DOE/EIS-0380
MAPAR 2014

FISCAL YEAR 2014 MITIGATION ACTION PLAN ANNUAL REPORT FOR THE 2008 LOS ALAMOS NATIONAL LABORATORY SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT

JANUARY 2015

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Title: **Fiscal Year 2014 Mitigation Action Plan Annual Report for the 2008 Site-Wide Environmental Impact Statement for continued Operation of Los Alamos National Laboratory**

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View of Sunrise Bluff from the Lower Water Canyon trail in Technical Area 71.

Los Alamos
NATIONAL LABORATORY
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Acronyms and Abbreviations

^{60}Co	Cobalt-60
^{137}Cs	Cesium-137
^{192}Ir	Iridium-192
ADEP	Associate Directorate for Environmental Programs
ADNHHO	Associate Director for Nuclear and High-Hazard Operations
ASER	Annual Site Environmental Report
BA	biological assessment
BMP	best management practice
BRMP	Biological Resources Management Plan
CRMP	Cultural Resources Management Plan
D&D	decontamination and decommissioning
DARHT	Dual-Axis Radiographic Hydrodynamic Test (Facility)
DD&D	decontamination, decommissioning, and demolition
DOE	Department of Energy
EA	Environmental Assessment
EIS	Environmental Impact Statement
EM	Emergency Management
EMS	Environmental Management System
ENV	Environmental Protection Division
ENV-ES	Environmental Stewardship Services (Group)
ESA	Endangered Species Act
EXID	excavation/fill/soil disturbance permit identification
Field Office	Los Alamos Field Office
FONSI	Finding of No Significant Impact
FRS	Flood Retention Structure
FY	Fiscal Year
HHRA	Human Health Risk Assessment
HMP	Habitat Management Plan
IRT	Integrated Review Tool
LANL	Los Alamos National Laboratory

LANS	Los Alamos National Security, LLC
MAP	Mitigation Action Plan
MAPAR	Mitigation Action Plan Annual Report
MAPS	Monitoring Avian Productivity and Survivorship
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NNSA	National Nuclear Security Administration
PCBs	polychlorinated biphenyls
PNM	Public Service Company of New Mexico
PRID	project requirements identification
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
SEA	Special Environmental Analysis
SERF	Sanitary Effluent Reclamation Facility
SERF-E	Sanitary Effluent Reclamation Facility Expansion
SET	Solar Evaporation Tanks
SHPO	State Historic Preservation Office
SME	subject matter expert
SWEIS	Site-Wide Environmental Impact Statement
SWWS	Sanitary Waste Water System
TA	Technical Area
T&E	threatened and endangered
TRU	transuranic
US	United States
USFWS	US Fish and Wildlife Service
WIPP	Waste Isolation Pilot Plant

Executive Summary

In Fiscal Year (FY) 2014, the United States Department of Energy/National Nuclear Security Administration Los Alamos Field Office and Los Alamos National Security, LLC Site-Wide Environmental Impact Statement (SWEIS) project office focused on tracking and managing mitigation action commitments and reporting. Several of the original mitigation action commitments have been completed and officially closed as reported in the second revision of the 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* (DOE 2014a). This FY 2014 Mitigation Action Plan Annual Report (MAPAR) reflects the status of, and the actions taken, for the remaining mitigation action commitments.

Highlights for FY 2014 include the following:

- Completion and distribution of the FY 2013 SWEIS MAPAR (DOE 2014b)
- Completion and distribution of the Calendar Year 2012 SWEIS Yearbook in December 2013 (LANL 2013a)
- Floodplain restoration and riparian habitat improvement in Sandia Canyon
- Publication of contaminant monitoring and biological resources management reports and journal articles
- Numerous improvements in trail management at Los Alamos National Laboratory, including new maps, a new trails website, and trail maintenance.
- Completion of deliverables that support annual mitigation action commitments

This FY 2014 MAPAR provides a summary of progress on mitigation action commitments from October 2013 to September 2014. Appendix I, the SWEIS MAPAR tracking log, is a snapshot of accomplishments; Appendix II is the FY 2013 Dual Axis Radiographic Hydrodynamic Test Facility MAPAR; Appendix III is the FY 2014 Trails Management Plan MAPAR; and Appendix IV is the report: *Field Validation of Predicted Large Game Movement Corridors and Pinch Points at Los Alamos National Laboratory* (LANL 2014a).

1.0 Background

The first Record of Decision (ROD) for the 2008 *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory* (DOE 2008a; DOE 2008b) was published in September 2008. In January 2009, the 2008 Site-Wide Environmental Impact Statement (SWEIS) Mitigation Action Plan (MAP) was finalized and included outstanding 1999 SWEIS (DOE 1999) MAP commitments, continuing mitigations from National Environmental Policy Act (NEPA) decisions made since the 1999 SWEIS, and those made in the September 2008 and June 2009 RODs for the 2008 SWEIS (DOE 2008a, 2009a). After the second SWEIS ROD was published in the Federal Register, the United States (US) Department of Energy (DOE)/ National Nuclear Security Administration (NNSA) Los Alamos Field Office (Field Office) issued a MAP Addendum (DOE 2009b). The 2008 SWEIS MAP was revised in November 2010 (DOE 2010a) and will continue to be revised to reflect subsequent changes as necessary. The 2008 SWEIS MAP was again revised during Fiscal Year (FY) 2014 (DOE 2014a) to close out numerous mitigations that have been completed and to revise other mitigations to make them more specific and measurable. Several of the original mitigation action commitments have been completed and officially closed as reported in the second revision of the 2008 SWEIS MAP (DOE 2014a). This FY 2014 Mitigation Action Plan Annual Report (MAPAR; DOE 2014b) reflects the status of, and the actions taken, for the remaining mitigation action commitments. This document is the sixth MAPAR for the 2008 SWEIS.

All work performed at Los Alamos National Laboratory (LANL) must be evaluated for environmental risk and all work performed to mitigate risk or meet contractual environmental commitments is an element of the LANL Environmental Management System (EMS) including the mitigations listed in this MAPAR. The LANL EMS is independently third-party certified to the international standard for environmental management systems: ISO 14001:2004. Environmental work is managed at LANL by several different organizations and may include a wide range of programmatic, facility, and support service resources and personnel. Risk evaluation and management is distributed LANL-wide to directorates, each having an EMS point of contact to assist implementation within their organizations. This collaborative, cooperative approach has proven a successful model for ensuring that environmental management is focused, responsive, and proactive. In 2015, any outstanding SWEIS MAP mitigations that have not yet been incorporated into organizational Environmental Action Plans will be integrated. The EMS point of contact for each directorate will be notified of mitigations they are responsible for and given due dates for reporting their information to LANL Environmental Stewardship Services (ENV-ES) NEPA personnel for incorporation into the quarterly MAP Status Updates as well as the MAP Annual Report.

The Integrated Review Tool (IRT) is the primary review tool used by Los Alamos National Security, LLC (LANS) environmental subject matter experts (SMEs) to identify environmental requirements applicable to an activity or project and to convey actions to activity and project owners. The IRT is an entry portal that all new and modified activity and project owners must use (LANL 2013) in order to identify applicable environmental requirements early in activity and project planning. The project requirements identification (PRID) system, excavation/fill/soil disturbance permit identification (EXID) process, and site selection reviews are all accessible from within the IRT. In addition, the IRT provides helpful gateway questions to activity/project owners to guide them to the appropriate tool(s) needed to identify their environmental requirements. For purposes of identifying environmental requirements for new and modified activity, project owners must complete a PRID in order to assure the applicable requirements are identified, AND that they are identified in a timely manner. LANS environmental SMEs reviewed and provided comments and requirements for 123 PRIDs and 553 EXIDs in FY 2013. Less than 10 environmental issues occurred in FY 2013 for projects that utilized the IRT. This is a >98.5% success rate ensuring environmental compliance for LANL projects. Project Leaders who do not use the IRT are in violation of LANL policy. All environmental issues are evaluated and mitigations put in place to prevent recurrence.

2.0 Mitigation Action Commitments

2.1 Dual-Axis Radiographic Hydrodynamic Test Facility Mitigation Action Plan (Appendix II)

NEPA Driver:

The *Dual-Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement (EIS) Mitigation Action Plan* (DARHT MAP; DOE 1996) requires a DARHT MAPAR to be prepared as part of implementing the DARHT MAP. The DARHT MAPAR provides a status of specific DARHT Facility operations-related mitigation actions that have been implemented to fulfill DOE commitments under the DARHT EIS ROD (DOE 1995). The FY 2013 DARHT MAPAR reflects 14 years of DARHT Facility operations-related mitigation measures and action plans (Appendix II). The ROD for the DARHT EIS states that DOE will develop and implement mitigation measures to protect soils, water, biotic, and cultural resources potentially affected by the facility. Appendix II, the DARHT MAPAR, covers progress on mitigation action commitments for FY 2013 because in 2009 the Field Office requested that the DARHT MAPAR be published as an appendix to this document.

Mitigations:

1. Monitor contaminants by sampling soils, plants, mammals, birds, and road kills at the facility and surrounding areas as well as at a control site away from the DARHT Facility.
2. Site monitoring and evaluation will consist of periodic soil, water, and other environmental analyses for solid, hazardous, mixed, and radioactive wastes.
3. Conduct annual Tribal tours of Nake'muu and maintenance visits.

Actions Taken:

Data have been compiled, evaluated, and documented in the 2013 Annual Site Environmental Report (ASER). The ASER was published and distributed on October 1, 2014 (LANL 2014b). Samples of soil and biota were collected during the summer months and submitted for analysis of radionuclides, metals, high explosives, and/or dioxin/furans. All data has been received and has been uploaded to the Intellus data base. Also, bird populations, diversity and composition were evaluated over a 16-year period.

Effectiveness of the Program and the Mitigations:

In FY 2014, there were no significant impacts from contaminants based on measurements of soil and biota from DARHT operations. Also, data collected on bird populations, diversity, and composition over a 16-year period show that bird populations and diversity do not change over time, but the composition has changed with differences in vegetation structure as a result of fire and insect activity.

Mitigation 1: Effective.

Mitigation 2: Effective.

Mitigation 3: Tours are conducted when requested.

Recommendation:

Tours of Nake'muu will continue to be arranged and conducted as necessary. Maintenance visits of Nake'muu will also be conducted as necessary. The ENV-ES Group will continue annual sampling at DARHT (Mitigations 1 and 2).

2.2 Trails MAPAR (Appendix III)

NEPA Driver:

In accordance with the 2003 *Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program* (DOE 2003), LANS continues to

implement a MAP and MAPAR for this environmental assessment (EA) through the Trails Management Program.

Mitigations:

1. Complete eligibility evaluations for historic trails under the National Historic Preservation Act (NHPA) and identify additional environmental issues on trails use.
2. Evaluate and manage trails to determine appropriate closures and/or restrictions.
3. Prepare a management plan for trails at LANL.
4. Support the use of volunteers for selected trails maintenance projects at LANL.
5. Plan, maintain, repair, and construct trails.

Actions Taken:

The Trails Working Group met nine times during FY 2014. Typically, Trails Working Group attendees include SMEs from LANS and the Field Office, as well as representatives from Los Alamos County, neighboring Pueblos, Bandelier National Monument/the National Park Service, the Santa Fe National Forest; and local residents.

In FY 2014, the Trails Management Program addressed the following:

- Issues surrounding the installation of new fences, gates, and kiosks at Technical Areas (TAs) 70 and 71.
- The security status of Los Alamos Canyon as it applies to reopening trails.
- The recent listing of the Jemez Mountains Salamander as an endangered species and its impact on trails use.
- The Los Alamos County Otowi Well Booster and Pipeline Project and how it may impact the Anniversary Trail.
- Repair of the fences adjacent to Gate 9 on New Mexico State Road 4.
- A presentation on trails and associated cultural resources was given at the Pajarito Environmental Education Center on May 29, 2014.
- A new trails website was created entitled "Taking Care of Our Trails": http://www.lanl.gov/community-environment/environmental-stewardship/protection/trails/index.php.
- The "Trails Management at LANL" brochure was revised and posted on the new trails website.
- Local geocaching points-of-contact were asked to inform fellow hobbyists that these activities are not allowed at LANL and to remove existing geocaches.

- Flagging and some fencing was removed along a section of the Powerline Point Trail to allow people to hike through an area about a mile from the Gate 4 trailhead.
- A NEPA Review of the 2003 EA was performed and it was found that no update or supplementation of the 2003 EA was recommended.
- Ground-truthing and updating of trail maps.
- Public outreach involving the rules of trail use for mountain bikers.
- Closure of an unofficial mountain bike trail.
- Trail closures for safety and security reasons.

Trails in the TA-70/71 area were also surveyed for damage that might have been caused by the September 2013 floods. While floodplains were considerably altered in some places, there was little impact to trails in TA-70 or 71. Upgraded access and parking at each of the TA-70 and 71 trailheads along New Mexico State Road 4 is currently on hold. Details regarding FY 2014 implementation of the Trails MAP are provided in Appendix III.

Effectiveness of the Mitigations:

Mitigation 1: Effective and ongoing. Numerous activities were undertaken in FY 2014 to manage archaeological sites near trails (see Appendix III, Section 3.3).

Mitigation 2: Effective and ongoing. Numerous activities were undertaken in FY 2014 to manage trails (see Appendix III, Sections 3.1 and 3.3).

Mitigation 3: The actions associated with this mitigation have been integrated into the revised Draft Cultural Resources Management Plan (CRMP) and future work will continue under the CRMP once it is finalized. It is recommended that this mitigation remain open until the CRMP is finalized.

Mitigation 4: Not Effective. No volunteers were used for trail maintenance in FY 2014.

Mitigation 5: Not effective. Additional funding and staff are needed to conduct trail maintenance for safety and to protect cultural and biological resources.

Recommendations:

Complete a LANL Trails Management Plan to include a strategy for Mitigation 1 and a plan for trails maintenance (Mitigations 2, 4, and 5). Mitigation 3 will remain open until the CRMP is finalized.

2.3 Special Environmental Analysis

NEPA Driver:

Mitigations were identified in the *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* (DOE 2000a) to mitigate actions taken in response to the Cerro Grande Fire. DOE/NNSA issued the Special Environmental Analysis (SEA) in September 2000 pursuant to the Council on Environmental Quality regulations implementing NEPA under emergency circumstances and regulatory requirements to provide an analysis of the Cerro Grande Fire emergency fire suppression, soil erosion, and flood control actions taken by DOE/NNSA and LANL between May and November 2000. DOE/NNSA also identified mitigations for these actions.

Mitigations:

1. Monitor biota and sediment contamination behind the Los Alamos Canyon Weir and the Pajarito Canyon Flood Retention Structure (FRS) and report results in the ASER.
2. Periodically remove sediment from the Los Alamos Canyon Weir based on sedimentation rate and contamination accumulation rate.

Actions Taken:

Results for 2013 have been compiled, evaluated, and documented in the 2013 ASER (LANL 2014b). Samples of small mammals and vegetation for radionuclides, metals, and polychlorinated biphenyls (PCBs) were collected from the Los Alamos Canyon Weir and from the Pajarito Canyon FRS during the summer months of 2014 and submitted for analysis. In addition, a research paper entitled *Polychlorinated Biphenyls in Whole-Body Field Mice Collected Upgradient and Downgradient of a Sediment Retention Structure in Los Alamos Canyon, Los Alamos National Laboratory, New Mexico, USA,* was published in the Journal of Environmental Protection (Fresquez 2014). Overall, the reduction of PCBs in whole-body field mice from both sites over time was attributed, in part, to sediment control practices.

A cleanout of sediment from behind the Los Alamos Canyon Weir was begun on April 29, 2014 and lasted four weeks. The FY 2014 cleanout included removal of 7500 cubic yards of sediment from behind the weir. The removed sediment is being stored in a former borrow pit approximately ¼ mile upstream from the weir. Any movement of sediment out of the borrow pit is unlikely. In the off chance that sediment is moved out of the borrow pit, it will be retained behind the weir. Sometimes sediment is removed from behind the weir and placed on the stream banks. The removed

material is contoured back to the original slope, compacted with the movement of the bulldozer, has a run-off berm along the toe of the slope, and is hydromulched with seed applied to stabilize the sediment.

Effectiveness of the Mitigations:

Mitigation 1: Effective and ongoing.

Mitigation 2: Effective and ongoing.

Recommendations:

Biota and sediment sampling from behind the Los Alamos Canyon Weir and the Pajarito Canyon FRS will continue annually. Additional cleanouts from behind these structures will likely be required in FY 2015.

2.4 Flood and Sediment Retention Structures

NEPA Driver:

These mitigations are from the *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 2002).

Mitigations:

1. Annually monitor the FRS for structural integrity and safe operations until removed.
2. Remove portions of the FRS in accordance with DOE/EA-1408 (DOE 2002).
3. Recycle demolition spoils from FRS decontamination, decommissioning, and demolition (DD&D) as appropriate.
4. Leave an aboveground portion of the FRS equivalent to the dimensions of a low-head weir to retain potentially contaminated sediments on LANL land.
5. Remove aboveground portions of the steel diversion wall below the FRS.
6. Recontour and reseed disturbed areas to protect surface water quality in Pajarito Canyon after the FRS is removed.

Actions Taken:

The annual inspection of the Pajarito Canyon FRS was conducted May 20, 2014 (UI-RPT-003, R4). From the inspection report: "The main structure does not have any obvious, significant structural deterioration and appears to be in good condition considering the construction method used and expected structure longevity. No corrective actions are recommended at this time."

Effectiveness of the Mitigation:

Mitigation 1: Effective. Annual inspections of the FRS will continue.

Mitigations 2–6: On hold pending removal of the FRS.

Recommendation:

It is recommended that the annual inspections of the FRS continue. The remaining mitigations are on hold until Area G (TA-54) is ready for capping because the material generated by the FRS removal could be used to partially cover Area G.

2.5 Outfall Reduction Initiative/Radioactive Liquid Waste Treatment Facility

NEPA Driver:

This mitigation stems from the 2008 SWEIS commitment related to outfall reduction as specified in the 2009 ROD. The EA and a mitigated Finding of No Significant Impact (FONSI) for the Sanitary Effluent Reclamation Facility Expansion (SERF-E) Project were issued in August 2010 (DOE 2010b, c). The mitigation action commitments associated with the 2010 mitigated FONSI (DOE 2010c) also addressed impacts to Sandia Canyon. A biological assessment (BA) for the 2008 SWEIS (LANL 2006a) also contributed to the development of this mitigation.

Mitigation:

1. All further actions affecting water flow volumes in Mortandad and Sandia canyons will be assessed for positive and negative impacts.

Actions Taken:

Operation of the expanded Sanitary Effluent Reclamation Facility (SERF) commenced in August 2012. The facility provides a blend of reclaimed effluent from the Sanitary Wastewater System Plant and well water to cool the supercomputers housed in the Nicholas Metropolis Center. Current estimates indicate that up to 110 million gallons of water could be provided annually.

No cooling tower water blow down or SERF product water has been diverted from Sandia Canyon. Therefore, no mitigations associated with hydrologic changes to the S-2 reach of Sandia Canyon have been required. A study to determine how much water is needed to maintain healthy wetlands in Sandia Canyon was completed in 2012. The study examined acceptable flow reductions and intensity combined with corrective actions to divert remaining flow to sufficiently maintain wetland viability and reduce soil erosion.

Total discharges into Sandia Canyon from each of the three permitted outfalls have decreased by 20% for 001, 40% for 03A027, and 24% for 03A199 compared with FY 2013.

The Sanitary Waste Water System (SWWS) is sending less water to TA-03 since steam condensate leaks into the SWWS collection system have been repaired. Prior to SERF, treated effluent from the SWWS went straight to Outfall 001. Since SERF became operational, some of the treated SWWS water is now also treated (a second time) at SERF. SERF now provides quality make-up water (including some of the water from the SWWS) for the cooling system at the Nicholas Metropolis Center. Because some SWWS water is now being used for make-up water after being treated at SERF, there is now less water going to Outfall 001 from the SWWS. The make-up water coming from SERF contains lower silica than production well water; therefore, the cooling towers can operate at higher cycles of concentration. Higher cycles of concentration result in less blow-down water discharged to the environment through Outfall 03A027. Thus, total discharges have been reduced compared to FY 2013.

Total discharges into Sandia Canyon from each of the three permitted outfalls for FY 2014:

FY14	Outfall 001 (gallons)	Outfall 03A027 (gallons)	Outfall 03A199 (gallons)
Oct-13	7,053,200	632,500	729,200
Nov-13	6,714,200	571,900	636,200
Dec-13	7,261,600	456,600	615,000
Q1 total	21,029,000	1,661,000	1,980,400
Jan-14	6,314,100	728,700	615,800
Feb-14	5,769,400	751,000	600,700
Mar-14	7,175,600	763,800	690,300
Q2 total	19,259,100	2,243,500	1,906,800
Apr-14	5,631,200	755,400	725,100
May-14	4,366,300	826,700	831,500
Jun-14	3,127,800	941,400	949,600
Q3 total	13,125,300	2,523,500	2,506,200
Jul-14	3,903,300	923,800	940,600
Aug-14	3,734,000	899,700	872,900
Sep-14	3,630,000	1,010,900	792,300
Q4 total	11,267,300	2,834,400	2,605,800

Yearly total flow data is also available in the ASER (LANL 2014b) and the annual SWEIS Yearbook (LANL 2013a).

DOE and LANS are committed to outfall reduction and the mitigation initiatives associated with the Radioactive Liquid Waste Treatment Facility (RLWTF) Upgrade Project. The RLTWF outfall into Mortandad Canyon is still permitted (under NPDES Permit No. NM0028355) but there has been no discharge to the canyon since November 2010. The Solar Evaporation Tanks (SET) portion was completed in October 2012. Operation of the SET is anticipated with the approval of the State of New Mexico groundwater permit expected in 2015.

Effectiveness of the Mitigation:

Mitigation 1: Effective; work will continue. The latest draft groundwater discharge permit is scheduled for public comment in early Calendar Year 2015.

Recommendation:

As per LANS policy, ensure PRID system and EXIDs are completed for projects potentially impacting canyons.

2.6 Off-Site Source Recovery Project

NEPA Driver:

This mitigation is derived from the 2008 ROD for the 2008 SWEIS (DOE 2008a, b).

Mitigation:

1. Institute controls on the quantities and methods of storing sealed sources containing Cobalt-60 (^{60}Co), Iridium-192 (^{192}Ir), or Cesium-137 (^{137}Cs) to mitigate the effects of potential accidents.

Actions Taken:

The LANL Off-Site Source Recovery Project does not currently accept sealed sources containing ^{60}Co, ^{192}Ir, or ^{137}Cs, the sources for which mitigation measures were identified in the 2008 SWEIS MAP (DOE 2010a).

Effectiveness of the Mitigation:

Mitigation 1: On hold.

Recommendation:

None at this time.

2.7 Sanitary Effluent Reclamation Facility Expansion

NEPA Driver:

This mitigation is derived from the MAP and FONSI (DOE 2010c) for the SERF expansion project EA (DOE 2010b), and the 2008 SWEIS ROD (DOE 2008a).

Mitigations:

1. Implement the SERF MAP.
    a. Follow the LANL Threatened and Endangered (T&E) Species Habitat Management Plan (HMP).
    b. Use appropriate erosion and runoff controls.
    c. Use best management practices (BMPs) for sensitive species and migratory bird protection.
    d. Revegetate disturbed areas.
    e. Mitigate actions taken within the wetland of the S-2 reach through wetland restoration or enhancement.
    f. Follow wetland and floodplain BMPs.
    g. Develop and use BMPs to prevent or lessen the movement of contaminated silt from the wetlands.
    h. Follow the LANL CRMP.

Actions Taken:

Construction of the expanded SERF is complete, and mitigations associated with S-2 reach are also complete. A restoration project in FY 2014 was completed in a segment of Sandia Canyon in Mexican Spotted Owl core habitat. This work had two phases. Phase 1 included planting over 100 native cottonwood, willow, New Mexico olive, and canyon grape plants along the stream channel. Phase 2 including the construction of four small water impoundments using logs and rocks found near the stream channel. The purpose of the restoration work was to increase the health and vigor of the riparian habitat in this area. This in turn will create a larger prey base for the Mexican Spotted Owl. The riparian restoration will be examined in the summer of 2015 to determine how effective the action was, looking at how many of the potted trees/shrubs survived and whether the water impoundments created habitat diversity.

