canyon after the FRS is removed.	DOE/EA-1408 (DOE 2002)	N/A	**Mitigation On Hold** This mitigation is on hold until the FRS is removed.	Remain on hold pending removal of the FRS	NNSA LANL Field Office/LANL Associate Directorate for Nuclear and High-Hazard Operations, LANL EPC
Project-Specific mitigation measures analyzed in the SWEIS						
2.5 Off-Site Source Recovery Project	Establish adequate controls on quantities and methods of storing sealed sources containing cobalt-60, iridium-192, or cesium-137 to mitigate effects of potential accidents.	2008 LANL SWEIS ROD DOE/EIS-0380 (DOE 2008b)	N/A	**Mitigation On Hold** LANL currently does not accept sealed sources	N/A	NNSA LANL Field Office/LANL Nuclear Engineering and Nonproliferation Division

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
				containing cobalt-60, iridium-192, or cesium-137.		
Institutional Resource Management Responsibilities						
2.6 Wildland Fire Management Plan	Continue to further reduce risks from wildfire by shipping legacy transuranic waste, currently stored in the Technical Area TA-54 domes, to the Waste Isolation Pilot Plant (WIPP).	DOE Wildfire Management Policy (February 2004); 2001 Federal Wildland Fire Management Policy and Implementing Actions (January 2001) SWEIS MAPs DOE/EIS-0380 (DOE 2008c)	In FY 2019, 17 shipments were transported by N3B from TA-54 to WIPP for long-term storage (Madsen 2019).	Annual requirement complete	Implement pollution prevention projects to reduce or eliminate waste streams. Continue shipments to WIPP.	NNSA LANL Field Office/DOE Environmental Management/N3B, LANL EPC

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
Commitments to Santa Clara Pueblo						
2.7 Commitments to Santa Clara Pueblo	The DOE/NNSA Field Office shall develop a work plan jointly with Santa Clara Pueblo to address environmental justice, human health concerns, and issues identified by Santa Clara Pueblo during the SWEIS process. The work plan will include specific tasks and timelines, and it will identify the necessary NNSA and Pueblo resources to help ensure implementation of the plan. In consultation with Santa Clara Pueblo, DOE/NNSA Los Alamos Field Office will update the MAP to incorporate these actions.	MAP and 2008 ROD DOE/EIS-0380 (DOE 2008b, c)	The NNSA issued a Notice of Federal Financial Assistance Award to Santa Clara Pueblo during the fourth quarter of FY 2018.	Commitment to the Santa Clara Pueblo is complete	Implement the "Work Plan for Santa Clara Traditional Human Health Risk Assessment Scenario and Reasonable Maximum Exposure." Recommend closing the mitigation in a MAP revision now that the Human Health Risk Assessment has been awarded funding.	NNSA LANL Field Office/DOE Environmental Management in conjunction with Santa Clara Pueblo

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
Transition of LANL NEPA mitigation commitments since the issuance of the 2008 LANL SWEIS						
2.8 Chromium Plume Control Interim Measure and Plume-Center Characterization	Mitigate potential noise and light impacts to the Mexican spotted owl during construction, drilling, and pumping activities by planning activities outside the breeding season, selecting equipment with lower noise levels and using noise barriers where appropriate. Direct all lighting away from the canyon or habitat areas.	DOE/EA-2005 MAP (DOE 2015)	Noise and tree-cutting restrictions associated with the Endangered Species Act and the LANL Threatened and Endangered Species Habitat Management Plan (LANL 2017a) were met for FY 2019.	Ongoing	Continue implementing	DOE Environmental Management/N3B
	Paint infrastructure so it blends in with the landscape to minimize potential visual impacts. Comply with the LANL Cultural Resources Management Plan (LANL 2017b).		No actions were taken during FY 2019.			
	Comply with the Endangered Species Act and adhere to LANL Threatened and Endangered Species		Restrictions for the Endangered Species Act and the LANL Threatened and Endangered Species Habitat Management Plan			

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
	Habitat Management Plan (LANL 2017a).		(LANL 2017) were met for FY 2019.	Ongoing	Continue implementing	DOE Environmental Management/N3B
2.8 Chromium Plume Control Interim Measure and Plume-Center Characterization (Cont.)	Implement required best management practices detailed in the "Floodplain Assessment of the Chromium Plume Control Interim Measure and Plume-Center Characterization in Mortandad Canyon" (LANL 2015b) to minimize short-term negative impacts.	DOE/EA-2005 MAP (DOE 2015)	Install new double-wall pipeline for CrIN-6 to CrEX-5 conversion project that is adjacent to floodplain. Best Management Practices implemented for all excavations and soil stockpiles. Floodplain restrictions were met for FY 2019.			
	Limit well pad footprints to the smallest size necessary to minimize land use impacts.		The well pad for the new R-70 well was minimized to avoid potential impacts to cultural sites. Pipeline installation activities utilized existing roadways to limit land use impacts.		Continue as necessary	
	Revegetate with native perennial vegetation to restore the area as infrastructure is downsized or no longer needed.		No actions were taken in FY 2019.			

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
2.8 Chromium Plume Control Interim Measure and Plume-Center Characterization (Cont.)	Implement Environmental Protection Agency regulated National Pollutant Discharge Elimination System General Permit for discharges from construction activities requirements to minimize the discharge of potential pollutants to watercourses.	DOE/EA-2005 MAP (DOE 2015)	All National Pollutant Discharge Elimination System General Permit requirements were met for FY 2019.	Ongoing	Continue implementing	DOE Office of Environmental Management/ N3B
	Require best management practices that will minimize short-term negative impacts associated with the Discharge Permit 1793.					

References

DOE 1996. "Dual Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement Mitigation Action Plan," Los Alamos, NM, DOE/EIS-0228, 1996.

DOE 2000. "Special Environmental Analysis for the Department of Energy, National Nuclear Security Administration, Actions Taken in Response to the Cerro Grande Fire at Los Alamos National Laboratory, Los Alamos, New Mexico," Department of Energy, Washington, D.C, DOE/SEA-03, September 2000.

DOE 2002. "Environmental Assessment for the Proposed Future Disposition of Certain Cerro Grande Fire Flood and Sediment Retention Structures at Los Alamos National Laboratory, Los Alamos, New Mexico," DOE/EA-1408, August 8, 2002.

DOE 2003a. "Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico," Department of Energy, DOE/EA-1431, September 2, 2003.

DOE 2003b. "Finding of No Significant Impact for the Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico," Department of Energy, DOE/EA-1431, September 2003.

DOE 2008a. "Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico," Department of Energy, NNSA, Albuquerque, New Mexico, DOE/EIS-0380, May 2008.

DOE 2008b. "Record of Decision: Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico," Department of Energy, NNSA, DOE/EIS-0380, 73 FR 55833, September 26, 2008.

DOE 2008c. "Mitigation Action Plan for the Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory," Department of Energy, NNSA, DOE/EIS-0380-MAP, December 2008.

DOE 2009. "Record of Decision: Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico," Department of Energy, DOE/EIS-0380, 74 FR 33232, July 10, 2009.

DOE 2010a. "2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EIS 0380) Mitigation Action Plan, Revision 1," Department of Energy, DOE/EIS-0380, 2010.

DOE 2010b. "Final Environmental Assessment for the Expansion of the Sanitary Effluent Reclamation Facility and Environmental Restoration of Reach S-2 of Sandia Canyon at Los Alamos National Laboratory Los Alamos, New Mexico," Department of Energy, DOE/EA-1736, August 24, 2010.

DOE 2014. "2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory (DOE/EIS-0380) Mitigation Action Plan: 2nd Revision," Department of Energy, LA-UR-14-21597, DOE/EIS-0380 MAPAR June 2014.

DOE 2015. "NA-LA NEPA Compliance Determination Form for the Radioactive Liquid Waste Treatment Facility (RLWTF) Upgrade Project," Department of Energy, LAN-15-05, Accession Number 18236, September 29, 2015.

DOE 2016. "Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico, Mitigation Action Plan, Revision 3," Department of Energy, Los Alamos Area Office, Los Alamos, NM, DOE/EIS-0380,

DOE 2018. "Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory," Department of Energy, NNSA, Washington, DC, DOE/EIS-0380-SA-05, April 2018.

DOE 2019a. "Final Supplemental Environmnetal Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico," Department of Energy, NNSA, DOE/EA-1339-S1, July 2019.

DOE 2019b. "Finding of No Significant Impact for the Final Supplemental Environmnetal Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico," Department of Energy, NNSA, DOE/EA-1339-S1, July 2019.

DOE 2019c. "Environmental Assessment: Construction and Operation of Solar Photovoltaic Array at Los Alamos National Laboratory," Department of Energy, Los Alamos, New Mexico, DOE/EA-2101, December 2018.

LANL 2015. "Trails Management Plan," Los Alamos National Laboratory, LA-UR-15-20807, November 2015.

LANL 2017a. "Threatened and Endangered Species Habitat Management Plan for Los Alamos National Laboratory," Los Alamos National Laboratory, LA-UR-17-29454, October 2017.

LANL 2017b. "A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico," Los Alamos National Laboratory, LA-UR-15-27624, March 2017.

LANL 2019. "Los Alamos National Laboratory 2018 Annual Site Environmental Report," Los Alamos National Laboratory, LA-UR-19-28950, September 2019.

Madsen, A. 2019. "Re: N3B Waste for CY 2018," Email communication from Madsen, A. (N3B) to Musgrave, K. (LANL), Los Alamos, New Mexico, October 1, 2019.

Appendix A: DUAL-AXIS RADIOGRAPHIC HYDRODYNAMIC TEST FACILITY MITIGATION ACTION PLAN ANNUAL REPORT FOR FY 2018

This page intentionally left blank.

