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SANDIA NATIONAL LABORATORIES

ANNUAL SITE **ENVIRONMENTAL REPORT**

NEVADA

TONOPAH

KAUA'I

HAWAI'I

2019

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NNSA National Nuclear Security Administration

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U.S. Department of Energy, National Nuclear Security Administration,
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2019 Annual Site Environmental Report for Sandia National Laboratories, Tonopah Test Range, Nevada, and Kaua'i Test Facility, Hawai'i

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for
United States Department of Energy
National Nuclear Security Administration
Sandia Field Office

Abstract

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the United States Department of Energy (DOE) National Nuclear Security Administration. The National Nuclear Security Administration's Sandia Field Office administers the contract and oversees contractor operations at Sandia National Laboratories, Tonopah Test Range (SNL/TTR) in Nevada and Sandia National Laboratories, Kaua'i Test Facility (SNL/KTF) in Hawai'i. Activities at SNL/TTR are conducted in support of DOE weapons programs and have operated at the site since 1957. SNL/KTF has operated as a rocket preparation launching and tracking facility since 1962.

DOE and its management and operating contractor are committed to safeguarding the environment, assessing sustainability practices, and ensuring the validity and accuracy of the monitoring data presented in this *Annual Site Environmental Report*. This report summarizes the environmental protection, restoration, and monitoring programs in place at SNL/TTR and SNL/KTF during calendar year 2019. Environmental topics include air quality, ecology, environmental restoration, oil storage, site sustainability, terrestrial surveillance, waste management, water quality, and implementation of the National Environmental Policy Act. This report is prepared in accordance with and as required by DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*, and has been approved for public distribution.

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Note to the Reader

The Sandia National Laboratories, Tonopah Test Range and Sandia National Laboratories, Kauaʻi Test Facility *Annual Site Environmental Report* presents summary data regarding environmental performance and compliance with environmental standards and requirements. In addition, DOE views this document as a valuable tool for maintaining a dialogue with our community about the environmental health of these sites and the commitment to protect our valuable resources. We continually strive to improve the quality of the contents of this annual report and to include information that is important to you. Please provide feedback, comments, or questions to:

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The Sandia National Laboratories, Tonopah Test Range, Nevada, and Kauaʻi Test Facility, Hawaiʻi, *Annual Site Environmental Report* can be found at the following website:
http://www.sandia.gov/news/publications/environmental/index.html

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Acronyms and Abbreviations

Term	Definition
A	
AD	anno Domini
AEC	Atomic Energy Commission
B	
BP	before the present
C	
ca.	circa
CAU	Corrective Action Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
D	
DOD	United States Department of Defense
DOE	United States Department of Energy
DOECAP	DOE Consolidated Audit Program
DRI	Desert Research Institute
E	
EISA	Energy Independence and Security Act
EMS	Environmental Management System
EO	executive order
EPA	United States Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
EPCRA	Emergency Planning and Community-Right-to-Know Act
ES&H	Environment, Safety, and Health
ESA	Endangered Species Act
F	
FDID	Fire Department Identification
FY	fiscal year
I	
IOC	inorganic compound
ISO	International Organization for Standardization
K	
KTF	Kaua'i Test Facility
M	
MBTA	Migratory Bird Treaty Act
MDA	minimal detectable activity
MDC	minimum detectable concentration
MDL	method detection limit

Term	Definition
N	
N/A	not applicable
NAC	Nevada Administrative Code
NAFR	Nellis Air Force Range
ND	not detected
NDEP	Nevada Division of Environmental Protection
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NRS	Nevada Revised Statute
NTESS	National Technology & Engineering Solutions of Sandia, LLC
P	
PCB	polychlorinated biphenyl
pH	potential of hydrogen
PL	Public Law
PM_{10}	particulate matter that has a diameter equal to or less than 10 microns
PQL	practical quantitation limit
Pu	plutonium
R	
RCRA	Resource Conservation and Recovery Act
S	
Sandia	Sandia National Laboratories
SARA	Superfund Amendments and Reauthorization Act
SNL	Sandia National Laboratories
SNL/CA	Sandia National Laboratories, California
SNL/KTF	Sandia National Laboratories, Kaua'i Test Facility, Hawai'i
SNL/NM	Sandia National Laboratories, New Mexico
SNL/TTR	Sandia National Laboratories, Tonopah Test Range, Nevada
SOC	synthetic organic compound
ssp.	subspecies
T	
TA	technical area
TTR	Tonopah Test Range
U	
U.S.	United States
USAF	United States Air Force
USC	United States Code
V	
var.	variety
VOC	volatile organic compound

Units of Measure

Unit	Definition
Bq/m^3	Becquerel per cubic meter
Ci/m	curies per meter
°F	degrees Fahrenheit
kg	kilogram
m	meter
µ	micron
µCi/mL	microcuries per milliliter
µg/L	micrograms per liter
$µg/m^3$	micrograms per cubic meter
µm	micrometer (micron)
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mph	miles per hour
mR	milliroentgen
mrem/year	millirems per year
pCi/g	picocuries per gram
pCi/L	picocuries per liter
ppb	parts per billion

Data Qualifiers

Laboratory Data Qualifier

Term	Definition
*	A replicate was outside limits.
B	The analyte was detected in the blank.
H	The analytical holding time was exceeded.
J	An estimated value, the analyte concentration was above the effective MDL and below the effective PQL.
N	A spike was outside limits.
U	The analyte was absent or below the method detection limit.
X	The data was rejected due to the peak not meeting identification criteria.

Data Validation Qualifier

Term	Definition
BD	The associated value was below the detection limit as used in radiochemistry to identify results that are not statistically different from zero.
J	The associated value was an estimated quantity.
J+	The associated numerical value was an estimated quantity with a suspected positive base.
J-	The associated numerical value is an estimated quantity with a suspected negative base.
None	There was no data validation for corrected gross alpha activity.
R	The data are unusable.

Executive Summary

Lawai, Hawai'i

Sandia National Laboratories (hereinafter referred to as Sandia) is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the DOE's National Nuclear Security Administration. This *Annual Site Environmental Report* was prepared in accordance with and as required by DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*, and is approved for public release. The United States Department of Energy (DOE) and its management and operating contractor for Sandia are committed to safeguarding the environment, reassessing sustainability practices, and ensuring the validity and accuracy of the monitoring data presented here. This report summarizes the environmental protection, restoration, and monitoring programs in place for Sandia National Laboratories, Tonopah Test Range (SNL/TTR) and Sandia National Laboratories, Kaua'i Test Facility (SNL/KTF) during calendar year 2019.

Environmental Management System

Sandia management takes environmental stewardship seriously. A robust Environmental Management System (EMS) was established in 2005 as part of this commitment. The EMS ensures a systematic approach to identifying environmental aspects, setting environmental objectives and monitoring environmental performance. Designed to meet the requirements of the globally recognized International Organization for Standardization (ISO) 14001:2015 standard, the EMS is ISO 14001:2015 certified. SNL/TTR and SNL/KTF personnel follow the EMS requirements, as verified by internal assessments in 2017 and 2018, respectively. This EMS is Sandia's primary platform for implementing the environmental management programs that help achieve annual site sustainability targets.

Site Sustainability

Sustainability practices and goals are defined in an annual Site Sustainability Plan. Sandia met or exceeded sustainability goals in several key areas in fiscal year (FY) 2019, including Scope 1 and Scope 2 greenhouse gas emissions and water use efficiency and management.

Environmental Performance

Environmental performance is tracked by DOE through measures and indicators and reported as part of an overall performance evaluation. During the most recent evaluation, Sandia earned an overall rating of very good.

Environmental Programs

Sandia National Laboratories, Tonopah Test Range

Sandia personnel conduct operations at SNL/TTR in support of DOE weapon programs. Sandia activities at TTR involve research and development as well as testing weapon components and delivery systems. Many of these activities require a remote testing range with a long flight corridor for airdrops and rocket launches, which TTR can provide. Navarro Research and Engineering personnel perform most of the environmental program activities at SNL/TTR. The National Nuclear Security Administration's Nevada Field Office retains responsibility for cleanup and management of SNL/TTR environmental restoration sites. There were no DOE reportable occurrences at SNL/TTR in 2019.

Air Quality Compliance Program. Program personnel support compliance with air quality regulations. In 2019, emissions from permitted sources complied with permitted limits for nonradiological air emissions.

Chemical Information System. Chemical containers are tracked along with information about the chemical hazards.