A new avian monitoring project was started in FY 2014 in the Sandia wetlands. This project is following a specific protocol called Monitoring Avian Productivity and Survivorship (MAPS). The MAPS protocol is a program in the Institute for Bird Populations and is used by thousands of operators across North America. After a minimum of five years of data collection, results can be compared to regional and national trends generated by this protocol allowing inferences to be made about the avian population health at this site. The avian monitoring was successfully implemented in its first year and operated according to the protocols. Population indices will be developed after four to five years of data collection following this methodology.

Effectiveness of the Mitigation:

Mitigation 1: Effective and complete.

Recommendation:

Formally close out this mitigation through the Field Office.

2.8 Wildland Fire Management Plan

NEPA Driver:

These mitigations are derived from the *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory* (DOE 2000b), the 2008 SWEIS and SWEIS MAP, DOE's Wildland Fire Management Program (DOE 2004), and the 2001 Federal Wildland Fire Management Policy and Implementing Actions (DOE Order 450.1A; DOE 2008c).

Mitigations:

1. Implement a wildland fire management plan with an adequately funded ongoing program.
2. Continue to further reduce wildfire risks by shipping legacy transuranic (TRU) waste, currently stored in the TA-54 domes, to the Waste Isolation Pilot Plant (WIPP) (3706 Campaign).

Actions Taken:

LANS implements a strategic Wildland Fire Management Plan through the LANL Wildland Fire Annual Operations Plan. In FY 2014, 15 key milestones were part of the Annual Operations Plan currently on track for completion. Inspection schedules were developed and coordinated with Facility Operations Directors to ensure road maintenance and repairs are completed. Fire Roads pre-season readiness review and inspection confirming road inspection schedules were completed. LANL heavy equipment was verified in place and operationally ready through a TA-49 Interagency Fire Base Readiness Review. Fire personnel expected to respond to a fire line received annual equivalency training. Coordination with Los Alamos County protocol, assets, and responsibilities was performed for wildland fire response on LANL property. Sand table exercises were conducted with key LANL fire management staff and responding agencies prior to the start of the Wildland fire season.

Work packages were developed identifying at least 400 acres for fuels treatment. These work packages include PRID, treatment prescription, maps, and detailed work descriptions. Monthly Fuel Prescription Inspection reports for firing sites were submitted. Web-based comprehensive wildland fire management tools were developed

and improved for faster incident preparedness, complex risk assessment, fire potential forecasting, analysis of Time Until Fire Arrival, improved reference document accessibility, risk-based prioritization for fuel treatments and improved interagency communications.

In addition, Incident Response Plans were developed for LANL firing sites to improve communication about LANL site hazards and implementation of fire suppression activities. Wildland fire danger awareness was publicized through a public information program, including the development of new web-based tools and technologies for fire risk and behavior analysis, and preparedness activities. In addition, approximately 300 acres of Defensible Space/Urban Interface treatments have been completed for 2014 in compliance with Wildland Urban Interface prescription standards. Key milestones for FY 2015 have been submitted to the DOE Field Office.

To reduce wildfire risks, shipments of TRU waste to WIPP continued into the middle of FY 2014. To date, 3,227.7 cubic meters of TRU waste have been shipped off-site as part of the 3706 Campaign. Shipments of TRU waste to WIPP were put on hold in the summer of 2014. Shipping operations were curtailed on February 5, 2014, due to an underground vehicle fire and subsequent radiological release on February 14, 2014. All off-site shipments of TRU waste will remain curtailed until WIPP reopens.

Effectiveness of the Mitigations:

Mitigation 1: Effective and ongoing. This mitigation results in the creation of defensible space, and removes excess fuel from LANL property.

Mitigation 2: On hold until the WIPP facility is operational.

Recommendation:

Continue to implement the annual plans to mitigate wildfire risks and continue shipments of waste to WIPP once the facility reopens.

2.9 Site-Wide Environmental Impact Statement Biological Assessment

NEPA Driver:

These mitigations are derived from the BA for the 2008 SWEIS (LANL 2006a). The LANL *Threatened and Endangered Species Habitat Management Plan for Los Alamos National Laboratory* (LANL 2014c) provides a management strategy for the protection of T&E species and their habitats on LANL property. The T&E Species HMP provides guidance for what, when, and where different types of activities are allowed without further review by the US Fish and Wildlife Service (USFWS). If T&E Species HMP requirements cannot be followed by project personnel, a BA must be prepared. Pursuant to Section 7 of the Endangered Species Act (ESA), 16 U.S.C. § 1536(a)(2), a BA is used to determine

and document whether a proposed activity is likely to adversely affect listed species, proposed species, or designated critical habitat. BAs account for the direct, indirect, and cumulative effects on T&E species from construction and operation of projects at LANL that cannot operate within the T&E Species HMP guidelines.

Mitigations:

1. Evaluate, through the PRID system, the use of span bridges instead of land bridges in areas that cross canyons in T&E species habitats to reduce environmental impacts (land bridge proposals will require USFWS consultation under the ESA).
2. Implement all reasonable and prudent measures in the BA through the PRID system and implementation of the T&E Species HMP (LANL 2014c).

Actions Taken:

A Floodplain Assessment for the proposed parking lot easement in Los Alamos Canyon was prepared and submitted to the Field Office. Another draft Floodplain Assessment for the sediment traps in Mortandad Canyon was submitted to the Field Office but was later determined to be unnecessary by Los Alamos Field Office legal counsel.

A presentation on biological resources management was given at the Accord Pueblos meeting at the request of the Field Office. Another similar presentation was given to the EMS Core team and several wildlife safety presentations were given at LANL. Additionally, training was provided by the New Mexico Avian Protection Working Group as part of the Mortandad corrective actions. The course covered how to reduce and eliminate avian electrocutions on power lines. It was attended by personnel from the LANL Utilities Group, the LANL Maintenance and Site Services Group, the LANL ENV-ES Group, Deployed Environmental Professionals, Los Alamos County utilities, and Bandelier National Monument.

LANS staff completed histories of T&E species surveys at LANL and the data were incorporated into the 2013 ASER (LANL 2014b). On March 3, 2013, a number of large mature Ponderosa Pine trees were cut during the installation of a power line into Mortandad Canyon. The area where this incident occurred was in occupied Mexican Spotted Owl core habitat. Under the LANL HMP, trees larger than 9 inches diameter at 4.5 feet above the ground are restricted from removal in core habitat. This incident resulted in a notification to the USFWS. A causal analysis was performed and it was determined that human error was the primary cause of this incident due to a misinterpretation of compliance requirements between the environmental SME and the organization performing the work. The following four mitigations were developed by ENV-ES biologists with input from the Field Office and the USFWS:

1. Install bird guard power poles around the two occupied Mexican Spotted Owl nests at LANL.
2. Require LANL utilities employees to attend training of bird guarding power poles.
3. Restore riparian habitat in Sandia Canyon.
4. Clean up and fence off the mesa top directly above a Mexican Spotted Owl nesting site below Sigma Mesa.

A work plan for corrective actions was prepared and is being implemented as a result of T&E Species HMP violations in Mortandad Canyon. The two occupied owl territories were visited to determine nest success. Nest success was not confirmed for either territory. The failure this year is likely due to the unusually cold weather in May when the chicks would have been most vulnerable. There were several nests in the avian nestbox network that failed in May across the site due to cold weather and it is logical to assume the same happened for the owls. LANL operations most likely did not play a role since operations around the Mortandad owls have not changed, both mesa tops around the nest site are developed, and there are no operations around the Threemile Canyon nest. The *Sensitive Species Best Management Practices Source Document* was updated and finalized in June (LANL 2014d). This management document specifies how state-listed and other sensitive species not on the federal endangered species list are managed at LANL.

Effectiveness of the Mitigations:

Mitigations 1 and 2: Implemented through the PRID program and the T&E Species HMP.

Recommendation:

Continue to implement Mitigations 1 and 2 through the PRID program and the T&E Species HMP. Continue to raise awareness and improve procedures across the institution to prevent environmental incidents.

2.10 Biological Resources Management Plan

NEPA Driver:

The commitment to create and maintain a Biological Resources Management Plan (BRMP) is derived from the 2008 SWEIS ROD. The *Biological Resources Management Plan for Los Alamos National Laboratory* (LANL 2007) outlines the commitment by LANS to conduct site operations using processes that minimize risks to mission implementation and biological resources. The BRMP is implemented annually.

Mitigation:

1. Implement the BRMP (LANL 2007).

   (The BRMP addresses LANS's commitment to conduct site operations using processes that minimize risk to both mission implementation and biological resources. The BRMP describes objectives, strategies, and actions that fulfill the following goals:

   a) Mission Support: Ensure and facilitate compliance with biological resource laws and regulations.

   b) Site Stewardship: Identify and mitigate adverse impacts on biological resources.

   c) Regional Commitment: Meet responsibilities as a good neighbor and trustee of natural resources.

Actions Taken:

LANS biologists submitted the LANL nomination application for the 2014 Presidential Migratory Bird Federal Stewardship Award to DOE Headquarters and received an "Honorable Mention."

LANS biologists completed the annual winter bird surveys, updated the Jemez Mountains Salamander site plan at the completion of the section 7 consultations to incorporate into the T&E Species HMP, installed seasonal road barriers into core habitat for the Mexican Spotted Owl during its breeding season, updated the T&E Species HMP, and began Mexican Spotted Owl annual surveys.

The following reports were prepared and submitted in FY 2014.

- *Avian Monitoring at the TA-36 Minie Site, TA-39 Point 6, and TA-16 Burn Grounds* (LANL 2014e)
- *Los Alamos National Laboratory Fall Avian Migration Monitoring Report 2010–2013* (LANL 2014f)
- *Threatened and Endangered Species Habitat Management Plan for Los Alamos National Laboratory* (LANL 2014c)
- *Sensitive Species Best Management Practices Source Document* (Updated June 2014) (LANL 2014d)
- *Field Validation of Predicted Large Game Movement Corridors and Pinch Points at Los Alamos National Laboratory* (LANL 2014a) (Appendix IV)

All four wildlife-related Institutional Animal Care and Use Committee protocols were updated due to an upcoming site visit by the national oversight organization, Association for Assessment and Accreditation of Laboratory Animal Care International.

Support activities were provided to the Bradbury Science Museum for the new biological resources exhibit. An endangered species presentation was given at the Environmental, Safety, and Health Division Seminar Series.

Additional FY 2014 work:

- Completed amphibian monitoring for chytridiomycosis infections.
- Conducted field visits for the Association for Assessment and Accreditation of Laboratory Animal Care International site visit on July 11, 2014.
- Provided Wildlife Safety Briefings to the Institutional Worker Safety Security Team and the Los Alamos Section of the American Society of Safety Engineers Monthly Meeting.
- Developed a long-term collaboration with the Valles Caldera National Preserve to allow LANL to maintain an off-site location for the avian nestbox monitoring project.
- Performed Jemez Mountains Salamander surveys in three locations at LANL following the new protocol.
- Completed avian monitoring projects at TA-15, the Sandia wetlands, the Pajarito wetlands, and around firing sites.
- Published the open pipes Lessons Learned at LANL, *Hazards to Birds from Open Metal Pipes,* in a peer-reviewed journal in September 2014 (Hathcock and Fair 2014). This paper was also highlighted nationally in a news release by the American Bird Conservancy.
- Completed Causal Analysis and Lessons Learned for the Mortandad tree felling incident and submitted to the Field Office.

Effectiveness of the Mitigation:

Mitigation 1: Effective as a result of implementation of the BRMP, T&E Species HMP, and use of the PRID program.

Recommendation:

Continue to implement the BRMP.

2.11 Cultural Resources Management Plan

NEPA Driver:

The commitment to create and maintain a CRMP is derived from the 2008 ROD for the 2008 SWEIS (DOE 2008b). The existing CRMP (LANL 2006b) was revised by LANS and submitted to the New Mexico State Historic Preservation Office (SHPO) in May 2012 and resubmitted in July 2013 for review.

Mitigation:

1. Implement CRMP (LANL 2006b).

   (The CRMP defines the responsibilities, requirements, and methods of managing cultural resources on LANL property. It provides an overview of the cultural resources program, establishes a set of procedures for effective compliance with historic preservation laws, addresses land-use constraints and flexibility, and makes the public aware of the stewardship responsibilities and steps being taken by the Field Office for managing the cultural heritage at LANL.)

Actions Taken:

In FY 2014, LANS cultural resource managers continued to support ongoing projects, including public use of recreational trails in TAs 70 and 71, wildland fire fuels mitigations, archaeological site fencing at Minie Firing Site, the Chromium Groundwater Remediation Project, the Mortandad Sediment Trap Revitalization project, support for a computer virtualization project for Nake'muu, the fire road maintenance project, the TA-51 legacy cleanup project, the Public Service Company of New Mexico (PNM) RL transmission line maintenance and new structure project in TAs 70 and 71, the Los Alamos County Wells Project, the security envelope enhancements project, and many others. LANS cultural resources staff gave tours of the archaeological sites Nake'muu and Tsirege for the Field Office, LANS student summer program, the LANS Women's Group, and the Taos Archaeological Society.

Historic building program work during FY 2014 included supporting the decontamination and decommissioning (D&D) program on projects involving buildings in TAs 8, 46, 49, and 60. Several damage assessments related to the September 13, 2013, flooding event were conducted and planning for the revitalization of Casa 1 in TA-18 was undertaken. Progress was made on the long-term surveillance and maintenance for historic buildings on the LANL preservation list, specifically the development of historic building signage for 34 key buildings identified in the CRMP. In March of 2014, a monument commemorating LANL's early nuclear reactors was placed at the former location of Omega Site in Los Alamos Canyon. Also in March, ENV-ES staff facilitated an inspection visit by SHPO staff members to two historic properties (TA-14-6 and TA-8-20) that have been or will be the subject of formal Section 106 consultation. In February, ENV-ES historic buildings staff participated in a peer exchange with Lawrence Livermore National Laboratory environmental staff and toured historic buildings, archives, and artifact collections areas at Livermore. Historic buildings staff gave tours or briefings for Chris Godsick, Federal Facilities Task Force, National Conference of State Historic Preservation Officers, Nevada and Los Alamos Field Offices, Associated Press Board of Directors, and Bill Gates.

Effectiveness of the Mitigation:

Mitigation 1: Effective when the PRID program is used.

Recommendations:

Continue to implement the CRMP.

2.12 Commitments to Santa Clara Pueblo

NEPA Driver:

The commitments to Santa Clara Pueblo are derived from the 2008 SWEIS MAP (DOE 2010a) and the 2008 ROD for the LANL SWEIS (DOE 2008b).

Mitigation:

1. The NNSA will continue its efforts to support the Pueblo and other tribal entities in matters of human health, and will participate in various intergovernmental cooperative efforts to protect indigenous practices and locations of concerns. The NNSA will conduct government-to-government consultation with the Pueblo and other tribal entities to incorporate these matters into the MAP.

Actions Taken:

The Field Office continues consultations with Santa Clara Pueblo to develop a mutually acceptable plan to address specific environmental justice and human health concerns and issues identified by Santa Clara Pueblo during the SWEIS process. NNSA provided Santa Clara Pueblo financial and technical assistance during the last quarter of FY 2010 to commence work on a Santa Clara Pueblo specific risk assessment plan, which would include specific tasks with timelines, and identify resources to implement this plan. Santa Clara Pueblo advised the Field Office of data acquisition problems during FY 2011, and the Field Office conducted meetings to try to address them. A draft plan on environmental justice and human health concerns and issues was submitted to the NNSA for review and comment during the first quarter of FY 2013. With technical input from the Field Office and LANS SMEs, the Santa Clara Pueblo Office of Environmental Affairs provided revisions to a second draft of a Santa Clara Pueblo Human Health Risk Assessment (HHRA) proposal and DOE provided comments on the draft in 3Q FY 2014.

Effectiveness of the Mitigation:

Mitigation 1: Effective.

Recommendation:

The Field Office continues to provide support to Santa Clara Pueblo to develop a draft plan for Tribal Council review.

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Appendix I

2008 Site-Wide Environmental Impact Statement

FY 2014 Mitigation Action Plan Annual Report

Tracking Log

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Table 1. 2008 SWEIS MAPAR Tracking Log FY 2014

(Green items are effective; yellow items are effective with opportunity for improvement; red items are ineffective or on-hold).

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Effectiveness of Mitigation	Recommendation	Responsible Party
Transition of Previous LANL NEPA Mitigation Commitments into the 2008 SWEIS MAP						
3.1 DARHT MAP	DOE will periodically (at least once a year) arrange for Tribal Officials to visit cultural resource sites within TA-15 that are of particular interest to the tribes.	MAP for DARHT EIS (DOE/EIS-0228; Oct. 1996)	Tours are conducted as requested by the tribes. Maintenance visits are conducted as needed.	Mitigation is effective. San Ildefonso Pueblo is invited to tour Nake'muu annually.	Continue to conduct tours as requested and maintenance visits as necessary.	ENV-ES Group Field Office – Cultural Resources Program Manager and Intergovernmental Programs (Tribal Affairs)
	Monitor contaminants by sampling soils, plants, mammals, birds, and road kills at the facility and surrounding areas as well as at a control site away from the DARHT Facility.		Samples of soil and biota were collected during the summer months and submitted for analysis of radionuclides, metals, high explosives, and/or dioxin/furans.	Mitigations are effective.	Continue annual sampling.	ENV-ES Group
	Site monitoring and evaluation will consist of periodic soil, water, and other environmental analyses for solid, hazardous, mixed, and radioactive wastes.					

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Effectiveness of Mitigation	Recommendation	Responsible Party
3.2 Trails MAP	Complete eligibility evaluations for historic trails under the NHPA and identify additional environmental issues on trails use.	DOE/EA-1431 (Aug. 2003) and FONSI (Sept. 2003)	No assessments were performed in FY 2014.	Mitigation is effective. Cultural sites are assessed on an as-needed basis.	Recommend development of a Trails Management Plan for LANL trails to develop a strategy for these evaluations.	ENV-ES Group Field Office – Cultural Resources Program Manager
	Evaluate and manage trails to determine appropriate closures and/or restrictions.		Nine Trails Working Group meetings were held in FY 2014. Several temporary trail closures occurred for security and habitat protection reasons. Trails are patrolled by Bandelier National Monument Rangers.	Mitigation is effective.	None.	ENV-ES Group Field Office – Landlord Program Manager
	Prepare management plans for trails at LANL.		This mitigation has been integrated into revised CRMP.	This work will continue under the new CRMP once it is finalized.	Close out mitigation through the Field Office once the CRMP has been finalized.	ENV-ES Group Field Office – Cultural Resources Program Manager and Landlord Program Manager
	Support the use of volunteers for selected trails maintenance projects at LANL.		New Institutional Agreement re: volunteer trails work established in June 2012.	Volunteers were not used in FY 2014 for trail maintenance.	Prepare work plan for FY 2015 to include trails maintenance by volunteer organizations.	ENV-ES Group
	Plan, maintain, repair, and construct trails.		Numerous trails and trail heads are in need of maintenance and repair.	Mitigation not effective.	Acquire adequate funding and staff to maintain trails for safety and resource protection.	ENV-ES Group

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Effectiveness of Mitigation	Recommendation	Responsible Party
3.3 SEA MAP	Monitor biota and sediment contamination behind the Los Alamos Canyon Weir and the Pajarito Canyon FRS and report results in the ASER.	DOE/SEA-03 (Sept. 2000)	Samples of small mammals and vegetation for radionuclides, metals, and PCBs were collected from the Los Alamos Canyon Weir and from the Pajarito Canyon FRS during the summer months of 2014 and submitted for analysis. In addition, a research paper, *Polychlorinated Biphenyls in Whole-Body Field Mice Collected Upgradient and Downgradient of a Sediment Retention Structure in Los Alamos Canyon, Los Alamos National Laboratory, New Mexico, USA*, was published in the Journal of Environmental Protection (Fresquez 2014).	Mitigation is effective.	Continue sampling annually.	ENV-ES Group Field Office – Emergency Management (EM)
	Periodically remove sediment from the Los Alamos Canyon Weir based on sedimentation rate and contamination accumulation rate.		Cleanout of the Los Alamos Canyon Weir was performed once in FY 2014 to stabilize potentially contaminated sediments. Cleanout occurred in April (7500 yd^3 removed and placed on the side slopes.)	Mitigation is effective.	Continue as needed. Additional cleanouts will likely be required in FY 2015.	Environmental Programs–Corrective Actions Program Field Office – EM

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Effectiveness of Mitigation	Recommendation	Responsible Party
3.4 FRS EA	Annually monitor the FRS for structural integrity and safe operations until removed.	DOE/EA-1408 (Aug. 2002)	The FRS is inspected annually. Last inspection was conducted on May 20, 2014. (Copy of inspection report available upon request.)	Mitigation is effective. "The main structure does not have any obvious, significant structural deterioration and appears to be in good condition considering the construction method used and expected structure longevity. No corrective actions are recommended at this time."	Continue annual inspections of the FRS.	Utilities and Institutional Facilities-Division Office
	Remove portions of the FRS in accordance with DOE/EA-1408.		None	**Mitigation On Hold** It is anticipated that the material generated by the FRS removal would be used to cover Area G when capped. Thus activities are on hold until Area G is ready for capping.	None	Associate Director for Nuclear and High-Hazard Operations (ADNHHO) ENV Division
	Recycle demolition spoils from FRS DD&D as appropriate.					
	Leave 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.		Will be reseeded when structure is removed.	**Mitigation On Hold** This mitigation is on hold until the FRS is removed.	Area will be re-contoured and reseeded once removal of the FRS is complete.	ADNHHO

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Effectiveness of Mitigation	Recommendation	Responsible Party
Project-Specific Mitigation Measures Analyzed in the SWEIS						
3.5 RLWTF/ Outfall Reduction	All further actions affecting water flow volumes in Mortandad and Sandia canyons will be assessed for positive and negative impacts.	BA for the 2008 SWEIS (LANL 2006a) 2009 ROD for the LANL SWEIS (July 2009)	SERF EA and FONSI issued in 2010. The Draft ground water permit is currently out for public comment. No water was discharged to Mortandad Canyon in FY 2014. Information on discharges to Sandia Canyon is presented in Section 2.5 in the main text.	Mitigation is effective.	Ensure PRIDs/EXIDs are used for projects potentially impacting canyons.	ENV Division Associate Directorate for Environmental Programs (ADEP) Field Office – EM
3.6 Off-Site Source Recovery Project	Institute controls on the quantities and methods of storing sealed sources containing ^{60}Co, ^{192}Ir, or ^{137}Cs to mitigate the effects of potential accidents.	2008 ROD for the LANL SWEIS (Sept. 2008)	None	**Mitigation On Hold** LANL currently does not accept sealed sources ^{60}Co, ^{192}Ir, or ^{137}Cs.	None	Nuclear Engineering and Nonproliferation-International Threat Reduction Group
3.7 SERF-E	Implement the SERF MAP	MAP and FONSI for DOE/EA-1736 (Aug. 2010) 2008 ROD for the LANL SWEIS (Sept. 2008)	Over 100 native cottonwood, willow, New Mexico olive, and canyon grape plants were planted along the stream channel for restoration purposes. Four small water impoundments using logs and rocks were constructed near the stream channel to improve riparian habitat. Avian monitoring has begun in the area.	Mitigation is effective.	Continue to implement mitigations associated with the S-2 reach.	ADEP

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Effectiveness of Mitigation	Recommendation	Responsible Party
Institutional Resource Management Responsibilities						
3.9 Wildland Fire Management Plan	Implement a wildland fire management plan with an adequately funded ongoing program. (Note: this plan is now called the Wildland Fire Operations Plan)	DOE Wildfire Management Policy (Feb. 2004) 2001 Federal Wildland Fire Management Policy and Implementing Actions (Jan. 2001) MAP for the 2008 SWEIS (Dec. 2008)	There are 15 key milestones, part of the Annual Operations Plan, currently on track for completion. Inspection schedules have been developed. Fire road maintenance and repairs were completed. 400 acres were identified for fuels mitigation work. Incident Response Plans were developed.	Mitigation is effective. Annual ongoing requirement.	Continue implementing annual plans to mitigate wildfire risks.	Emergency Operations-EM
	Continue to further reduce wildfire risks by shipping legacy TRU waste, currently stored in the TA-54 domes, to WIPP (3706 Campaign).		3,227.7 m^3 of TRU waste have been shipped to date as part of the 3706 Campaign.	Mitigation is on hold until shipments to WIPP resume.	Resume shipments to WIPP once the facility reopens.	ADEP
3.11 SWEIS BA	Through PRID system, evaluate the use of span bridges instead of land bridges in areas that cross canyons in T&E species habitats to reduce environmental impacts (land bridge proposals will require USFWS consultation under the ESA).	BA for the 2008 SWEIS (LANL 2006a)	Span bridges are not the preferred alternative for any projects to date.	Mitigation is effective.	Consideration of span bridges is assessed on a project-specific basis in the PRID tool.	ENV-ES Group
	Implement all reasonable and prudent measures in the BA through the institutional project review process and implementation of the LANL T&E Species HMP (LANL 2011a).		Two Floodplain Assessments were transmitted to the Field Office in FY 2014. Presentations were given to LANL organizations and Accord Pueblos. Training on Avian Protection was conducted. Histories of T&E species surveys at LANL were completed. Corrective actions as a result of tree felling in Mortandad Canyon were developed.	Mitigation is effective and measurable on a project by project basis.	None.	ENV-ES Group