Dual-Axis Radiographic Hydrodynamic Test Facility

Mitigation Action Plan

Annual Report for Fiscal Year 2018

Prepared for:

U.S. Department of Energy National Nuclear Security Administration Los Alamos Field Office

Contents

Tables

Figures

EXECUTIVE SUMMARY

In fiscal year (FY) 2018, all radionuclides and chemicals in soil and sediment collected from around the perimeter of the Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility were either not detected, similar to baseline statistical reference level (mean plus three standard deviations of chemicals in soil or sediment during the DARHT Facility pre-operations monitoring phase), or below ecological screening levels that are protective of biota. Selenium concentrations in sediment and at the firing point were found to be increasing over time and will continued to be monitored. The majority of elements observed in small mammals and avian samples were similar to or below the regional statistical reference level. There were no impacts from DARHT operations on archaeological resources (i.e., Nake'muu Pueblo). The natural environment has a larger impact on the deterioration of the standing wall architecture of Nake'muu Pueblo than operations at DARHT. Although FY 2018 radionuclide and chemical levels were not at concentrations detrimental to human health or to the environment, there were measurable amounts of depleted uranium soil and sediment media and the levels increased over time until 2006. Concentrations of depleted uranium in most media decreased in 2007, which may correspond to the success of employing steel containment vessels. However, because increases of uranium in all media were noted until at least 2006 and uranium may linger in soils for some time, monitoring of these media will continue until the concentrations are similar to baseline statistical reference levels. Overall, foam mitigation has significantly reduced the amount of blast residues released into the environment compared with open-air detonations, and the use of steel containment vessels further reduced those amounts over foam mitigation.

ACRONYMS

ASER	Annual Site Environmental Report
BA	Biological and Floodplain/Wetland Assessment
CFR	Code of Federal Regulations
DARHT	Dual-Axis Radiographic Hydrodynamic Test (facility)
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPC-CP	Environmental Protection and Compliance - Compliance Programs
EPC-ES	Environmental Protection and Compliance - Environmental Stewardship
FR	Federal Register
FY	fiscal year
LANL	Los Alamos National Laboratory
MAP	Mitigation Action Plan
MAPAR	Mitigation Action Plan Annual Report
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
pCi/g	picocuries per gram
ROD	Record of Decision
SWEIS	Site-Wide Environmental Impact Statement
SWPPP	Stormwater Pollution Prevention Plan
TA	technical area
TCDD	2,3,7,8-tetrachlorodibenzodioxin
TNT	2,4,6-trinitrotoluene
VPB	Vessel Preparation Building
WFO-FOD	Weapons Facilities Operations, Facilities Operations Directorate

1.0 INTRODUCTION

This *Mitigation Action Plan Annual Report* (MAPAR) was prepared by the U.S. Department of Energy (DOE)/National Nuclear Security Administration (NNSA) as part of implementing the *Dual-Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement Mitigation Action Plan* (MAP) (DOE 1996). This MAPAR provides status on specific Dual-Axis Radiographic Hydrodynamic Test (DARHT) Facility operation-related mitigation actions implemented to fulfill DOE commitments under the DARHT Environmental Impact Statement (EIS) Record of Decision (ROD) (DOE 1995), the DARHT MAP (DOE, 1996), and the 2008 Site-Wide Environmental Impact Statement (SWEIS) MAP (DOE 2008). In January 2009, the SWEIS MAP was finalized; it includes outstanding 1999 SWEIS MAP commitments, all continuing mitigations from National Environmental Policy Act (NEPA) decisions made since the 1999 SWEIS, and those made in the September 2008 and June 2009 SWEIS RODs. Although no new commitments were identified for DARHT, some of the earlier commitments were completed; for example, the need to continue the archeological monitoring of Nake'muu Pueblo which is the only ancestral pueblo at Los Alamos National Laboratory (LANL) retaining its original standing walls.

The DOE/NNSA Los Alamos Field Office (Field Office) is responsible for implementing the DARHT MAP, which is now included in the 2008 SWEIS MAP. In June 2004, DOE provided stakeholders with the first MAPAR, complete with the full scope of commitments and action plans implemented under the DARHT MAP during fiscal year FY 2003.

This MAPAR reports on the full scope of actions implemented in FY 2018 (October 1, 2017, through September 30, 2018) and represents the eighteenth year of DARHT Facility operation-related mitigation measures and action plans. All construction-related mitigation measures and action plans were completed in FY 1999 (LANL 1999).

1.1 BACKGROUND

DOE issued the final EIS on the DARHT Facility (DOE/EIS-0228) at LANL in August 1995 and published the ROD in the Federal Register (60 FR 53588) on October 16, 1995. The DARHT MAP is being implemented consistent with DOE regulations under the NEPA as stated in DOE's Final Rule and Notice for Implementing NEPA (10 Code of Federal Regulations [CFR] 1021, Section 331(a), revised July 9, 1996).

The ROD on the DARHT Final EIS states that DOE decided to complete and operate the DARHT Facility at LANL while implementing a program to conduct most tests inside steel containment vessels with containment to be phased in over 10 years (the Phased Containment option of the Enhanced Containment alternative[2]). In general, open-air detonations occurred from 2000 to 2002, and detonations within a foam medium occurred from 2003 to 2006. A containment vessel qualification shot was conducted at the Technical Area (TA)-39 Firing

[2] In addition to containment with vessels, additional mitigation measures for use at the DARHT Facility are ongoing. These include aqueous foam for particulate mitigation that are aimed at reducing release of materials from test shots and the future construction of an indoor containment vessel preparation enclosure.

Point 6 in 2006, and shots within steel containment vessels at the DARHT Facility were implemented in May 2007 through September 2018.

The ROD further states that DOE will develop and implement several mitigation measures to protect soil, water, and biological and cultural resources potentially affected by the DARHT Facility construction and operation (DOE 1995). In addition, DOE agreed to an ongoing consultation process with affected American Indian tribes to ensure protection of resources of cultural, historic, or religious importance to the tribes. As discussed in Section 5.11, Volume 1, of the DARHT Final EIS, DOE also committed to taking special precautions to protect the Mexican spotted owl (*Strix occidentalis lucida*) by preparing and implementing a LANL-wide *Habitat Management Plan* (LANL 2017a) for all threatened and endangered species. The DARHT MAP describes those commitments in detail (DOE 1996).

In December 1995, LANL biologists completed a Biological and Floodplain/Wetland Assessment (BA) for the DARHT Facility as required under the Endangered Species Act of 1973 (Keller and Risberg 1995). The BA includes mitigation measures expected to prevent any likely adverse effect to any threatened or endangered species or modification to critical habitat. The mitigation measures identified in the BA were the basis for U.S. Fish and Wildlife Service concurrence with a finding of "may affect, but not likely to adversely affect," and have been used as the basis for establishing mitigation commitments and action plans. These BA mitigation measures, through implementation of the DARHT MAP, have established some of the guidelines under which the DARHT Facility was constructed and will be operated to mitigate the identified potential impacts.

1.2 MAP FUNCTION AND ORGANIZATION

The functions of the DARHT MAP are to (1) document potentially adverse environmental impacts of the Phased Containment option delineated in the final DARHT EIS, (2) identify commitments made in the Final EIS and ROD to mitigate those potential impacts, and (3) establish action plans to carry out each commitment (DOE 1996).

The DARHT MAP is divided into eight sections. Sections I through V provide background information regarding the NEPA review of the DARHT Facility project and an introduction to the associated MAP. Section VI references the Mitigation Action Summary Table that summarizes the potential impacts and mitigation measures; indicates whether the mitigation is design-, construction-, or operations-related; summarizes the organization responsible for the mitigation measure; and summarizes the projected or actual completion date for each mitigation measure. Sections VII and VIII discuss the MAPAR commitment and the potential impacts, commitments, and action plans.

Under Section VIII, potential impacts are categorized into the following five areas of concern:

- general environment, including impacts to air and water;
- soils, especially impacts affecting soil loss and contamination;
- biological resources, especially impacts affecting threatened and endangered species;
- cultural/paleontological resources, especially impacts affecting the archaeological site known as Nake'muu Pueblo; and

- human health and safety, especially impacts pertaining to noise and radiation.

Each category includes a brief statement of the nature of the impact and its potential cause(s). The commitment made to mitigate the potential impact is identified. The action plan for each commitment is described in detail with a description of actions to be taken, pertinent time frames for the actions, verification of mitigation activities, and identification of agencies/organizations responsible for satisfying the requirements of the commitment.

1.3 MAP DURATION AND CLOSEOUT

The DARHT MAP will be implemented for the anticipated operational life (approximately 30 years) of the DARHT Facility (DOE 1996). Within the DARHT MAP, each DOE commitment and action plan specifies a time frame, verification strategy, and responsible agency/organization. The MAP also includes a summary of mitigation actions that identifies the projected/actual period of mitigation action completion. Each mitigation action time frame correlates with one or more of the following DARHT Facility project stages: design, construction, and operations. This information generally refers to when an individual action will be initiated and completed. All construction-related mitigation measures were completed in FY 1999 (LANL 1999).

1.4 DARHT FACILITY SCHEDULE AND STATUS

The court-ordered injunction on DARHT Facility construction was lifted on April 16, 1996, and DOE authorized resumption of construction activities on April 26, 1996. The DARHT Facility construction contractor was fully mobilized on August 23, 1996, and full-scale construction was authorized and began on September 30, 1996. In July 1999, with the appropriate DOE authorization, the DARHT Project Office initiated DARHT Facility operations.

During the late summer of 2000, two high-explosive shots using 16 pounds of 2,4,6-trinitrotoluene (TNT) were performed. The purpose of these two experiments was to acquire accelerometer data on the building at the Nake'muu Pueblo archaeological site. In the late fall of 2000, the first major hydrotest was performed, fragment mitigation measures were in place, and post-shot cleanup was conducted to minimize the release of contaminants to the environment.

In the summer of 2001, one major system checkout experiment and three major hydrotests were performed. Fragment mitigation measures were in place and post-shot cleanup was conducted to minimize the release of contaminants to the environment. Each of the four experiments returned state-of-the-art quantitative radiographic information. The final three hydrotests illuminated the complex hydrodynamics of mockups of stockpiled systems.

In the fall of 2002, hydrotesting continued with two major experiments that again returned state-of-the-art quantitative radiographic information of mockups of stockpiled systems. Fragment mitigation measures were in place and post-shot cleanup operations were conducted. An aqueous foam containment method of particulate containment and blast mitigation was tested at another firing site for implementation at the DARHT Facility.

