LA-UR-20-28438

Title:	**Fiscal Year 2020 Mitigation Action Plan Annual Report for the 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

This page intentionally left blank

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 (October 1- September 30) 2020 Mitigation Action Plan Annual Report (MAPAR). This fiscal year (FY) 2020 annual report includes mitigations identified in the *Mitigation Action Plan for Los Alamos National Laboratory Operations* (MAP for LANL Operations). Actions taken to meet these mitigations are presented in this report. In FY 2020, the mitigation commitments identified in the MAP for LANL Operations have been met, are ongoing, or are on hold until preceding actions are taken.

1.0 Introduction

The *Mitigation Action Plan for Los Alamos National Laboratory* (MAP for LANL Operations) is a comprehensive plan for all current and ongoing mitigations identified in the 2008 Site-Wide Environmental Impact Statement (SWEIS) and other National Environmental Policy Act (NEPA) documents. The MAP for LANL Operations discusses the measures that the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) considered for the mitigation or reduction of potential adverse effects contributed to LANL operations. The MAP is a living document that is revised to incorporate additional mitigation requirements associated with additional records of decision (RODs), NEPA decisions, or to meet the objectives set out in the 2008 SWEIS and other NEPA documents.

NNSA Policy, NAP-451.1, *National Environmental Policy Act Compliance Program*, requires the tracking and annual reporting of the progress made in implementing mitigations and the effectiveness of the mitigation actions committed to in a NEPA decision document and documented in the associated MAPs. This Mitigation Action Plan Annual Report (MAPAR) fulfills this requirement, documenting the mitigation actions identified in the MAP for LANL Operations and subsequent MAPs associated with the operation of Los Alamos National Laboratory (LANL). As required by the MAP for LANL Operations, a draft MAPAR summarizing the work conducted by LANL in the previous fiscal year (FY) is submitted for review to the DOE/NNSA Los Alamos Field Office. The DOE/NNSA Los Alamos Field Office finalizes and publishes the MAPAR.

The MAP for LANL Operations requires tracking of mitigation actions in a log that includes information regarding the scope, schedule, interim milestones, deliverables, and closures of the mitigation actions and any issues identified during the previous FY. The MAPAR provides the completed tracking log with a summary of the major actions taken in the previous FY (Table 3-1).

During the preparation of the MAPAR, the MAP for LANL Operations is reviewed to determine whether the mitigation actions remain effective and if any mitigation actions have been completed and need to be formally closed. Revision of the MAP for LANL Operations may be recommended in the MAPAR to address significant changes, new actions, or deficiencies.

This FY 2020 MAPAR reports on the status of mitigation commitments and all executed actions for mitigation commitments that have taken place in FY 2020.

2.0 Background

In May 2008, the 2008 LANL Site-Wide Environmental Impact Statement (2008 SWEIS) was published, since then there have been two associated RODs. 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 original 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 was 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 2020, the 2008 SWEIS MAP was again updated to incorporate mitigations from the *Final Supplemental Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory* (Forest Health SEA) (*DOE/EA*-2122) and the *Final Environmental Assessment for the Construction and Operation of a Second Fiber Optic Line to Los Alamos National Laboratory (*Fiber Optic EA*) (DOE/EA-2122)*.

The 2020 MAP revision acknowledges that the majority of mitigations identified in the 2008 SWEIS have been cancelled, completed, or integrated into established LANL programs. The remaining mitigations in the MAP are those that have been integrated from other NEPA documents since the issuance of the 2008 SWEIS. Recognizing this MAP as the main MAP for Los Alamos National Laboratory Operations (LANL Operations) allows for the integration of all mitigations identified in NEPA documents, not only those identified in the 2008 SWEIS. The title of the MAP was changed to the MAP for Los Alamos National Laboratory Operations (LANL Operations) to better reflect the incorporated mitigations.

The *Dual-Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement (EIS) Mitigation Action Plan* (DOE 1996) requires a MAPAR to be prepared as part of implementing the Dual-Axis Radiographic Hydrodynamic Test (DARHT) MAP. The DARHT MAPAR provides a status of specific DARHT Facility operation-related mitigation actions that are implemented to fulfill DOE commitments under the DARHT EIS ROD (DOE 1995).

Appendix A is the FY 2019 DARHT MAPAR, which provides details of the progress on mitigation action commitments. The FY 2019 DARHT MAPAR is summarized in Table 3-1 along with actions taken in FY 2020. Because sampling results are not available until the second quarter of each year, the DARHT MAPAR reporting is one fiscal year behind the annual MAPAR. The FY 2019 DARHT MAPAR reports on the full scope of actions implemented in FY 2019 (October 1, 2018, through September 30, 2019) and represents 22 years of DARHT Facility operation-related MAPs.