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Effectiveness of Mitigation	Recommendation	Responsible Party
3.12 BRMP	Implement BRMP. (The BRMP addresses LANL's commitment to conduct site operations using processes that minimize risk to both mission implementation and biological resources. The BRMP describes objectives, strategies, and actions that fulfill the following goals: 1. Mission Support: Ensure and facilitate compliance with biological resource laws and regulations 2. Site Stewardship: Identify and mitigate adverse impacts on biological resources 3. Regional Commitment: Meet responsibilities as a good neighbor and trustee of natural resources.)	DOE/EIS-0238 ROD (Sept. 1999) and DOE/EIS-0380 ROD (Sept. 2008)	LANS biologists received an "Honorable Mention" in the 2014 Presidential Migratory Bird Federal Stewardship Award. Biologists completed the annual winter bird surveys, updated the Jemez Mountains Salamander site plan at the completion of the section 7 consultations to incorporate into the T&E Species HMP, installed seasonal road barriers into core habitat for the Mexican Spotted Owl during its breeding season, updated the T&E Species HMP, and began Mexican Spotted Owl annual surveys. Four LANL reports dealing with biological resources were published. Developed a long-term collaboration with the Valles Caldera National Preserve to allow LANL to maintain an off-site location for the avian nestbox monitoring project. Conducted Jemez Mountains Salamander surveys.	Mitigation is effective as a result of implementation of the BRMP and use of the PRID tool.	Continue to implement the BRMP.	ENV-ES Group Field Office – Biological Resources Program Manager

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Effectiveness of Mitigation	Recommendation	Responsible Party
3.13 CRMP	Implement CRMP. (The CRMP defines the responsibilities, requirements, and methods of managing cultural resources on LANL property. It provides an overview of the cultural resources program, establishes a set of procedures for effective compliance with historic preservation laws, addresses land-use constraints and flexibility, and makes the public aware of the stewardship responsibilities and steps being taken by the Field Office for managing the cultural heritage at LANL.)	2008 ROD for the LANL SWEIS (Sept. 2008)	In FY 2014, cultural resource managers continued to support ongoing projects, including public use of recreational trails in TAs 70 and 71, wildland fire fuels mitigations, archaeological site fencing at Minie Firing Site, the Chromium Groundwater Remediation Project, the Mortandad Sediment Trap Revitalization Project, support for a computer virtualization project for Nake'muu, the fire road maintenance project, the TA-51 legacy cleanup project, the PNM RL Line maintenance and new structure project in TAs 70 and 71, the Los Alamos County Wells Project, the security envelope enhancements project, and many others. Historic building program work included supporting the D&D of buildings in TAs 8, 46, 49, and 60, several flood damage assessments, planning for the revitalization of Casa 1 in TA-18, progress was made on the long-term surveillance and maintenance for historic buildings on the LANL preservation list, a monument commemorating LANL's early nuclear reactors was placed at the former location of Omega Site in Los Alamos Canyon, staff facilitated an inspection visit by SHPO staff members to two historic properties (TA-14-6 and TA-8-20) that have been or will be the subject of formal Section 106 consultation.	Mitigation is effective when project review process is followed.	Continue to implement the CRMP.	ENV-ES Group Field Office – Cultural Resources Program Manager

Topic	Mitigation Action Commitment	NEPA Driver	Actions Taken	Effectiveness of Mitigation	Recommendation	Responsible Party
Commitments to Santa Clara Pueblo						
3.22 Consultations with Santa Clara Pueblo	"…NNSA will undertake implementation of the decisions announced in this ROD in conjunction with a MAP. The MAP will be updated as the need arises to identify actions that would address specific concerns and issues raised by the Santa Clara Pueblo as well as those of other tribal entities in the area of LANL." "…with respect to the concerns raised by the Santa Clara Pueblo, the NNSA will continue its efforts to support the Pueblo and other tribal entities in matters of human health, and will participate in various intergovernmental cooperative efforts to protect indigenous practices and locations of concerns. NNSA will conduct government-to-government consultation with the Pueblo and other tribal entities to incorporate these matters into the MAP."	MAP and 2008 ROD for the LANL SWEIS (Sept. 2008)	The Santa Clara Pueblo Office of Environmental Affairs provided revisions to a second draft of a Santa Clara Pueblo HHRA proposal and DOE provided comments on the draft in 3Q FY 2014.	Mitigation is effective	The Field Office continues to provide support to Santa Clara Pueblo to develop a draft plan for Tribal Council review.	DOE/NNSA Field Office – Intergovernmental Programs (Tribal Affairs) in conjunction with Santa Clara Pueblo

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Appendix II

Dual-Axis Radiographic Hydrodynamic Test Facility

Mitigation Action Plan Annual Report Covering FY 2013

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Dual-Axis Radiographic Hydrodynamic Test Facility

Mitigation Action Plan

Annual Report Covering FY 2013

Prepared by:
Department of Energy Los Alamos Site Office
National Nuclear Security Administration

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ACRONYMS

ASER	Annual Site Environmental Report
BA	Biological and Floodplain/Wetland Assessment
BSRL	baseline statistical reference level
CFR	Code of Federal Regulations
DARHT	Dual-Axis Radiographic Hydrodynamic Test (facility)
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
ENV-ES	Environmental Stewardship (group)
ENV-RCRA	Water Quality and RCRA [Resource Conservation and Recovery Act] (Group)
FY	fiscal year
HAZMAT	Hazardous Materials Response Team
HMP	habitat management plan
ISL	industrial screening level
ISM	Integrated Safety Management (system)
LANL	Los Alamos National Laboratory
MAP	Mitigation Action Plan
MAPAR	Mitigation Action Plan Annual Report
MDL	method detection limit
NCB	NEPA, Cultural, and Biological
NEPA	National Environmental Policy Act of 1969
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
RMT	Resources Management Team
ROD	Record of Decision
RSRL	regional statistical reference level
SEA	Special Environmental Analysis
SHPO	State Historic Preservation Officer
SL	screening level
SWEIS	Site-Wide Environmental Impact Statement
SWPPP	Stormwater Pollution Prevention Plan
TA	technical area
TAL	target analyte list
TCP	traditional cultural property
TNT	trinitrotoluene(2,4,6-)
VPB	Vessel Preparation Building
WFO-FOD	Weapons Facilities Operations, Facilities Operations Directorate
WPA	work package agreement

EXECUTIVE SUMMARY

In fiscal year 2013 there were no significant impacts from contaminants based on measurements of soil, sediment, vegetation, field mice, and bees from Dual-Axis Radiographic Hydrodynamic Test (DARHT) operations at Los Alamos National Laboratory. Also, DARHT operations did not have significant impacts to the bird populations and diversity; changes in composition (types of birds) were attributed to changes in vegetation structure from fire and insect activity. There are no impacts from DARHT operations to archaeological resources (i.e., Nake'muu Pueblo) and the natural environment is having a greater effect on the deterioration of the standing wall architecture than operations at DARHT. Although 2013 contaminant levels were not at concentrations detrimental to human health or to the environment, there were measurable amounts of depleted uranium in all media and the levels increase over time until 2006. Concentrations of depleted uranium in most media decreased in 2007 and may correspond to the success of employing steel containment vessels. However, since 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 potential contaminants released into the environment compared with open-air detonations, and the use of steel containment vessels further reduced those amounts over foam mitigation.

1.0 INTRODUCTION

This Mitigation Action Plan Annual Report (MAPAR) has been prepared by the U.S. Department of Energy (DOE)/National Nuclear Security Administration (NNSA) as part of implementing the Dual-Axis Radiographic Hydrodynamic Test (DARHT) facility Mitigation Action Plan (MAP; DOE 1996). This MAPAR provides status on specific DARHT facility operations-related mitigation actions that have been implemented to fulfill DOE commitments under the DARHT Environmental Impact Statement (EIS) Record of Decision (ROD; DOE 1995) and MAP and the 2008 Site-Wide EIS (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 of 1969 (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, 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 that were implemented during FY 2013 (October 1, 2012 through September 30, 2013) and represents the 14th year of DARHT facility operations-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 Federal Register 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 has 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[1]). In general, open-air detonations occurred from 2000 through 2006 and detonations within a foam medium occurred from 2002 through 2006. A containment vessel qualification shot was conducted at the Technical Area 39 (TA-39) Firing Point 6 in 2006, and shots within steel containment vessels at DARHT were implemented in May of 2007. Overall, three hydrodynamic test shots within steel containment vessels at DARHT were conducted in FY 2007, two in FY 2008, none in FY 2009, four in FY 2010, three in FY 2011, six in FY 2012, and five in FY 2013.

The ROD further states that DOE will develop and implement several mitigation measures to protect soils, water, and biotic and cultural resources potentially affected by the DARHT facility

[1] In addition to containment with vessels, additional mitigation measures for use at DARHT are ongoing. These include aqueous foam for particulate mitigation that is aimed at reducing release of materials from test shots.

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 (HMP; LANL 2014a) for all threatened and endangered species occurring throughout LANL. The DARHT MAP elaborates upon those commitments (DOE 1996).

In December 1995, LANL 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 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 for potential impacts to threatened or endangered species and critical habitat as identified in the DARHT MAP. 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;
- biotic resources, especially impacts affecting threatened and endangered species;
- cultural/paleontological resources, especially impacts affecting the archaeological site known as Nake'muu; 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 operational life (about 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 on the DARHT first axis.

During the late summer of 2000, two very simple high-explosive shots using 16 lb of TNT (trinitrotoluene[2,4,6-]) were performed. The purpose of these two experiments was to acquire accelerometer data on the building at the Nake'muu archaeological site. In the late fall of 2000, the first major hydrotest using the DARHT first axis was performed, fragment mitigation measures were in place, and postshot 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 postshot 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 postshot cleanup operations were conducted. An aqueous foam containment method of particulate containment and blast mitigation was tested at another firing site for implementation at DARHT. Also during 2002, the DARHT Project continued the major installation of the injector and accelerator components of the second axis. Two major DARHT second-axis commissioning milestones were achieved in 2002. On July 2, 2002, the second-axis injector achieved conceptual design-4a early with e-beam parameters of >250 amps at >2.0 MeV. On December 21, 2002, the full accelerator achieved the technical criteria of conceptual design-4d with e-beam parameters of >1.0 kA at >12.0 MeV for longer than 400 nanoseconds.

In 2003, the construction of the Vessel Preparation Building (VPB) was completed. One hydrotest was fired in the fall of 2003 and again returned 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 DARHT. The aqueous foam mitigation method achieved at least a 5% reduction in material released to the open air as

prescribed for Phase I of the Phased Containment option. Steel plates and concrete replaced surface gravel at the firing pad to enhance cleanup activities following experiments.

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

In FY 2005, hydrotesting continued with three major hydrotest experiments. Fragment mitigation was implemented during these experiments to mitigate blast effects. Aqueous foam particulate mitigation using a fabric tent configuration for containing the foam was 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 2013, single-walled steel containment vessels were used for all hydrotest experiments to mitigate the fragments and particulate emissions associated with the experiment. These steel containment vessels achieved at least a 40% reduction in material released to the open air as prescribed for Phase II of the Phased Containment option. The steel vessels were decontaminated on the DARHT firing point and transported to the VPB, where they were prepared for the next experiment. A major DARHT second-axis commissioning milestone was achieved in FY 2007. The DARHT Axis II team successfully kicked four pulses through to the target on the scaled accelerator. Each of the four pulses were 35 nanoseconds in duration and uniformly spaced 400 nanoseconds apart. The kicker and downstream transport system performed extremely well. Overall, three hydrodynamic test shots within steel containment vessels at DARHT were conducted in FY 2007, two in FY 2008, none in FY 2009, four in FY 2010, three in FY 2011, six in FY 2012, and five in FY 2013.

2.0 MAP IMPLEMENTATION

The DARHT MAP is implemented on an annual basis in coordination with the federal FY funding cycle. At the beginning of each FY, the DARHT MAP mitigation actions are reviewed and formalized in a LANL work package agreement (WPA). Following WPA authorization, the mitigation actions are initiated. On an annual basis, critical information and data gathered during the mitigation actions are analyzed and summarized; these results are published in the MAPAR.

The DOE/NNSA Field Office NEPA Compliance Officer, who is ultimately responsible for implementing the DARHT MAP, delegates MAP management and tracking to LANL organizations; currently the Environmental Stewardship Group (ENV-ES) manages the MAP. Using the annual WPA, ENV-ES coordinates with the appropriate LANL organizations to ensure mitigation action implementation and to prepare the annual report.

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 should report changes in mitigation actions to the MAP. To ensure the public

has full access to this information, the MAPAR is placed in the Los Alamos and Albuquerque DOE Public Reading Rooms.

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

3.0 DARHT MAP SCOPE, SCHEDULE, AND STATUS

This MAPAR documents the scope and results of mitigation action tasks that were implemented throughout FY 2013. The scope of tasks completed in FY 2013 represents the 14th year of operations-related mitigation. Table 3-1 provides a summary of the scope of potential impacts and commitments addressed in this MAPAR.

Table 3-1. Summary of Potential Impacts and Commitments Addressed in this MAPAR

DARHT MAP Potential Impacts/Commitments	DARHT Phase	MAPAR Section
A. General Environment		
1. Contamination of the environment surrounding DARHT facility with radioactive or hazardous material: 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	Operations	3.1
3. Contamination of the environment with various types of hazardous materials as a result of spills within the DARHT facility	Operations	3.1
4. Contamination of the environment with hazardous levels of various substances as a result of discharges of contaminated water from the DARHT facility	Operations	3.1
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)	Operations	3.2
C. Biotic 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 as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (n–x).	Operations	3.3
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).	Operations	3.3

DARHT MAP Potential Impacts/Commitments	DARHT Phase	MAPAR Section
C. Biotic Resources (continued)		
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).	Operations	3.3
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.	Operations	3.3
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.	Operations	3.3
7. DARHT facility construction and operation could impact the Jemez Mountains salamander (*Plethodon neomexicanus*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).	Operations	3.3
8. DARHT facility construction and operation could impact the bald eagle (*Haliaeetus leucocephalus*) as a result of noise from firings and other operations, as well as other activities at the firing sites: Commitments (a, b).	Operations	3.3
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).	Operations	3.3
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).	Operations	3.3
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, 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	3.4
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	3.5

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: a structural failure of containment vessels or during open-air firing operations; release of various types of waste as a result of cleaning out the containment vessels; release of various hazardous materials as a result of spills within the DARHT facility; and 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 associated with these potential impacts are as follows:

b) ENV-ES will monitor contaminants by sampling soil, plants, mammals, birds, and bees at baseline locations and, following the start of operations, within the potential impact area of DARHT, once per year.

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 bee, and small mammal tissue samples have been collected from around the DARHT facility and analyzed during the construction phase (1996–1999) for baseline conditions. The results of 4 years of analysis of DARHT samples are summarized in a composite report (Nyhan et al. 2001) and were used to calculate baseline statistical reference levels (BSRLs); 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).

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

This section of the MAPAR summarizes the results of analyses of soil, sediment, vegetation, field mice, birds, and bees collected around the perimeter of DARHT during FY 2013 (Figure 3-1). All of the raw data can be found in the Annual Site Environmental Report (ASER) (LANL 2014b).

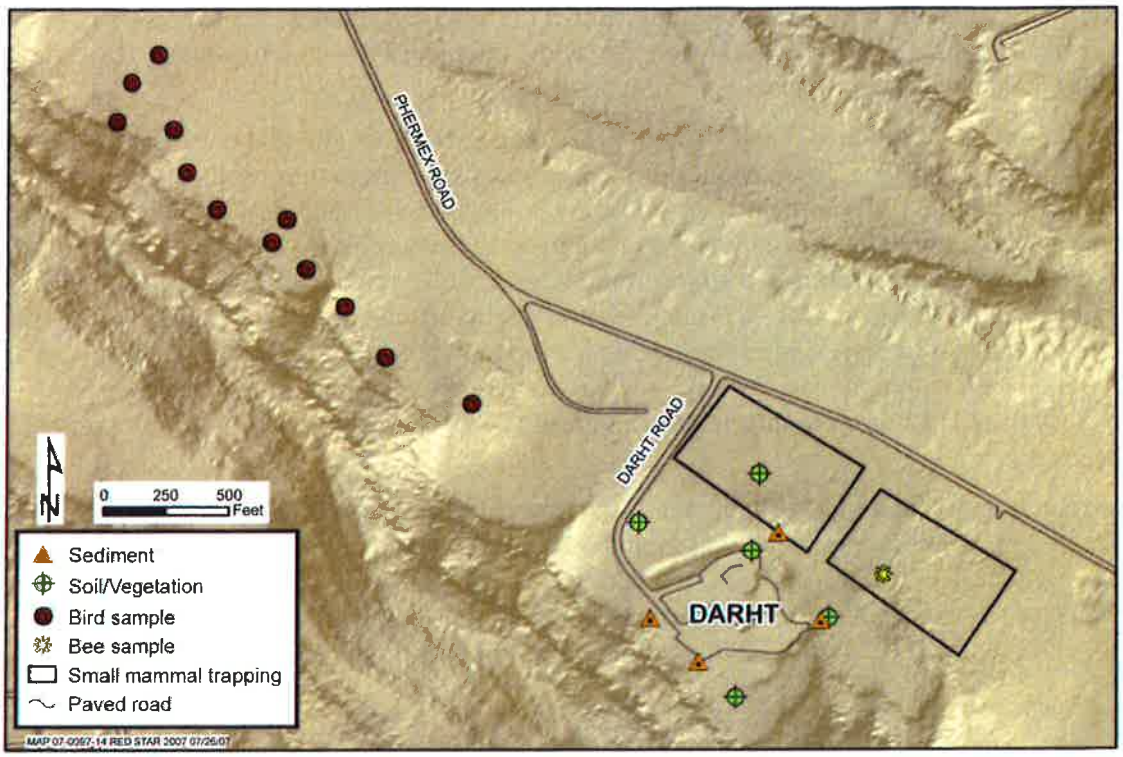

Figure 3-1. Sample locations for soil, sediment, vegetation, field mice, birds, and bees around DARHT.

Soil and Sediment Monitoring. Soil samples were collected north of the firing point and around the perimeter of the DARHT facility on the north, east, south, and west sides (see Figure 3-1). In addition, sediment samples were collected on the north, east, south, and southwest sides. All samples were submitted to ALS Laboratory Group, under chain-of-custody procedures for the analysis of tritium, plutonium-238, plutonium-239/240, strontium-90, americium-241, cesium-137, uranium-234, uranium-235, uranium-238; 23 target analyte list (TAL) chemicals; and high explosives. In addition, dioxins and furans were analyzed by Cape Fear Analytical, LLC, in one soil sample collected nearest the firing point.

We compared the radionuclide and TAL element results in soil and sediment from the DARHT sampling with both BSRLs and regional statistical reference levels (RSRLs). RSRLs are the upper-level background concentration (mean plus 3 standard deviations = 99% confidence level) derived from soil collected from regional areas away from the influence of the Laboratory. RSRLs represent natural and fallout sources, are calculated as data become available, and can be found in the ASER.

The use of both reference levels is employed because the BSRLs for some radionuclides and chemicals may be biased as a result of changes in pre- and post-sampling locations and the change in analytical techniques.

Most radionuclides in soil and sediment collected from within and around the perimeter of the DARHT facility were either not detected or below the statistical reference levels. A nondetected value is one in which the result is lower than 3 times the counting uncertainty and is not

significantly different ($\alpha = 0.01$, or 99% confidence level) from 0 (Keith 1991, Corely et al. 1981) or less than the minimum detectable activity. Those few radionuclides, however, that were above the statistical reference levels were far below the industrial screening levels (ISLs) and do not pose an unacceptable dose to any site workers.

The only radionuclides in soil and sediments around the DARHT site that consistently measure higher than the (baseline) reference level over the years are the uranium isotopes, primarily uranium-238 in the soil sample nearest the firing point. Because open-air detonations occurred from 2000 through 2006, it would not be uncommon to find particles of depleted uranium in the soil around the site. Uranium-238 concentrations in the soil sample collected nearest the firing point peaked in 2008 (55 pCi/g dry) and, because operations have changed to include the use of closed containment vessels (and subsequent cleanup of debris around the site), the concentrations of uranium-238 within the facility have decreased dramatically to baseline levels. See MAP Section VIII.A.1(d) for more information and results concerning the use of steel containment vessels.

Last year, one perimeter soil sample out of the four collected measured higher than normal for uranium-238; the north perimeter soil sample measured 39 pCi/g, which accounts for the spike in 2012 (Figure 3-2). Because open-air detonations occurred from 2000 through 2006, it is not unexpected to find small particles of depleted uranium in the soil around the site on occasion. This year, the levels of uranium-238, including the amounts on the north side, are at BSRLs.

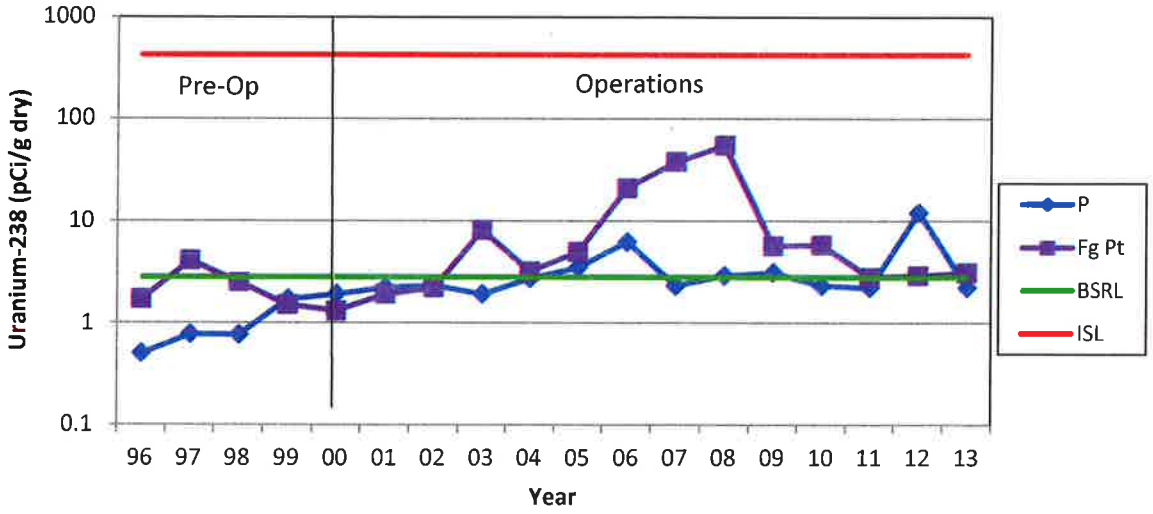

Figure 3-2. Uranium-238 concentrations in soil collected within (near the firing point) and around (north-, east-, south-, and west-side average) the DARHT facility at TA-15 from 1996–1999 (preoperations) to 2000–2013 (during operations) compared with the BSRL and the ISL. Note the logarithmic scale on the vertical axis.

Most of the TAL elements, with the exception of sodium and selenium, in the soil and sediment samples collected within and around the DARHT facility were below both the BSRLs and the RSRLs. There are no ISLs for sodium and selenium is far below the ISL of 5680 mg/kg and not a concern.

Beryllium, listed as a chemical of concern before the start-up of operations at DARHT (DOE 1995), was not detected in any of the soil or sediment samples above reference levels. Also, beryllium concentrations in soil over the 14-year operations period have remained stable over time (Figure 3-3).