In 2003, the construction of the Vessel Preparation Building (VPB) was completed. One hydrotest was fired in the fall of 2003, returning state-of-the-art quantitative radiographic information of a mockup of a stockpile system. This experiment was the initial implementation of aqueous foam mitigation for a hydrotest experiment at the DARHT Facility. The aqueous foam

mitigation method achieved at least a five percent reduction in material released to the open-air as prescribed for Phase I of the Phased Containment option. Steel plates and concrete replaced surface gravel at the firing pad to enhance cleanup activities following experiments.

In FY 2004, two major hydrotests were conducted. Aqueous foam particulate mitigation was implemented during these experiments to mitigate blast effects. One of these experiments was the first foam-mitigated experiment to use the new fabric tent configuration for containing the foam.

In FY 2005, hydrotesting continued with three major hydrotest experiments. Fragment mitigation and aqueous foam particulate mitigation using a fabric tent configuration for containing the foam were implemented during these experiments to mitigate blast effects.

In FY 2006, hydrotesting continued with three major hydrotest experiments. Aqueous foam particulate mitigation using a fabric tent configuration for containing the foam was again implemented during these experiments to mitigate blast effects. The VPB underwent a Phase II readiness review in FY 2006 and was approved to begin operations, including the staging, preparation, and decontamination of containment vessels.

In FY 2007 through 2018, single-walled steel containment vessels were used for all hydrotest experiments to mitigate the fragments and particulate emissions associated with the experiments. These steel containment vessels achieved at least a 40 percent reduction in material released to the open-air as prescribed for Phase II of the Phased Containment option. The steel vessels were transported to VPB where they were decontaminated and prepared for the next experiment. Since 2007, 51 hydrodynamic test shots within steel containment vessels at DARHT were conducted.

2.0 MAP IMPLEMENTATION

The DARHT MAP is implemented on an annual basis in coordination with the federal FY cycle.

The function of the MAPAR is to fulfill DOE's commitment to the stakeholders to report the general status and critical information regarding activities associated with implementation of the DARHT MAP. The MAPAR reflects new information or changed project and environmental circumstances and changes in mitigation actions or changes to the MAP. In order to ensure the public has full access to this information, the DARHT MAPAR is published each year in conjunction with the SWEIS MAPAR and is available in the LANL's electronic public reading room.

The organization of the MAPAR is intended to provide the reader with a clear understanding of the scope and status of mitigation actions implemented annually under the DARHT MAP. The MAPAR consists of the following main sections: introduction and background; MAP implementation; MAP scope, schedule, and status including results on potential impacts; and conclusions and recommendations, including future MAP implementation.

3.0 DARHT MAP SCOPE, SCHEDULE, AND STATUS

This FY 2018 MAPAR documents the scope and results of mitigation action tasks implemented throughout FY 2018. Table 3-1 provides a summary of the scope of potential impacts and commitments addressed in this MAPAR.

Table A 3-1. FY 2018 MAPAR potential impacts and commitments addressed

DARHT MAP Potential Impacts/Commitments	DARHT Phase	MAPAR Section
A. General Environment		
1. Contamination of the environment surrounding DARHT Facility with radioactive or hazardous materials: Commitments (b–e)	Operations	3.1
2. Contamination of the environment with various types of wastes as a result of cleaning out the containment vessels		
3. Contamination of the environment with various types of hazardous materials as a result of spills within the DARHT Facility		
4. Contamination of the environment with hazardous levels of various substances as a result of discharges of contaminated water from the DARHT Facility		
B. Soil		
1. Loss of soil and vegetation could occur during construction and operation of the DARHT Facility as a result of severe stormwater runoff: Commitments (a–c).	Operations	3.2
2. Soil erosion and damage to plants caused by additional construction and operations activities, especially off-road and groundbreaking activities: Commitments (a–e)		
C. Biological Resources		
1. DARHT Facility construction and operations could impact threatened and endangered species as a result of impacts from firings and other operations and activities at the firing sites: Commitments (b–d).	Operations	3.3
2. DARHT Facility construction and operation could impact the Mexican spotted owl *(Strix occidentalis lucida*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (n–x).		
3. DARHT Facility construction and operation could impact the American peregrine falcon *(Falco peregrinus anatum*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).		
4. DARHT Facility construction and operation could impact the Northern goshawk (*Accipiter gentilis*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a–c).		
5. DARHT Facility construction and operation could impact the spotted bat (*Euderma maculatum*) as a result of noise from firings and other operations, as well as other activities at the firing sites.		
6. DARHT Facility construction and operation could impact the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) as a result of noise from firings and other operations, as well as activities at the firing sites.		

DARHT MAP Potential Impacts/Commitments	DARHT Phase	MAPAR Section
7. DARHT Facility construction and operation could impact the Jemez Mountains salamander (*Plethodon neomexicanus*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).	Operations	3.3
8. DARHT Facility construction and operation could impact the bald eagle (*Haliaeetus leucocephalus*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).		
9. DARHT Facility construction and operation could impact the Townsend's pale big-eared bat (*Corynorhinus townsendii*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).		
10. DARHT Facility construction and operation could impact the wood lily (Lilium philadelphicum var. andinum) as a result of firings and other operations, as well as other activities at the firing sites: Commitments (a, b).		
D. Cultural/Paleontological Resources		
1. Blast effects, such as shock waves and flying debris, from shots using high-explosive charges could affect nearby archaeological sites, especially Nake'muu Pueblo, and the immediately surrounding environment: Commitments (b, e–g).	Operations	3.4
2. Structural or other damage to as-yet-unknown Native American cultural resources within the area of potential effects from the DARHT Facility site. This could occur as a result of DOE's lack of knowledge of these resources in the DARHT Facility area: Commitments (a, b).	Construction/ Operations	
E. Human Health and Safety		
1. Adverse health effects on workers and the general public from high noise levels associated with the DARHT Facility, especially construction and test firings: Commitment (a)	Construction/ Operations	3.5
2. Adverse health effects on workers from radiation from DARHT Facility operations: Commitments (a–c)	Operations	

3.1 MITIGATION ACTIONS FOR THE GENERAL ENVIRONMENT

Summary of Potential Impacts

MAP Section VIII.A.1(b–e)

The DARHT MAP identifies the potential for hazardous and radioactive materials to be released to the general environment surrounding the DARHT Facility. Hazardous and radioactive materials could be released to the general environment through the following mechanisms: (1) a structural failure of containment vessels or during open-air firing operations; (2) release of various types of waste as a result of cleaning out the containment vessels; (3) release of various hazardous materials as a result of spills within the DARHT Facility; and (4) release of hazardous levels of various substances as a result of discharges of contaminated water from the DARHT Facility.

Mitigation Action Scope

The operational mitigation actions (MAP Section VIII.A.1 (b-e) associated with these potential impacts are as follows:

(b) Environmental Protection and Compliance - Environmental Stewardship (EPC-ES) will monitor contaminants once a year by sampling soil, sediment, vegetation, mammals, birds, and honey or honey bees at baseline locations and, following the start of operations, within the potential impact area of DARHT. Note: Starting in FY 2014, soil plus one biota component (on a rotating basis) will be collected per the MAP.

(c) Other site monitoring and evaluation will consist of periodic soil, water, and other environmental analyses for solid, hazardous, mixed, and radioactive wastes should spills or other unplanned events occur.

(d) Double- and single-walled steel containment vessels will be used appropriately.

(e) Vessels will be decontaminated.

Status

MAP Section VIII.A.1(b)

Since 1996, soil, sediment, vegetation, honey bees, and small mammal samples have been collected from around the DARHT Facility and analyzed during the construction phase (1996–1999) for baseline conditions. The results of four years of analyses to DARHT samples were summarized in a composite report (Nyhan et al. 2001). These results were used to calculate baseline statistical reference levels; these are the concentrations of radionuclides and other chemicals (mean plus 3 standard deviations = 99% confidence level) around the DARHT Facility before the start-up of operations, as per the DARHT MAP (DOE 1996). Baselines for potential contaminants, populations, and species diversity in birds were developed at a later date (Fresquez et al. 2007). Bird abundance and diversity were not negatively impacted at DARHT Facility based on long-term data (Keller et al. 2015). Avian population monitoring was replaced with avian nest box monitoring in 2014.

In FY 2000, operations-phase environmental monitoring was initiated by collecting a suite of samples similar to those collected during the construction phase. Future monitoring of environmental media will continue by documenting accumulations of contaminants in the environmental media to assess the cumulative impact.

Monitored constituents in soil and sediment include radionuclides, beryllium (and other metals), and organic chemicals such as high explosives, dioxins, and furans. Starting in 2014, soil plus one type of biota were collected per year, with the biota type being rotated each year. This section of the MAPAR summarizes the results of analyses of soil, sediment, and vegetation collected around the perimeter of the DARHT Facility in FY 2018 (Figure 3-1). All of the data can be found in the Annual Site Environmental Report (ASER) (LANL 2019).

Composite soil samples from zero to two inches (five subsamples per location) were collected in June 2018 on the north, east, south, and west sides of the DARHT Facility perimeter along the fence line (Figure 3-1). An additional soil composite sample was collected about 75 feet north of the firing point along the side of the protective berm. Sediment grab samples (zero to six inches)

were collected on the north, east, south, and southwest sides. All soil and sediment samples were analyzed for tritium, plutonium-238, plutonium-239/240, strontium-90, americium-241, cesium-137, uranium-234, uranium-235/236, uranium-238 inorganic elements including aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc; and for high explosives. The sample nearest to the firing point was also analyzed for dioxins and furans.