3.0 Mitigation Action Commitments

The mitigation actions are outlined in the MAPAR Tracking Log for FY 2020, Table 3-1. These actions are based on the mitigation measures and commitments that were previously incorporated in the 2008 SWEIS alternatives and includes other mitigation measures and commitments from previous NEPA decisions.

In FY 2020, the mitigation commitments identified in the MAP for LANL Operations have been met, are ongoing, or are on hold until preceding actions are taken.

Table 3-1. Mitigation Tracking Log for FY 2020

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
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, honey, honeybees, and bird eggs and nestlings from around the DARHT Facility and in front of the firing site in 2019 were compiled, analyzed, and reported in the 2019 Annual Site Environmental Report (ASER). All road kills from control sites away from the facility are reported in the 2019 ASER. All samples collected were either similar to the baseline statistical reference level or below screening levels protective of biota (LANL 2020). In May 2020, samples collected from soil and sediment from four areas around the DARHT Facility and in front of the firing site were analyzed and will be reported in the 2020 ASER.	Annual requirement complete	Based on the previous 19 years of monitoring contaminants at the DARHT Facility, it is recommended that the DARHT MAP be re-evaluated to determine if mitigations should be updated or closed.	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.)	Conduct Tribal tours of Nake'muu Pueblo as requested. Perform annual surveillance and maintenance activities. (Appendix A).	MAP for DARHT Environmental Impact Statement (EIS)	No requests for tribal visits were received in FY 2020, though annual surveillance and maintenance activities were conducted in the fourth quarter FY 2020.		Continue visits to Nake'muu Pueblo as requested by the Pueblo de San Ildefonso	NNSA LANL Field Office/LANL EPC Group

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
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 2019 ASER (LANL 2020). 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 2020). Understory vegetation and small mammals from the up-gradient side of both locations were collected in June 2020. All samples were submitted for analysis and results will be published in the 2020 ASER.	Annual requirement complete	Continue annual sampling and analysis	LANL EPC and DOE Environmental Management/Newport News Nuclear BWXT (N3B)

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
Special Environmental Analysis (Cont.)	Periodically remove sediment from the Los Alamos Canyon weir.	DOE/SEA-03 (DOE 2000)	N3B did not clean out the sediment detention basins behind the Los Alamos Weir because there was minimal flow in 2019, and there has been no flow in 2020.	Ongoing	Continue maintenance on clean-outs as necessary	DOE Environmental Management/N3B
Flood and Sediment Retention Structure (FRS)	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 30, 2020, (UI RPT-003, R10) 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
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)	In 2020 the FRS structure was added to the Facilities Information Management System (FIMS)	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
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
Off-Site Source Recovery Project	Institute 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 containing	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
				cobalt-60, iridium-192, or cesium-137.		
Wildland Fire Management	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, five (5) shipments were transported by N3B from TA-54 to WIPP for long-term storage (Madsen 2020).	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
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 2015a, b)	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 2020.	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 taken in FY 2020.			
	Comply with the Endangered Species Act and adhere to LANL Threatened and Endangered Species Habitat Management Plan (LANL 2017a).		Restrictions for the Endangered Species Act and the LANL Threatened and Endangered Species Habitat Management Plan (LANL 2017a) were met for FY 2020.			

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
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" to minimize short-term negative impacts.	DOE/EA-2005 MAP (DOE 2015a, b)	Best management practices are implemented for all excavations and soil stockpiles. Floodplain restrictions were met for FY 2020.	Ongoing	Continue implementing	DOE Environmental Management/N3B
	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 2020.			

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
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 2015a, b)	All National Pollutant Discharge Elimination System General Permit requirements were met for FY 2020.	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.					
Forest Health	Fire Road Stabilization	Wildfire SEA (DOE/EA-1329-S1) (DOE 2019)	• Update LANL Engineering Standards for new unpaved roads • Improve fire roads to reduce stormwater erosion • Develop procedure for monitoring cultural sites near fire roads	Ongoing	Continue implementing	NNSA LANL Field Office/LANL EPC & Emergency Management
	Integration of Forest Health Objectives		• Develop and implement an Annual Operating Plan for fuels mitigation and forest health actions	Ongoing	Continue implementing	NNSA LANL Field Office/LANL EPC & Emergency Management