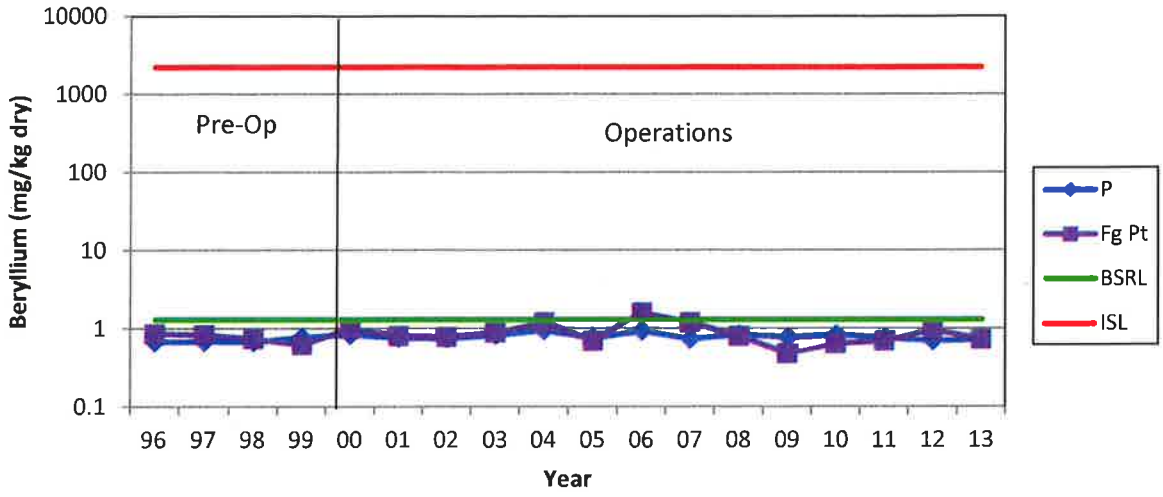

Figure 3-3. Beryllium concentrations in soil collected within (near the firing point) and around the DARHT perimeter (north-, west-, south-, and east-side average) at TA-15 from 1996–1999 (preoperations) to 2000–2013 (during operations) compared with the BSRL and the ISL. Note the logarithmic scale on the vertical axis.

None of the 20 high explosive chemicals analyzed were detected above the method detection limits (MDLs) in any of the soil or sediment samples collected within and around the perimeter of the DARHT facility, including the sample closest to the firing point. Also, most dioxins and furans were not detected above the MDLs in the soil sample nearest the firing point. (Note: Trace amounts [>MDL<Detection Limit] of 1,2,3,4,6,7,8-heptachlorodibenzodioxin and 1,2,3,4,6,7,8,9-octachlorodibenzodioxin were found. Trace amounts of these two chemicals were detected last year.)

Although not analytically surveyed for in 2013, no polychlorinated biphenyls or semivolatile organic compounds in soil and sediment samples collected around the perimeter of the DARHT facility in 2007 were detected above the reporting limits.

Vegetation Monitoring. Overstory (tree needles and branch) vegetation samples were collected on the north, south, west, and east sides of the DARHT complex and submitted to ALS Laboratory Group for the analyses of the same radionuclides and TAL chemicals as for soil.

All radionuclide concentrations, including uranium-238 (Figure 3-4), in overstory vegetation collected from around the perimeter of the DARHT facility were either not detected (most results) or detected below the BSRLs (or RSRLs when BSRL data were not available). In the past, uranium-238 was usually the only radionuclide to be detected in overstory vegetation around the DARHT facility (probably as a result of foliar deposition more than by root uptake), but since 2007 the concentrations have generally decreased from all sides of the DARHT

perimeter. This general decrease in uranium-238 concentrations to the BSRL was probably due to the change in contaminant mitigation procedures from open-air and/or foam mitigation (2000–2006) to closed steel containment (vessel) mitigation starting in 2007.

Screening levels (SLs) for biota were set at 10% of the standard by the dose assessment team at the Laboratory to identify the potential contaminants of concern (McNaughton 2006).

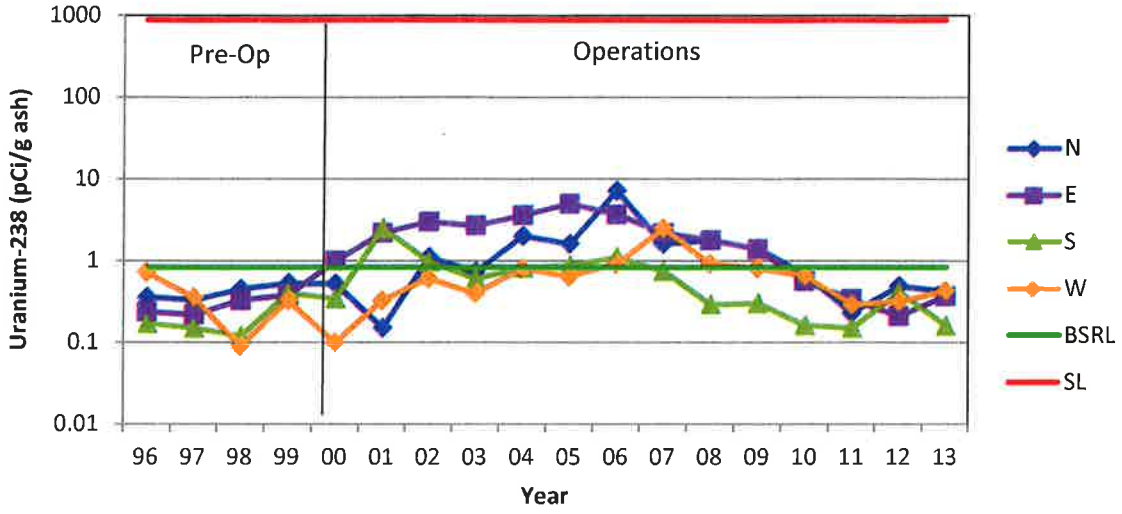

Figure 3-4. Uranium-238 in overstory vegetation collected from the north (N), east (E), south (S), and west (W) side of the DARHT facility at TA-15 from 1996–1999 (preoperations) through 2000–2013 (during operations) compared with the BSRL and the SL. Note the logarithmic scale on the vertical axis.

The results for the 23 TAL elements, including metals like beryllium and mercury, in overstory vegetation collected from around the DARHT facility show that all of the metals were either below the detection limits or detected below the BSRLs (or below the RSRLs when BSRL data were not available).

Small Mammal Monitoring. Small mammals, mostly deer mice (*Peromyscus* spp.), are collected using Sherman live traps from two sample grids located on the north and northeast side of the DARHT facility. Samples of whole-body mice were submitted to ALS Laboratory Group for analyses of the same radionuclides and TAL elements as for the other biota.

All radionuclides in a composite field mouse sample (n=5) collected from the north and northeast side of the DARHT facility were either not detected (most results) or below the BSRLs.

Using uranium-238 concentrations to model trends over time, the amounts, as seen with vegetation, exhibit an increase to 2007 and then decrease thereafter to the BSRL; this is concurrent with the change in detonation mitigation practices from open-air and/or foam-mitigated detonations during the 2000 through 2006 period to closed vessel containment starting in 2007 (Figure 3-5).

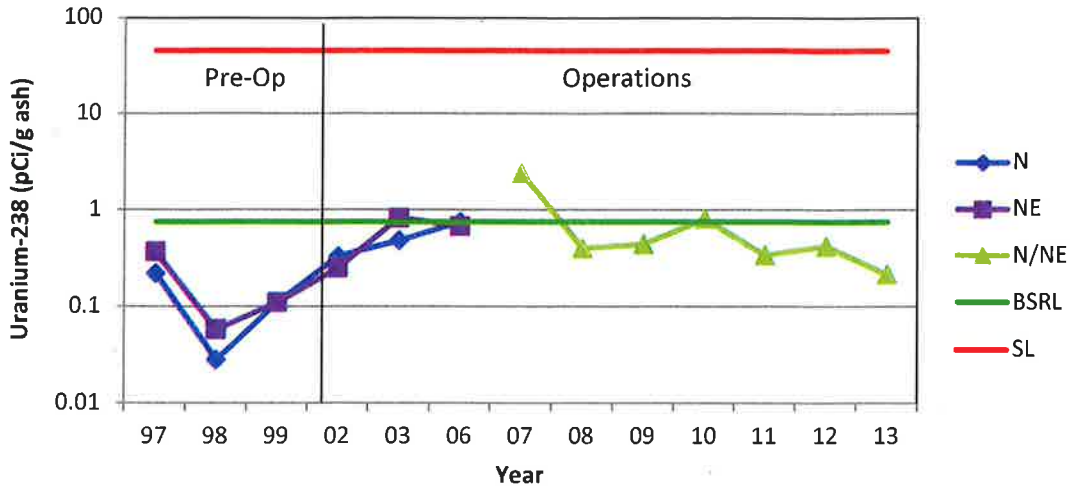

Figure 3-5. Uranium-238 concentrations in (whole-body) mice collected from the north (N), northeast (NE), and north-northeast (N/NE) side of the DARHT facility at TA-15 from 1997–1999 (preoperations) through 2002–2013 (during operations) compared with the BSRL and the SL. Note the logarithmic scale on the vertical axis.

Most TAL elements, with the exception of lead, in a field mouse sample collected from the northeastern perimeter of the DARHT facility were either not detected or similar to RSRLs (based on 2007–2013 data; n = 12) (Fresquez 2013). The amount of lead detected in the mouse sample was higher than the RSRL. However, the amount of lead in soil from the north-side perimeter of DARHT (14 mg/kg) were far below the ecological screening levels (<120 mg/kg, respectively) for the deer mouse and not a concern (LANL 2009).

Most dioxin or furan chemicals in a field mouse sample were not detected above the MDL; only an estimated trace amount (above the MDL but below the detection limit) of 1,2,3,4,6,7,8-heptachlorodibenzodioxin and 1,2,3,4,6,7,8,9-octachlorodibenzodioxin were listed, but the levels were below the RSRL (based on 2008–2011 data; n = 8) (Fresquez 2013). Trace amounts of 1,2,3,4,6,7,8-heptachlorodibenzodioxin and 1,2,3,4,6,7,8,9-octachlorodibenzodioxin were also detected in soil near the firing point above the MDL.

Bee Monitoring. All radionuclide concentrations in a honey bee sample collected from a hive located on the northeastern perimeter of the DARHT facility were either not detected (most results) or below the BSRLs.

A comparison of uranium-238 in bee samples over the preoperational and operational period at DARHT reveals the same general trend observed with the other biotic samples, that there is an increase in activity to around 2006 and then a sharp decrease concurrent with the change in detonation mitigation practices from open-air/foam (2000–2006) to closed vessel containment starting in 2007 (Figure 3-6).

Only a few of the TAL elements (beryllium and lead) in a composite bee sample collected from a hive northeast of the DARHT facility were higher than the RSRLs (based on 2010–2012 data; n = 4). Most of these TAL elements, however, were within the same order of magnitude as the

RSRLs and are probably a reflection of the low number of background samples used to calculate an RSRL.

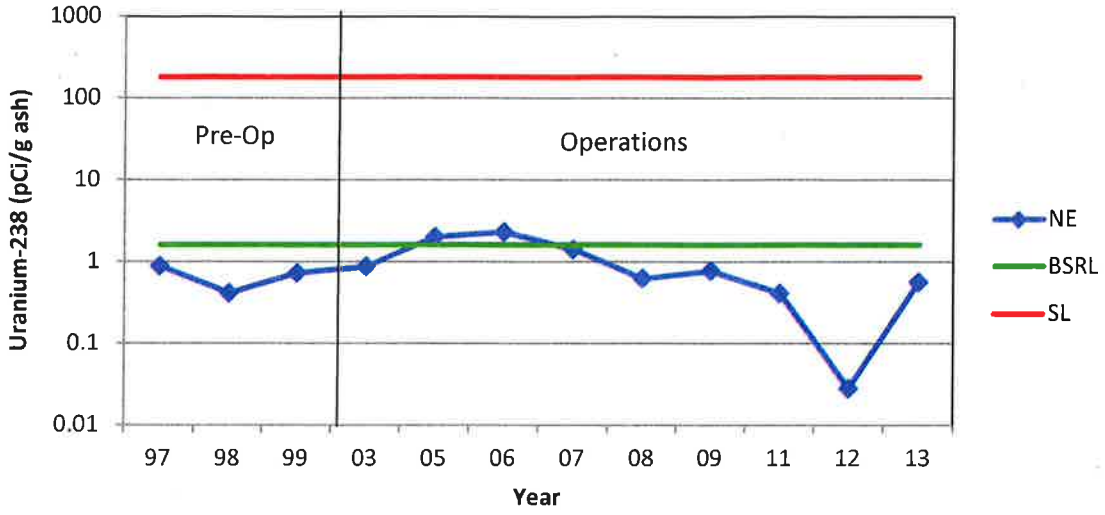

Figure 3-6. Uranium-238 concentrations in bees collected from the northeast (NE) side of the DARHT facility at TA-15 from 1997–1999 (preoperations) through 2003–2013 (during operations) compared with the BSRL and the SL. Note the logarithmic scale on the vertical axis.

Bird Monitoring. Birds were collected for population, composition, and diversity estimates using 12 mist capture net traps spaced about 200 ft to 1,600 ft outward from the west side of the DARHT facility. The objective of the bird monitoring project is to determine the general (ecological) stress levels around the vicinity of DARHT caused by facility operations (e.g., noise, disturbance, construction, and traffic).

The number of birds, taxa, diversity and evenness (distribution) of birds collected in 2013 are similar to those collected before the start-up of operations at DARHT (Figure 3-7). However, the types of birds collected at DARHT have changed since the late 1990s/early 2000s. The site has gradually changed from a ponderosa pine– (*Pinus ponderosa*–) dominated plant community to a more piñon/juniper (*Pinus edulis/Juniperus monosperma*) habitat because of wild land fire and bark beetle activity that has killed almost all of the ponderosa pines in the project area.
The top six most common birds during the preoperation period included the Chipping Sparrow (*Spizella passerina*)>Virginia's Warbler (*Vermivora virginiae*)>Western Bluebird (*Sialia mexicana*)>Broad-tailed Hummingbird (*Selasphorus platycercus*)>Pygmy Nuthatch (*Sitta pygmaea*)>Mountain Chickadee (*Poecile gambeli*)=Gray Flycatcher (*Empidonax wrightii*). This year, the top six birds included the Chipping Sparrow>Virginia's Warbler=Western Bluebird>Rock Wren (*Salpinctes obsoletus*)>Black-headed Grosbeak (*Pheucticus melanocephalus*)=Blue-gray Gnatcatcher (*Polioptila caerulea*). Birds not collected during the preoperational period but are present in 2013 include the American Robin (*Turdus migratorius*), Black-chinned Hummingbird (*Archilochus alexandri*), Blue-gray Gnatcatcher, Brown-headed Cowbird (*Molothrus ater*), Cordilleran Flycatcher (*Empidonax occidentalis*), MacGillivray's Warbler (*Oporornis tolmiei*), and Rock Wren.

The Virginia's Warbler is listed in the top 100 birds at risk in "North America in the Birder's Conservation Handbook" (Wells 2007) and is a common inhabitant of the ecosystem near the DARHT facility.

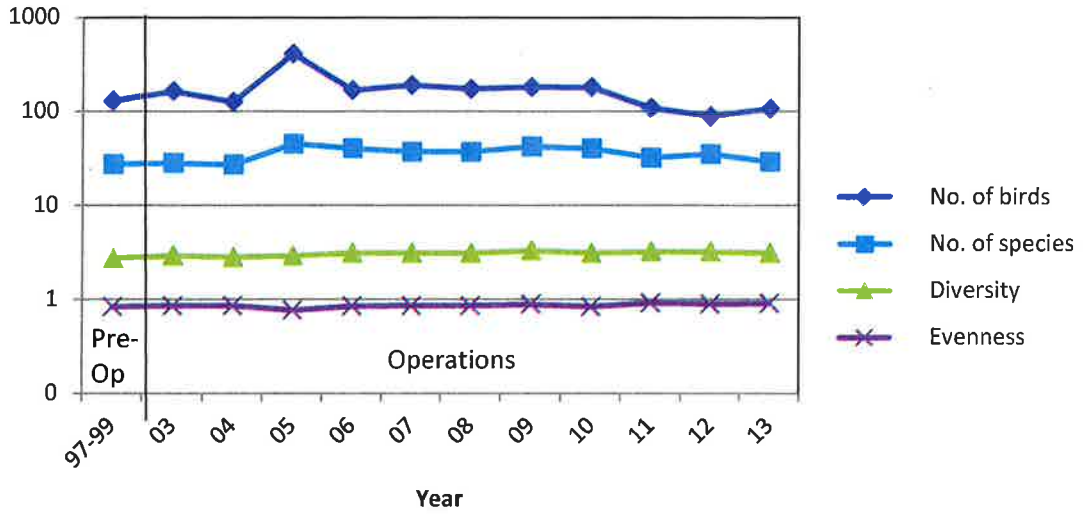

Figure 3-7. Populations, number of species, diversity, and evenness of birds occurring before (1997–1999) and during (2003–2013) operations at DARHT. Note the logarithmic scale on the vertical axis.

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. On January 18, 2005, approximately 385 gallons of mineral oil was released from an aboveground storage tank into the secondary containment system during an oil transfer, this released material did not reach 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 from 2000 through 2006 and detonations within a foam medium occurred from 2002 through 2006. A containment vessel qualification shot was conducted at the TA-39 Firing Point 6 in 2006, and shots within single-walled steel containment vessels at DARHT were implemented in May of 2007. Three hydrodynamic test shots within single-walled steel containment vessels at DARHT were conducted in 2007. Two hydrodynamic test shots were conducted within single-walled steel containment vessels at DARHT in 2008. These steel containment vessels achieved at least a 40% reduction in material released to 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 (mostly) of the firing point at various distances (50, 135, and 200 m) 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 prescribed 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 prescribed 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; during FY 2008 containment vessels continued to be decontaminated on the DARHT 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 to 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 has 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 has developed containment vessel cleanout processes in support of the commitment to decontaminate vessels used in experiments.

Process equipment for managing debris from vessel shots has been installed in the VPB. Procedures for vessel cleanout, decontamination, and stabilization of debris from vessel shots have been 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 of at TA-54, Area G (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 (ISM) 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 in 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 (HAZMAT). The HAZMAT is on call full-time to respond to all emergency spills within the LANL site and, as needed, the LANL region. The mineral oil release was not considered a spill because it did not reach the environment and did not require HAZMAT deployment.

Summary of Potential Impacts

MAP Section VIII.A.4

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

Mitigation Action Scope

Water discharged from the DARHT facility cooling tower will be monitored to ensure compliance with outfall permits as stated in the National Pollutant Discharge Elimination System (NPDES) permit for the DARHT facility site. Should discharge levels exceed permit limits,

LANL's Water Quality and RCRA (Resource Conversation and Recovery Act) Group (ENV-RCRA) will act to bring the facility into compliance.

Status

MAP Section VIII.A.4

Water flow from the DARHT facility cooling tower is routinely monitored by ENV-RCRA to ensure compliance with the NPDES permit. There was an NPDES chlorine exceedance at the DARHT 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 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 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 ENV-RCRA.

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, as necessary, by WFO-FOD environmental personnel and ENV-RCRA.

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 ENV-RCRA.

Mitigation Action Scope

MAP Section VIII.B.2(a–e)

The operations mitigation actions 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 ENV-ES to avoid disturbance to threatened and endangered species and other wildlife species.

c) ENV-ES must be notified before any new groundbreaking activities. ENV-ES will review all new sites and evaluate any potential impacts associated with the action. ENV-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 ENV-ES based on topographic aspects and vegetation composition.

e) Indigenous trees and/or other indigenous vegetation 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 site is managed according to procedures that restrict access to authorized personnel on special work assignments such as postshot 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)

Under the ISM System at LANL, all planning, construction, and operations activities must comply with the institutional process established under LANL Implementation Procedure 405.0 (P405.0)—also known as the NEPA, Cultural, and Biological (NCB) Review. (Note: These activities previously were governed by Laboratory Implementation Requirement 404-30.02.0.)

This implementation procedure establishes the institutional requirements to ensure that contractual work-smart standards for NEPA, cultural resources, and biological resources are consistently met. In addition to requiring full compliance with applicable NEPA, cultural resources, and biological resources Federal regulations, P405.0 requires full and effective implementation of the LANL HMP (LANL 2014a). These standards are measured by performance criteria contained in the Laboratory Performance Requirement 404-00-00 Appendix 3 (Environmental Protection—Ecological and Cultural Resources). ENV-ES is the Office of Institutional Coordination for P405.0 and is responsible for developing, revising, and maintaining the document, as well as technically assisting in its full and effective implementation.

Under the institutional Wildland Fire Management Plan (LANL 2007, update for 2012) and wildfire risk reduction program, some of the forested areas surrounding the DARHT facility site have been thinned. The forest thinning was determined to be necessary to minimize the immediate risk of a wildfire starting in the overgrown forest that originally surrounded the DARHT facility site. The specific location and amount of thinning was planned and implemented in full compliance with P405.0. Additional thinning was conducted along the exclusion fence to eliminate dead, hazardous trees that might damage the fence. The DARHT facility site forest-thinning activities were conducted in consultation with the Ecology Group (now ENV-ES) to ensure appropriate protection of Mexican spotted owl and other wildlife habitat in the area (such as vegetation buffer zones and erosion control). All applicable NEPA, biological resources, and cultural resources regulatory requirements—including MAP Section VIII.B.2(b–e)—for DARHT facility operations and other facility management activities around the DARHT facility site are fully addressed through the ongoing implementation of P405.0.

3.3 Mitigation Actions for Biotic 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 because of noise from firings and other operations, as well as other activities at the firing site. These activities could also impact other sensitive species potentially residing in or traversing the project area. If present, the following species could be affected: American peregrine falcon, northern goshawk, bald eagle, spotted bat, Townsend's pale big-eared bat, New Mexico meadow jumping mouse, Jemez Mountains salamander, and the wood lily.

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 ENV-ES on all DARHT facility site threatened and endangered species issues through the ongoing implementation of the LANL HMP. LANL will conduct the necessary

species monitoring and habitat protection measures required for the DARHT facility site through the HMP (LANL 2014a).

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 HMP. During FY 2000, site-wide implementation of the HMP was included as part of the institutional requirements in P405.0. 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 P405.0. The HMP was last updated in March 2014.

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, and the immediate surrounding environment.

Mitigation Action Scope

MAP Section VIII.D.1(b, e–g)

The operations mitigation actions 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 using photographs or other means of recording to determine if activities at TA-15 are causing any structural changes to the cultural site over time.

f) DOE will periodically arrange for tribal officials to visit cultural resource sites within TA-15 that are of particular interest to the tribes (at least once a year).

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 evaluate procedures/measures for mitigation periodically. 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 from 2000 through 2006 and detonations within a foam medium and steel containment vessels occurred from 2002 through 2006 and from 2007 through

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 9-year-long annual assessment of physical conditions at Nake'muu (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 DARHT (Vierra and Schmidt 2006). As a result of this statistically quantitative study, additional annual monitoring at Nake'muu under the DARHT MAP was determined to not be required and was suspended in FY 2007. Note that yearly qualitative assessments of Nake'muu have also been performed as part of the MAP for the Special Environmental Analysis (SEA) associated with the Cerro Grande fire (DOE 2000a). These field checks, conducted by the LANL Resources Management Team (RMT), include brief assessments of the standing walls at Nake'muu along with checks of the associated fire road and firebreak. During the period of FY 2006 through FY 2009 the Nake'muu field checks were directly tied into the annual visit by the Pueblo de San Ildefonso required by the DARHT MAP, which provided Pueblo de San Ildefonso visitors for the DARHT tour with the opportunity to witness and discuss conditions at this ancestral pueblo.

Due to the Las Conchas Fire, June 2011, no field assessment visit was conducted to Nake'muu and therefore no detailed photography was conducted during FY 2011. Detailed photographic documentation of the site was resumed in FY 2012 in order to perform the annual condition assessment of the walls. The 2012 photographs were compared with the photographs taken in 2010. Erosion of the mortar exposing the chinking stones between tuff blocks was noted as well as the fall of three stones from the top of walls. The FY 2013 annual photographic documentation of the site was conducted on May 31 and July 19, 2013, by members of the RMT. Natural erosion continues to be seen throughout the sites. No individual stones or sections of walls were noted to have fallen since the previous assessment in June of 2012. However, small areas of undercutting is evident at several walls, daylight can be seen beneath the base stones. These areas and wall sections will be closely watched in the upcoming years for evidence of further erosion and for potential wall failure.

MAP Section VIII.D.1(f)

Representatives from Pueblo de San Ildefonso visited Nake'muu with members of the RMT on November 10, 2010 (FY 2011). Several attempts for FY 2012 tours of Nake'muu for the Pueblo de San Ildefonso were scheduled and canceled because members of Pueblo de San Ildefonso were unable to attend. No visits of Nake'muu were conducted during FY 2013 for the Pueblo de San Ildefonso. Wildland fire environmental conditions limited safe access to the site during portions of the fiscal year as well as unforeseen conflicts arising on scheduled tour dates.