Small mammals, such as mice, are ideal for monitoring chemicals and radionuclide exposures and uptake in biological systems because of their close contact with soil, burrowing behavior, and because of their omnivorous diets (Smith et al. 2002, Talmage and Walton 1991). Small mammals have been periodically trapped and collected from near the DARHT Facility and chemically analyzed. In 2018, one individual deer mouse (*Peromyscus maniculatus*) was collected and analyzed for inorganic elements, one pinyon mouse (*Peromyscus trueii*) was collected and analyzed for dioxins and furans, and a composite of four individual brush mice (*Peromyscus boylii*) was collected and analyzed for radionuclides. Typically, replicate samples are collected and analyzed; however, because of the effects of severe drought on small mammal abundance, trapping success in 2018 was poor. Small mammals were captured using Sherman® live traps. All animal handling procedures were approved by LANL's Institutional Animal Care and Use Committee.

Bird eggs have sometimes been shown to reflect chemical exposures from the location where a female bird feeds during egg formation (Dauwe et al. 2005). However, the female's chemical body burdens from previous exposures, such as on migration routes from wintering grounds, can also become mobilized from lipid stores and deposited into eggs (Bustnes et al. 2010). Nestlings tend to reflect local chemical exposures due to their limited mobility. Eggs that did not hatch and nestlings that died of natural causes were collected from nest boxes surrounding the DARHT Facility and chemically analyzed. Three egg samples consisting of an individual western bluebird egg (*Sialia mexicana*), and two composite samples of four western bluebird eggs were collected and submitted for inorganic element analyses. One individual western bluebird nestling was collected and analyzed for inorganic elements as well as plutonium and uranium isotopes.

Results of most chemical analyses were compared with the baseline statistical reference levels. The baseline statistical reference levels for the DARHT Facility are the levels below which 99% of samples collected at the facility occurred during 1996 to 1999, before the beginning of firing site operations (Nyhan et al. 2001). In cases where there are no baseline statistical reference levels (mostly inorganic elements like aluminum, calcium, cobalt, iron, magnesium, manganese, potassium, sodium, vanadium, and zinc), the soil and biota chemical results were compared with regional statistical reference levels.

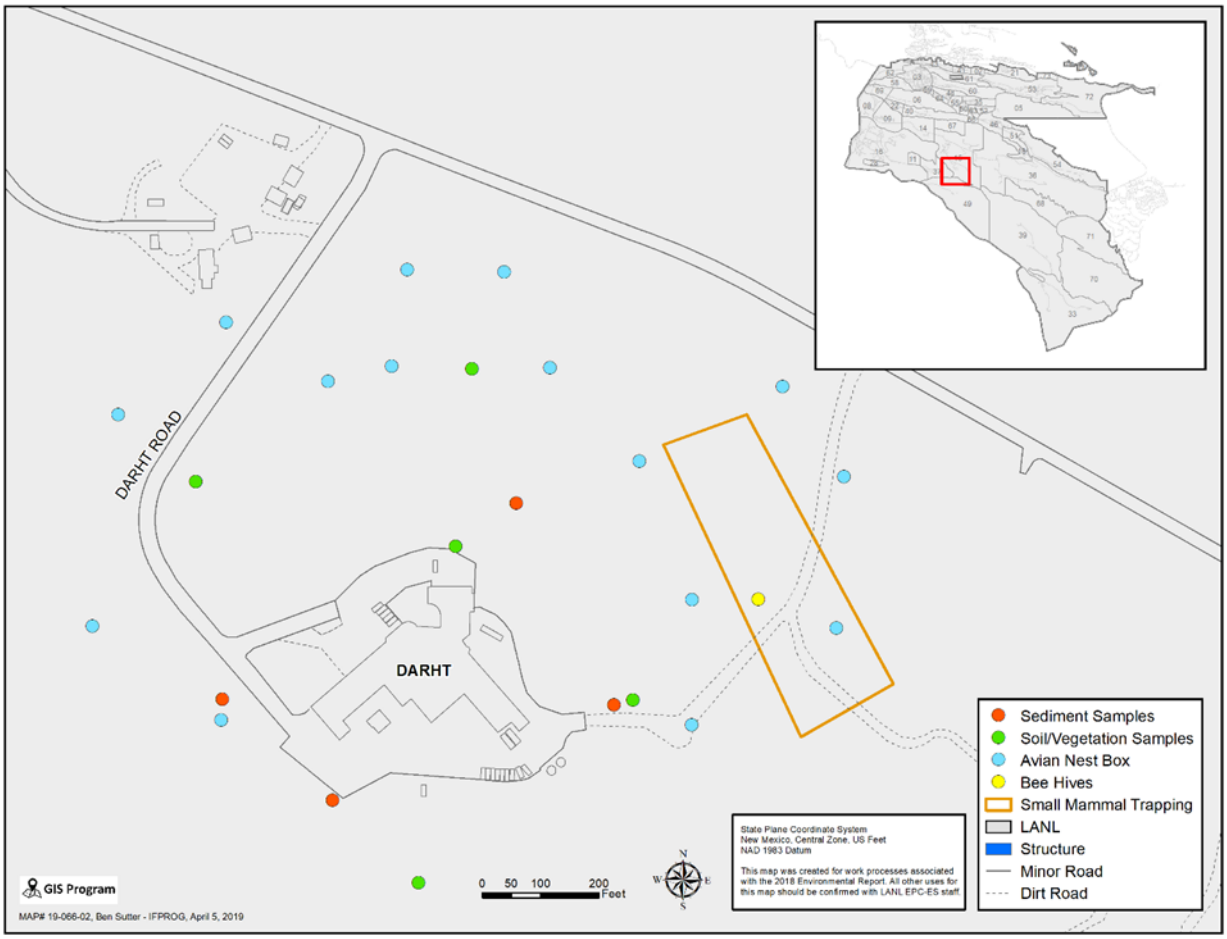

Figure A 3-1. Soil, sediment, and biological sample locations at DARHT Facility

Soil and Sediment Results at the DARHT Facility

Soil and sediment samples collected around the DARHT Facility did not contain detectable levels of tritium, americium-241, cesium-137, plutonium-238, or plutonium-239. The majority of samples did not contain detectable levels of strontium-90. In 2018, all soil and sediment samples contained all three isotopes of uranium; this result was consistent with previous years. Several samples contained activities of uranium that were higher than the regional statistical reference level and the baseline statistical reference level. The relative isotopic abundance of urainum-234, uranium-235, and uranium-238 activities indicate that the uranium in these samples are depleted uranium (uranium from testing activities) rather than natural uranium (e.g. 84.7% U-238, 1.1% U-235, and 15.2% U-234 [International Atomic Energy Agency 2019]). All radionuclide activities were far below ecological screening levels that were protective of biota.

Operations at the DARHT Facility have changed since 2007 to include the use of closed-containment vessels. Since 2008, uranium-238 activity near the firing point has mostly decreased to the baseline statistical reference level, though the trend is not statistically significant (Kendall's Tau, $p > 0.05$). Levels of radionuclides in soil and sediment samples collected around the DARHT Facility are not increasing over time (Kendall's Tau, $p > 0.05$; Figure 3-2).

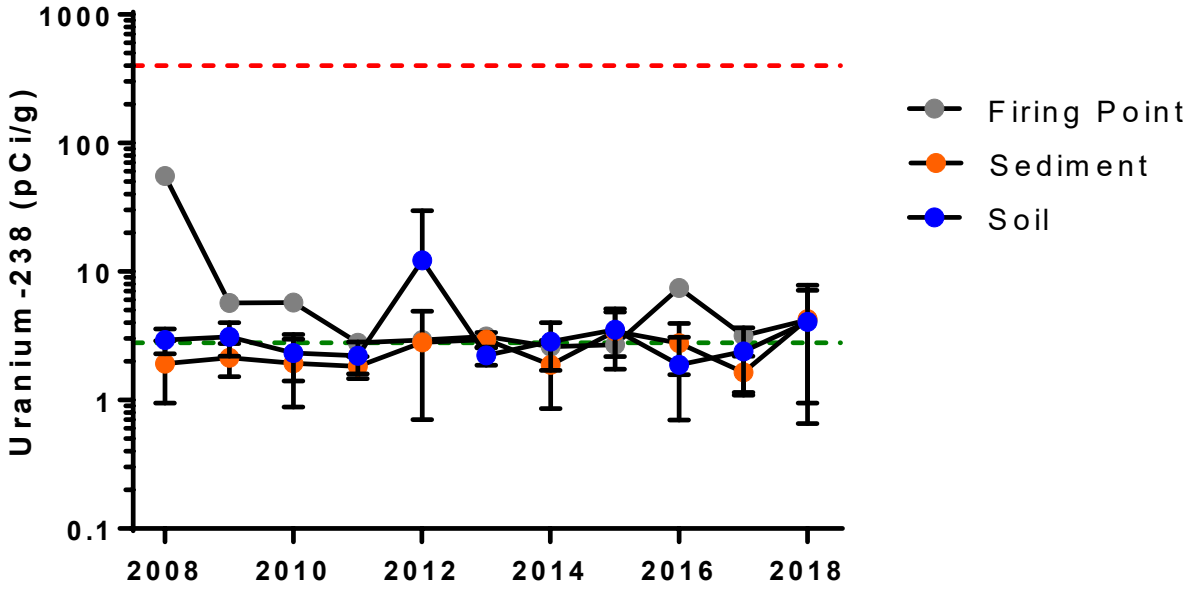

Figure A 3-2. Urainum-238 activities in surface soil and sediment samples

Uranium-238 activities in surface soil and sediment samples collected around the DARHT Facility and in the firing point soil sample, from 2008 to 2018, compared with the baseline statistical reference level (mean plus three standard deviations of soil uranium-238 pre-operations; green dashed line) and the lowest no-effect ecological screening level for the plant (red dashed line). Note the logarithmic scale on the vertical axis. Points represent true values (firing point) or represent means (sediment and soil) and error bars represent standard deviation. Bottom error bars are absent on some points as the error would have been a negative value; however, negative values cannot be shown on a logarithmic axis.

All inorganic elements tested for were detected in soil and sediments samples collected in 2018 around the DARHT Facility. Concentrations of aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, mercury, nickel, potassium, and silver were below all reference and screening levels including the baseline statistical reference levels, regional statistical reference levels, and both the no- and low-effect ecological screening levels.