Cultural Resource Program. Program personnel review and document potential impacts to archeologic sites and historic properties. In 2019, assessment forms were prepared for projects proposed at three properties in the previously established SNL/TTR Historic District. Architectural resource assessment forms were also prepared to support State Historic Preservation Office discussions regarding the two towers demolished in 2017 without consultation.

Ecology Program. Biota is monitored as an element of the overall environmental monitoring process and to support compliance with wildlife regulations and laws. Ecological data are collected to support documentation, land use decisions, and ecological and wildlife awareness campaigns to ensure safe work environments and sustainable decision-making strategies.

National Environmental Policy Act Program. Program personnel coordinate with DOE to ensure compliance and provide technical assistance in project planning, including preparations for the next series of B61-12 flight tests. In 2019, 10 projects were reviewed, and the environmental impacts were documented.

Oil Storage Program. Oil storage containers and equipment are managed, operated, and maintained to prevent inadvertent releases to the environment and to comply with applicable regulations. In 2019, there were eight stationary aboveground storage tanks, two mobile refuelers, a bulk storage area, a transformer storage area, and numerous mobile generators at SNL/TTR. There were no reportable oil spills or releases in 2019.

Quality Assurance. All environmental monitoring is conducted in accordance with program-specific plans that contain applicable quality assurance elements and meet appropriate federal, state, and local requirements for conducting sampling and analysis activities.

Radionuclide National Emission Standards for Hazardous Air Pollutants. Radionuclide air emissions from Sandia facilities are reported each year. The only radionuclide sources at SNL/TTR are three environmental restoration sites, which are sources of diffuse radionuclide emissions due to

the resuspension of contaminated soils. In 2019, calculated doses were well below the 10 mrem/year dose limit set by the United States Environmental Protection Agency and DOE.

Terrestrial Surveillance Program. Surveillance activities are conducted at on-site and off-site locations; soil is sampled for various parameters. In 2019, results of the sampling events were below comparison reference values, where applicable. The exception was an arsenic result that exceeded a soil screening level but was within the historical range of values. Results for americium-241 were consistent with previous years, given the history of the area. Environmental dosimeters used to measure dose from ambient gamma radiation indicated levels above comparison reference values and may be attributed to the variety of elevations, proximity to bedrock, and statistical nature of radioactivity.

Waste Management Program. Waste generated during 2019 included hazardous waste and other regulated, recycled materials, and polychlorinated biphenyl waste. Hazardous waste and other regulated waste was shipped off-site to permitted facilities.

Water Quality Programs. The public water system is routinely sampled and analyzed to demonstrate conformance with primary drinking water standards. In 2019, all public water system sample results were below established values. There are five septic tank systems; none of these systems required maintenance, sampling, or pumping in 2019.

Sandia National Laboratories, Kaua'i Test Facility

SNL/KTF is located on the island of Kaua'i within the boundaries of the U.S. Department of Defense Pacific Missile Range Facility. The site, which has been an active rocket-launching location since 1962, provides a high-quality integrated facility for conducting a wide range of test operations. These operations support materials research, components development, advanced reentry-vehicle technologies, water entry-and-recovery systems, missile defense testing, and sensor research and development testing. There were no DOE reportable occurrences at SNL/KTF in 2019.

Air Quality Compliance Program. Program personnel support compliance with air quality regulations. In 2019, activities complied with permitted operating limits.

Chemical Information System. Chemical containers are tracked along with information about the chemical hazards.

Cultural Resource Program. Program personnel review and document potential impacts to archeologic sites and historic properties. In 2019, one mitigative action was required.

Ecology Program. Biota is monitored as an element of the overall environmental monitoring process and to support compliance with wildlife regulations and laws. Ecological data are collected to support documentation, land use decisions, and ecological and wildlife awareness campaigns to ensure safe work environments and sustainable decision-making strategies.

National Environmental Policy Act Program. Program personnel coordinate with DOE to ensure compliance and provide technical assistance in project planning. In 2019, seven projects were reviewed, and the environmental impacts were documented. In March 2019, the DOE issued a Finding of No Significant Impact for the Continued Operation of The Kaua'i Test Facility based on the analysis presented in the Site-Wide Environmental Assessment.

Oil Storage Program. Oil storage containers and equipment are managed, operated, and maintained to prevent inadvertent releases to the environment and to comply with applicable regulations. In 2019, there was one underground fuel storage tank, one aboveground fuel storage tank, three

generator base tanks, and four used oil storage drums at SNL/KTF. There were no reportable oil spills or releases in 2019.

Quality Assurance. All environmental monitoring is conducted in accordance with program-specific plans that contain applicable quality assurance elements and meet appropriate federal, state, and local requirements for conducting sampling and analysis activities.

Terrestrial Surveillance Program. Surveillance activities are conducted to analyze surface soil at SNL/KTF approximately every five years. No sampling occurred in 2019 (the next sampling is scheduled to occur in 2023).

Waste Management Program. In 2019, no asbestos abatement was conducted at the Mount Haleakala site on Maui.

Water Quality Program. Drinking water is obtained through the Pacific Missile Range Facility public water system. In 2019, the three on-site septic tanks were inspected, and one was pumped. There were no compliance issues.

PART ONE

SANDIA NATIONAL LABORATORIES
TONOPAH TEST RANGE, NEVADA

Chapter 1. SNL/TTR Introduction

Wild Horses (*Equus ferus*) family

OVERVIEW ■ Tonopah Test Range is located on approximately 280 square miles (179,200 acres) of withdrawn land within the boundaries of the Nevada Test and Training Range. Sandia National Laboratories personnel conduct operations at Tonopah Test Range in support of the United States Department of Energy Weapons Ordnance Program. The site has never been used for the detonation of nuclear weapons.

This *Annual Site Environmental Report* was prepared in accordance with and as required by the United States Department of Energy (DOE) per DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*. This report is made available to the public in electronic form at the following website:

https://www.sandia.gov/news/publications/environmental_reports/

Sandia National Laboratories (hereinafter referred to as Sandia) is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC (NTESS), a wholly owned subsidiary of Honeywell International Inc., for the DOE National Nuclear Security Administration. Sandia personnel manage and operate the DOE-owned Tonopah Test Range (TTR) in Nevada. The DOE National Nuclear Security Administration Sandia Field Office in Albuquerque, New Mexico, administers the contract and oversees contractor operations.

Part One of this *Annual Site Environmental Report* summarizes the environmental protection and monitoring programs in place at Sandia National Laboratories, Tonopah Test Range (SNL/TTR) during calendar year 2019. While all 2019 program activities are performed continuously, they are reported on a calendar year basis unless otherwise noted (programs based on the fiscal year operate from October 1 through September 30, annually).

1.1 Purpose

Sandia personnel—providing the synergy and interdependence between a nuclear deterrence mission and broader national security missions to forge a robust capability base and empower solutions to complex national security problems—anticipate and resolve emerging national security challenges, innovate and discover new technologies to strengthen the nation's technological superiority, create value through products and services that solve important national security challenges, and inform the national debate for which technology policy is critical to preserving security and freedom throughout the world. Information about recent technologies developed at Sandia can be found at the following website:

http://www.sandia.gov/news/index.html

1.1.1 Operating Contract and DOE Directives

The Prime Contract for management and operations of Sandia defines the corporation's contractual obligations. The DOE directives that pertain to environmental protection and management are as follows:

- DOE O 231.1B, Admin Change 1, *Environment, Safety and Health Reporting,* ensures that DOE receives information about events that have affected or could adversely affect the health, safety, and security of the public or workers, the environment, the operation of DOE facilities, or DOE credibility. This *Annual Site Environmental Report* is prepared in accordance with this directive.
- DOE O 232.2A, *Occurrence Reporting and Processing of Operations Information*, requires timely notification to the DOE complex about events that could adversely affect the health and safety of the public or workers, the environment, DOE missions, or DOE credibility.
- DOE O 435.1, Change 1, *Radioactive Waste Management*, ensures that all DOE radioactive waste is managed in a manner that is protective of worker and public health and safety and of the environment. Under this directive, contractors who manage and operate DOE facilities are required to plan, document, execute, and evaluate the management of DOE radioactive waste.
- DOE O 436.1, *Departmental Sustainability*, places environmental management systems and site sustainability at the forefront of environmental excellence. Sandia personnel implement this directive through an International Organization for Standardization (ISO) 14001:2015-certified Environmental Management System (EMS) at the primary operating locations of Sandia National Laboratories, New Mexico (SNL/NM) and Sandia National Laboratories, California (SNL/CA). Although it is not part of the scope of the certification, Sandia personnel at SNL/TTR follow the management approach of the ISO 14001 standard (ISO 2004).
- DOE O 458.1, Admin Change 3, *Radiation Protection of the Public and the Environment*, establishes requirements to protect the public and the environment against undue risk from radiation associated with radiological activities under the control of DOE pursuant to the Atomic Energy Act.