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
Forest Health (Cont.)	Jemez Mountains Salamander Habitat Protection	Wildfire SEA (DOE/EA-1329-S1) (DOE 2019)	• Update the LANL Pesticide Discharge Management Plan to prohibit herbicide in Jemez Mountain Salamander Habitat	Ongoing	Continue implementing	NNSA LANL Field Office/LANL EPC & Emergency Management
	Fuels Mastication Adaptive Management		• Develop invasive species best management practices document • Prepare a cost-benefit analysis on fuels reduction options • Incorporate experiments, monitoring, and adaptive management into mastication treatments	Ongoing	Continue implementing	NNSA LANL Field Office/LANL EPC & Emergency Management
Construction and Operation of a Second Fiber Optic Line to LANL	Transportation	Fiber Optic EA (DOE/EA-2122) (DOE 2020)	• Develop a traffic safety plan during construction activities • Restore Forest Service Road 24 to pre-construction conditions • Maintain Forest Service Road 24 to protect road from erosion and vehicle impacts	**Mitigation On Hold** This mitigation is on hold until construction of the second fiber line begins	Remain on hold until construction begins	

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
Construction and Operation of a Second Fiber Optic Line to LANL (Cont.)	Erosion and Sediment Control	Fiber Optic EA (DOE/EA-2122) (DOE 2020)	• Use erosion and sediment control best management practices during construction activities	**Mitigation On Hold** This mitigation is on hold until construction of the second fiber line begins	Remain on hold until construction begins	
	Site Restoration		• Restore disturbed areas to a natural appearance and successfully revegetate	**Mitigation On Hold** This mitigation is on hold until construction of the second fiber line begins	Remain on hold until construction begins	
	Special Wildlife Considerations		• Construction operations are conducted to minimize potential disturbance to wildlife • Design structures to reduce visual impact, reflection, and glare	**Mitigation On Hold** This mitigation is on hold until construction of the second fiber line begins	Remain on hold until construction begins	

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Mitigation Status[1]	Recommendation	Responsible Party
Construction and Operation of a Second Fiber Optic Line to LANL (Cont.)	Housekeeping	Fiber Optic EA (DOE/EA-2122) (DOE 2020)	• Construction sites and access roads are kept in an orderly condition	**Mitigation On Hold** This mitigation is on hold until construction of the second fiber line begins	Remain on hold until construction begins	

References

DOE 1995. "Record of Decision Dual Axis Radiographic Hydrodynamic Test Facility," Department of Energy, 60 FR 53588, October 16, 1995.

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 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 2015a. "Final Environmental Assessment for Chromium Plume Control Interim Measure and Plume-Center Characterization, Los Alamos National Laboratory, Los Alamos, New Mexico," Department of Energy, DOE/EA-2005, December 2015.

DOE 2015b. "Mitigation Action Plan for Chromium Plume Control Interim Measure and Plume-Center Characterization, Los Alamos National Laboratory, Los Alamos, New Mexico," Department of Energy, DOE/EA-2005, December 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 2019. "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-1329-S1, July 2019.

DOE 2020. "Environmental Assessment: Construction and Operation of a Second Fiber Optic Line to Los Alamos National Laboratory," Department of Energy, DOE/EA-2122, May 2020.

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 2020. "Los Alamos National Laboratory 2019 Annual Site Environmental Report," Los Alamos National Laboratory, LA-UR-20-26673, September 23, 2020.

Madsen, A. 2020. "RE: FY 20 SWEIS MAPAR- Chromium Updates," Email communication from A. Madsen (N3B) to K. Musgrave (LANL), September 28, 2020.

Appendix A: Dual-Axis Radiographic Hydrodynamic Test Facility Mitigation Action Plan Annual Report for FY 2019

This page intentionally left blank.

National Nuclear Security Administration

Dual-Axis Radiographic Hydrodynamic Test Facility

Mitigation Action Plan

Annual Report for Fiscal Year 2019

Prepared for:

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

Contents

List of Tables

List of Figures

Executive Summary

In fiscal year (FY) 2019, 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 bees and avian samples were similar to or below the regional statistical reference level. There were no impacts from DARHT operations on archaeological resources (e.g., 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 2019 radionuclide and chemical levels were not at concentrations detrimental to human health or to the environment, there were measurable amounts of depleted uranium in the 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/National Nuclear Security Administration (DOE/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 2019 (October 1, 2018, through September 30, 2019) and represents the nineteenth 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 Point 6

[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.

in 2006, and shots within steel containment vessels at the DARHT Facility were implemented in May 2007 through September 2018. In April 2020, the DARHT weather enclosure was completed. The new structure encloses the DARHT firing point, thereby protecting equipment while also creating a predictable environment for experimentation. The DARHT weather enclosure also creates another barrier to protect soil, water, and biological and cultural resources that may be affected by DARHT operations.