Consistent with observations from previous years, several soil and sediment samples, including the sample collected at the firing point, contained concentrations of barium, manganese, selenium, thallium, and vanadium that exceeded the no-effect ecological screening level for the plant or the no- and low-effect ecological screening level for the American robin (*Turdus migratorius*). However, all concentrations of these elements were below the regional statistical reference level and the baseline statistical reference level (when available); the regional statistical reference level of these elements was also above the no-effect ecological screening level. Three sediment samples contained zinc concentrations that were higher than regional statistical reference level or were above the no-effect ecological screening level for the American robin (*Turdus migratorius*). Although concentrations of some inorganic chemicals

exceeded the no-effect ecological screening levels, the majority were below the low-effect ecological screening levels. The number of locations with concentration potentially associated with adverse effects at an individual level was minimal, and no impacts to populations or communities of plants and animals are expected.

Similar to 2017, selenium concentrations were increasing over time at the firing point and in all four sediment samples; arsenic was increasing in soil samples collected on the east and south sides (Kendall's Tau, $p < 0.05$, Figure 3-3). In 2018, copper was also observed to be increasing in sediment collected from the east side of the DARHT Facility (Kendall's Tau, $p < 0.05$). These trends will be monitored closely in future sampling. No other elements are increasing over time around the DARHT Facility.

Beryllium, listed as a chemical of potential concern before the start-up of operations at the facility (DOE 1995), was not detected above the baseline statistical reference level (1.3 milligrams per kilogram) in any of the soil or sediment samples in 2018. Beryllium concentrations in all soil and sediment samples from 2008 to 2018 have been below the baseline statistical reference level (Figure 3-3).

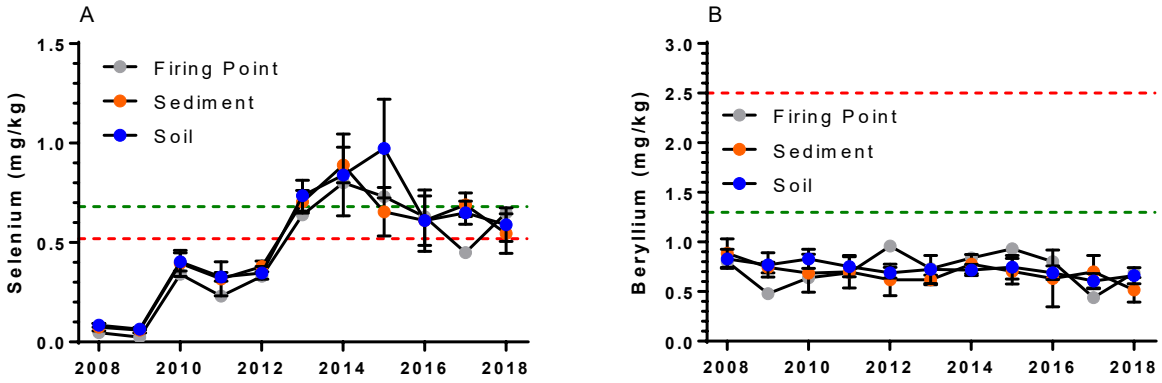

Figure A 3-3. (A) Selenium and (B) beryllium concentrations in surface soil and sediment samples collected around the DARHT Facility and firing point

From 2008 to 2018, surface soil and sediment samples collected around the DARHT Facility and firing point were analyzed to determine the concentration of selenium and beryllium. The results were compared with the baseline statistical reference level (mean plus three standard deviations of soil concentrations pre-operations (green dashed line) and the lowest no-effect ecological screening level (red dashed line). Points represent true values (firing point) or represent means (sediment and soil) and error bars represent standard deviation.

Consistent with previous years, no high-explosive chemicals were detected in any of the soil or sediment samples collected within or around the perimeter of the DARHT Facility in 2018, including the sample closest to the firing point. All furans and most dioxins, including 2,3,7,8-tetrachlorodibenzodioxin (TCDD), were not detected in the soil sample collected at the firing site. The only dioxin congeners that were detected include 1,2,3,4,6,7,8-heptachlorodibenzodioxin and 1,2,3,4,6,7,8,9-octachlorodibenzodioxin at a concentration of 0.547 and 4.2 nanograms per kilogram, respectively. There are no ecological screening levels for these dioxin congeners; however, toxic equivalent factors for TCDD-like compounds can be

used to determine the toxic equivalents of dioxin-like compounds. The toxic equivalent factor is 0.01 for 1,2,3,4,6,7,8-heptachlorodibenzodioxin and 0.0003 for 1,2,3,4,6,7,8,9-octachlorodibenzodioxin (Van den Berg et al. 2006); multiplying the detectable concentrations of these congeners by their respective toxic equivalents factors yields a value that is orders of magnitude less than the no-effect ecological screening level for TCDD.

Avian Egg and Nestling Results at the DARHT Facility

In bird eggs, several inorganic elements were not detected, including antimony, arsenic, beryllium, cadmium, lead, nickel, silver, thallium, and vanadium; these observations are similar with previous years. Mercury was detected above the regional statistical reference level (0.179 milligrams per kilogram) in two eggs at 0.21 and 0.21 milligrams per kilograms dry weight. These levels are below the lowest observable adverse effect level of 1.7 milligrams per kilogram dry weight (Thompson 1996). All other detectable concentrations of elements were below the regional statistical reference level.

The only inorganic elements that were not detected in the nestling were beryllium, cobalt, mercury, and vanadium. The fact that mercury was detected in eggs, but not observed in the nestling, could suggest that the adult female birds ingested mercury at other locations, incorporated it into their tissues, and then redeposited the mercury into the eggs that were collected at the DARHT Facility. Another possible explanation is that mercury was not observed in nestling samples because the rapid growth of nestlings typically dilutes lipophilic contaminant levels in their tissues (Anderson and Hickey 1976). Antimony was detected in the nestling as above the regional statistical reference level; all other inorganic elements were below the regional statistical reference level.

Plutonium-238, plutonium-239, uranium-234, and uranium-235/236 were not detected in the nestling sample. However, similar to nestlings evaluated in 2017, uranium-238 was observed (0.0095 picocuries per gram) but was far below the biota dose screening level (DOE 2002). Uranium isotopes 234, 235/236, and 238 have been detected in soils, sediments, and small mammals collected around the DARHT Facility at levels that have exceeded the regional statistical reference levels in the recent past (Gaukler et al. 2018, Fresquez et al. 2016). These results suggest that uranium was bioavailable and was being incorporated into nestling tissues.

Small Mammal Results at the DARHT Facility

In a deer mouse sample, most inorganic elements were detected, except for mercury and vanadium. All inorganic elements were below the regional statistical reference level, including beryllium. A number of inorganic elements were decreasing over time including beryllium (Figure 3-4), cobalt, copper, iron, magnesium, manganese, and silver (Kendall's Tau, $p < 0.05$). Antimony and zinc however, were increasing over time (Kendall's Tau, $p < 0.05$). These observations were not consistent with observations in soil or sediment from the general area and could be an artifact caused by small sample size. Regardless, the levels of antimony and zinc were below the regional statistical reference level.

Most radionuclides were not detected in the small mammal sample in 2018. Strontium-90 and all three uranium isotopes were detected and were above the regional statistical reference level, but were below the biota dose screening level that is protective of biota. Both uranium-234 and uranium-238 activities in small mammals were decreasing over time between 2008 and 2018

(Kendall's Tau, $p < 0.05$; Figure 3-4). The amount of uranium-238 in small mammals, as seen with soil, increased until the year 2007 and then decreased thereafter; the decrease was concurrent with the change from open-air and/or foam-mitigated detonations during the 2000–2006 period to closed vessel containment, starting in 2007.

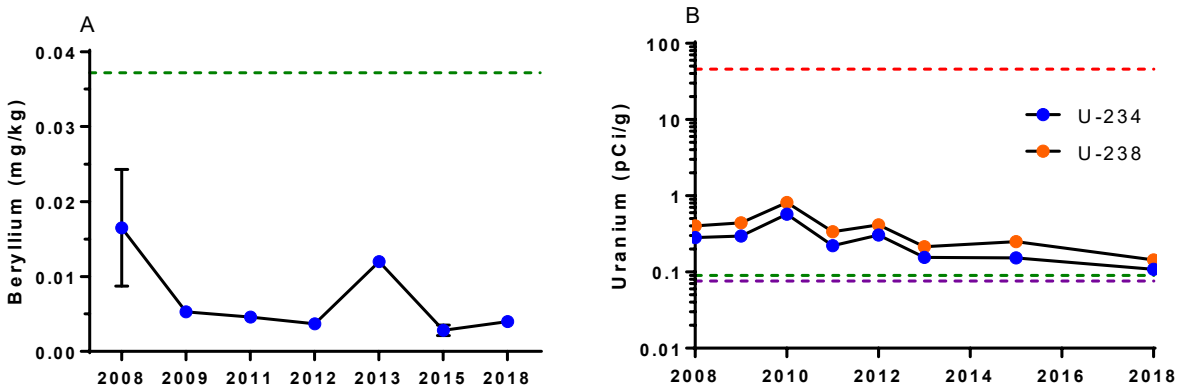

Figure A 3-4. (A) Beryllium concentrations and (B) uranium-234 and uranium-238 activities in composite whole body mice

In composite whole body mice collected near the DARHT Facility perimeter at TA-15 during 2008 to 2018. Figure A 3-4 describes the beryllium concentrations and uranium-234 and -238 activities were compared to the regional statistical reference levels (e.g., mean plus three standard deviations of small mammals collected from background locations). These graphs show beryllium and uranium-234 (green dashed lines), uranium-238 (purple dashed line) and the biota dose screening level (red dashed line). Note vertical axis is a linear scale for beryllium and a logarithmic scale for uranium. Points represent true values, or the mean when multiple results were available; error bars represent standard deviation. Note mg/kg = milligrams per gram and pCi/g = picocuries per gram.

Octachlorodibenzodioxin-1,2,3,4,6,7,8,9 was the only dioxin detected in the pinyon mouse (*Peromyscus truei*) and was below the regional statistical reference level. All other dioxins and all furans were not detected. The majority of the results in soil, sediments, bird tissues, and small mammals are similar with previous results and constituents are decreasing over time. These results suggest that operations at the DARHT Facility are not negatively affecting the ecosystem.