1.2 History

A brief history of Sandia National Laboratories and of operations at SNL/TTR is provided below. For more details, see Chapter 7.

1.2.1 Sandia National Laboratories

On November 1, 1949, Sandia Corporation, a wholly owned subsidiary of Western Electric, began managing and operating Sandia Laboratory. In 1979, Congress recognized the facility as a national laboratory. From 1993 to mid-2017, Sandia Corporation was a wholly owned subsidiary of Martin Marietta (Lockheed Martin Corporation). In May 2017, the name of the management and operating

contractor changed to National Technology & Engineering Solutions of Sandia, LLC (NTESS), a wholly owned subsidiary of Honeywell International Inc.

1.2.2 Sandia National Laboratories, Tonopah Test Range

In the early 1950s, Sandia personnel used three ranges as test sites: the Los Lunas Test Site (Kirtland Air Force Base Practice Bombing Range) in New Mexico, the Salton Sea Test Site in California, and the Yucca Flat Test Site in Nevada. As testing parameters changed, these sites were deemed inadequate. See Chapter 6 for details on the history and establishment of SNL/TTR.

Sandia personnel then identified Cactus Flats, located in the northwest corner of the then-named Nellis Bombing and Gunnery Range near the town of Tonopah, Nevada, as a temporary site for testing ballistic and nonnuclear features of atomic weapons (SNL/NM 1996). In 1956, a land use permit was obtained from the United States Air Force (USAF). In 1957, Tonopah Test Range was established for the U.S. Atomic Energy Commission (now DOE) and became operational for testing weapon systems.

Today, the U.S. Department of Defense (DOD) Nevada Test and Training Range is divided into the North Range and the South Range. SNL/TTR is located northwest and the DOE Nevada National Security Site is located between the North Range and South Range (Figure 1-1). SNL/TTR includes facilities that are designed and equipped to gather data on aircraft-delivered inert test vehicles. As technologies changed, the facilities and capabilities at SNL/TTR were expanded to accommodate tests related to the DOE Weapons Ordnance Program.

In 2002, the USAF and the National Nuclear Security Administration signed a land use permit that was valid until October 2019. A new land use permit "Department of the Air Force Permit to National Nuclear Security Administration for Real Property Located on the Nevada Test and Training Range, Nevada" (USAF/NNSA 2019) was issued and is valid until November 2029. The permit is for the non-exclusive use, operation, and occupancy of an approximately 5.5-square-mile portion of the Nevada Test and Training Range.

All activities detailed in this report were conducted in 2019 prior to the issue of the new permit. Accordingly, all figures in this report reflect conditions prior to the permit change.

1.3 Location Description

SNL/TTR is located on withdrawn land (withheld from the public domain) which is permitted from the USAF within the boundaries of the Nevada Test and Training Range. Sandia personnel use the land to support DOE and USAF activities and missions.

The area north of the SNL/TTR boundary is comprised of sparsely populated public lands jointly administered by the U.S. Bureau of Land Management and the U.S. Forest Service. Cattle graze this land in winter and spring. There is also a substantial irrigated farming operation north of the range. SNL/TTR lies within a portion of the Nevada Wild Horse Range herd area, which is administered by the U.S. Bureau of Land Management.

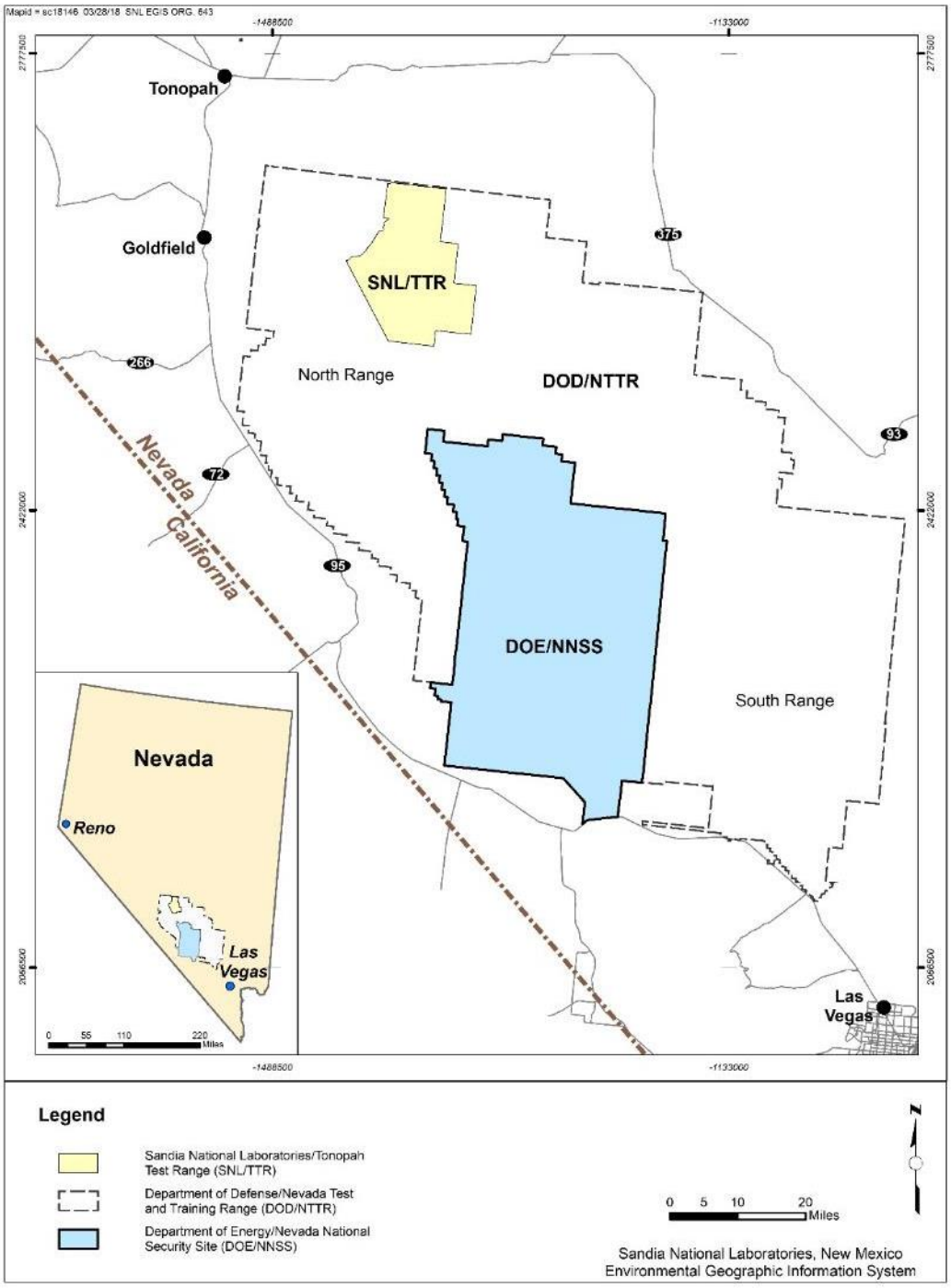

Figure 1-1. SNL/TTR location within the boundaries of the Nevada Test and Training Range

1.4 Demographics

The nearest residents live in the towns of Goldfield, Nevada, population 268, and Tonopah, Nevada, population 2,478 (Census 2012a). Goldfield and Tonopah are approximately 22 miles west and 32 miles northwest of the site boundary, respectively. Las Vegas, estimated population 651,319 (Census 2020), the largest municipality in Nevada by population, is approximately 140 miles southeast of the site boundary.

1.5 Activities and Facilities

SNL/TTR personnel conduct operations in support of DOE weapons programs. The site offers a unique test environment for use by other government agencies and their contractors as well. The facilities, large land area, and site security are available for conducting a wide variety of tests. Activities involve conducting research and development as well as testing weapon components and delivery systems. Many of these activities require a long flight corridor for airdrops and rocket launches, which SNL/TTR can provide. Capabilities such as modern electronic tracking instrumentation and data acquisition systems ensure complete and accurate test data.