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, which 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 the 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 2019, 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 are transported to VPB where they were decontaminated and prepared for the next experiment. Since 2007, 55 hydrodynamic test shots within steel containment vessels at DARHT have been conducted.

2.0 MAP IMPLEMENTATION

The DARHT MAP is implemented on an annual basis through the yearly monitoring of soil, water, and biological and cultural resources with the results published in the Annual Site Environmental Report (ASER) and reported in the annual DARHT MAPAR. The DARHT MAPAR is published in coordination with the federal FY cycle. Typically, the information provided in the DARHT MAPAR is from the previous FY cycle which is reported in the annual MAPAR for the Continued Operations at LANL

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 MAPAR for the Continued Operations at LANL 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 under the DARHT MAP.

3.0 DARHT MAP SCOPE, SCHEDULE, AND STATUS

This FY 2019 MAPAR documents the scope and results of mitigation action tasks implemented throughout FY 2019. Table 3-1 provides a summary of the scope of potential impacts and commitments addressed in this MAPAR.

Table A 3-1. FY 2019 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.		
7. DARHT Facility construction and operation could impact the Jemez Mountains salamander (*Plethodon neomexicanus*) as a		

DARHT MAP Potential Impacts/Commitments	DARHT Phase	MAPAR Section
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 for 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; (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 of DARHT samples are summarized in a composite report (Nyhan et al. 2001) and 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. Routine biological samples collected around DARHT have included overstory branches, small mammals, honey bees (*Api mellifera*) and/or honey, and bird eggs and nestlings. Samples of soil, sediment, and one type of biota are collected annually; typically, vegetation, honey or honey bees. Small mammal sampling is rotated annually, so that each is samples once in a three-year period. Bird samples are collected opportunistically when abandoned or infertile eggs or deceased nestlings are found in local nest boxes.

In 2019, soil, sediment, honey bees, honey, and bird egg and nestling around the facility were sampled. All samples were collected around the perimeter of DARHT (Figure 3-1). Soil samples were collected in May 2019 on the north, east, south, and west sides of the DARHT perimeter

along the fence line. Five soil subsamples were collected at each location at a depth from zero to two inches, combined and mixed together to form a composite sample. An additional composite soil sample was collected approximately 75 feet north of the firing point along the protective berm.