3.1.1.1 MAP Section VIII.A.1(c)

For routine DARHT Facility operations, the sampling and analysis methodology used in the environmental baseline monitoring conducted under Section VIII.A.1(b) (see above) was designed to include environmental monitoring requirements under this mitigation action. Should the DARHT Facility experience a substantial accidental spill or release of hazardous or radioactive materials, additional environmental monitoring would be conducted under this mitigation action, as necessary. No significant spills that reached the environment have occurred at the DARHT Facility.

3.1.1.2 MAP Section VIII.A.1(d)

In accordance with the ROD for the DARHT Final EIS, DOE was operating the DARHT Facility while implementing a program to conduct tests inside single-walled steel containment vessels with containment (Note: current DARHT nomenclature is confinement) to be phased in over 10 years (the Phased Containment option of the Enhanced Containment alternative) (DOE 1995). In general, open-air detonations occurred during 2000 to 2006 and detonations within a foam medium occurred during 2002 to 2006. A containment vessel qualification shot was conducted at the TA-39 firing point six in 2006, and shots within single-walled steel containment vessels at the DARHT Facility were implemented in May of 2007. In 2007, three hydrodynamic test shots within single-walled steel containment vessels at the DARHT Facility were conducted. In 2008, two hydrodynamic test shots were conducted within single-walled steel containment vessels at the DARHT Facility. These steel containment vessels achieved at least a 40% reduction in material released into the open-air as prescribed for Phase II of the Phased Containment option.

Measurements using a variety of sampling methodologies (e.g., air particulates, adhesive films, surface swipes, and video analysis) at the firing point and sites downwind at various distances (50, 135, and 200 meters), during open-air and foam detonations, showed that use of foam reduced the size of a plume generated from a hydrodynamic test and the dispersal of contaminants by an average of 80% (Duran 2008); this is far above the 5% reduction required for Phase I of the Phased Containment option.

Similarly, potential contaminant releases during foam mitigation and the use of steel containment vessels were compared using surface swipes, particulate air sampling, and monitoring of detonation gases at the vessel and around the immediate work area. The use of steel containment vessels showed an additional 20% reduction over foam mitigation in potential emissions of uranium and beryllium as a result of a shot. In other words, the use of steel containment vessels reduced the amount of potential contamination by 99.9% and was far above the 40% reduction in material released to the open-air as required for Phase II of the Phased Containment option.

3.1.1.3 MAP Section VIII.A.1(e)

The VPB located at TA-15 near the DARHT Facility underwent a Phase II readiness review in FY 2006 and the facility was approved to begin operations including the staging, preparation, and decontamination of containment vessels. The containment vessel qualification shot conducted in 2006 provided baseline data/characterization of vessel debris resulting from hydrodynamic testing and analysis of the generated gas byproducts to aid in the disposal of future material, to provide data for personnel safety, and to aid in the development of future cleanout procedures for the containment vessels.

Containment vessel decontamination operations began in FY 2007; in FY 2008 containment vessels continued to be decontaminated on the DARHT Facility firing point. Following decontamination, the vessels were transported to the VPB and prepared for the next experiment.

Summary of Potential Impacts

MAP Section VIII.A.2

The DARHT MAP identifies the potential for contamination of the environment with various types of waste as a result of cleaning out the containment vessels.

Mitigation Action Scope

The cleaning operations will recycle materials as much as reasonably possible and use appropriate operations processes to limit discharges of waste into the environment. Waste minimization techniques will be applied to those materials that cannot be recycled and they will be disposed of in permitted disposal facilities.

Status

MAP Section VIII.A.2

LANL completed construction of a permanent VPB to be operated at TA-15 near the DARHT Facility. This facility is approved to stage, prepare, and decontaminate, as appropriate, the vessels used in the DARHT hydrodynamic experiments. LANL developed containment vessel cleanout processes in support of the commitment to decontaminate vessels used in experiments.

Process equipment for managing debris from vessel shots was installed in the VPB. Procedures for vessel cleanout, decontamination, and stabilization of debris from vessel shots were prepared to support containment vessel experiments. Waste minimization techniques were applied during the vessel cleanout and decontamination processes. Typically, nonrecyclable materials were placed into 55-gallon drums, fixed with cement, and disposed and an appropriate disposal facility (Zumbro 2010).

Summary of Potential Impacts

MAP Section VIII.A.3

The DARHT MAP identifies the potential for contamination of the environment with various types of hazardous material as a result of spills within the DARHT Facility.

Mitigation Action Scope

Spill containment (physical barriers or sills) within the DARHT Facility will be provided by engineering design to contain all hazardous material spills that could occur. Additionally, a spill prevention control and countermeasures plan will be required before facility operation begins and will be maintained for the life of the facility. Also, a spill response/emergency response team and/or equipment will be available, which can be deployed in the event of an accident.

Status

MAP Section VIII.A.3

Spill containment (physical barriers or sills) within the DARHT Facility is in place and is maintained to contain all hazardous material spills that could occur. A *Spill Prevention Control and Countermeasures Plan* was completed and approved before DARHT Facility operations began. This plan will be maintained for the life of the facility consistent with the requirements

under the LANL Integrated Safety Management System and Environmental Protection Agency Oil Pollution Prevention Regulation, 40 CFR Part 112. The DARHT Facility has not had a substantial accidental spill of hazardous materials. Should an accidental spill occur at the DARHT Facility, appropriate emergency actions will be taken in accordance with existing operational procedures. These emergency actions would include deployment of the LANL Hazardous Materials Response Team. The team are on call full-time to respond to all emergency spills within the LANL site and, as needed, the LANL region. The mineral oil release was not considered a spill because it did not reach the environment and did not require Hazardous Materials Response Team deployment.

Summary of Potential Impacts

MAP Section VIII.A.4

The DARHT MAP identifies the potential for contamination of the environment with hazardous levels of various substances as a result of discharges of industrial water from the DARHT Facility cooling tower.

Mitigation Action Scope

Water discharged from the DARHT Facility cooling tower will be monitored to ensure compliance with outfall permits as stated in the National Pollutant Discharge Elimination System (NPDES) permit for the DARHT Facility site. Should discharge levels exceed permit limits, LANL's Environmental Protection and Compliance - Compliance Programs (EPC-CP) will act to bring the facility into compliance.

Status

MAP Section VIII.A.4

Water flow from the DARHT Facility cooling tower was routinely monitored by EPC-CP to ensure compliance with the NPDES permit. There was an NPDES chlorine exceedance at the DARHT Facility cooling tower (Outfall 03A185) in FY 2006. The compliance sample result of >2.2 mg/L exceeded the daily maximum permit requirement of 500 µg/L (0.5 mg/L). Corrective actions were taken to get the discharge back into compliance. Since 2010, the cooling tower discharges have been tied into the LANL sanitary wastewater treatment plant at TA-46. Consequently, Outfall 03A185 was removed from LANL's NPDES permit on October 10, 2012.

3.2 Mitigation Actions for Soil

Summary of Potential Impacts

MAP Section VIII.B.1(a–c), 2(a–e)

According to the DARHT MAP, loss of soil and vegetation could occur during construction and operation of the DARHT Facility as a result of severe storms and consequent severe stormwater runoff. In addition, off-road and groundbreaking activities caused by additional construction and operational activities may result in further soil erosion and damage to plants.

Mitigation Action Scope

MAP Section VIII.B.1(a–c)

The operational mitigation actions MAP Section VIII.B.1 (a-c) associated with these potential impacts are as follows:

(a) Adherence to all soil erosion mitigation measures in accordance with the operational *Stormwater Pollution Prevention Plan* (SWPPP) to ensure that erosion and sedimentation are minimized and that drainage facilities are in place to control runoff. These measures will include temporary and permanent erosion control, sedimentation control, surface restoration and revegetation, stormwater attenuation in paved and unpaved areas, routine inspection, and best management practices, which include minimization of fuel and oil spills, good housekeeping practices, and control of stored material and soil stockpiles.

(b) Modification of the SWPPP if control measures are ineffective.

(c) Establishment and continuance of erosion/sediment control best management practices. The best management practices required by the SWPPP shall be continually monitored and maintained.

Status

MAP Section VIII.B.1(a)

The DARHT Facility operations are conducted in full compliance with an existing SWPPP. The SWPPP has been implemented to ensure that erosion and sedimentation are minimized and measures are in place to control runoff. The plan includes required measures for temporary and permanent erosion control, sedimentation control, surface restoration and revegetation, stormwater attenuation in paved and unpaved areas, routine inspection, and a best management practices plan, which includes minimization of fuel and oil spills, good housekeeping practices, and control of stored material and soil stockpiles. The scope, implementation, and modification of the operational SWPPP are routinely reviewed by Weapons Facilities Operations, Facilities Operations Directorate (WFO-FOD) environmental personnel and EPC-CP.

MAP Section VIII.B.1(b)

If control measures prescribed in the SWPPP are determined to be ineffective, the scope and implementation of the operational SWPPP will be modified by WFO-FOD environmental personnel and EPC-CP, as necessary.

MAP Section VIII.B.1(c)

Best management practices prescribed in the SWPPP are continually monitored and maintained by DARHT Facility representatives and WFO-FOD environmental personnel. Current control measures have proven appropriate and effective. If control measures are determined to be ineffective, the scope and implementation of the SWPPP are modified, as necessary, by the WFO-FOD environmental personnel and EPC-CP.

Mitigation Action Scope

MAP Section VIII.B.2(a–e)

The operations mitigation actions MAP Section VIII.B.2(a–e) associated with these potential impacts are as follows:

(a) Workers must avoid off-road activities and stay within approved rights-of-way.

(b) Any proposed activities requiring the disturbance of mature trees and shrubs must first be approved by EPC-ES to avoid disturbance to threatened and endangered species and other wildlife species.

(c) EPC-ES must be notified before any new groundbreaking activities. EPC-ES will review all new sites and evaluate any potential impacts associated with the action. EPC-ES will also provide mitigation to minimize potential impacts, including revegetation as addressed in the SWPPP.