The majority of test activities occur within Cactus Flat, a valley with almost no topographical relief flanked by mountains and hills. The remote range ensures public safety and national security.

Current DOE activities at SNL/TTR include:

- Air drop operations (test units dropped from aircraft)
- Explosives operations (render-safe operations, including handling, transporting, and storing explosives)
- Missile operations (ground- and air-launched missiles)

Navarro Research and Engineering personnel perform or support most environmental program functions at SNL/TTR on behalf of the management and operating contractor for Sandia, including air monitoring, Environmental Restoration Project activities, National Environmental Policy Act (NEPA) compliance, spill response, waste management operations, and water quality monitoring. Navarro Research and Engineering personnel also support SNL/TTR personnel during tests by operating optics equipment, radar units, and recovering test objects.

In 1963, the DOE (formerly the Atomic Energy Commission) implemented Operation Roller Coaster to evaluate the dispersal of radionuclides when nuclear devices were subjected to chemical explosions while in storage or transit (Chapman et al. 2018). This operation resulted in radionuclide-contaminated soils (see Section 3.4).

1.5.1 Mission Control Center

The SNL/TTR Mission Control Center tower is a four-story structure that affords a 360-degree view of the site. It houses mission critical systems that coordinate all test activities during testing operations. SNL/TTR is instrumented with a wide array of signal-tracking equipment, including high-speed cameras, telemetry, and radar tracking devices that are used to characterize ballistics, aerodynamics, and parachute performance of test units.

1.5.2 Environmental Restoration Project

The Environmental Restoration Project at SNL/TTR was initiated in 1980 to address contamination resulting primarily from the 1963 nuclear weapons destruction testing and related support activities. In late 1992 and early 1993, an agreement was reached between DOE headquarters and the Albuquerque and Nevada field offices to designate the DOE Nevada Field Office as responsible for all environmental restoration sites at SNL/TTR. The National Nuclear Security Administration was established in 2000, and responsibility for all environmental restoration sites in Nevada still resides with the National Nuclear Security Administration Nevada Field Office, with the exception that National Emission Standards for Hazardous Air Pollutants (NESHAP) compliance and reporting for environmental restoration activities is currently being addressed by DOE. However, environmental program management at SNL/TTR is a joint effort between SNL/TTR and SNL/NM personnel, with oversight from DOE. For more information on the Environmental Restoration Project, see Chapter 3.

1.6 Environmental Setting

The topography at SNL/TTR is characterized by a broad, flat valley bordered by two north- and south-trending mountain ranges: Cactus Range to the west (occurring mostly within the boundaries of SNL/TTR) and Kawich Range to the east. Cactus Flat is the valley floor, where the main operational area of SNL/TTR is located. An area of low hills outcrops in the south. Elevations range from 5,347 feet at the valley floor to 7,482 feet at Cactus Peak. The elevation of the town of Tonopah is 6,047 feet.

1.6.1 Geology

SNL/TTR is located in the western part of the Basin and Range geophysical province. This area is marked by horst and graben topography, a system of mountains and down-dropped fault valleys formed through regional extension. SNL/TTR is northeast of the Walker Lane lineament, a zone of transcurrent faulting and shear, and northwest of the Las Vegas Valley shear zone (SNL/NM 1982).

Cactus Range to the west of SNL/TTR is the remnant of a major volcanic center consisting of relatively young (six million years old) folded and faulted Tertiary volcanics. This range is one of at least five northwest-trending, raised structural blocks that lie along the Las Vegas Valley/Walker Lane lineaments (ERDA 1975).

1.6.2 Surface Water

Drainage patterns within and near SNL/TTR are intermittent (ephemeral stream channels) and end in closed basins. Ephemeral streams occasionally carry spring runoff to the center of Cactus Flat, where there is a string of north–south trending dry lake beds; however, due to the high rate of evaporation, little is recharged to the groundwater (DRI 1991).

An *ephemeral spring* flows only briefly in the immediate locality in response to precipitation.

There are several small springs within the Cactus and Kawich ranges. Three occur within SNL/TTR boundaries: Cactus Spring, Antelope Spring, and Silverbow Spring. Water from these springs does not travel more than approximately 100 feet before it dissipates through evaporation and infiltration. The effect on the landscape is purely local.

1.6.3 Groundwater

SNL/TTR personnel obtain water from local wells. The U.S. Geological Survey has recorded groundwater depths from 21 to 454 feet below ground surface at the site. Approximate groundwater levels have been recorded as follows:

- Antelope Mine Well in the Cactus Range at 21 feet below ground surface
- EH2 Well near the TTR Airport at 454 feet below ground surface
- Area 9 Well located near the northern end of the site at 131 feet below ground surface
- Production Well 6 in Area 3 at 350 feet below ground surface

1.6.4 Ecology

An ecosystem is a network of living organisms and nonliving components that interact with one another to comprise an overall environment. The ecosystem at SNL/TTR includes the interactions among many living components, such as humans, animals, insects, plants, and fungi, within several habitat types. Nonliving components within the ecosystem include air, water, mineral soil, buildings, structures, roads, and paved surfaces. The habitats of the SNL/TTR ecosystem include dwarf shrub

and saltbrush shrubland in the lower elevations, Great Basin mixed desert scrub in the intermediate elevations, and an abundance of Joshua tree (*Yucca brevifolia*) and junipers (*Juniperus spp.*) with increased elevations. The SNL/TTR ecosystem is a dynamic entity that is impacted by external and internal factors. External factors include such influences as climate, time, topography, and biota. Internal factors include the introduction of non-native species to the ecosystem and human disturbance and interactions (through development) within the various habitats.

An *ecosystem* is a network of living organisms and nonliving components (e.g., air, water, mineral soil, buildings, and roads) that interact to comprise an overall environment.

In general, the Nevada Test and Training Range land withdrawal has had a positive effect on local plant and animal life at SNL/TTR. Since much of the withdrawal area is undisturbed by human activity, large habitat areas are protected from the effects of public use. For more information on the ecology at SNL/TTR, see Chapter 4.

1.6.5 Climate

The climate at SNL/TTR is typical of high desert, midlatitude locations, with large diurnal and seasonal changes in temperature and little total rainfall. Temperature extremes at the test range vary from highs near 104°F in summer, with lows approaching −22°F in winter. July and August are the hottest months, with highs generally around 90°F during the day and dropping to the 50s°F at night. January conditions vary from highs in the 40s°F to lows of around 20°F.

Average annual precipitation at the Tonopah Airport (the closest weather station with 30 or more years of data), elevation 5,426 feet, is 5.08 inches of precipitation (WRRC 2020). Typically, the months of May and July have the highest averages of 0.54 and 0.53 inches, respectively, and December has the lowest with 0.27 inches. The site has been known to receive snowfall from October through May, averaging 13 inches per year.

Temperature extremes at the test range vary from highs near 104°F in summer, with lows approaching −22°F in winter.

Winds are generally from the northwest in winter and early spring, switching to southerly directions during summer. The mountain-and-valley system channels the wind such that the wind seldom blows from eastern or southwestern directions. Dust storms are common in the spring when monthly average wind speeds reach 15 miles per hour. During the spring and fall, there may be a diurnal wind cycle, bringing northwest winds in the early hours and shifting to southerly winds by afternoon.

Chapter 2. SNL/TTR Compliance Summary

Western Fence Lizard (*Sceloporus occidentalis*)

OVERVIEW ■ Sandia operations at SNL/TTR comply with federal, state, and local environmental regulations, statutes, executive orders, and DOE directives. Regular audits, appraisals, and inspections identify areas for improvement as well as noteworthy practices.

Sandia operations at SNL/TTR comply with federal, state, and local environmental requirements, including DOE directives and presidential executive orders (EOs). As part of this compliance, personnel adhere to strict reporting and permitting requirements.

All SNL/TTR operations and activities, including those that are part of environmental programs, are performed under the Environment, Safety, and Health (ES&H) policy, which includes the following statement:

> Sandia integrates environmental, safety and health throughout the lifecycle of its operations to ensure the:
>
> - Protection of Members of the Workforce by providing a safe and healthful workplace.
> - Protection of the environment by preventing or minimizing pollution and waste, pursuing sustainable resource use, and protecting biodiversity and ecosystems.
> - Protection of the public through the prevention or minimization of releases of hazardous materials.
> - Satisfaction of contractual requirements.
> - Establishment, measurement, and monitoring of ES&H objectives to enhance performance and drive continual improvement.