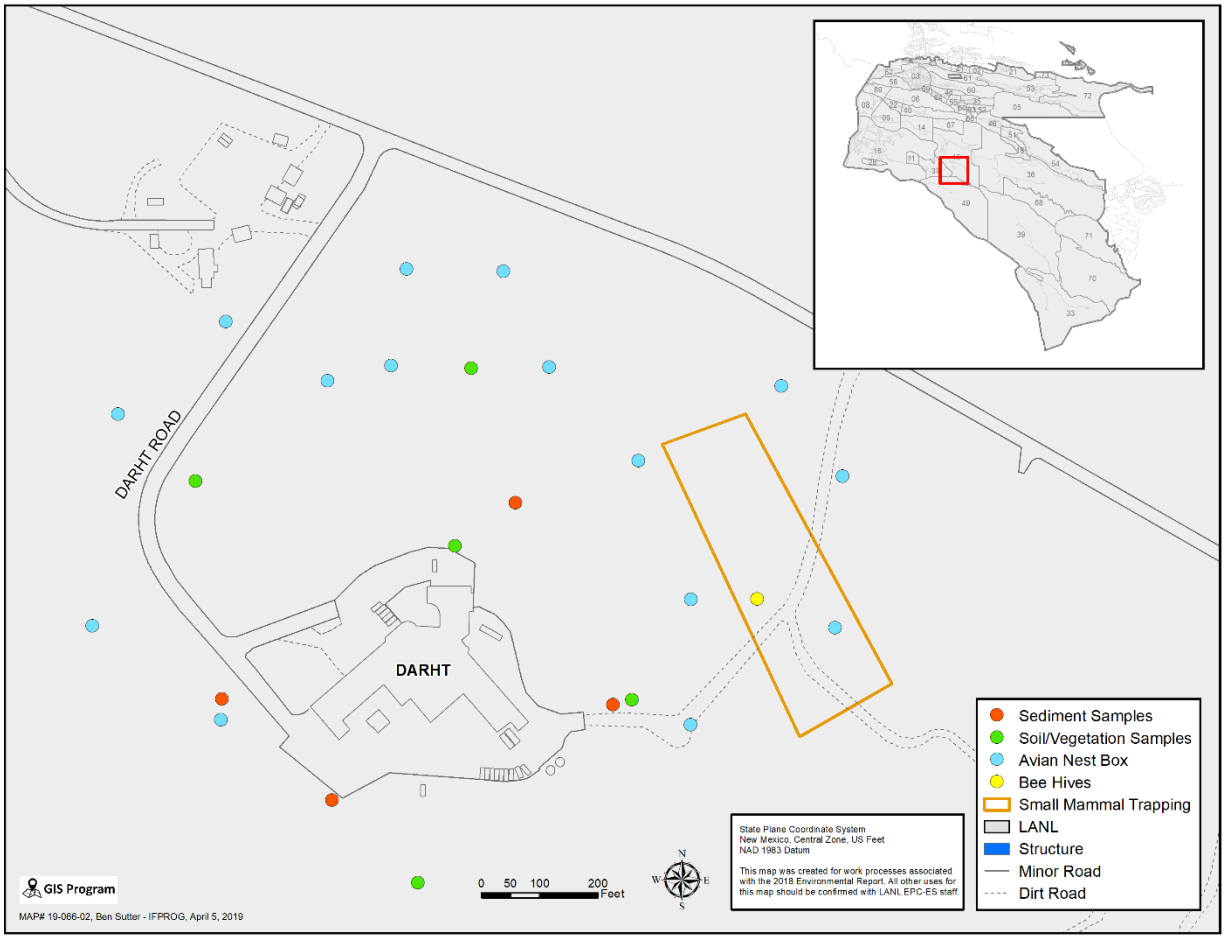

Figure A 3-1. Soil, sediment, and biological sample locations at DARHT Facility.

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.

Beehives were established north of DARHT and bees were consistently collected and chemically analyzed through 2013. In 2019, three old beehives were replaced with three new beehives and bees. One of the old hives still contained live bees, which was collected for inorganic element and radionuclide analyses. Honey was also collected from the old active hive and was analyzed for inorganic elements, radionuclides, high explosives, and per- and polyfluoroalkyl substances (PFAS).

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 bird'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.

Sample results are compared with the baseline statistical reference levels which are based on samples collected at the facility during 1996 to 1999, before the beginning of firing site operations. The baseline level for each constituent is the level below which 99% of samples from this time occurred (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 are compared with regional statistical reference levels. The regional statistical reference level for a chemical or radionuclide is the level below which 99% of the regional background locations results fall. Soil and sediment constituent concentrations are also compared with ecological screening levels which are the highest level of a radionuclide or chemical in the soil that is known to not affect selected animals or plants (the no-effect ecological screening level) and the lowest level known to have caused an adverse effect on selected animals or plants (the low-effect ecological screening level) (LANL 2017).

No vegetation or small mammal samples were collected in 2019.

Results for Radionuclides and Chemicals in Soil, Sediment, Honey Bees, Honey, Bird Eggs, and Nestlings at the Dual-Axis Radiographic Hydrodynamic Test 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. Detectable activities of cesium-137, plutonium-238, plutonium-239/240, and strontium-90 were all below the baseline regional statistical reference level, and/or regional statistical reference level.

In 2019, all soil and sediment samples contained all three isotopes of uranium; this result is 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]). The highest level of uranium-238 was observed in a sediment sample collected on the south side of DARHT. This sample resulted in 21.2 pCi/g uranium-238 and is higher than typically observed. The majority (97%) of uranium-238 activities are less than 10pCi/g in soil and sediment collected at DARHT. All radionuclide activities are far below ecological screening levels that are 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).