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 before FY 2007, aqueous foam. The postshot operations for the experiments were conducted according to experiment-specific integrated work documents and the following established standard procedures:

- WFO-OS-ES-050 General Safety for Firing Site Areas
- WFO-OS-ES-030 General Firing Operations
- HX-DARHT-TP-1039 DARHT Firing Operations
- HX-DARHT-TP-1040 General Explosive Operations at DARHT
- DX-PRO-012 Division Waste Management Procedure
- WFO-OS-HS-025 Radiological Controls

These procedures have been determined appropriate by DOE and are implemented under the LANL ISM 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 ISM System requirements, these procedures appropriately address DARHT MAP commitments that are designed to minimize the short- and long-term release of contaminants (radioactive and hazardous materials) to the DARHT facility site.

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 for the DARHT facility site. Such damage could occur as a result of DOE's lack of knowledge of these resources in the DARHT facility area.

Mitigation Action Scope

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

The operational mitigation actions 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 (SHPO), as appropriate, for concurrence of eligibility determinations and potential effects.

Status

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

DOE and the LANL Ecology Group completed the Phase II cultural resources assessment and cultural resources report for the DARHT facility project. On May 20, 1999, the SHPO officially concurred with a DOE and LANL finding that the construction and operation of the DARHT facility will have "no adverse effect" on cultural resources in the potentially affected area (DOE 1999). In addition, as part of the LANL SWEIS MAP, in FY 2000 LANL completed the

"Comprehensive Plan for the Consideration of Traditional Cultural Properties and Sacred Sites at Los Alamos National Laboratory" (DOE 2000b). This DOE plan was approved in August 2000 and provides the institutional framework for identifying and documenting two specific types of cultural resources: traditional cultural properties (TCPs) and sacred sites (DOE 2000b). As part of DARHT facility operations, DOE and LANL will continue to consult with the four Accord Pueblos through annual tours, as necessary, to minimize the potential for structural or other damage to as-yet-unknown Native American cultural resources within the area of potential effects for the DARHT facility site. Cultural resource surveys conducted as part of the Cerro Grande Rehabilitation Project did not identify any new archaeological sites in the vicinity of the DARHT facility. No new TCP or sacred site issues were identified during FY 2007 through FY 2010. Any future TCP and sacred site issues will be addressed as part of the institutional process established under the "Comprehensive Plan for the Consideration of Traditional Cultural Properties and Sacred Sites at Los Alamos National Laboratory" (DOE 2000b).

In FY 2013, the annual visit of the Pueblo de San Ildefonso to Nake'muu and the associated rehabilitation monitoring and site condition assessment originally under the SEA MAP was integrated into the annual implementation of the Cultural Resources Management Plan (LANL 2006), a revision of which is currently being reviewed by the State Historic Preservation Office.

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)

Under this section of the DARHT MAP there is a commitment 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 ISM 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 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 Rad-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 ISM 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 HX-DARHT-AP-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 2013 there were no significant impacts from contaminants based on measurements of soil, sediment, vegetation, field mice, and bees from DARHT operations. Also, the comparison of bird species diversity and composition, a qualitative measurement, before and during DARHT operations, showed no significant impacts to the bird populations.

Although 2013 contaminant levels were not at concentrations detrimental to human health or to the environment, there were still measurable amounts of depleted uranium in all media, and the levels were increasing over time to at least 2006. Concentrations of depleted uranium in most media decreased in 2007 and may correspond to the success of employing steel containment vessels and/or to cleanup of detonation debris. However, since increases of uranium in all media were noted until at least 2006 and uranium may linger in soils for some time, the monitoring of all or part of these media should be continued to a point where the concentrations are similar to BSRLs.

Foam mitigation significantly reduced the amount of potential contaminants released into the environment compared with open-air detonations, and the use of steel containment vessels further reduced those amounts over foam mitigation.

Regarding potential impacts from DARHT operations on Nake'muu, the natural environment is having a greater effect on the deterioration of the standing wall architecture than the operations at DARHT.

4.1 2013 MAP Implementation

In July 1999, all construction-related DARHT MAP mitigation commitments and action plans were completed. The FY 2013 DARHT MAP activities represent the 14th year of operation implementation. The DARHT MAP activities implemented during FY 2013 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 Field Office.

4.2 Recommendations

- **Continue monitoring for contaminants that are above BSRLs or are on increasing trends.** Future (2014) DARHT operations will likely incorporate more contained tests. As a result, impacts from a given year of DARHT operations on the environment should eventually decrease and this decreasing trend should be considered in future monitoring decisions. However, uranium-238 appears to have accumulated in soils and sediments, particularly near the firing point, and may impact biotic resources over a period of years. These potential cumulative impacts should continue to be monitored, especially for contaminants such as uranium-238 that are above BSRLs or are on increasing trends.
- **Reevaluate environmental monitoring strategy**. The environmental monitoring strategy for DARHT should be reevaluated with consideration of issues such as (1) budget, (2) movement to contained shots in 2007, (3) trend in contaminant concentrations and comparison with the benchmark thresholds of BSRLs (RSRLs) and SLs, and (4) the results of the 2005 special study on the effects of discontinuity in sample data.
- **Continue to issue the DARHT MAPAR annually.** The DARHT MAPAR will continue to be issued annually as part of the SWEIS MAPAR. Detailed analysis of DARHT monitoring data and results will continue to be published in the ASER.
- **Continue environmental rehabilitation activities and annual tribal visits at Nake'muu.** Annual monitoring at Nake'muu has been discontinued, but site visits every 2 to 3 years for vegetation removal, etc., and annual tribal visits should continue. Future TCP and sacred site issues should be addressed as part of the institutional process established under the "Comprehensive Plan for the Consideration of Traditional Cultural Properties and Sacred Sites at LANL" (DOE 2000b).
- **Continue to manage DARHT facility operations in accordance with ISM.** Under the institutional implementation of the ISM System, 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.

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Appendix III

Fiscal Year 2014 Trails Management Program

Mitigation Action Plan

Annual Report

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LA-UR-14-28361
Approved for public release; distribution is unlimited.

Title: # Fiscal Year 2014 Trails Management Program Mitigation Action Plan Annual Report

October 2014

Prepared by: Daniel S. Pava, Environmental Protection Division, Environmental Stewardship Services Group (ENV-ES)

Mountain bikers at the Potrillo Canyon Trailhead, summer 2014.

Los Alamos
NATIONAL LABORATORY
EST. 1943

Contents

ACRONYM LIST

DOE	Department of Energy
EA	environmental assessment
ENV-ES	Environmental Stewardship Services (Group)
FONSI	Finding of No Significant Impact
FY	Fiscal Year
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security, LLC
MAP	Mitigation Action Plan
MAPAR	Mitigation Action Plan Annual Report
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
SWEIS	Site-Wide Environmental Impact Statement
TA	Technical Area

1.0 EXECUTIVE SUMMARY

This Trails Management Program Mitigation Action Plan Annual Report (Trails MAPAR) has been prepared for the Department of Energy (DOE)/National Nuclear Security Administration (NNSA) as part of implementing the 2003 *Final Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program* (DOE 2003). The Trails Mitigation Action Plan (MAP) is now a part of the *Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory (DOE/EIS 0380) Mitigation Action Plan* (SWEIS MAP) (DOE 2008). The MAP provides guidance for the continued implementation of the Trails Management Program at Los Alamos National Laboratory (LANL) and integration of future mitigation actions into the SWEIS MAP to decrease impacts associated with recreational trails use at LANL.

This ninth MAPAR includes a summary of the LANL Trails Management Program activities and actions during Fiscal Year (FY) 2014, from October 2013 through September 2014.

2.0 CONTEXT: TRAILS AT LANL

Trails use at LANL has been considered one of the benefits of working and living in Los Alamos County. However, there was never an explicit DOE or LANL policy or mechanism to balance recreational trails use on LANL property with environmental, cultural, safety, security, and operational concerns. In 2003, the DOE directed LANL to establish such a program. DOE/NNSA published the *Final Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program* and a Finding of No Significant Impact (FONSI) (DOE 2003) in September 2003. The NNSA issued a MAP for this environmental assessment (EA) on the same date.

The most pertinent trails issues identified in the EA were:

- DOE/NNSA does not have a public recreational mission established by Congress.
- The public gets conflicting messages regarding trail use on LANL property because signs, access controls, and enforcement at LANL vary.
- Trespassing occasionally occurs from LANL onto adjacent lands where trail use is not permitted.
- Trail use poses threats to some cultural and natural resources.
- Trail use in certain LANL areas increases the risks of human exposure at potential release sites, and other operational and natural hazards including wildfires.
- Security concerns are posed by the use of certain LANL trails.

The MAP established the Trails Management Program, which is implemented through individual projects, including measures for planning, repair and construction, environmental protection,

safety, security, and post-repair and construction end-state conditions assessments. A standing Trails Working Group made up of LANL and other agency's stakeholders was formed to carry out this program.

In March 2014, at the request of the DOE/NNSA Los Alamos Field Office, the Los Alamos National Security, LLC (LANS) Environmental Stewardship Services Group (ENV-ES) prepared a National Environmental Policy Act (NEPA) Review evaluating whether the *Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program* (DOE 2003) required supplementation and/or revision. LANS NEPA staff concluded that the analyses in the 2003 EA was still relevant and its description and resource impacts remained accurate and did not require an update or supplementation. The NEPA Review noted that there have been local changes that have a potential to affect resources and resource management since the 2003 EA, including:

- The Las Conchas Fire impacted LANL watersheds and canyons where there are actively-used trails.
- The listing of the Jemez Mountains salamander as endangered by the United States Fish and Wildlife Service. The salamander has habitat in some areas at LANL where there are actively-used trails.
- Ongoing drought and climate change impacts (similar to the drought impacts that existed pre-Cerro Grande Fire).
- Increased use of certain LANL trails by the public as a result of social media, and restrictions on adjoining public lands.
- Impacts to cultural resources in areas accessible to the general public.

The NEPA Review noted that LANS and DOE/NNSA have worked together and done much to promote better trails management in the 10 years since the EA, associated FONSI, and MAP were released. Specifically, LANS has been conducting public tours and is in the process of installing fencing and kiosks with information about the rules and risks associated with recreational trails use at trailheads across Technical Areas (TAs) 70 and 71. In addition, a new LANL website "Taking Care of Our Trails" (http://www.lanl.gov/community-environment/environmental-stewardship/protection/trails/index.php) now provides maps and guidance that balance responsible stewardship with the privilege of public access.

The NEPA Review concluded that while there have been some changes, which potentially affect the resources analyzed in the 2003 EA, these changes are not significant in context or intensity. Therefore, no update or supplementation of the 2003 EA was recommended because the MAP associated with the EA, in conjunction with the LANL Cultural and Habitat Resources Management Plans, are in place to manage these resources and mitigate impacts. These Management Plans are in place to address issues as they arise using an adaptive management approach.

Trails management program goals:

- Reduce the risk of damage and injury to property, human life, health, and sensitive natural and cultural resources from social trail use at LANL.
- Facilitate the establishment of a safe, viable network of linked trails across the Pajarito Plateau that traverse land holdings of various private and government entities for recreational use and for alternate transportation purposes without posing a threat to DOE and NNSA mission support work at LANL or disrupting LANL operations.
- Maintain the security of LANL operations.
- Respect the wishes of local Pueblos to maintain access to traditional cultural properties by Pueblo members while also preventing unauthorized public access to adjacent Pueblo lands and other lands identified as both religious and culturally sensitive areas to Native American communities.
- Adapt trail use at LANL to changing conditions and situations in a responsive manner.
- Maintain the recreational functionality of DOE lands so that the land remains open to all members of the public for non-motorized recreation, in compliance with federal laws and LANL operational constraints.

3.0 TRAILS MANAGEMENT PROGRAM

The Trails Working Group met nine times in FY 2014. The Trails Working Group held its 100th meeting in August 2014. Typically, Trails Working Group attendees include subject-matter experts from LANL, representatives from Los Alamos County, nearby Pueblos, Bandelier National Monument, the Santa Fe National Forest, and interested local residents. Meetings provide an ongoing and in-depth forum for discussing and resolving trails mitigation issues that arise from active adaptive management. What follows are the highlights of the FY 2014 Trails Management Plan implementation at LANL.

3.1 Fixing and Protecting Trails

Trail repair and protection continued to focus primarily on the 4,000-acre tracts known as TAs 70 and 71 located between White Rock and Bandelier National Monument. This buffer area is easily accessed from Pajarito Acres and State Road 4, and has been used by the public for decades. The trailhead at Gate 9 that provides vehicular access from State Road 4 to an electrical substation was closed in FY 2014 because there are other more suitable trailheads nearby. Shortly thereafter the fence was cut in a number of places. Repairs were made to the fence and there has been no further damage or unauthorized entrance observed.

3.2 Public Information

In FY 2014, the Trails Management Program assigned names to all of the major trails in TAs 70 and 71, including those that had not previously had been named. Maps have been revised to reflect these changes. Signs were installed in the trailhead kiosks at TAs 70 and 71. These signs include QR (quick response) codes that can be scanned by smart phones to obtain trail maps and more detailed information about the trails and Trails Management Program. Enhanced outreach to local groups such as the Sierra Club and the Pajarito Environmental Education Center reinforced the need to contact the Trails Working Group when formal group tours are desired. A presentation about the Trails Management Program was made by LANS staff during a PEEC meeting in May 2014.

In order to provide more information to the public, the Trails Management Program updated the "Taking Care of Our Trails" website (http://www.lanl.gov/community-environment/environmental-stewardship/protection/trails/index.php) during FY 2014. The website states that continued access and use of LANL trails is contingent upon being good stewards of these federal lands. There are interactive map features and descriptions, and a revised pdf brochure *Trails Management at LANL*.

3.3 Cultural and Biological Resources Protection

In order to improve protection from damage by off-trail mountain bike use, the major thrust of cultural resources protection during FY 2014 were Trails Management Program efforts to enhance controls and increase public awareness about trails use in TAs 70 and 71. In the late spring of 2014, Pajarito Acres residents reported a new unapproved mountain bike trail near the intersection of the Lower Water Canyon and Ruin Mesa Trails. ENV-ES staff investigated and blocked off the trails and posted signs closing the area. A media campaign about responsible mountain bike use on LANL trails followed, and no further incidents have been reported.

During FY 2014, the Trails Working Group developed a TA70 and 71 Group Visits Policy. The DOE/NNSA Los Alamos Field Office asked LANS to assist in defining what such a policy might entail. The Field Office was responding in part to recent concerns expressed in correspondence from one of the neighboring Pueblos and a recent publicized group tour organized by a local environmental education organization. TAs 70 and 71 are adjacent to Pajarito Acres and accessible by the public from many trailheads along State Road 4. They are popular locales for hiking, biking, and equestrian activities. These DOE lands are not developed but they are designated in LANL planning documents as reserve/buffer and set aside for future experimental science. It is also deemed a "General Access Area" which allows public access. The area is replete with cultural resource sites that must be protected. The Trails Management Program has addressed these concerns during the past several years through a combination of improved signs and trailhead kiosks, access modifications, trail realignments, trail closures, and public outreach/education.

Trails Management Program staff also coordinated a site visit to the Anniversary Trail in March 2014 that provided more detailed information about cultural and historic resources to Los Alamos County's project team working on a new water supply line that would traverse this area. Sites will be avoided and protected once the project commences.

The LANL Habitat Management Plan provides a strategy for the protection of threatened and endangered species and their habitats on LANL property. The Mexican Spotted Owl (*Strix occidentalis lucida*) and Southwestern Willow Flycatcher (*Empidonax trailii extimus*) are federally listed threatened or endangered species and may occur in areas traversed by trails. Mexican Spotted Owl surveys began on March 1 and concluded mid-May. There were seasonal trail closures when these surveys were conducted. Most trails were reopened, but trails in areas where the surveys indicated owls were present remained closed until August 31. Reopening the Los Alamos Canyon Trail between State Road 4 and West Road was discussed, as was the possibility of including it in the Bandelier National Monument patrol area. Issues concerning Mexican Spotted Owl impacts in the Canyon, and polychlorinated biphenyl cleanup would need to be resolved before the area could open to the public. Some parts of Los Alamos Canyon are potential habitat for the Jemez Mountain Salamander (*Plethodon neomexicanus*), added to the federal list of threatened and endangered species in 2013.

During FY 2014, the Trails Working Group continued to review the problem of feral cattle in White Rock Canyon, which can be accessed by LANL hiking trails. This is a trails management issue for several reasons. The canyon is part of the White Rock Canyon Reserve, which is an inappropriate place for cattle. There are sensitive species present, and there is a potential for the cattle to damage habitat and cultural resources, and they threaten the safety of hikers. Cameras installed in FY 2013 on the Ancho Springs Trail showed wildlife including bear, cougar, bobcat, and also cattle. A report with recommendations for feral cattle removal options was submitted to the DOE/NNSA Los Alamos Field Office in FY 2013 and is pending further action.

3.4 Security and Safety

During FY 2014, the Trails Management Program continued to coordinate with Bandelier National Monument on patrols and law enforcement in TAs70/71. This has been facilitated by the revised Superintendent's Compendium and agreement between DOE/NNSA and the Park Service that allows enforcement pursuant to 36 Code of Federal Regulations on certain DOE lands at LANL. LANS cultural resources staff contacts Bandelier National Monument personnel when doing field work in the areas patrolled by National Park Service rangers. The Trails Working Group contacts LANS security on matters of unauthorized trails use and parking to access trails. The Trails Management Program also coordinated with the Los Alamos County Trails and Open Space Program on a variety of issues affecting both Los Alamos County and LANL/DOE, including trails maintenance, closures, and way-finding.

Clarification was issued after many inquiries regarding use of LANL trails for the hobby of geocaching. The Trails Management Program worked with Los Alamos County Trails and Open Space staff to contact local geocaching points of contact to inform them that these activities are not allowed on LANL property, and requested that existing geocaches be removed.

There were no trail closures at LANL resulting from rains or flooding in FY 2014. However, pedestrian, bike, and vehicular access to the Mortandad Bench Trail was restricted from July 25 to August 11 for security reasons. Trails Management Program staff helped LANS physical security to plan and coordinate this closure. The Mortandad Canyon Trail is closed indefinitely due to large scale remediation work taking place in the canyon.

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Appendix IV

Field Validation of Predicted Large Game Movement Corridors and Pinch Points at Los Alamos National Laboratory

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LA-UR-14-28639
November 2014

Field Validation of Predicted Large Game Movement Corridors and Pinch Points at Los Alamos National Laboratory

Los Alamos
NATIONAL LABORATORY
EST. 1943

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CONTENTS

ACRONYMS

ANOVA	analysis of variance
BRMP	Biological Resources Management Plan
DSA	Decision Support Application
ENV-ES	Environmental Protection Division – Environmental Stewardship Services
GIS	Geographic Information System
GPS	Global Positioning System
LANL	Los Alamos National Laboratory
MDA	Material Disposal Area
PIR	passive infrared
SD	standard deviation
TA	Technical Area
VHF	very high frequency

1.0 INTRODUCTION

Overall Purpose

In 2007, Los Alamos National Laboratory (LANL or the Laboratory) adopted a Biological Resources Management Plan (BRMP) that describes the Laboratory's goals, objectives, and strategies for managing biological resources (Hansen et al. 2007). One of the identified objectives is to maintain the ability of large game animals (including mule deer and Rocky Mountain elk) to migrate across LANL property. To achieve this objective, LANL is identifying locations of large game movement pathways across the landscape, and developing best management practices to maintain those pathways including recommendations to minimize the occurrence and severity of animal-vehicle accidents on LANL property.

Bennett (2006) modeled movement corridors for large game at LANL using Geographic Information System (GIS) analyses and Rocky Mountain elk telemetry data. By identifying large game movement corridors, LANL can better manage activities to facilitate wildlife movement to adjacent properties while minimizing adverse human–large game interactions. In preparation for this study, the movement corridor model was updated in 2011. Information from this study will feed into LANL management tools such as the Decision Support Application (DSA) spatial analysis tool and the Long-Term Strategy for Environmental Stewardship and Sustainability.

The overall purpose of this study was to test the real-world use of the locations identified as movement corridors and pinch points (areas of constricted movement around facilities and roads) by large game. We addressed this question in two ways: (1) a one-year camera study using detections of wildlife by trail cameras to compare use of pinch point areas to non-movement-corridor areas along Pajarito Road, and (2) an analysis of the location of animal-vehicle accidents relative to the predicted locations of large game movement corridors crossing Pajarito Road.

Specific Study Objectives:

- Test the animal movement model identification of movement corridors and pinch points for LANL.
- Compare accident locations to movement corridor and pinch point locations.
- Provide observations on seasonal animal use of the Pajarito Road area.

Previous Research on Rocky Mountain Elk and Mule Deer Habitat Use and Movements in the LANL Area

During the period of 1995 to 2003, several studies were conducted in the Los Alamos area on the survival, movements, and habitat use of Rocky Mountain elk using both very high frequency (VHF) and Global Positioning System (GPS) telemetry collars (Biggs et al. 1998, Wolf 2003, Bennett 2006, Biggs et al. 2010, Rupp and Rupp 2010, Hansen et al. 2012). In general, habitat selection studies documented that elk prefer grassland habitats (Biggs et al. 1998, Bennett 2006,

Biggs et al. 2010). Biggs et al. (2010) found that in some (but not all) seasons following the Cerro Grande fire, elk preferred areas that had been severely burned. Biggs et al. (1998) recorded most observations of elk on slopes of less than 20 degrees, and Bennett (2006) found that elk decreased their use of an area as the slope increased.

Biggs et al. (1998) documented 7 of 10 marked elk residing year-around on the Pajarito Plateau. Wolf (2003) found that elk wintering on LANL property remained primarily on LANL or at lower elevations in the Jemez District of the Santa Fe National Forest (in the American Springs area west of LANL) during non-winter months, while elk wintering on Bandelier National Monument property spent non-winter months at the Valles Caldera National Preserve or on the higher elevations of the Jemez District of the Santa Fe National Forest. Hansen et al. (2004), using spotlight survey data, documented elk on LANL property in both summer and winter, with a consistent increase each year of number of elk sighted per kilometer travelled in the summer during 2000 through 2003. Rupp and Rupp (2010) described elk in the Jemez as displaying "quasi-migratory" movements—seasonal home ranges were difficult to delineate but animals moved in response to the best resources available at the time. They observed an increase in movement activity in November and in April/May relative to other periods of the year.

Snow depth appears to be an important factor in elk movements in winter since 90 percent of all elk locations occurred in locations with snow depths of less than 8 centimeters (Rupp and Rupp 2010). Increased snowfall appears to push elk out of the higher elevations of the Jemez Mountains during wet winters. Increased numbers elk sightings in February during spotlight surveys on LANL property were correlated with higher levels of January snowfall (Hansen et al. 2004). Wolf (2003) found that the number of elk wintering on Bandelier National Monument was directly related to accumulated snow depths.

Less data is available for mule deer habitat use and movements. Hansen et al. (2012) documented extensive use of residential areas within the Los Alamos townsite by mule deer year-around, with deer crossing roads an average of two to seven times per day. Mule deer home ranges straddled highways as well as primary, secondary, and tertiary arterial roads. Bender et al. (2007) found that adult female mule deer in north-central New Mexico had annual survival rates ranging from 0.63 to 0.91 during 2002 through 2004. The most common cause of adult female mortality was starvation, and they estimated annual rates of population change ranging from -35 percent to +6 percent during this period. Given a lack of natural food sources, residential or commercial areas with irrigated landscaping and/or effluent outfalls are likely to be attractive to mule deer in a wildland-urban interface setting during periods with low precipitation.

Previous Research on Factors Influencing Animal-Vehicle Accidents in the LANL Area

Biggs et al. (2004) analyzed vehicle-accident data in the LANL area from 1990 through 1999 and examined landscape factors associated with accident sites. They found that locations that had a downward slope to the road and larger quantities of vegetation taller than 2 meters in height were more likely to be accident hotspots.

Hansen et al. (2012) found that deer vehicle-accident locations were only weakly correlated with the densities of recorded deer road crossings by telemetered deer. This was likely because accidents were rare on roads with low speed limits, while those roads were frequently crossed by deer.

Roadside visibility and speed limits apparently play as large or larger a role in animal-vehicle accident locations as the frequency of use of an area by large game. Frequency of animal-vehicle accidents in the Los Alamos region are significantly related to season and time of day, with the most accidents occurring during seasons of shorter day length, in the hours immediately following sunset (Biggs et al. 2004, Hansen et al. 2012). This represents the time of year when LANL's evening commuter traffic occurs after sunset; when there may be increased movement of large game animals during the breeding season; and when in some years large game animals may move onto the Pajarito Plateau from the Jemez Mountains in response to snowfall at higher elevations.