An Integrated Safety Management System is used to incorporate safety into management and work practices at all levels so that missions are accomplished while protecting the worker, the public, and

the environment. Thus, management of safety functions becomes an integral part of mission accomplishment and meets requirements outlined by DOE. The following five core functions guide the integration of safety into all work practices: define the scope of work, analyze the hazards, develop and implement hazard controls, perform work within controls, and provide feedback for continuous improvement.

2.1 Environmental Management System

Sandia management takes the responsibility of protecting the environment seriously and requires employees, contractors, and visitors to adhere to the ES&H policy. There is a continuing cycle of planning, implementing, evaluating, and improving the EMS. The EMS facilitates identification of the environmental aspects and impacts of Sandia's activities, products, and services; identification of risks and opportunities that could impact the environment; evaluation of applicable compliance obligations; establishment of environmental objectives; and, creation of plans to achieve those objectives and monitor their progress.

DOE O 436.1, *Departmental Sustainability*, provides requirements for managing sustainability. Sandia personnel implement this order through an ISO 14001-certified (ISO 2004) EMS. Sandia National Laboratories received initial ISO 14001:2004 certification in June 2009. In 2015, the SNL/NM and SNL/CA site-specific certifications were integrated into a multi-site ISO 14001:2004 certification. In 2018, the EMS was recertified under the new ISO 14001:2015 (ISO 2015). SNL/TTR operations do not need to be included in the certification, provided that an internal assessment is conducted every three years to ensure that personnel follow the EMS requirements. In January 2017, an EMS ISO 14001:2004 assessment was conducted at SNL/TTR. Additional information can be found at the following external EMS website:

www.sandia.gov/about/environment/environmental_management_system/index.html

The EMS provides the following benefits:

- Improved environmental performance
- Enhanced compliance with environmental regulations
- Strengthened pollution prevention efforts
- Improved resource conservation
- Increased environmental efficiencies and reduced costs
- Enhanced image with the public, regulators, and potential new hires
- Heightened awareness of environmental issues and responsibilities

For fiscal year (FY) 2019, air emissions, hazardous materials use, and hazardous waste generation were identified as the top three significant aspects for Sandia operations. When significant aspects and negative impacts have been identified, environmental objectives—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts.

Aspects are any elements of activities, products, or services that can interact with the environment, and *impacts* are any changes in the environment, whether adverse or beneficial, wholly or partially resulting from activities, products, or services.

2.2 Site Sustainability Plan

A Site Sustainability Plan is prepared annually to assist DOE in meeting its sustainability goals and the broader sustainability program set forth in EO 13834, *Efficient Federal Operations* (EO 13834). Sandia's most recent plan, *Fiscal Year 2020 Site Sustainability Plan* (SNL/NM 2019a), describes the performance status for FY 2019. Additional information about pollution prevention activities is provided in Chapter 3.

Sustainability goals are being met or exceeded in several key areas. Table 2-1 presents performance status for several selected key areas (SNL/NM 2019a).

Table 2-1. Site Sustainability Plan performance status for key areas

DOE Goal/Sandia Objective	Sandia Performance Status through FY 2019
Clean and Renewable Energy	
Renewable electric energy should account for not less than 7.5% of a total agency electric consumption by FY 2013 and each year thereafter.	Met this objective by purchasing renewable energy credits. In FY 2019, renewable energy credit purchases accounted for 18.4% of electric consumption.
Electronic Stewardship	
Purchases: 95% of eligible acquisitions each year are EPEAT-registered products.	Met this objective with 98.3% of eligible electronics acquisitions being EPEAT-registered products in FY 2019.
Fleet Management	
75% of light-duty vehicle acquisitions must consist of alternative-fuel vehicles.	Met this objective in FY 2019.
Greenhouse Gas Reduction	
Year-over-year Scope 1 and Scope 2 greenhouse gas emissions reduction from an FY 2008 baseline. Year-over-year Scope 3 greenhouse gas emissions reduction from an FY 2008 baseline.	Reduced Scope 1 and Scope 2 greenhouse gas emissions by 46% in FY 2019 relative to an FY 2008 baseline. However, between FY 2018 and FY 2019, emissions increased by 29%. Scope 3 greenhouse gas decreased by 12.7% in FY 2019 relative to the FY 2008 baseline.
Organizational Resilience	
Discuss overall integration of climate resilience in emergency response, workforce, and operations procedures and protocols.	Began to meet this objective by developing a Climate Change Vulnerability Assessment. The assessment will be integrated into future emergency response operations and building plans.
Pollution Prevention and Waste Reduction	
Reduce at least 50% of nonhazardous solid waste sent to treatment and disposal facilities. Reduce construction and demolition materials and debris sent to treatment and disposal facilities. Year-over-year reduction; no set target.	Met this objective by diverting 61% of nonhazardous solid waste. Reduced construction and demolition waste by 23% through diversion.
Sustainable Acquisition	
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring that BioPreferred and biobased provisions and clauses are included in all applicable contracts.	Implemented efforts to improve the promotion of sustainable acquisition and procurement, including establishing a process to ensure that the appropriate provisions are included in all applicable contracts.
Sustainable Buildings	
Comply with the revised guiding principles for High Performance and Sustainable Buildings for at least 15% (by building count) of existing buildings greater than 5,000 gross square feet by FY 2020, with annual progress thereafter.	Met this objective with 20.98% of buildings achieving compliance with guiding principles.

Table continued on next page

Table 2-1. Site Sustainability Plan performance status for key areas (continued)

DOE Goal/Sandia Objective	Sandia Performance Status through FY 2019
Sustainable Energy Management	
Reduce energy intensity in goal-subject buildings by 30% relative to an FY 2003 baseline and by 1% year-over-year thereafter.	Did not meet this objective. Energy intensity increased by 3.7% from FY 2018 to FY 2019.
Water Use Efficiency and Management	
Reduce potable water intensity by 20% relative to an FY 2007 baseline by FY 2015 and 0.5% year-over-year thereafter.	Achieved 20.1% reduction in FY 2019 relative to an FY 2007 baseline.

DOE = U.S. Department of Energy EPEAT = Electronic Product Environmental Assessment Tool FY = fiscal year

2.3 Environmental Compliance

DOE directives listed in the management and operating contract for Sandia as well as applicable federal, state, and local laws and regulations define the primary contractual obligations for management and operation of SNL/TTR. Directives that pertain to environmental protection and management are discussed in Chapter 1 with some included herein for specific operational information. In 2019, the management and operating contractor adhered to the requirements cited in Section 2.3.1 for SNL/TTR operations as stated in the compliance status.

On May 17, 2018, EO 13834, *Efficient Federal Operations,* affirms that agencies shall meet such statutory requirements in a manner that increases efficiency, optimizes performance, eliminates unnecessary use of resources, and protects the environment. Section 8 of the new executive order revokes EO 13693, *Planning for Federal Sustainability in the Next Decade*.

2.3.1 Federal Requirements

Federal environmental requirements applicable to SNL/TTR operations, along with the compliance status, follows.

Environmental Planning

National Environmental Policy Act (NEPA) of 1969

This act requires federal agencies to assess and consider human health and environmental issues associated with proposed actions, be aware of the potential environmental impacts associated with these actions, and include this information in early project planning and decision-making. NEPA review of federally funded proposed actions is conducted in accordance with 10 CFR 1021, *National Environmental Policy Act Implementing Procedures*.

Compliance Status

NEPA checklists are prepared for proposed projects and activities to assess potential environmental consequences. After completion of a NEPA checklist, NEPA Program personnel review projects for compliance with existing DOE NEPA documents and determinations. When required, a NEPA checklist is forwarded to DOE for review and determination.

Section 3.5 provides information on NEPA activities.

Environmental Restoration

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and amended in 1986

Also known as the "Superfund," this act establishes liability compensation, clean-up, and emergency response requirements for inactive hazardous waste sites. CERCLA also requires federal facilities to report hazardous substances spills to the National Response Center. The Superfund Amendments and Reauthorization Act (SARA) of 1986 establishes additional reporting requirements that are addressed under "Chemical Management."

Compliance Status

As required by CERCLA, a Preliminary Assessment and Site Inspection was conducted at SNL/TTR in 1988. This inspection confirmed that no sites qualify for the National Priorities List, which lists the nation's high-priority cleanup, or Superfund, sites. Therefore, with respect to inactive hazardous waste sites, there are no applicable CERCLA remediation requirements.