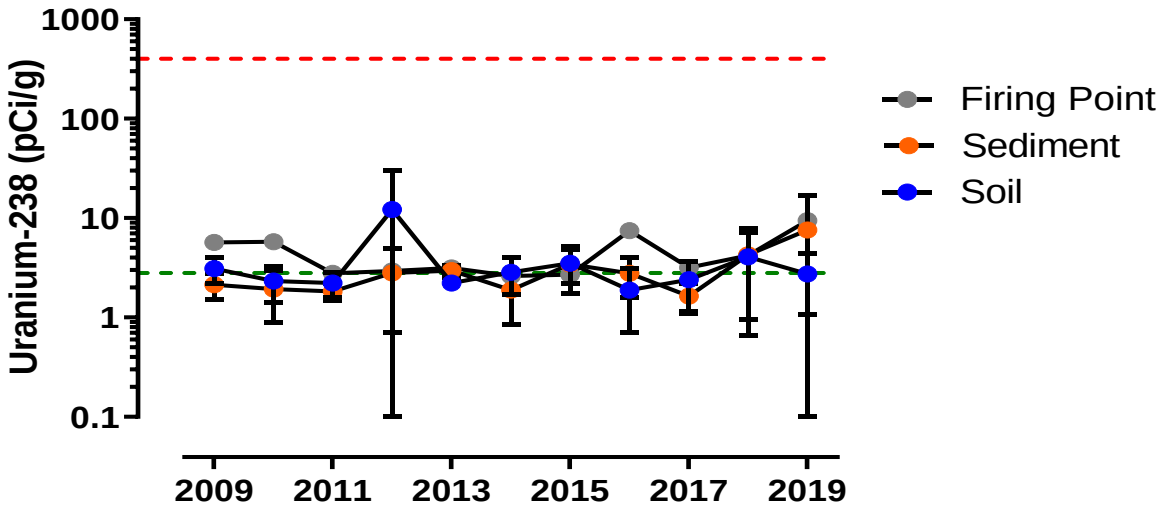

Figure A 3-2. Urainum-238 activites in surface soil and sediment samples.

Figure 3-2 describes the uranium-238 activities in surface soil and sediment samples collected around the DARHT Facility, and in the firing point soil sample, from 2008 to 2019. The description is 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, except for mercury, were found at detectable concentrations in all soil and sediment samples collected in 2019. Mercury was found at detectable concentrations in some samples. Concentrations of aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, iron, lead, magnesium, 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 of select elements. Consistent with observations from previous years, in some soil and sediment samples concentration of manganese (four samples), mercury (one sample), thallium (six samples), and vanadium (nine samples) exceeded the no-effect ecological screening level for the plant, montane shrew, or American robin and/or the low-effect ecological screening level for the

American robin. This included the soil sample collected at the firing point; however, all concentrations of these elements were below the regional statistical reference level and the baseline statistical reference level (when available). As a note, the regional statistical reference level of these elements is also above the no-effect ecological screening level.

The soil sample collected at the firing site contained copper (19 mg/kg) that was higher than regional statistical reference level (17 mg/kg) and the no-effect ecological screening level for the American robin (14 mg/kg), but was below the baseline statistical reference level (86 mg/kg). Six soil and sediment samples contained selenium concentrations (range 0.75 to 0.95 mg/kg) that were above the baseline statistical reference level (0.68 mg/kg) and the no-effect ecological screening level for the plant (0.52 mg/kg) and montane shrew (0.70 mg/kg) but were below the regional statistical reference level (1.79 mg/kg). Three sediment samples contained zinc concentrations (range 53 to 90 mg/kg) that were higher than the regional statistical reference level (50 mg/kg) and were above the no-effect ecological screening level for the American robin (47 mg/kg). Three sediment samples also exceeded the regional statistical reference level for sodium (140 mg/kg; range of exceedances 170 to 230 mg/kg) while no other reference values for sodium are available. 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 concentrations potentially associated with adverse effects at an individual level are minimal, and no impacts to populations or communities of plants and animals are expected.

Consistent with data in previous years, selenium (Figure 3-3) and copper concentrations were increasing over time in the sediment sample collected from the east side of DARHT; in 2019, zinc in sediment was also increasing at this sampling location (Kendall's Tau, $p < 0.05$). Arsenic, cadmium, and selenium were increasing over time in soil collected from the east side of DARHT and arsenic was increasing over time in soil collected from the south side (Kendall's Tau, $p < 0.05$). These trends will be monitored closely in future sampling. No other elements are increasing over time around DARHT.

From 2008 to 2019, surface soil and sediment samples collected around the DARHT Facility and firing point were analyzed to determine the concentration of selenium and beryllium (Figure 3-3). 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.