Elk Movement Model, Corridors, and Pinch Points

Bennett (2006) used GIS to integrate a habitat suitability model and a barrier model into a least-cost path model that predicts seasonal Rocky Mountain elk movement routes across the landscape. The habitat suitability model estimated how elk used resources within the study area by comparing elk locations from telemetry data to the availability of resources defined by random points within each home range. Biggs et al. (1998) defined five distinct seasons for elk as winter (November–February), spring (March–April), calving (May–June), summer (July–August), and fall (September–October). A predictive habitat suitability equation was developed through logistic regression for each season and a composite yearly equation was developed.

The barrier model was developed for features that act as physical barriers to elk movement such as buildings, fences (security and industrial), roads, steep slopes, and major water bodies. These features were weighted based on the amount of impedance they impose on elk movement. The habitat suitability model and the barrier model were combined to produce a cost surface. The cost surface represented a relative cost per cell for elk movement. Low cost cells (better habitat, fewer barriers) facilitate movement and high cost cells (less desirable habitat, more barriers) impede movement. The least-cost path movement model was developed within a raster environment with a grid cell resolution of 30 meter by 30 meter.

Elk movement corridors were defined using cost surfaces, source areas, and destination areas. Source and destination areas were identified from areas of frequent use by radio collared elk, with source areas being defined within LANL boundaries and destination areas in the neighboring properties of United States Forest Service, Bandelier National Monument, and Pueblo de San Ildefonso lands. Bennett (2006) defined movement corridors as 1,000-feet-wide least-cost pathways from source to destination areas.

For this study, Bennett updated her large game movement model in 2011–2012 by updating the barrier model with new LANL roads, facilities, and fences. After the barrier model was updated, a new cost surface was generated. Bennett also identified three areas along Pajarito

Road on LANL property as possible "pinch points." Pinch points are sections of a movement corridor that are constricted due to topographical features or other physical barriers including fences and buildings. Pinch points were identified in movement corridors crossing Pajarito Road where the corridor was constricted or funneled along a steep canyon or drainage and was further constricted by buildings or security fences along the road.

2.0 STUDY AREA

Los Alamos is located in northern New Mexico, about 35 miles northwest of Santa Fe (Figure 1). LANL facilities can be found in 50 different work areas (called technical areas) that are spread across 36 square miles of the Pajarito Plateau. Pajarito Road is one of three major roads traversing southeast to northwest through the Laboratory. The technical areas along Pajarito Road house a significant portion of LANL's nuclear operations. Existing and planned projects include construction of a new Transuranic Waste Facility, the Material Disposal Area C (MDA-C) closure, and the Material Disposal Area G (MDA-G) closure. Prior to April 2004, Pajarito Road was open to public access. Since that time, access to Pajarito Road has been limited to LANL badgeholders. Pajarito Road, at its intersection with New Mexico State Road 4, had 4,984 average daily vehicle trips in 2004 (DOE/NNSA 2008).

The elevation along Pajarito Road ranges from 6,521 feet to 7,420 feet. The habitat within the general area varies from ponderosa pine on the mesa tops within the higher elevations to piñon-juniper woodlands at the lower elevation. There are open field areas on some mesa tops, and areas of wetlands and riparian habitats at the bottom of Pajarito Canyon. Two-mile Canyon lies to the south of Pajarito Road in the upper (western) part of the Corridor. Pajarito Canyon lies to the south in the central portion of Pajarito Road. In the lower (eastern) portion of Pajarito Road, the road lies in the bottom of Pajarito Canyon. Mortandad Canyon lies to north of Pajarito Road in the upper portion, and Cañada del Buey lies to the north in the lower portion.

Concerns have been raised by the Pueblo de San Ildefonso that LANL operations have created barriers or altered elk movements in such a way that fewer elk are crossing onto tribal property. Pueblo de San Ildefonso property extends west of New Mexico State Road 4 approximately ½ to 1 mile north of Pajarito Road along the eastern half of the road, north of Cañada del Buey. Bennett's movement model (Figure 2) shows four potential large game movement corridors from LANL to the Pueblo de San Ildefonso property. Of these, two require large game animals to cross Pajarito Road, and an additional corridor is optionally accessed by crossing Pajarito Road.

Model results have identified several large game movement corridors crossing Pajarito Road and three pinch points along the road (Figure 2). The westernmost pinch point is located to the east of Technical Area (TA) 59, in a small drainage area. The next pinch point occurs mainly on the south side of Pajarito Road in TAs 55, 50, 63, and 66. The easternmost pinch point occurs near TA-18 and TA-54 on the south side of Pajarito Road in TA-51.

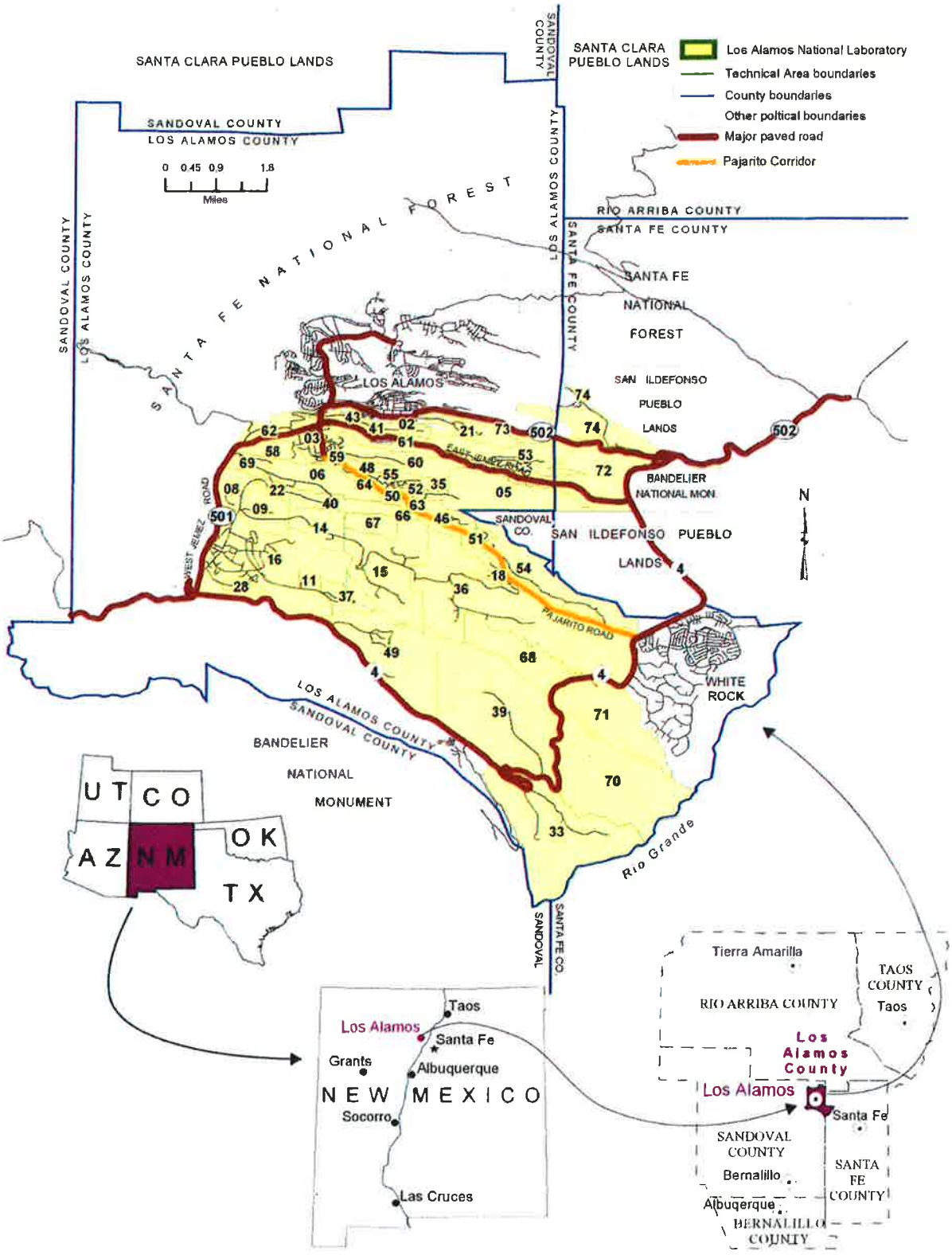

Figure 1. Los Alamos National Laboratory, New Mexico, with Pajarito Road shown in orange.

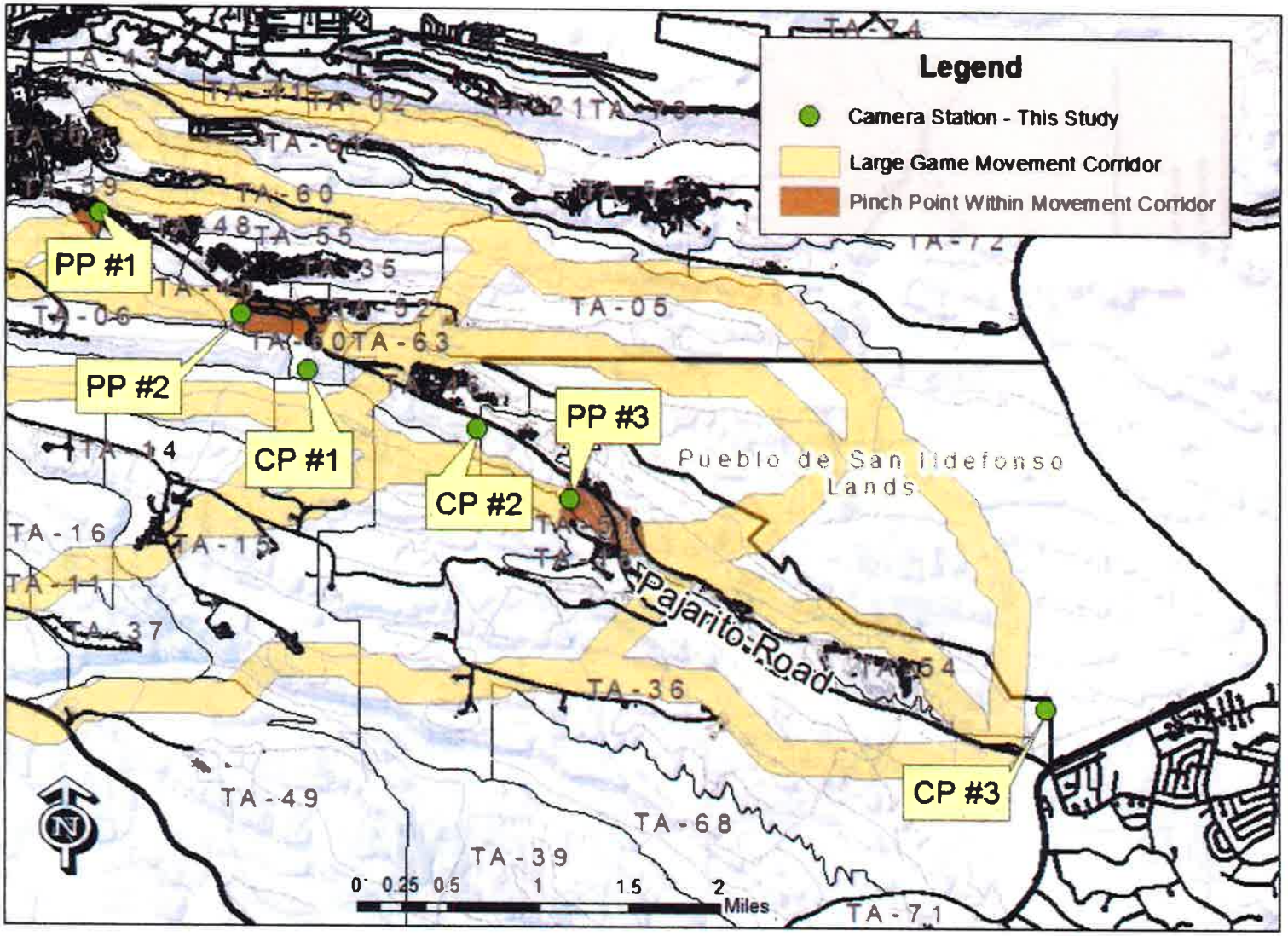

Figure 2. Locations of camera stations along Pajarito Road at Los Alamos National Laboratory. Green marks pinch point (PP) and non-movement-corridor (CP) camera station locations in this study. For display purposes, map shows movement corridors wider than 1,000 feet.

3.0 METHODS

Camera Stations

We used Bushnell® Trophy Cam digital trail cameras to establish six camera stations adjacent to Pajarito Road. These trail cameras are triggered by movement and infrared heat to record photos of passing wildlife. Stations consisted of two cameras mounted directly or indirectly opposing one another. A camera station was placed in each of the three pinch points in areas that had evidence of wildlife use. Three additional camera stations were placed in non-movement-corridor areas as controls. The control camera stations were placed outside of movement corridors but in areas where wildlife encounters were possible (for example, areas potentially used by wildlife for foraging). Figure 2 shows the location of pinch point and control point camera stations.

Figure 3. Picture of wildlife camera installed with t-posts.

Cameras were secured in a protective case with a LANL-issued lock, and secured either to a tree or t-post with a MasterLock® python cable. In some locations t-posts were used to mount the cameras and in other locations trees were used. T-posts were only used in areas where trees suitable for mounting cameras did not exist (Figure 3). Locking the cameras minimized the possibility of camera or memory card theft.

To ensure the cameras would not take photos of any classified actions or property, the camera locations were not placed within any security area and the fields of view of the cameras were not in line of sight of any secured area or activity. In addition, all images were initially screened in the field while downloading images. Any image that had questionable content was deleted. The images were also reviewed and cataloged while uploading to a LANL computer and stored in a database.

The cameras were deployed at the six selected sites in early April 2011. A period of about six weeks was used to test the cameras' operation. At the beginning of the testing period, two cameras were placed at each station and mounted roughly 30 to 50 feet from each other with the camera's field of view facing the other camera. This configuration had mixed results. Many false positive images were obtained. False positive images are images that do not include wildlife

species and usually are caused by wind, rain/snow, insects, or birds landing on vegetation. In most cases, camera configuration was changed so that one camera's field of view would capture images of wildlife moving toward it and the other camera would capture images of the same wildlife moving away from it. Better results were obtained with fewer false positive images.

During the testing period, cameras were checked daily to assess for proper positioning and determine sensor sensitivity settings. Strong winds proved to be a challenge for the camera placement. Branches of trees and shrubs were trimmed, and the cameras were set on the low sensor setting to minimize photos of moving vegetation from high winds. As the spring winds decreased, the cameras were set to the normal sensor setting. During the testing period, cameras were placed at different heights depending on the terrain. Originally, a set height of 1.5 meters from the ground surface was used to mount the cameras. However, terrain within the field of view affected what was visible in the photo. Therefore, camera mounting height was then adjusted based on the surrounding terrain to maximize the field of view of each camera. Even though camera mounting heights differed among the cameras, the field of view was consistent. Camera mounting height was between 3.5 and 4.5 feet for all cameras. Each image showed ground to skyline.

The camera study was officially begun on May 12, 2011, and ended on May 11, 2012. The settings used are in Table 1 (Bushnell Outdoor Technology 2009). Cameras were set to place a date and time stamp on each image as well as the moon phase and the ambient temperature. Cameras were checked weekly. When checking cameras, the status of each camera was recorded in a field log book referenced by the 3-digit property number. The camera's memory card was replaced with a blank card. All memory cards were numbered. The memory card number was recorded for each camera in the field log. Battery life of the camera was checked. Batteries were replaced when battery power was low. The camera settings were verified and the camera was placed back into operation. All details of the camera check were recorded in the field log book by date.

Table 1. Bushnell Trophy Camera Settings

Mode	Camera
Image Size	5M Pixel
Capture Number	3 (selects how many photos are taken in sequence per trigger)
Interval	1 second (selects the length of time that the camera will "wait" until it responds to any additional triggers from the passive infrared (PIR) sensor after an animal is first detected and remains within the sensor's range)
Sensor Level	normal (selects the sensitivity of the PIR sensor. The "High" setting will make the camera more sensitive to infrared (heat) and more easily triggered by motion, and the "Low" setting makes it less sensitive to heat and motion.
Time Stamp	On (select "On" if you want the date and time (that the photo was captured) imprinted on every photo.

Memory cards collected from the cameras were downloaded to a computer and images were stored on an Environmental Protection Division – Environmental Stewardship Services Group (ENV-ES) server. Two persons reviewed each image for the presence of wildlife. Any image that was questionable was further reviewed by additional personnel. The image information was entered in to the BRMP database. Information included date and time of the image, wildlife species, number of animals, sex of the animal (when detectable), and camera station. Only distinct observations were recorded in the database. For example, if a camera took seven images of the same animal, only one record was entered into the database, but all of the images were retained and related to this single record. Time stamps were compared between cameras at the same station to reduce the possibility of double-counting an observation.

Night images required careful attention. In many images, only an eye shine was visible. If an eye shine was detected but nothing else could be distinguished in the image, then the image was enhanced using image-processing software such as Microsoft Office Picture Manager. By adjusting the brightness and contrast, the image of the wildlife was sometimes clearer. In these cases where the image was dark, animal identification was based on animal size, body shape, and, if multiple time series pictures existed, by animal movement.

Accident Locations

We expanded the accident database described in (Biggs et al. 2004) to include accidents from 2000 through 2011. Additional records from the Los Alamos Police Department, the LANL security force, and personal and newspaper reports of animal-vehicle accidents were added to the database of animal-vehicle accidents in Los Alamos County. Where available, we recorded the species involved, the location, date, and time of the accident, cost estimates of damage to vehicles, injuries to humans, and injuries to animals. Accident locations were recorded into the GIS.

Analyses

We began the study with the following testable hypotheses.

- Do animals use pinch point areas more than control areas?
- Are accident locations associated with modeled pinch point locations?
- Are there significant seasonal differences in animal occurrence?

An animal detection was defined as each distinct observation of one or more animals of a particular species. If multiple pictures were taken of an animal or a group of animals that could be identified over time (for example, if an animal laid down within range of a camera), all photographs taken of that animal or group within a 2-hour period were counted as one detection. We calculated the weekly rate of detections of each species photographed per camera station. We also recorded group size for each detection. We tested for normality in the weekly rate data using a Shapiro-Wilks test and a Normal Quantile-Quantile plot. We used a one-sided

Student's t-test to test the hypothesis that detection rates were higher at pinch points than at control points during the period of the study.

We used GIS to examine the occurrence of animal-vehicle accidents within pinch points, within movement corridors crossing Pajarito Road not containing pinch points, and in non-corridor road stretches. We tested the null hypothesis that accidents occurred at proportionally the same frequency in pinch point areas, non-pinch-point movement corridors, and non-corridor locations along Pajarito Road with a Pearson's Chi-Squared goodness-of-fit test.

4.0 RESULTS

Detections of Species at Camera Stations

We recorded nine different species at the camera stations along Pajarito Road. There were a total of 520 detections at the six camera stations, including eight where the species could not be identified. Three species had over 100 detections each: mule deer (*Odocoileus hemionus*; n = 181), Rocky Mountain elk (*Cervus canadensis*; n = 161), and coyotes (*Canis latrans*; n = 139). All other species occurred ≤10 times, including mountain lion (*Felis concolor*), bobcat (*Lynx rufus*), striped skunk (*Mephitis mephitis*), raccoon (*Procyon lotor*), gray fox (*Urocyon cinereoargenteus*), and black bear (*Ursus americanus*).

The only species that had a significant difference in weekly detection rates between pinch point stations and control stations was coyote (p = 0.041; Table 2). Coyotes were detected over three times as often at pinch points as at control points. Although the total number of detections of other carnivores was relatively small, bobcats, raccoons, black bears, and grey foxes combined were also observed twice as often at pinch point stations than control stations. Detections of mule deer and elk were relatively evenly distributed between pinch points and control points.

Table 2. Weekly rate of detections for species detected at camera stations located at movement corridor pinch points and at control sites along Pajarito Road, Los Alamos National Laboratory, New Mexico, between 12 May 2011 and 11 May 2012. "Other Carnivores" included black bear, bobcat, raccoon, gray fox, mountain lion, and striped skunk.

Species	Weekly Detection Rates (SD)		P-Value
	Pinch Points (n = 3)	Control Points (n = 3)	
Mule deer	0.995 (1.084)	1.131 (0.543)	0.572
Elk	0.918 (0.514)	0.918 (0.621)	0.500
Coyote	1.047 (0.521)	0.31 (0.185)	0.041
Other Carnivores	0.207 (0.136)	0.103 (0.129)	0.197

During the period of 27 June 2011 through 8 July 2011, LANL was closed due to the Las Conchas wildfire. The town of Los Alamos was also evacuated for part of this period. Because we continued operating camera stations past the official end date of this study, we had data from 2012 for this same time period. We compared detection rates between 2011 and 2012 to see if the Laboratory closure and/or the large wildfire occurring to the west of LANL property affected animal movements along Pajarito Road. The data set was too small for statistical testing, but there was no suggestion that detection rates were substantially different in 2012 versus 2011 (Table 3).

Table 3. Number of detections and total number of animals counted for elk, mule deer, coyotes, and other carnivores between 27 June and 8 July in 2011 and 2012.

Species	Number of Detections		Total Number of Animals Counted	
	2011	2012	2011	2012
Elk	8	10	30	16
Mule Deer	7	8	12	13
Coyote	2	6	2	6
Other Carnivores	2	3	2	3

For coyotes, mule deer, and elk, we tested for changes in detection rates among seasons. For mule deer and elk, we also tested for changes in average group size among seasons. Since there were no significant differences in detection rates between pinch point stations and control stations for mule deer and elk, we pooled all station data for seasonal analyses of these species. Seasonal data were not always normally distributed, so we used a nonparametric analysis of variance (ANOVA) (Kruskal-Wallis test) for analyses of coyote and deer seasonal data, and a parametric ANOVA for analysis of elk seasonal data. Group size data were also not normally distributed, so we used a nonparametric ANOVA (Kruskal-Wallis test) for analyses of elk and deer group sizes.

There was no evidence of seasonal differences in detections of coyotes at the pinch point stations (K-W statistic = 3.167, $p = 0.53$, dof = 4; Figure 5) or control stations (K-W statistic = 7.698, dof = 4, $p = 0.103$). Seasonal detections of elk were not significantly different at the $\alpha = 0.05$ level ($F = 2.555$, $p = 0.0638$), although detection rates were at least twice as high in the winter, calving, and summer seasons relative to the spring and fall seasons. Detections of deer did not differ by season (Kruskal-Wallis statistic 4.034, dof = 4, $p = 0.401$). Both deer and elk showed evidence of group sizes varying by season, although elk differences were not significant at the $\alpha = 0.05$ level (deer, Kruskal-Wallis statistic = 9.963, dof = 4, $p = 0.0411$; elk, Kruskal-Wallis statistic = 7.986, dof = 4, $p = 0.0921$; Figure 6).