Hazardous Waste

Federal Facility Agreement and Consent Order

This agreement is an ongoing action with the State of Nevada, DOE, and the DOD (DOD, DOE, and State of Nevada 1996).

All DOE cleanup activities at certain specified facilities in the State of Nevada must be conducted in conformance with the requirements of this agreement. The order is an enforceable agreement with stipulated penalties for violations.

Compliance Status

DOE has assumed responsibility for the following environmental restoration sites that are subject to this agreement: Nevada National Security Site, Areas within SNL/TTR, Areas within the Nevada Test and Training Range, Central Nevada Test Area, and Project Shoal Area (east of Carson City in Churchill County).

Section 3.4 provides information on environmental restoration sites.

Federal Facility Compliance Act of 1992

This act requires federal facilities to comply with all federal, state, and local requirements for hazardous and solid waste, including full compliance with the restrictions and prohibitions on extended storage of wastes that do not meet the applicable hazardous waste treatment standards.

Compliance Status

SNL/TTR operations do not generate mixed waste, and there is currently no mixed waste stored on-site; therefore, these requirements are not applicable at SNL/TTR.

Resource Conservation and Recovery Act (RCRA), enacted in 1976

This act and the Nevada Revised Statutes regulate the generation, transportation, treatment, storage, and disposal of hazardous and nonhazardous solid wastes. Applicable regulations, including Nevada implementing regulations, are listed in the References ("State of Nevada Environmental Regulations").

Note: Under the small-quantity generator designation, hazardous waste can only be stored on-site for a maximum of 180 days before it must be shipped off-site for treatment and disposal at a U.S. Environmental Protection Agency (EPA) permitted facility.

Small-quantity generators and conditionally exempt small-quantity generators of RCRA hazardous waste in Nevada are no longer required to file a biennial hazardous waste report.

Compliance Status

SNL/TTR operations generate less than 1,000 kg of hazardous waste through normal operations each month, which classifies the site for small-quantity generator status subject to applicable requirements of 40 CFR 262, *Standards Applicable to Generators of Hazardous Waste.*

Nonhazardous municipal solid waste, such as office and food refuse, is disposed of at the SNL/TTR Class II sanitary landfill (operated by a USAF operations and maintenance contractor).

Section 3.8 summarizes waste management activities during 2019.

Radiation Protection

Atomic Energy Act of 1946 (42 United States Code [USC] § 2011 et seq.)

This act promotes the proper management of source, special nuclear, and byproduct nuclear materials.

Compliance Status

DOE sets radiation protection standards and retains authority for radionuclides through DOE directives and federal regulations. Compliance is achieved through adherence to these directives and applicable regulations in 10 CFR 830, *Nuclear Safety Management*, and 10 CFR 835, *Occupational Radiation Protection*.

DOE O 435.1, Change 1, *Radioactive Waste Management*

This order establishes requirements for managing radioactive waste in a manner that protects worker and public health and safety and the environment.

Under this order, DOE contractor-operated facilities are required to plan, document, execute, and evaluate the management of radioactive waste.

Compliance Status

Chapter 3 provides information on radioactive waste management.

DOE O 458.1, Admin Change 3, Radiation Protection of the Public and the Environment

This order limits the annual doses from all sources of ionizing radiation and exposure pathways that could contribute significantly to total dose. The limits are total effective dose of 100 mrem/year, equivalent dose to the lens of the eye of 1,500 mrem/year, and equivalent dose to the skin or extremities of 5,000 mrem/year. These limits exclude dose from radon and its decay products in air, dose received by patients from medical sources of radiation, and dose from background radiation.

Air pathways. DOE facilities are required to comply with EPA standards for radiation protection as regulated by NESHAP and implemented in 40 CFR 61 Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities," specific to radionuclides emitted from DOE facilities (except for radon).

Biota. This order protects biota, ensuring that radiological activities having the potential to impact the environment must be conducted in a manner that protects aquatic animal, terrestrial plant, and terrestrial animal populations in local ecosystems from adverse effect due to radiation and radioactive material released from DOE operations.

Residual radioactivity of real and personal property. This order specifies the control and clearance of real and personal property with residual radioactivity. Personal property with residual radioactivity above the limits specified in this order is not cleared from radiological control. Pursuant to written procedures, personal property that is potentially contaminated or activated is surveyed prior to clearance, or a process knowledge evaluation is conducted to verify that the personal property has not been contaminated with radioactive material nor exposed to energy capable of inducing radioactivity in the material. In some cases, both a radiological survey and a process knowledge evaluation are performed. DOE issued a moratorium in January 2000 that prohibited the clearance of volume-contaminated metals, and subsequently in July 2000 suspended the clearance of metals from DOE radiological areas for recycling purposes.

Water pathways. For a drinking water system operated by DOE, DOE facilities must provide a level of radiation protection equivalent to that provided to members of the public by the community drinking water standards in 40 CFR 141, *National Primary Drinking Water Regulations*, i.e., not to exceed the radionuclide maximum contaminant levels. The regulations reference a derived concentration technical standard for radionuclides in drinking water that could be consumed continuously (365 days a year). This is a conservative approach, which assumes that a member of the public resides at the location continuously.

Compliance Status

Air pathways. At SNL/TTR, the only current pathway for potential exposure is through air. Chapter 3 provides further information on air pathways.

Biota. Currently, no biota sampling is conducted due to the low-impact operations at SNL/TTR. However, if changing operations or conditions warrant, sampling will be initiated on a case-specific basis to ensure compliance with DOE O 458.1.

Residual radioactivity of real and personal property. Excess property with residual radioactivity above the limits set in DOE O 458.1 is either retained for continued use within DOE facilities or transferred to the SNL/NM Radioactive and Mixed Waste Management Unit for disposal as radioactive waste. Property clearance activities in 2019 included the following: Radiation Protection Department personnel processed no personal property clearance surveys, no metals subject to the moratorium or the suspension were cleared, and no real property was cleared.

Water pathways. Currently, there is no water pathway for radionuclides in drinking water at SNL/TTR; therefore, the DOE-derived concentration standards for a water pathway are not applicable. Chapter 3 provides information about the public water system at SNL/TTR.

Air Quality

Clean Air Act of 1970, as amended

This comprehensive federal law regulates air emissions from stationary and mobile sources. The act calls for the EPA to describe and track air pollutants from stationary and mobile sources and to establish ambient air quality standards.

Nonradionuclide emissions. Air emissions from nonradionuclide sources, such as a portable screen or maintenance shop activities, are permitted under a Class II Air Quality Operating Permit issued by the Nevada Division of Environmental Protection.

Radionuclide emissions. The EPA retains compliance authority for all radionuclide air releases, which are regulated by NESHAP and implemented under 40 CFR 61, Subpart H, "National Emissions Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities." Additional requirements pertaining to radionuclide emissions are contained in DOE O 458.1, Admin Change 3, *Radiation Protection of the Public and the Environment*.

Compliance Status

Nonradionuclide emissions. Compliance is achieved through adherence to the conditions of permits and applicable regulations.

Radionuclide emissions. Compliance is achieved through annual reporting of radionuclide air emission releases and dose assessment.

Section 3.1 provides a summary of regulated air quality emissions at SNL/TTR.

Water Quality

Clean Water Act of 1972 and amendments

This act establishes a permitting structure and regulatory direction to protect the "waters of the United States" by restoring and maintaining the chemical, physical, and biological integrity of U.S. waters; protecting fish, wildlife, and recreation; and reducing pollutant discharges.

Nevada Division of Environmental Protection. This agency administers regulations relevant to water pollution, wastewater discharges, septic tank system effluents, and stormwater runoff.

Compliance Status

Compliance is achieved through adherence with Nevada Division of Environmental Protection requirements.

Wastewater discharge is sampled annually. Septic tank systems are pumped as needed. Stormwater is managed through National Pollutant Discharge Elimination System permits, which includes a general construction permit.

Section 3.9 provides information on water quality programs.

Energy Independence and Security Act (EISA) of 2007, Section 438

This section of the act requires federal agencies to manage stormwater runoff from federal development projects for the protection of water resources.

Compliance Status

Sandia projects planned through the NEPA process are reviewed for EISA § 438 eligibility. If applicable, EISA § 438 requires the use of site planning, design, construction, and maintenance strategies to maintain or restore predevelopment site hydrology (stormwater runoff), ensuring that receiving surface waters are not impacted negatively.