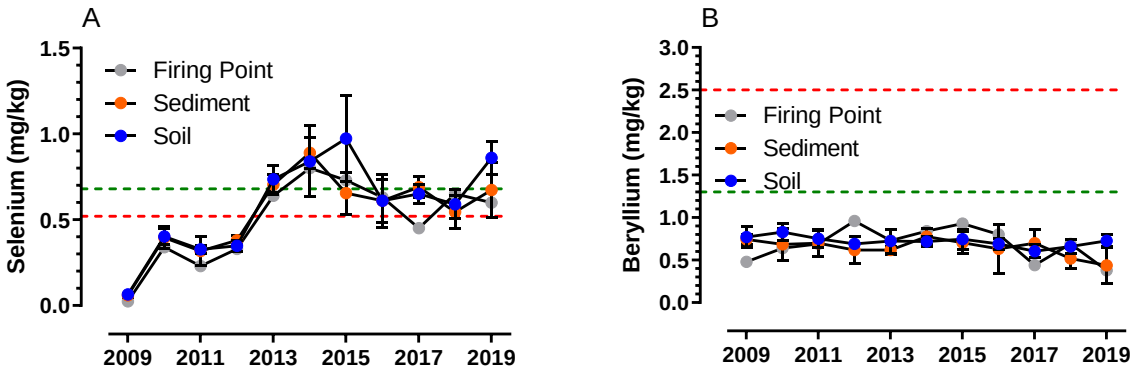

Figure A 3-3. (A) Selenium and (B) beryllium concentrations in surface soil and sediment samples collected around the DARHT Facility and firing point.

Similar to 2017, selenium concentrations were increasing over time at the firing point and in all four sediment samples; arsenic was also 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).

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

During 2019, a bird egg was collected and sampled. As similar to previous years, inorganic elements were not detected, including antimony, arsenic, beryllium, cadmium, lead, nickel,

silver, thallium, and vanadium. All other detectable concentrations of elements were below the regional statistical reference level.

Plutonium-238 and plutonium-239/240 were not detected in the nestling samples that were collected in 2019. Uranium-234, uranium-235/236, and uranium-238 were detected in nestlings and were similar with previous results; uranium-238 was detected (0.225 and 0.270 pCi/g) above the regional statistical reference level (0.197 pCi/g; Figure 4). Though not enough data are available for a trend analyses, there is no difference of uranium-234 or uranium-238 isotopes in nestlings collected from DARHT (n=4) when compared with background [(n=3), unpaired t test, $p > 0.05$, Figure 4]. All radionuclide levels were far below the biota dose screening level (DOE 2019). Uranium isotopes 234, 235/236, and 238 have been detected in soils, sediments, and small mammals collected around DARHT at levels that have exceeded the regional statistical reference levels in the recent past (Gaukler et al. 2018, Fresquez et al. 2017). These results suggest that uranium is bioavailable and is being incorporated into nestling tissues but is below levels associated with harmful effects.

Figure 3-4 describes the uranium-234 and uranium-238 activities in nestling samples collected around DARHT and from the background location located at Bandelier National Monument from 2017 to 2019. Data are compared with the regional statistical reference level (the mean plus three standard deviations of background concentrations; purple dashed line for uranium-234 and green dashed line for uranium-238) compared with the biota dose screening level (red dashed line red for uranium-234 and gray for uranium-238). Note the linear scale on the vertical axis. Columns represent mean values and error bars represent standard deviation.