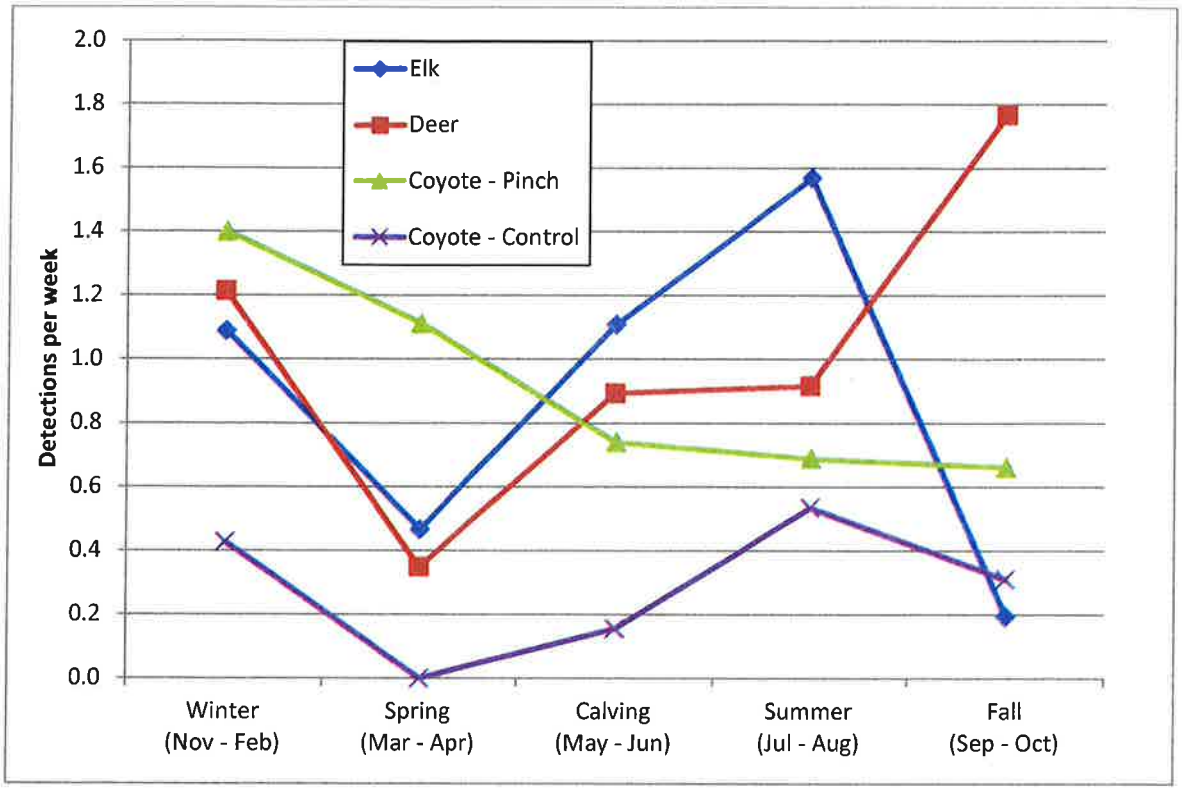

Figure 5. Seasonal detection rates for mule deer, Rocky Mountain elk, and coyote at camera stations along Pajarito Road, Los Alamos National Laboratory, New Mexico, May 2011–May 2012.

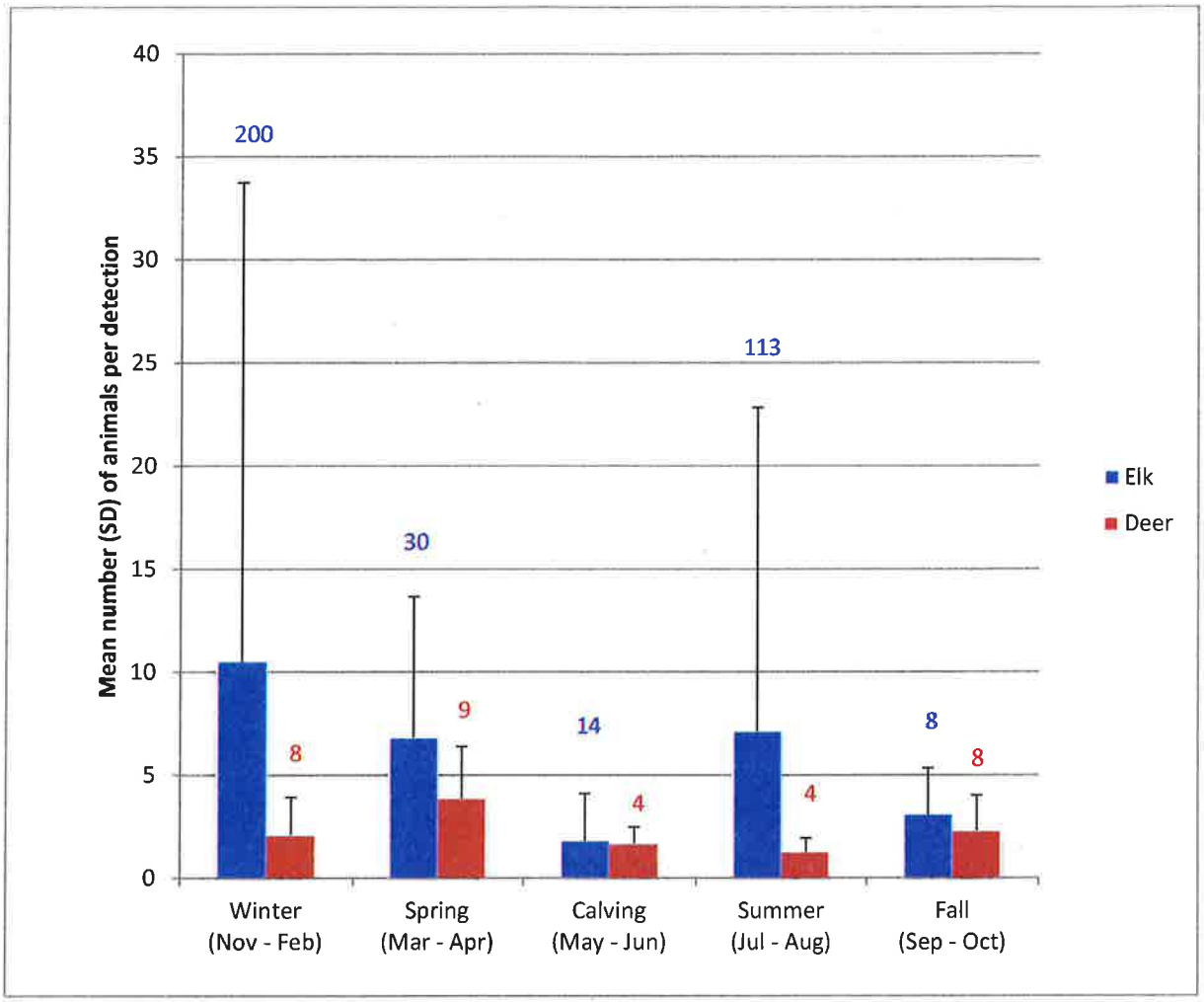

Figure 6. Mean seasonal group sizes of elk and deer detected at camera stations along Pajarito Road, Los Alamos National Laboratory, New Mexico, May 2011–May 2012. Error bars represent the positive standard deviation, and the number above each bar represents the maximum group size recorded for that species in that season.

We photographed elk with young calves and deer with fawns (Figure 7), demonstrating that elk and deer are using the area near Pajarito Road for raising young. There were a total of 31 detections of elk and 37 detections of deer during the calving season along Pajarito Road (see charts of elk and deer occurrences during calving season versus other seasons, Appendix A). Use of the Pajarito Road area during calving season was common for both elk and deer.

Figure 7. **Photographs from camera stations of elk with nursing young (top) and mule deer with twin spotted fawns (bottom). Black arrows point at the fawns in the photograph.**

Animal-Vehicle Accidents

We analyzed the locations of 98 animal-vehicle accidents that occurred along Pajarito Road from 1990 through July 2011 (data was not available for 2003 and 2004). Animal-vehicle accidents in Los Alamos County most commonly involve mule deer, with elk as the second most commonly involved species (Biggs et al. 2004). For Pajarito Road, 70.3 percent of the road is not within an identified movement corridor. Pinch point locations cover 17.4 percent of Pajarito Road, and non-pinch-point corridors cover 12.3 percent of Pajarito Road.

Of the 98 accidents, 56 percent (55 accidents) occurred outside of any movement corridor, 30 percent (29 accidents) occurred within pinch points, and 14 percent (14 accidents) occurred within non-pinch-point movement corridors (Figure 8). A Pearson's chi-squared goodness of fit test found that the distribution of accidents along Pajarito Road was not random with respect to movement corridors ($\chi^2 = 11.49$, $p = 0.0032$). There were more accidents than expected associated with pinch points, and fewer accidents than expected associated with non-movement-corridor locations.

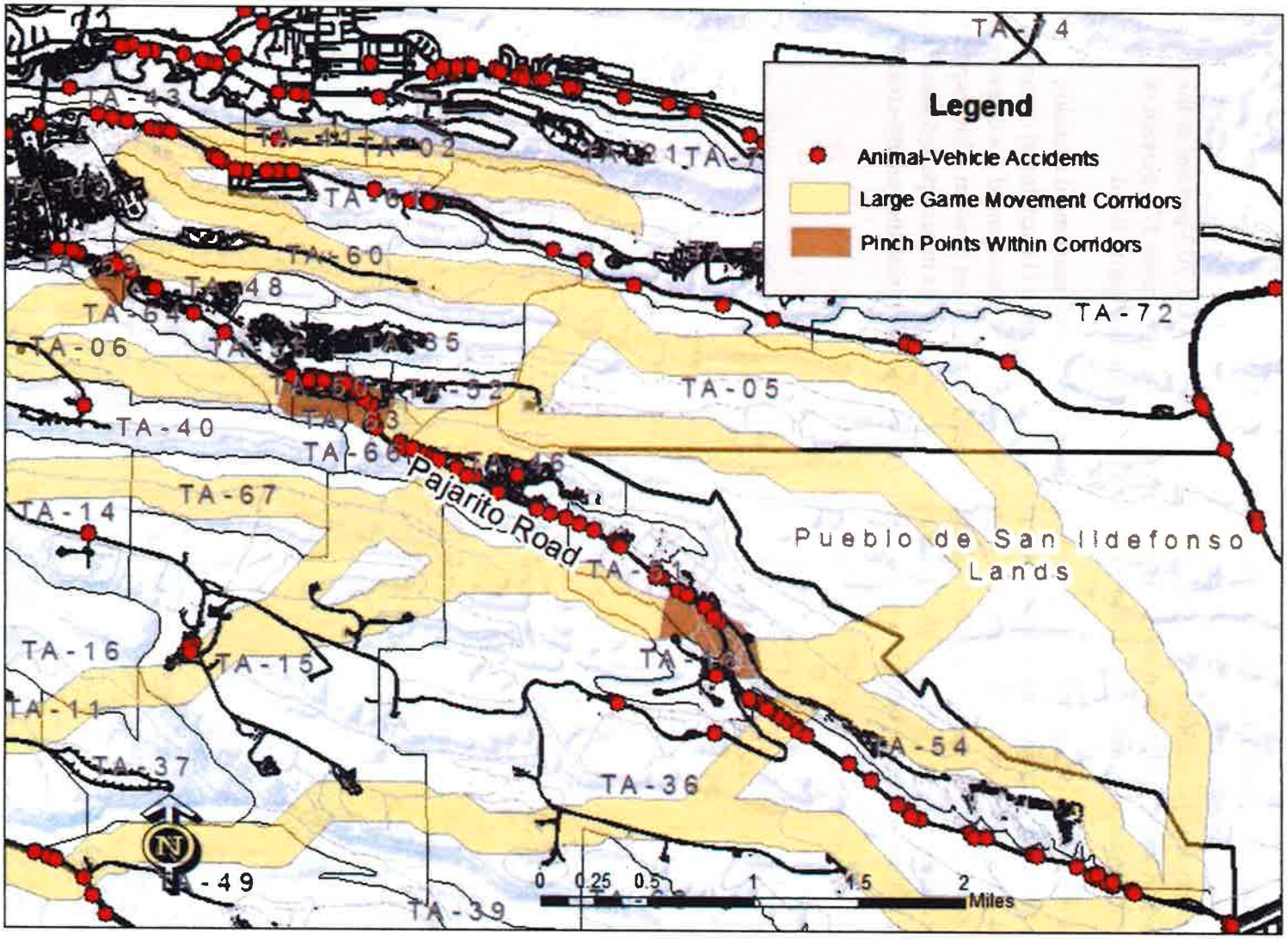

Figure 8. **Map showing locations of animal-vehicle accidents along Pajarito Road from 1990 through 2011 in relation to predicted large game movement corridors.**

Photo Station near the LANL-Pueblo de San Ildefonso Boundary

We compared the annual detection rates of animals at the Pajarito Road Control Point #3 (CP #3), which was located north of Pajarito Road near the Pueblo de San Ildefonso boundary, but outside of a movement corridor, to the detection rates measured at our other camera stations (see Figure 2) between May 2011 and May 2012 (Table 4).

Table 4. Average weekly detection rates of animals at pinch point camera stations, control point camera stations 1 and 2, and detection rates at control point camera station 3 at Los Alamos National Laboratory, New Mexico, between 12 May 2011 and 11 May 2012. Control Point Station #3 was located near the LANL-Pueblo de San Ildefonso boundary.

Species	Weekly Detection Rates (SD)		
	Pinch Points (n=3)	Control Point Station #1 and #2	Control Point Station #3
Mule deer	0.995 (1.084)	1.144 (0.768)	1.108
Elk	0.918 (0.514)	1.173 (0.617)	0.407
Coyote	1.047 (0.521)	0.417 (0.014)	0.097
Other Carnivores	0.207 (0.136)	0.136 (0.165)	0.039

Mule deer were detected at the camera station near the LANL-Pueblo de San Ildefonso boundary (CP #3) at about the same rate they occurred at all other Pajarito Road stations. Other species (elk, coyotes, and other carnivores) were detected less frequently at CP #3 than at other stations.

CP #3 is considerably east of the other photo stations, entirely in piñon-juniper habitat, and is not adjacent to a deep canyon, unlike the other photo stations. Our results suggest that this location may be less attractive to elk and carnivores than other areas adjacent to Pajarito Road further west. However, the detections of elk and deer here suggest that large game are not excluded from this area by LANL operations.

Discussion

In this study, corridor pinch points did not predict the locations where we would observe more deer or elk when compared to non-pinch point areas. Our camera stations were set up near, but out of sight of, Pajarito Road. Pinch points were developed from portions of movement corridors where the corridor was constricted or funneled. The movement corridors in this study were developed by predicting direct animal movement from a source area to a receiving area. The corridors take into consideration not only the cost of barriers and the suitability of habitat but also distance by assuming that with all other things being equal, lower impedance is given to the shortest distance. When a corridor hits an area where there is ample forage and resident animals, an animal using the corridor may elect to wander and forage rather than travel on a

direct route. In addition, there were several movement corridors along the Pajarito Road corridor that did not contain pinch points. These corridors were not tested for increased use.

Our photographic evidence suggests that at least some elk and deer were resident in the area. For most of its length, Pajarito Road is located either on a mesa top or in the bottom of a wide canyon, with flat or moderately sloped woodland habitat on either side of the road. Our results suggest that locally moving animals did not have a preference for the pinch point locations, and were using the entire habitat around Pajarito Road on a relatively equal basis.

The movement corridor modeling did take into account the relative cost of the corridor cells and surrounding non-corridor cells. However, the increased cost or impedance of non-corridor cells within the forage area along Pajarito Road was small compared to the impedance values within the movement corridor. Instead of applying a constant distance buffer (1,000 feet) to the corridor, a threshold impedance could be applied to include areas into the corridor that cross forage areas where impedance only increases as a factor of distance. Segments of the corridor can have similar cost to adjacent areas especially if there are wide areas of foraging habitat such as seen adjacent to Pajarito Road.

Despite the lack of observed preference for pinch points by elk and deer along Pajarito Road, the evidence suggests that the pinch points do have value in predicting animal movements. Pinch points located on Pajarito Road had more animal-vehicle accidents than expected by chance. Coyotes and other carnivores were more likely to be detected at pinch point locations than at non-movement corridor locations. Possibly animals that are climbing in and out of the canyons on either side of Pajarito Road have a greater probability of being detected in the movement corridor locations.

The camera study results demonstrated that large game animals are present in the Pajarito Road area year-round, that elk and deer are calving or fawning and raising young in the area, and that large game and carnivores apparently move freely around and along Pajarito Road. We did not find any evidence suggesting that the presence of LANL-related roads or facilities is preventing the movement of large game from LANL property onto Pueblo de San Ildefonso property.

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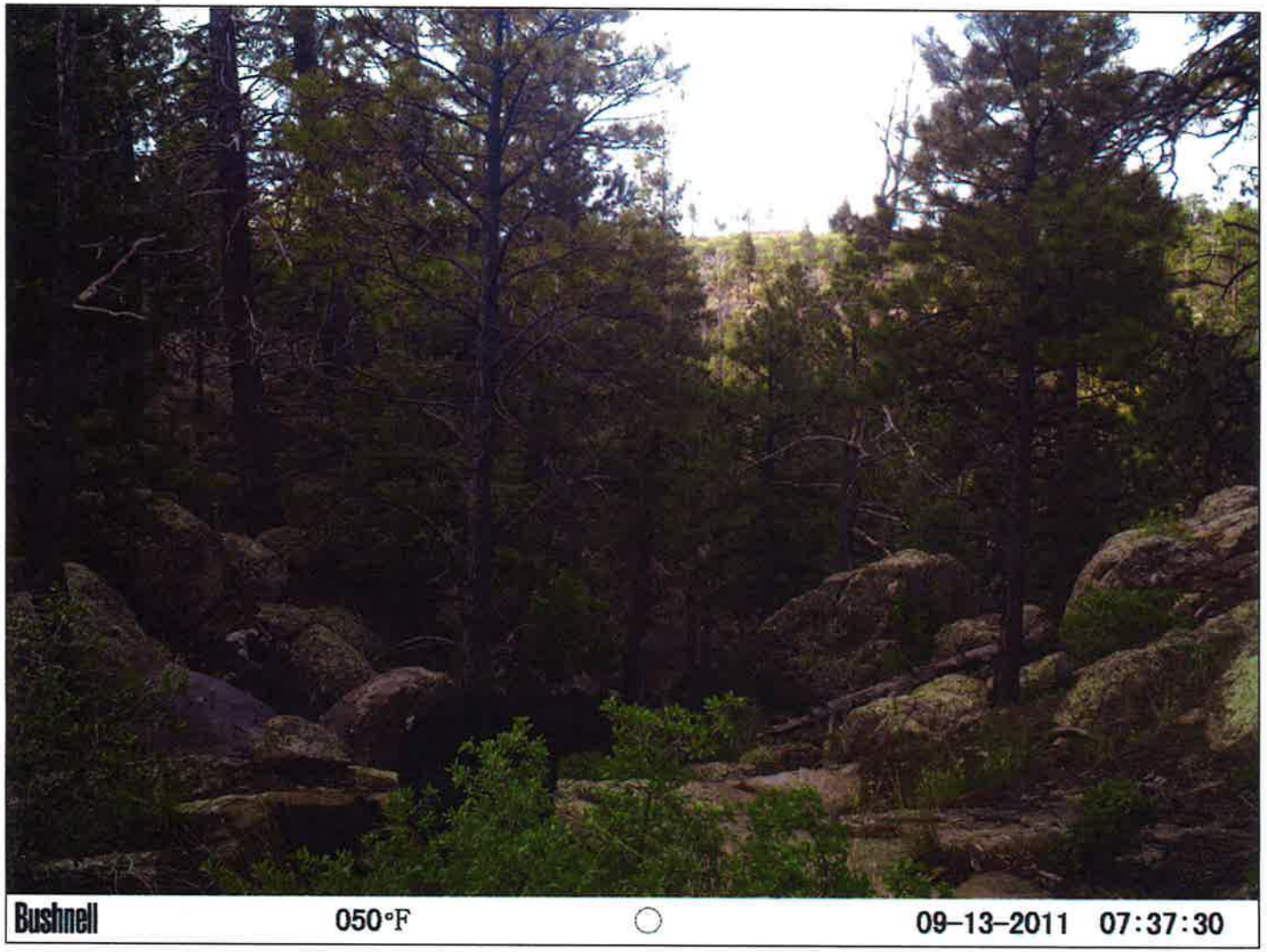
Appendix A: Supplemental Data. Number of detections of elk and deer by season at pinch point camera stations and control camera stations.

Total Number of Occurrences by Site/Season and Species

Seasonal	CALA	CEEL	FECO	LYRU	MEME	ODHE	PRLO	UNKNOWN	URAM	URCI
Spring CP1	0	4	0	0	0	1	0	0	0	0
Spring CP2	0	3	0	0	0	2	0	0	0	0
Spring CP3	0	0	0	0	0	2	0	0	0	0
Spring PP1	16	3	0	0	0	1	0	0	0	0
Spring PP2	13	0	0	0	0	1	1	0	0	0
Spring PP3	1	0	0	0	0	6	0	0	0	0
Total Spring	30	10	0	0	0	13	1	0	0	0
Calving CP1	3	13	1	0	0	0	0	0	0	0
Calving CP2	0	2	0	0	0	5	0	0	0	0
Calving CP3	0	0	0	0	0	8	0	0	0	0
Calving PP1	10	6	0	0	1	15	1	0	1	2
Calving PP2	6	2	0	0	0	1	0	0	0	0
Calving PP3	1	8	0	0	0	8	0	0	0	0
Total Calving	20	31	1	0	1	37	1	0	1	2
Summer CP1	0	13	0	0	0	4	0	0	0	0
Summer CP2	0	0	0	0	0	1	0	0	0	0
Summer CP3	1	1	0	1	0	9	0	2	0	0
Summer PP1	2	13	0	0	0	2	1	0	1	0
Summer PP2	7	20	0	0	0	0	0	1	1	0
Summer PP3	4	6	0	0	0	10	0	0	1	0
Total Summer	14	53	0	1	0	26	1	3	3	0
Fall CP1	0	1	0	0	0	2	0	0	0	0
Fall CP2	3	2	0	0	0	14	0	0	1	0
Fall CP3	0	2	0	1	0	21	0	2	0	0
Fall PP1	3	0	0	0	0	8	1	0	4	0
Fall PP2	3	0	1	0	0	0	1	0	0	0
Fall PP3	4	2	0	0	0	9	0	0	0	0
Total Fall	13	7	1	1	0	54	2	2	5	0
Winter CP1	5	13	1	0	0	4	0	1	0	0
Winter CP2	4	13	0	0	0	20	0	0	0	0
Winter CP3	1	12	0	0	0	2	0	1	0	0
Winter PP1	34	2	0	1	0	3	2	1	1	1
Winter PP2	18	0	0	3	0	2	0	0	0	0
Winter PP3	0	20	0	1	0	20	0	0	0	0
Total Winter	62	60	1	5	0	51	2	3	1	1
CP Total	17	79	2	2	0	95	0	6	1	0
PP Total	122	82	1	5	1	86	7	2	9	3

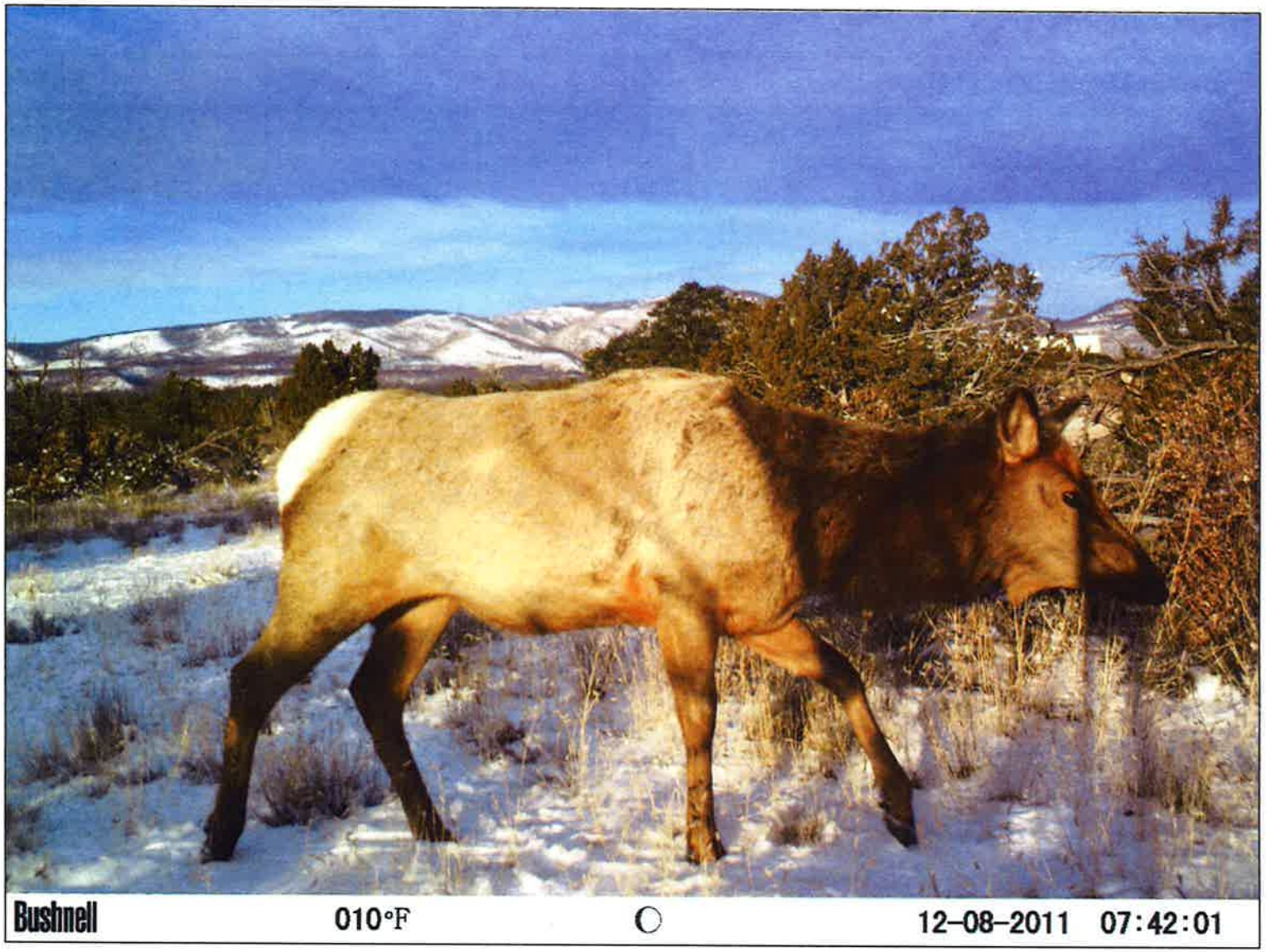
Appendix B: Photos from study camera stations