Oil Pollution Act of 1990 (§ 311) (with implementing regulations in 40 CFR 112, Oil Pollution Prevention)

This act establishes requirements for the prevention of, preparedness for, and response to oil discharges at specific non-transportation-related facilities to prevent oil from reaching navigable waters of the United States and adjoining shorelines, and to contain discharges of oil. The act requires the development and implementation of a Spill Prevention, Control, and Countermeasure Plan.

Compliance Status

A Spill Prevention, Control, and Countermeasure Plan is implemented and maintained at SNL/TTR.

Section 3.6 provides information on the Oil Storage Program.

Safe Drinking Water Act of 1974, as amended

This act was established to protect the quality of drinking water in the U.S., focusing on all waters actually or potentially designed for drinking use, whether from aboveground or underground sources.

Nevada Division of Environmental Protection Bureau of Safe Drinking Water. Safe drinking water protection activities are conducted under Nevada Division of Environmental Protection regulations.

Compliance Status

SNL/TTR meets standards for drinking water as defined in the act. Production Well 6 provides all drinking water for the Main Compound.

Compliance is achieved through adherence of permit requirements. SNL/TTR operates under two permits issued by Nevada Division of Environmental Protection: one for the public water system and one for the arsenic removal treatment system. The Nevada Division of Environmental Protection characterizes this public water system as a Non-Transient Non-Community Water System.

Section 3.9 provides information on water quality programs.

Chemical Management

Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986

EPCRA, also known as the Superfund Amendments and Reauthorization Act (SARA) Title III, requires reporting of toxic chemicals used and released by federal, state, and local governments and industry. These provisions help increase the public's knowledge of and access to information on chemicals at a facility, their uses, and releases into the environment. The Emergency Release Notification requirements were established under Section 304 of EPCRA. The Toxic Release Inventory reporting requirement was established under Section 313 of EPCRA.

Compliance Status

In 2019, there were no reportable quantity releases of an extremely hazardous substance requiring notification under Section 304 of EPCRA.

In 2019, no releases resulting from SNL/TTR operations met the threshold requiring a Toxic Release Inventory report under Section 313 of EPCRA.

Table 2-2 provides further details on applicable EPCRA requirements.

Federal Insecticide, Fungicide, and Rodenticide Act, enacted in 1910 and amended in 1972

This act governs the registration, distribution, sale, and use of pesticides in the United States.

Compliance Status

All herbicides, rodenticides, and insecticides used at SNL/TTR follow EPA requirements and are applied in accordance with applicable label guidelines and regulations by state-licensed contractors.

Toxic Substances Control Act, enacted in 1976 and later amended

This act regulates the manufacture, processing, distribution, use, and disposal of specific chemical substances and/or mixtures.

Compliance Status

At SNL/TTR, compliance with this act primarily involves managing asbestos and polychlorinated biphenyls (PCBs). There are no PCB-contaminated transformers at SNL/TTR. Asbestos abatement-related activities are conducted in accordance with applicable regulatory requirements, as needed.

Pollution Prevention

Pollution Prevention Act of 1990

This act declares as national policy that pollution should be prevented or reduced at the source (42 USC § 13101 et seq.).

A toxic chemical source reduction and recycling report is required for facilities that meet the reporting requirements under EPCRA, Section 313.

Compliance Status

See the previous EPCRA discussion under "Chemical Management."

Natural Resources

Bald and Golden Eagle Protection Act (16 U.S. Code § 668-668d), enacted in 1940

This act prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions.

Compliance Status

An avian protection plan is in place that addresses potential impacts to eagle species known to occur in the area. In 2019, no eagle mortality or nesting concerns were encountered.

Chapter 4 presents information on avian surveillance.

Endangered Species Act of 1973, amended in 1982

This act applies to both private individuals and federal agencies. Section 7 of the Endangered Species Act requires consultation with the U.S. Fish and Wildlife Service to ensure that actions are not likely to harm or jeopardize the continued existence of federally listed species or result in the destruction or adverse modification of designated critical habitat.

Compliance Status

Activities with the potential to impact identified endangered species were managed through the NEPA process. In 2019, protected species clearance surveys were conducted as needed, and no endangered species were identified.

Chapter 4 provides more information about threatened or endangered species occurring at SNL/TTR.

Fish and Wildlife Conservation Act (Public Law [PL] 96-366), enacted in 1980, and the Lacey Act Amendments (PL 97-79), enacted in 1981

These acts were established to ensure that wildlife receives equal consideration with other natural resources when managing ecosystems.

As stated in 16 USC § 2901, the purpose is: "(1) to provide technical assistance to the States for the development, revision, and implementation of conservation plans and programs for nongame fish and wildlife; and (2) to encourage all Federal departments and agencies to utilize their statutory and administrative authority, to the maximum extent practicable and consistent with each agency's statutory responsibilities, to conserve and to promote conservation of nongame fish and wildlife and their habitats."

In 2013, DOE and the U.S. Department of Interior's Fish and Wildlife Service entered a *Memorandum of Understanding, Responsibilities of Federal Agencies to Protect Migratory Birds* in order to enhance collaboration in promoting the conservation of migratory bird populations (DOE and FWS 2013). This strengthens migratory bird conservation between the two federal agencies in coordination with state, tribal, and local governments.

Compliance Status

In 2019, fish and wildlife conservation compliance was achieved through avian surveys.

Chapter 4 presents information on the Ecology Program avian surveillance activities.

Migratory Bird Treaty Act (MBTA) of 1918 (and amendments)

This act implemented the 1916 Convention for the Protection of Migratory Birds. The original statute implemented the agreement between the United States and Great Britain (for Canada), and later amendments implemented treaties between the United States and Mexico, the United States and Japan, and the United States and Russia.

The MBTA prevents taking, killing, possessing, transporting, and importing migratory birds, their eggs, parts, or nests. Federal institutions are not exempt from the MBTA.

Compliance Status

An avian protection plan is in place that provides procedures that address potential impacts to migratory birds known to occur in the area. In 2019, compliance was achieved through an annual avian survey.

Chapter 4 presents information on the Ecology Program avian surveillance activities.

Sikes Act of 1960 (PL 86-97), enacted in 1960, and the amendments of 1986 (PL 99-561) and 1997 (PL 105-85 Title XXIX), were reauthorized in 2013

This act protects and enhances fish, wildlife, and other natural resources that exist on and are associated with military lands in the United States.

Compliance Status

In 2019, compliance was achieved by adherence with the Memorandum of Understanding between DOE and the U.S. Fish and Wildlife Service.

Chapter 4 provides information on the Ecology Program.

Wild Free-Roaming Horses and Burros Act (PL 92-195), enacted in 1971, and amendments

This act declares that wild free-roaming horses and burros are living symbols of the historic and pioneer spirit of the West, that they contribute to the diversity of life forms within the nation, and that they enrich the lives of the American people.

The policy states that wild free-roaming horses and burros shall be protected from capture, branding, harassment, or death. To accomplish this, areas where they are presently found are to be considered an integral part of the natural system of the nation's public lands.

Compliance Status

The Bureau of Land Management Las Vegas District is responsible for management of wild horses at SNL/TTR. In 2019, there were no concerns with wild free-roaming horses and burros; therefore, coordination with Bureau of Land Management was not necessary.

Executive Order 11988 of 1977, Floodplain Management, as amended

This executive order requires federal agencies to consider impacts associated with the occupancy and modification of floodplains; reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains.

Compliance Status

There are no designated floodplains at SNL/TTR.

Executive Order 11990 of 1977, Protection of Wetlands, as amended

This executive order requires federal agencies to minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands.

Compliance Status

There are no significant wetlands at SNL/TTR; however, some very limited wetlands exist near several springs. These provide an important source of drinking water for wildlife in the area.

Quality Assurance

DOE Order 414.1D (DOE O 414.1D Admin Change 1), Quality Assurance

This order is in addition to 10 CFR 830, *Nuclear Safety Management*, Subpart A, "Quality Assurance." The purpose of the order is to achieve quality in all work and ensure that products and services meet or exceed customer requirements/expectations.

Compliance Status

All environmental sampling and analysis that was conducted in 2019 conformed to applicable quality assurance plans.

Chapter 5 provides information on quality assurance.

Cultural Resources

AFI 32-7065, Cultural Resources Management Program

This Air Force Instruction establishes guidelines for managing and protecting cultural resources on property affected by Air Force operations in the United States.

Compliance Status

Cultural Resource Program personnel ensure the review, oversight, and documentation of cultural resources at SNL/TTR. When appropriate, these activities are coordinated with DOD. In 2019, no projects included coordination between DOE and DOD.