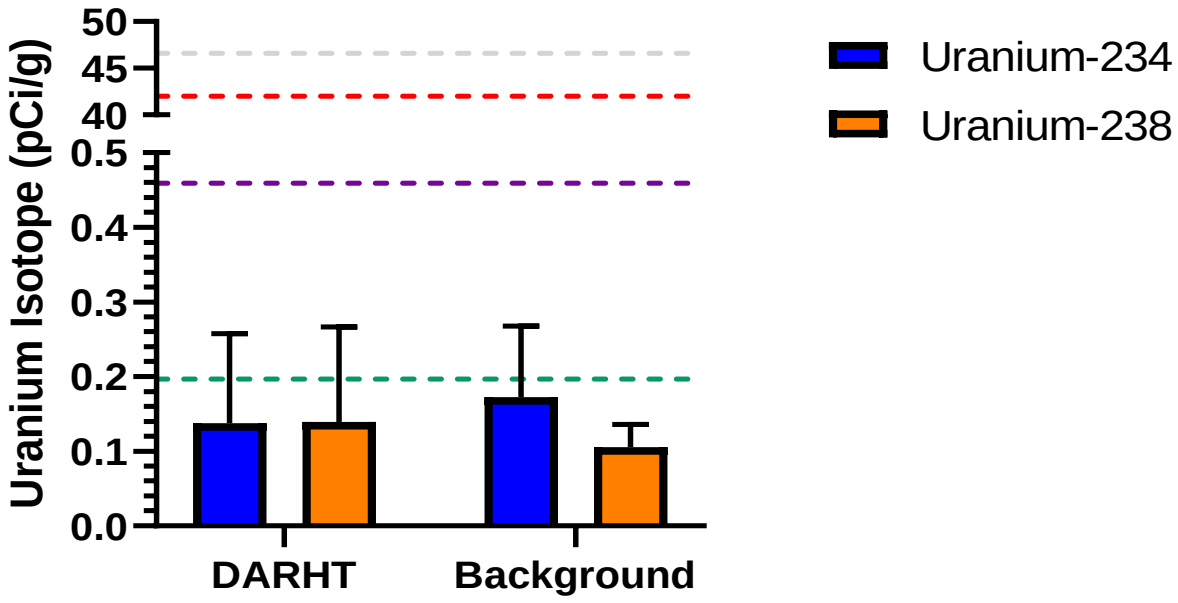

Figure A 3-4. Uranium-234 and Uranium-238 concentrations in nestling samples collected around DARHT and background locations from 2017 – 2019.

Honey Bees and Honey Results at the DARHT Facility

Honey bees were analyzed for inorganic elements and radionuclides. The majority of inorganic elements were below the regional statistical reference level and no inorganic elements in honey bees are changing over time. Tritium, uranium-234, and uranium-238 were the only radionuclides that were detected. No radionuclides are increasing in bees over time and uranium-238 was found to be decreasing over time (Kendall's Tau, $p < 0.05$). As only one sample from background is available, a regional statistical reference level could not be calculated; however, comparisons between the honey bee sample collected from DARHT was made with the honey bee sample collected from a background location. Uranium isotopes in the honey bee sample from DARHT were less than background and tritium levels were similar. All radionuclide activities were below the biota dose screening levels.

The honey sample was analyzed for inorganic elements, radionuclides, high explosives, and PFAS. No radionuclides, high explosives, or PFAS were detected. As only one honey sample from background is available for inorganic elements, a regional statistical reference level could not be calculated; however, comparisons between the honey sample collected from DARHT was made with the honey sample collected from a background location. The majority of inorganic elements were similar in concentrations and detection patterns. No constituent levels found in honey collected near DARHT are of ecological concern.

Summary

Overall, monitoring these different types of environmental media around DARHT suggest that most constitutes are similar to pre-operation or background levels, below levels associated with adverse effects, and are not of ecological concern. However, as some constitutes are increasing over time and uranium isotopes are detected often above background, continually monitoring is recommended.

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. To date, no significant spills have occurred at the DARHT Facility that have reached the environment.

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 shows 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.

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 are applied during the vessel cleanout and decontamination processes. Typically, nonrecyclable materials are 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 is on call full-time to respond to all emergency spills within the LANL site and, as needed, the LANL region.

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 (such as vegetation buffer zones and erosion control) for the Mexican spotted owl (*Strix occidentalis lucida*) and other wildlife habitat in the area. 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 2019.

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, which 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 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, is 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 2019 annual photographic documentation of the site was conducted in the fourth quarter of the FY, by LANL archaeologists. Based on the survey 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 2018 and FY 2019 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, the procedures appropriately address DARHT MAP commitments that have been 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 2019, 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 and honey bees/honey were similar or below the regional statistical reference level.

Although FY 2019 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 since 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 2019 DARHT MAP activities represent the nineteenth year of operation implementation. The DARHT MAP activities implemented in FY 2019 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.

- Fully incorporate the annual DARHT MAPAR into the MAPAR for the Continued Operations at LANL and discontinue to prepare a separate DARHT 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

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.

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

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).

DOE 2019. "A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota," U.S. Department of Energy report DOE-STD-1153-2019.

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 April 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 2019*," Los Alamos National Laboratory Report LA-UR-20-26673 (2020).

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).

Van den Berg M., L. Birnbaum, A.T.C. Bosveld, B. Brunstrom, P. Cook, M. Feely, J. Giesy, A. Hanberg, R. Hasegawa, S. Kennedy, T. Kubiak, J.C. Laresn, F.X. Rolaf van Leeuwen, A.K.D. Liem, C. Nolt, R.E. Peterson, L. Poellinger, S. Safe, D. Schrenk, D. Tillitt, M. Tysklind, M. Younes, F. Waern, and T. Zacharewski. 2006. "Toxic Equivalency Factors

(TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife," *Environmental Health Perspectives,* 106: 775-792.

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.