(d) The size of a vegetation buffer zone between the facilities and the edge of the mesa tops will be determined by EPC-ES based on topographic aspects and vegetation composition.

(e) Native vegetation, for this elevation and forest type, will be planted, as appropriate, for erosion control, landscaping, and additional wildlife habitat.

Status

MAP Section VIII.B.2(a)

DARHT Facility operations are conducted according to procedures that, in part, restrict facility workers to designated areas. Access to undesignated areas of the DARHT Facility is managed according to procedures that restrict access to authorized personnel on special work assignments such as post-shot material recovery or fire-suppression operations. All other workers avoid off-road activities and stay within approved rights-of-way.

MAP Section VIII.B.2(*b-e*)

In accordance with System Description (SD) 400 *Environmental Management System*, all new and modified planning, construction, and operations activities (excluding office, business, and administrative functions) must be reviewed for requirements and needed controls for the following:

- Air quality
- Biological resources
- Cultural resources
- NEPA
- Pollution prevention, including resource conservation and sustainable practices
- Potential release sites (Solid Waste Management Units and Areas of Concern)
- Waste and materials management
- Water quality

In addition to requiring full compliance with the above, the SD400 requires full and effective implementation of the LANL *Habitat Management Plan* (LANL 2017). EPC-ES is the Office of

Institutional Coordination for the SD400 and is responsible for developing, revising, and maintaining the document, as well as technically assisting in its full and effective implementation.

Under the LANL *Five-Year Wildland Fire Management Plan* (2016-2020) (LANL 2016) and weapons facilities procedure *Vegetation and Fuels Prescription Control Requirements for Sited High Explosives Facilities* (WFO-OP-276), defensible space surrounding the DARHT Facility has been maintained. The DARHT Facility site defensible space activities were reviewed by EPC-ES biologists and EPC-CP stormwater subject matter experts to ensure appropriate protection of Mexican spotted owl (*Strix occidentalis lucida*) and other wildlife habitat in the area (such as vegetation buffer zones and erosion control). All applicable NEPA, biological resources, and cultural resources regulatory requirements, including MAP Section VIII.B.2(b–e), for DARHT Facility operations and other facility management activities around the DARHT Facility site are fully addressed through the ongoing implementation of SD400.

3.3 Mitigation Actions for Biological Resources

Summary of Potential Impacts

MAP Section VIII.C.1(b–d); 2(n–x); 3(a, b); 4(a–c); 5(a); 6(a); 7(a, b); 8(a, b); 9(a, b); and 10(a, b)

According to the DARHT MAP, DARHT Facility construction and operation could impact federally protected threatened and endangered species such as the Mexican spotted owl (*Strix occidentalis lucida*) because of noise from firings and other operations, as well as other activities at the firing site.

Mitigation Action Scope

MAP Section VIII.C.1(b–d); 2(n–x); 3(a, b); 4(a–c); 5(a); 6(a); 7(a, b); 8(a, b); 9(a, b); and 10(a, b)

These sections of the DARHT MAP commit DOE and LANL to implementing mitigation measures selected to protect threatened, endangered, and sensitive species in the DARHT Facility area. These mitigation measures collectively require DARHT Facility representatives to continue to coordinate with EPC-ES on all DARHT Facility threatened and endangered species issues through the ongoing implementation of the LANL *Habitat Management Plan*. LANL biologists will conduct the necessary species monitoring and habitat protection measures required for the DARHT Facility through the *Habitat Management Plan* (LANL 2017a).

Status

MAP Section VIII.C.1(b–d); 2(n–x); 3(a, b); 4(a–c); 5(a); 6(a); 7(a, b); 8(a, b); 9(a, b); and 10(a, b)

Since January 1999, LANL has fully implemented the *Habitat Management Plan*. During FY 2000, site-wide implementation of the *Habitat Management Plan* was included as part of the institutional requirements in SD400. All applicable NEPA, biological resources and cultural resources regulatory requirements (including MAP Section VIII.C.1 [b–d]; 2 [n–x]; 3 [a, b]; 4 [a–c]; 5 [a]; 6 [a]; and 7 [a, b]) for DARHT Facility operations are addressed through the ongoing implementation of SD400. The *Habitat Management Plan* was last updated in 2017. The historic

nest site adjacent to DARHT is still empty and no new Mexican spotted owls (*Strix occidentalis lucida*) were found around DARHT in FY 2018.

3.4 MITIGATION ACTIONS FOR CULTURAL RESOURCES

Summary of Potential Impacts

MAP Section VIII.D.1(b, e–g)

The DARHT MAP identifies potential impacts from blast effects, such as shock waves and flying debris, from shots using high-explosive charges. These blast effects could affect nearby archaeological sites, especially Nake'muu Pueblo and the immediate surrounding environment.

Mitigation Action Scope

MAP Section VIII.D.1(b, e–g)

The operations mitigation actions MAP Section VIII.D.1(b, e–g) associated with these potential impacts are as follows:

(b) For large high-explosive-charge experiments, a temporary expendable fragment mitigation, consisting of glass plates (to dissipate energy), a sand bag revetment, or other shielding material will be constructed as necessary on a case-by-case basis to mitigate blast effects.

(e) A long-term monitoring program will be implemented at Nake'muu Pueblo using photographs or other means of recording to determine if activities at TA-15 are causing any structural changes to the cultural site over time.

(f) DOE will periodically arrange for Tribal Officials to visit cultural resource sites within TA-15 that are of particular interest to the tribes (at least once a year). DOE is now conducting visits to cultural resource sites in TA-15 as well as Nake'muu Pueblo when requested by Tribal Officials.

(g) The DARHT Facility operator will periodically pick up metal fragments in the areas where fragments land, and they will invite local tribes to participate (at least once a year) so that Tribal Representatives can observe whether there has been damage to any cultural resource sites. DOE will periodically evaluate procedures/measures for mitigation. If damage is discovered, necessary changes will be implemented and reported in the MAPAR. Such changes will be implemented in consultation with the four Accord Pueblos (Cochiti, Jemez, Santa Clara, and San Ildefonso).

Status

MAP Section VIII.D.1(b)

In general, open-air detonations occurred during 2000 to 2006 and detonations within a foam medium and steel containment vessels occurred during 2002 to 2006 and during 2007 to 2008, respectively. None of the large explosive shots in 2002 or 2003 (two shots each year) required fragment mitigation for blast effects, and the employment of foam and steel containment vessels in the latter years significantly reduced the size of a plume and the dispersal of materials (Duran 2008).

Thus, with regard to fragment mitigation measures, all future shots will be evaluated on a case-by-case basis to determine the need for additional fragment protection; however, the current use of steel containment vessels basically eliminates this mitigation concern.

MAP Section VIII.D.1(e)

The results of the nine year-long annual assessment of physical conditions at Nake'muu Pueblo (1998–2006) led to the conclusion that the natural environment, in particular the amount of yearly snowfall and elk moving through the site, are responsible for the deterioration of the standing wall architecture, not the operations at the DARHT Facility (Vierra and Schmidt 2006). As a result of this statistically quantitative study, additional annual monitoring at Nake'muu Pueblo under the DARHT MAP was determined to not be required and was suspended in FY 2007. Note that yearly qualitative assessments of Nake'muu Pueblo have also been performed as part of the MAP for the special environmental analysis associated with the Cerro Grande fire (DOE 2000a). These field checks, conducted by the LANL archaeologists, include brief assessments of the standing walls at Nake'muu Pueblo along with checks of the associated fire road and firebreak. During the period of FY 2006 to 2009, the Nake'muu Pueblo field checks were directly tied into the annual visit by the Pueblo de San Ildefonso, which provided Pueblo de San Ildefonso visitors on the DARHT Facility tour with the opportunity to witness and discuss conditions at this ancestral pueblo.

The FY 2018 annual photographic documentation of the site was conducted on September 12, 2018, by LANL archaeologists. Three and one-half stones from the top of a wall were identified to have fallen since the previous assessment in September 2017. Two chinking stones were also identified to have fallen from two different walls since the previous FY's assessment. Natural erosion continues to be seen throughout the site as well as slight mortar loss. Several wall areas continue to show evidence of undercutting, of which a few show a slight increase in this undercutting from between the FY 2017 and FY 2018 assessments (LANL 2017c).

MAP Section VIII.D.1(f)

No requests for visits were received from Pueblo de San Ildefonso in FY 2018.

MAP Section VIII.D.1(g)

Fragment mitigation measures are implemented for experiments that have the potential to generate fragments. Mitigation measures for material releases to the environment include steel containment vessels implemented in FY 2007, and aqueous foam implemented before FY 2007. The post shot operations for the experiments were conducted according to experiment-specific integrated work documents and established procedures.

These procedures were determined appropriate by DOE and are implemented under the LANL *Integrated Safety Management System* as an integral part of DARHT Facility operations and provide the operational basis and procedures for recovery of metal fragments dispersed during operational shots. In addition to the *Integrated Safety Management System* requirements, these procedures appropriately address DARHT MAP commitments that are designed to minimize the short- and long-term release of contaminants (radioactive and hazardous materials) from the DARHT Facility.

Summary of Potential Impacts

MAP Section VIII.D.2(a, b)

The DARHT MAP identifies the potential for structural or other damage to as-yet-unknown Native American cultural resources within the area of potential effects at the DARHT Facility Such damage could occur as a result of DOE's lack of knowledge of these resources at or around the DARHT Facility.

Mitigation Action Scope

MAP Section VIII.D.2(a, b)

The operational mitigation actions, MAP Section VIII.D.2(a, b), associated with this potential impact are as follows:

(a) Consultation with the four Accord Pueblos will continue to identify and protect any such cultural resources throughout the life of activities at the DARHT Facility.

(b) Evaluation of cultural resources in the vicinity of TA-15 will also be coordinated with the New Mexico State Historic Preservation Officer, as appropriate, for concurrence of eligibility determinations and potential effects.

Status

MAP Section VIII.D.2(a, b)

No requests for visits were received in FY 2018.