Pinch Point 1. Black bear

Control Point 2. Mule Deer Buck

Pinch Point 1. Bobcat



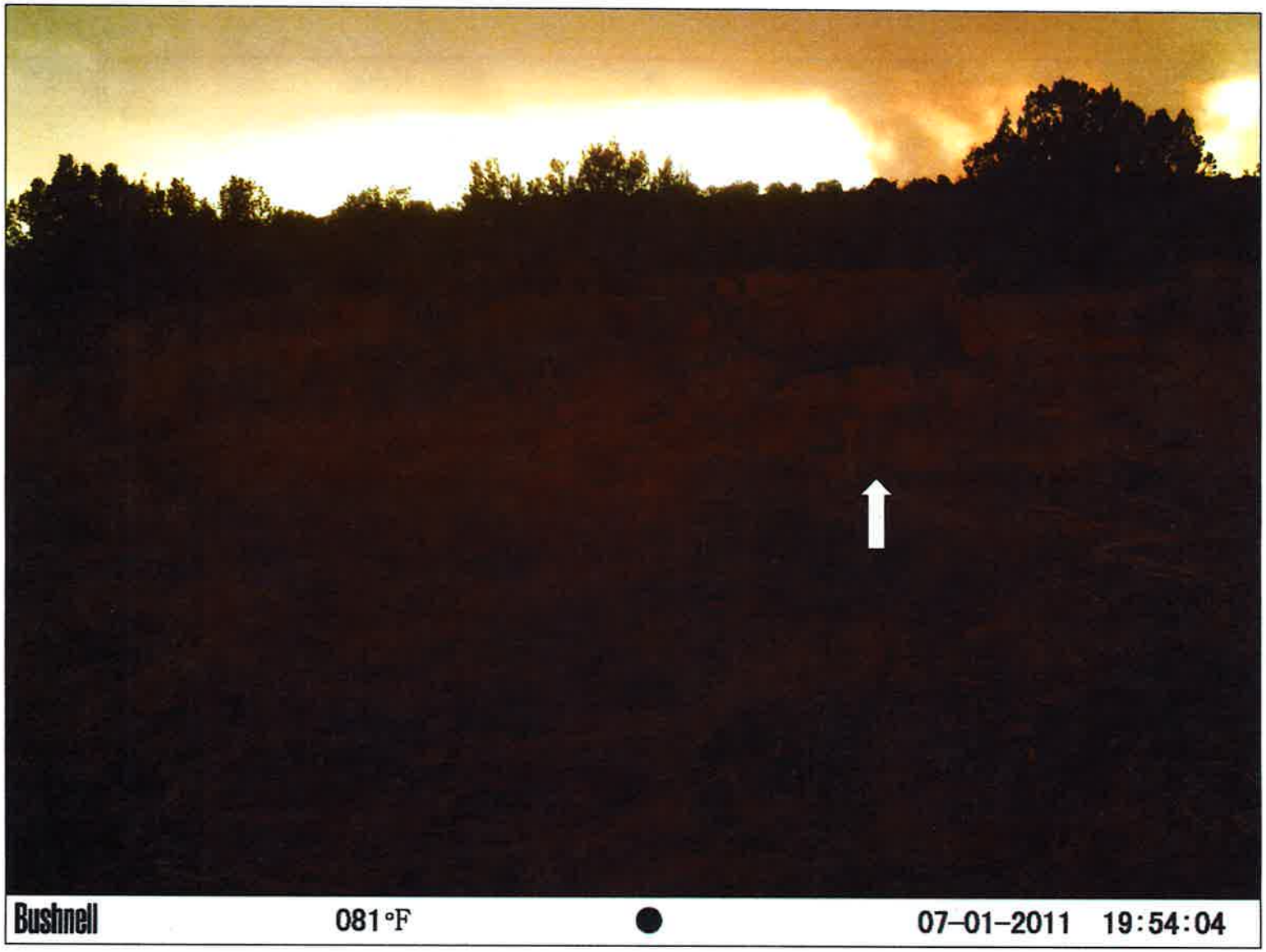
Control Point 1. Rocky Mountain Cow Elk

Control Point 1. Rocky Mountain Cow Elk

Control Point 1. Rocky Mountain Elk

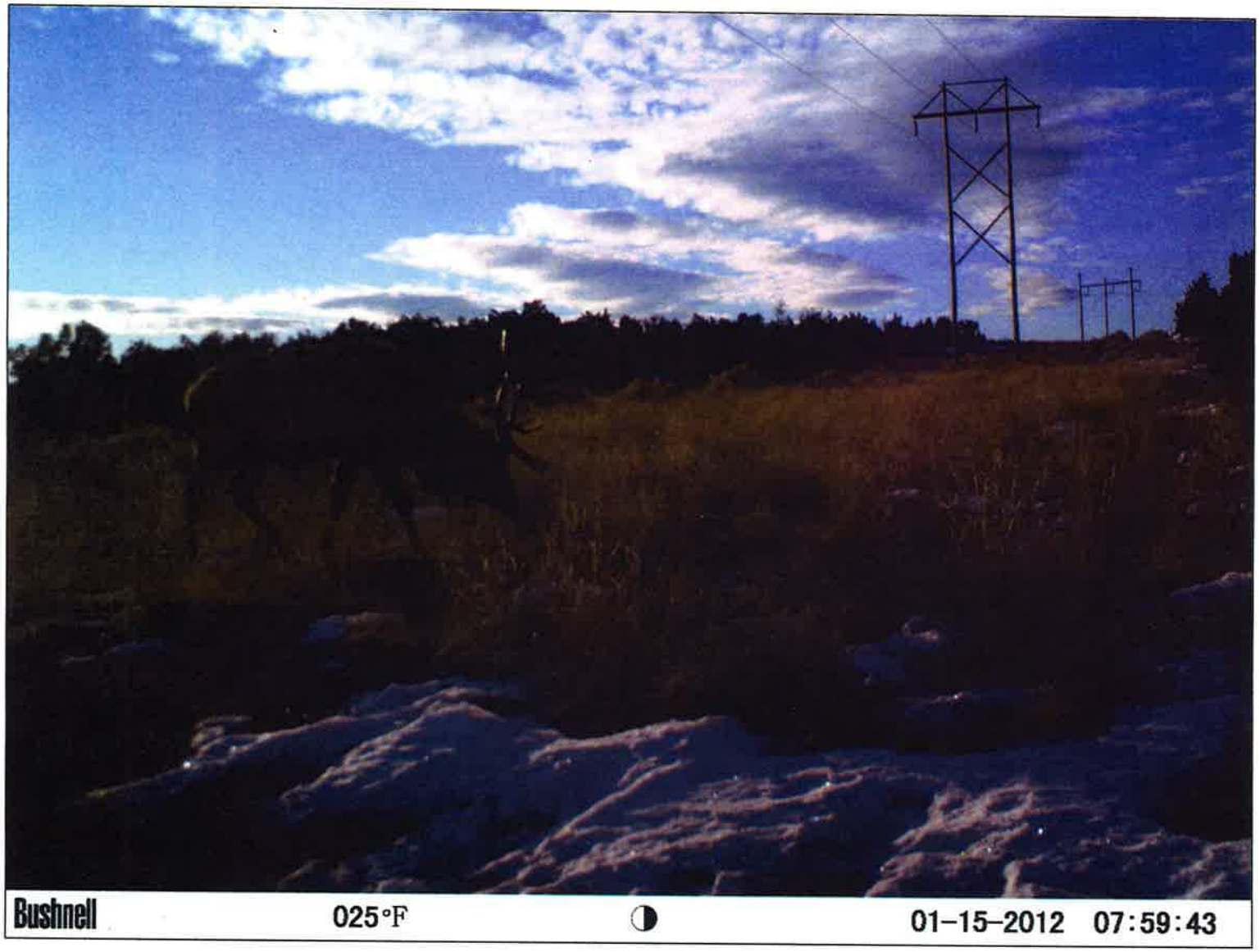
Pinch Point 1. Coyotes (Note: The time stamp malfunctioned on the camera for this period. This photo was taken in June of 2011.)

Control Point 2. Rocky Mountain Elk (Note: The time stamp malfunctioned on the camera for this period. This photo was taken in August of 2011.)

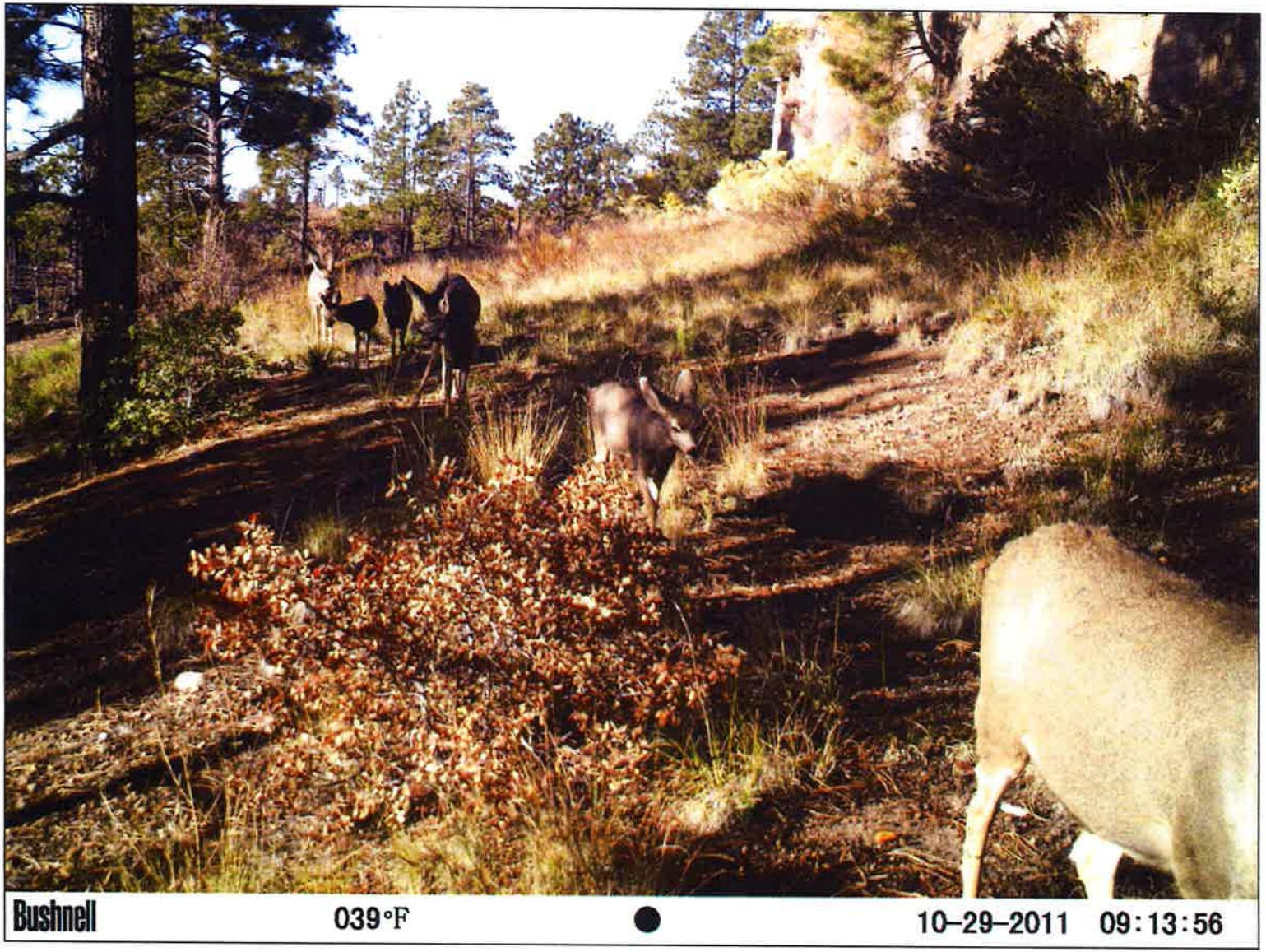


Control Point 3. A mule deer with the Las Conchas fire in the background

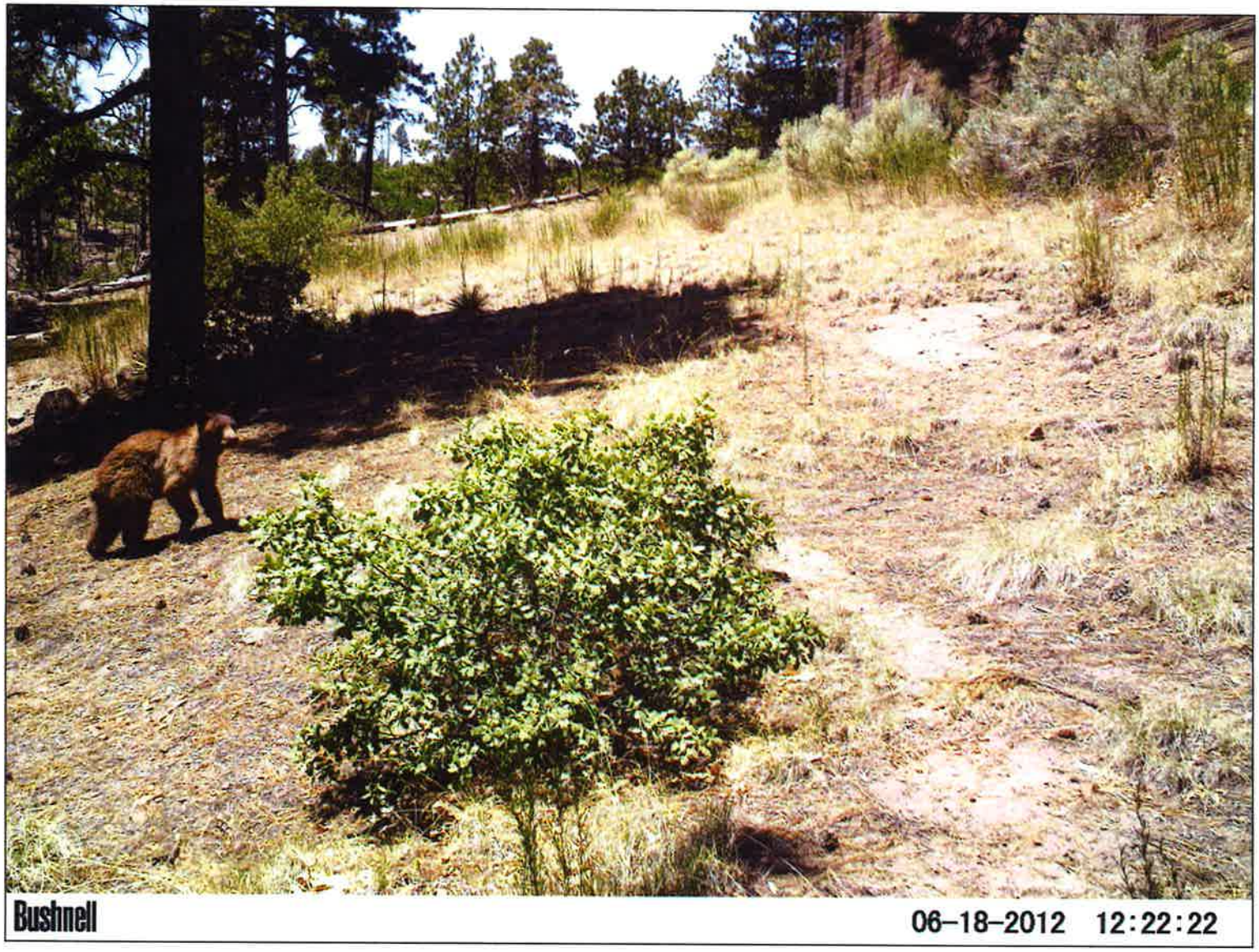
Control Point 2. Grey Fox



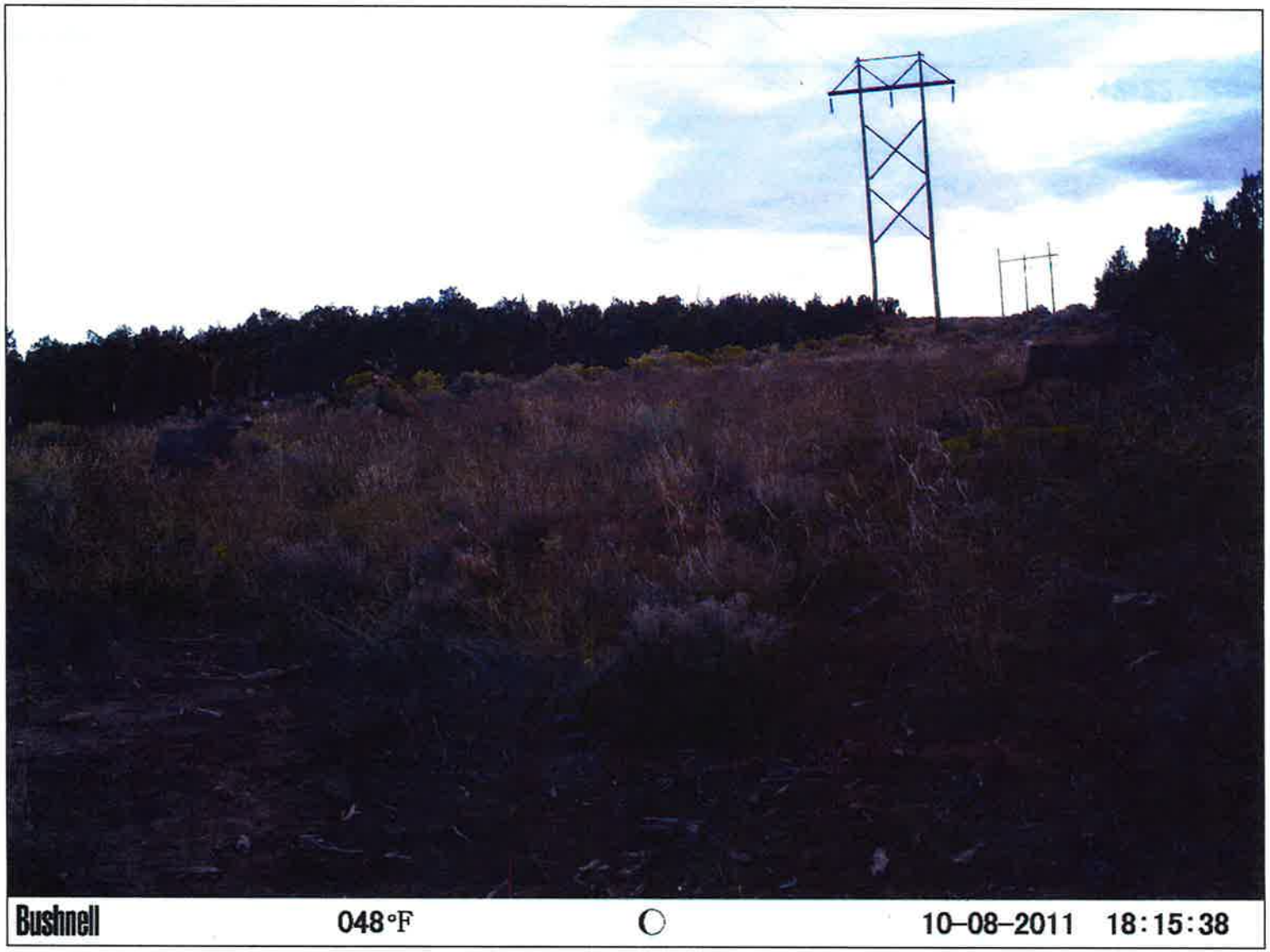
Control Point 3. Rocky Mountain Bull Elk



Pinch Point 1. Mule deer does and fawns



Pinch Point 1. Black Bear

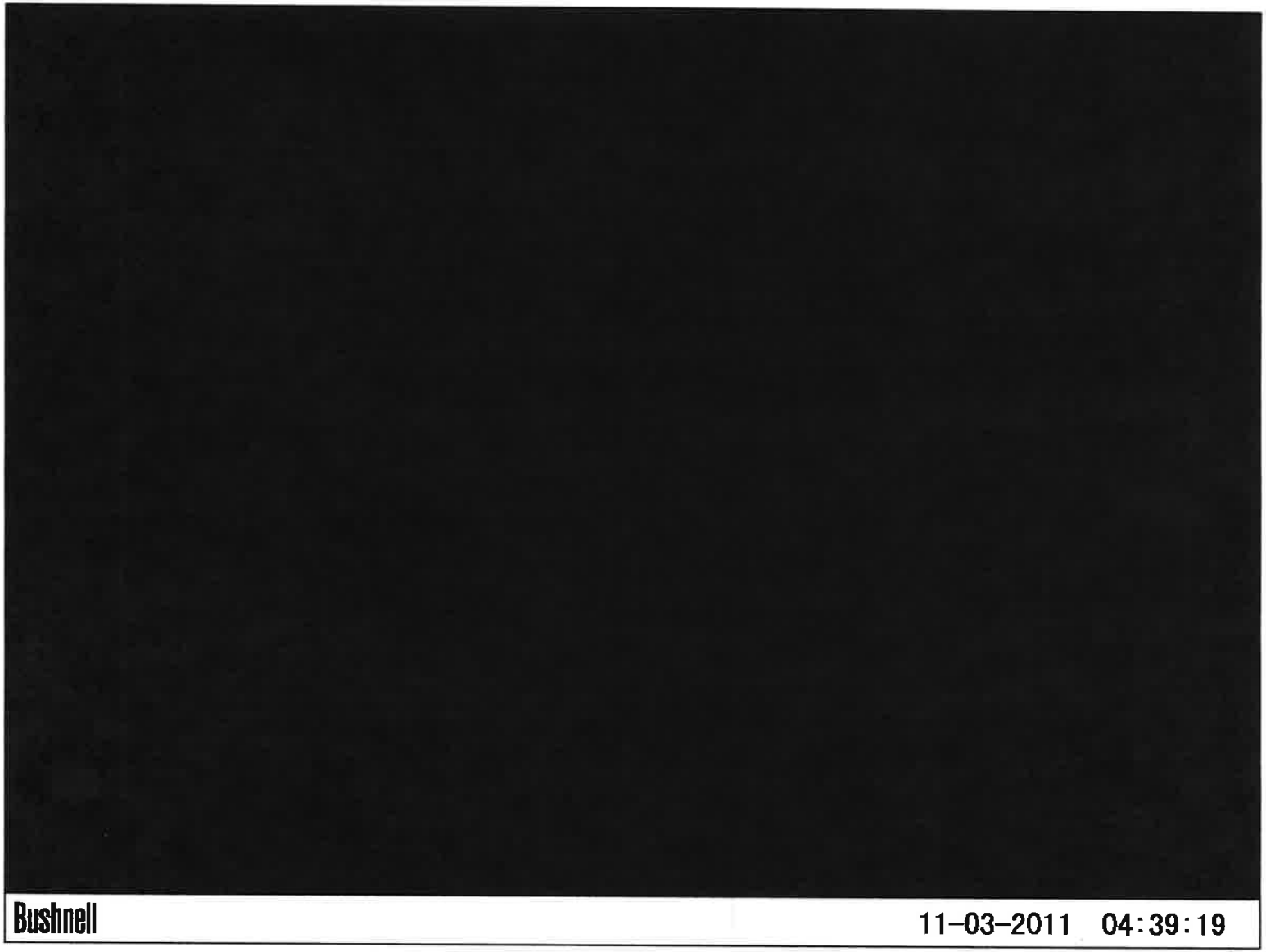


Control Point 3. Mule Deer Bucks

Control Point 3. Mule Deer Buck

Pinch Point 1. Rocky Mountain Elk, bull and calf

Pinch Point 1. Rocky Mountain Elk calf



Control Point 2. Mountain lions