3.5 Mitigation Actions for Human Health and Safety

Summary of Potential Impacts

MAP Section VIII.E.1(a)

The DARHT MAP identifies potential adverse health effects on workers and the general public from high noise levels associated with the DARHT Facility, especially from construction and test firing.

Mitigation Action Scope

MAP Section VIII.E.1(a)

There is a commitment in the DARHT MAP to provide noise protection to workers in the form of ear muffs or ear plugs, depending on the expected noise levels, per Occupational Safety and Health Administration Act of 1972 requirements.

Status

MAP Section VIII.E.1(a)

Under the institutional implementation of the Integrated Safety Management System, DARHT Facility operations are managed according to specific procedures that collectively address a wide range of potential impacts to worker safety and health. These procedures fully address potential adverse health effects on workers from high noise levels associated with the DARHT Facility during test firing by requiring the use of appropriate personal protective equipment.

Summary of Potential Impacts

MAP Section VIII.E.2(a–c)

The DARHT MAP identifies the potential for adverse health effects on workers from radiation from DARHT Facility operations.

Mitigation Action Scope

MAP Section VIII.E.2(a–c)

The operations mitigation actions, MAP Section VIII.E.2(a–c), associated with this potential impact are as follows:

(a) Radiation shielding will be provided around the accelerators to limit radiation exposure to workers in the facility.

(b) DARHT Facility workers will be required to complete DOE-certified core radiological training (minimum Radiation-Worker I level) and be enrolled in the LANL dosimetry program.

(c) Engineered controls will be installed as visual indicators to notify workers when the accelerators are operating.

Status

MAP Section VIII.E.2(a–c)

Under the institutional implementation of the Integrated Safety Management System, DARHT Facility operations are managed according to specific procedures that collectively address a wide range of potential impacts to worker safety and health. DARHT Facility accelerator operations are conducted in accordance with the DARHT Operations Standard AP-DARHT-014. This procedure requires appropriate training, radiation dosimetry program participation, and acceleration operations that collectively protect workers from exposure to unacceptable levels of radiation.

4.0 CONCLUSIONS

In FY 2018, all radionuclides and chemicals in soil and sediment collected from around the perimeter of the DARHT Facility were either similar to the baseline statistical reference level or below screening levels protective of biota. The majority of elements observed in avian eggs were similar or below the regional statistical reference level.

Although FY 2018 radionuclide and chemical levels were not at concentrations detrimental to human health (DOE 1999a) or to the environment (LANL 2018, DOE 2002, EPA 2018), there were still measurable amounts of depleted uranium in all media. The depleted uranium, selenium and arsenic levels have been increasing over time to at least FY 2006

The natural environment appears to have a larger effect on the deterioration of the standing wall architecture at Nake’muu Pueblo than the operations at the DARHT Facility.

4.1 2018 MAP IMPLEMENTATION

In July 1999, all construction-related DARHT MAP mitigation commitments and action plans were completed. The FY 2018 DARHT MAP activities represent the eighteenth year of operation implementation. The DARHT MAP activities implemented in FY 2018 were a continuation of DARHT Facility operations-phase MAP tracking and annual reporting. Should the scope of the DARHT Facility project change during the operations stage, as part of the appropriate NEPA review, the scope of the DARHT MAP could be changed by NNSA as necessary and as directed by the DOE/NNSA Field Office.

4.2 RECOMMENDATIONS

- Continue monitoring for contaminants that are above baseline statistical reference levels or are on increasing trends.
- Continue to issue the DARHT MAPAR annually as part of the SWEIS MAPAR. Detailed analysis of DARHT monitoring data and results will continue to be published in the LANL ASER.
- Continue environmental monitoring activities and tribal visits as requested at Nake'muu Pueblo. Vegetation removal and site condition monitoring will continue to occur annually. Tribal visits will be facilitated when requested by the Pueblo (see Section VIII.D.1(f)).
- Continue to manage DARHT Facility operations in accordance with Integrated Safety Management. Continue to manage DARHT Facility operations according to specific procedures that collectively address a wide range of potential impacts to worker safety and health including, but not limited to, noise and radiation hazards.

REFERENCES

Anderson, D and J. Hickey. “Dynamics of Storage of Organochlorine Pollutants in Herring Gulls.” *Environmental Pollution* 10 (1976): 183-200.

Bustnes, J.O., B. Moe, D. Herzke, S. Hanssen, and D. Nordstad.. “Strongly increasing blood concentrations of lipid-soluble organochlorines in high arctic common eiders during incubation fast.” *Chemosphere* 79 (2010): 320-325.

DOE 1995: U.S. Department of Energy, “*Dual-Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement Record of Decision*,” DOE/EIS-0228 (October 1995).

DOE 1996: U.S. Department of Energy, “*Dual-Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement Mitigation Action Plan*,” DOE/EIS-0228 (January 1996).

DOE 1999a: U.S. Department of Energy, “*The Long-Term Control of Property: Overview of Requirements in Orders DOE 5400.1 and 5400.5*,” U.S. Department of Energy Brief EH-412-0014/1099 (October 1999).

DOE 2000a: U.S. Department of Energy, “*Special Environmental Analysis for the Department of Energy, National Nuclear Security Administration: Actions Taken in Response to the Cerro Grande Fire at Los Alamos National Laboratory, Los Alamos, New Mexico*,” DOE/SEA-03, Department of Energy, Los Alamos Area Office (September 2000).

DOE 2002: U.S. Department of Energy, “*A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*,” U.S. Department of Energy Standard DOE-STD-1153-2002 (July 2002).

DOE 2008: U.S. Department of Energy, “*Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*,” DOE/EIS-0380 (December 2008).

Dauwe T, E. Janssens, L. Bervoets, R. Blust, and M. Eens. “Heavy-metal concentrations in female laying great tits (Parus major) and their clutches.” *Archives of Environmental Contamination and Toxicology* 49 (2005): 249-256.

Duran 2008. “*Environmental Assessment of Foam Mitigation and Vessel Contained Shots*,” Los Alamos National Laboratory Report LA-UR-08-2289 (April 2008).

EPA 2018: U.S. Environmental Protection Agency, Glossary from the Risk Assessment Portal, Accessed September 2018, http://www.epa.gov/risk_assessment/glossary.htm.

Fresquez, P.R., C. Hathcock, and D. Keller, “*Bird Surveys at DARHT before and during Operations: Comparison of Species Abundance and Composition and Trace Elements*,” Los Alamos National Laboratory Report LA-14355 (November 2007).

Fresquez, P.R., S. Gaukler, L. Hansen, C. Hathcock, D. Keller, and M. McNaughton. "Ecosystem Health," *Annual, Site Environmental Report*, New Mexico, Los Alamos, (2017). Los Alamos National Laboratory: LA-UR-17-27987, ch. 7 p. 1–45.

Gaukler, S.,C. Hathcock, and M. McNaughton. "Ecosystem Health," *Annual Site Environmental Report*, New Mexico, Los Alamos, (2018). Los Alamos National Laboratory: LA-UR-18-28565, ch. 7 p. 1–65.

International Atomic Energy Agency. Depleted Uranium. Accessed October 2019, https://www.iaea.org/topics/spent-fuel-management/depleted-uranium.

Keller, D.C., and D. Risberg, "Biological and Floodplain/Wetland Assessment for the Dual-Axis Radiographic Hydrodynamics Test (DARHT) Facility," New Mexico, Los Alamos National Laboratory Report LA-UR-95-647 (December 1995).

Keller, D.C., P.R. Fresquez, L.A. Hansen, and D.R. Kaschube, Avian Community Composition in Response to High Explosive Testing Operations at Los Alamos National Laboratory in Northern New Mexico," *Journal of Environmental Protection* 6.12 (2015): 1442-1453.

LANL: Los Alamos National Laboratory, "*CD-4 Milestone for the Dual-Axis Radiographic Hydrodynamic Test Facility*," Los Alamos National Laboratory Memorandum ESH-20/Ecol-99-0235 (June 1999).

LANL: Los Alamos National Laboratory, "*Wildland Fire Management Plan*," Los Alamos National Laboratory Report LA-UR-16-20979 (2016).

LANL: Los Alamos National Laboratory, "*Threatened and Endangered Species Habitat Management Plan for Los Alamos National Laboratory*," Los Alamos National Laboratory Report LA-UR-17-29454 (2017a).

LANL: Los Alamos National Laboratory, "*A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico*," Los Alamos National Laboratory Report LA-UR-15-27624, (2017c).

LANL: Los Alamos National Laboratory, "*Los Alamos National Laboratory Annual Site Environmental Report 2018*," Los Alamos National Laboratory Report LA-UR-19-28950, (2019).

Nyhan, J.W., P.R. Fresquez, K.D. Bennett, J.R. Biggs, T.K. Haarmann, D.C. Keller, and H.T. Haagenstad. "*Baseline Concentrations of Radionuclides and Trace Elements in Soils, Sediments, Vegetation, Small Mammals, Birds, and Bees around the DARHT Facility: Construction Phase (1996 through 1999),*" Los Alamos National Laboratory Report LA-13808-MS (2001).

Smith, P.N., Cobb, G.P., Harper, F.M., Adair, B.M., McMurry, S.T. "Comparison of White-Footed Mice and Rice Rats as Biomonitors of Polychlorinated Biphenyl and Metal Contamination." *Environmental Pollution* 119. (2002): 261–268.

Talmage, S.S. and Walton, B.T. “Small Mammals as Monitors of Environmental Contaminants,” *Reviews of Environmental Contamination and Toxicology* 119 (1991): 47–145.

Thompson, D. Mercury in Birds and Terrestrial Mammals in W. Beyer, G. Heinz, & A. Redmon-Norwood (Eds.), Environmental Contaminants in Wildlife Interpreting Tissue Concentrations (1st ed., pp. 341–356). Boca Raton, Florida: CRC Press, Inc.

Vierra, B.J. and K.M. Schmidt, “*A Current Assessment of the Nake'muu Monitoring Program*,” Los Alamos National Laboratory Report LA-UR-06-8130 (2006).

Zumbro, M., personal communication, Los Alamos National Laboratory, May 10, 2010.