Chapter 6 provides information on the Cultural Resource Program.

American Indian Religious Freedom Act, enacted in 1978 and amended in 1994

This act protects the rights of Native Americans to exercise their traditional religions by ensuring access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.

Compliance Status

Planning through the NEPA process identifies potential impacts to cultural resource sites, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, no activities required interaction with any Native American tribes.

Chapter 6 provides information on the Cultural Resource Program.

Archaeological Resources Protection Act, enacted in 1979 and amended in 1988

This act governs disturbance of archeological sites on federal and Indian lands in the United States and the removal and disposition of archeological collections from those sites.

Compliance Status

Planning through the NEPA process identifies potential impacts to archaeological sites, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, one survey was conducted with no archaeological sites identified. No testing or excavation was required in 2019.

Chapter 6 provides information on the Cultural Resource Program.

DOE O 144.1, Department of Energy American Indian Tribal Government Interactions and Policy

This order addresses interactions with American Indian Tribal representatives in relation to any DOE proposed work that may involve tribal rights and interests.

Compliance Status

Planning through the NEPA process identifies proposed work that may involve tribal rights and interests. No proposed work involved tribal rights and interests and, accordingly, no interactions occurred in 2019.

DODI 4710.02, DOD Interactions with Federally Recognized Tribes

This DOD instruction implements DOD policy, assigns responsibilities, and provides procedures for DOD interactions with federally recognized tribes.

Compliance Status

Cultural Resource Program personnel ensure the review, oversight, and documentation of cultural resources at SNL/TTR. When appropriate, these activities are coordinated with DOD. In 2019, no projects included coordination between DOE, DOD, and Native American tribes.

Chapter 6 provides information on the Cultural Resource Program.

DODI 4715.16, Cultural Resources Management

This DOD instruction outlines DOD policy and assigns responsibilities for complying with applicable federal statutory and regulatory requirements, executive orders, and presidential memorandums for the integrated management of cultural resources on D0D-managed lands.

Compliance Status

Cultural Resource Program personnel ensure the review, oversight, and documentation of cultural resources at SNL/TTR. When appropriate, these activities are coordinated with DOD. In 2019, no projects included coordination between DOE and DOD.

Chapter 6 provides information on the Cultural Resource Program.

DOE O 430.1C, Real Property Asset Management

This order establishes the approach for the life-cycle management of real property assets that aligns the real property portfolio with DOE mission needs in a safe, secure, cost-effective, and sustainable manner.

Compliance Status

Planning through the NEPA process identifies potential impacts to real property, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, no mitigative actions were required.

Chapter 6 provides information on the Cultural Resource Program.

DOE P 141.1, Management of Cultural Resources

This policy ensures that DOE programs, including the National Nuclear Security Administration, and field elements integrate cultural resources management into their missions and activities.

Compliance Status

Cultural Resource Program personnel ensure the review, oversight, and documentation of cultural resources at SNL/TTR. Planning through the NEPA process identifies potential impacts to archaeological sites and historic properties, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, no mitigative actions were required.

Chapter 6 provides information on the Cultural Resource Program.

National Historic Preservation Act, enacted in 1966 and amended in 2000

This act requires federal agencies to identify, record, and protect cultural resources and to assess the impact of proposed projects on historic or culturally important sites, structures, or objects. The regulations in 36 CFR 800, *Protection of Historic Properties* implement the section 106 process for accommodating historic preservation concerns with the needs of Federal undertakings.

Historic buildings and structures may include structures at least 50 years of age that are historically significant or younger structures that are of exceptional significance. Nominations for potentially eligible properties adhere to the implementing regulations in 36 CFR 60, *National Register of Historic Places.*

Compliance Status

Planning through the NEPA process identifies potential impacts to archaeological sites and historic buildings, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, State of Nevada Architectural Resource Assessment forms were prepared for projects proposed at three properties in the previously established SNL/TTR Historic District. These forms support DOE consultations with Nevada State Historic Preservation Office personnel regarding potential effects on historic buildings. Two architectural resource assessment forms were also prepared to support State Historic Preservation Office discussions regarding the two towers demolished in 2017 without consultation.

Chapter 6 provides information on the Cultural Resource Program.

Native American Graves Protection and Repatriation Act, enacted in 1990

This act requires federal agencies and institutions that receive federal funding to inventory their collections, consult with federally recognized Native American entities, and repatriate human remains or cultural items that are discovered or excavated.

Compliance Status

Planning through the NEPA process identifies potential impacts to cultural resource sites, and appropriate documentation is submitted to support mitigation of adverse effects when necessary. In 2019, no cultural items were discovered or excavated.

Chapter 6 provides information on the Cultural Resource Program.

Table 2-2. SNL/TTR applicable EPCRA reporting requirements

Section	EPCRA Section Title	Description
301–303	Emergency Planning	Prepare an annual report that lists chemical inventories above the reportable Threshold Planning Quantities listed in 40 CFR 355 Appendix B, including the location of the chemicals and emergency contacts.
304	Emergency Release Notification	Provide notification of reportable quantity releases of extremely hazardous substances, as defined by CERCLA, to the required entities.
311–312	Hazardous Chemical Inventory	Report on Community Right-to-Know requirements for (1) all hazardous chemicals present at a facility at any one time in amounts equal to or greater than 10,000 pounds and (2) all extremely hazardous substances present at a facility in amounts equal to or greater than 500 pounds or the Threshold Planning Quantity, whichever is lower. A safety data sheet must be available for hazardous chemicals present at the facility.
313	Toxic Release Inventory	Submit a Toxic Release Inventory report to the required entities for facilities that release toxic chemicals listed in SARA Title III over a threshold value.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
EPCRA = Emergency Planning and Community Right-to-Know Act
SARA = Superfund Amendments and Reauthorization Act
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Playa lake, Tonopah Test Range

2.3.2 Nevada State Environmental Regulations

The State of Nevada administers most of the environmental requirements applicable to SNL/TTR (Table 2-3). Specific state administrative requirements include those governing air quality, solid and

hazardous waste management, wildlife, water quality, and radiation control. The EPA administers radionuclide air emissions directly.

Table 2-3. SNL/TTR applicable State of Nevada administrative requirements

Chapter and Provisions	Applicable Sources or Activities
NAC-444, *Sanitation*	
NAC-444.570 to NAC-444.980, Solid Waste Disposal	• Disposal of construction debris • Disposal of routine nonhazardous solid wastes • Disposal of septic sludge • Disposal of hazardous waste • Disposal of PCB • Disposal of asbestos
NRS-444A, *Programs for Recycling*	
NRS-444A.010 to NRS-444A.120, Programs for Recycling	• Recyclables (including waste tires)
NAC-445A, *Water Controls*	
NAC-445A.9656 to NAC-445A.9706, Septic Tanks	• Septic tanks
NAC-445A.228 to NAC-445A.272, Discharge Permits	• Surface water runoff
NAC-445A.450 to NAC-445A. 6731, Public Water Systems	• Water wells • Operator certification • Treatment of water • Distribution of water • Storage structures • Water conservation plan
NAC-445B, *Air Controls*	
NAC-445B.001 to NAC-445B.3477, Air Pollution	• Open burning • Hazardous air pollutants from stacks and vents • Disturbance of soils during construction (particulate matter) • Class II operating permit
NAC-445B.400 to NAC-445B.774, Emissions from Engines	• Generators • Mobile sources
NAC-459, *Hazardous Materials*	
NAC-459.9921 to NAC-459.999, Storage Tanks	• Spill reporting
NAC-477, *State Fire Marshall*	
NAC-477.323, Permit to Store Hazardous Material	• Hazardous material storage
NAC-504, *Wildlife Management and Propagation*	
NAC-504	• Management of all plants and wildlife, including state-listed threatened, endangered, protected, and sensitive species
NAC-534, *Underground Water and Wells*	
NAC-534.010 to NAC-534.500, Underground Water and Wells	• Drilling, construction, operation, and plugging (abandonment) of wells and boreholes

Note: The Nevada Administrative Code is accessed through https://www.leg.state.nv.us/NAC/CHAPTERS.HTML. The Nevada Revised Statute is accessed through https://www.leg.state.nv.us/NRS/.
NAC = Nevada Administrative Code
NRS = Nevada Revised Statute
PCB = polychlorinated biphenyl
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

The Resource Conservation and Recovery Act regulates the generation, transportation, treatment, storage, and disposal of hazardous chemical waste and nonhazardous solid wastes.

2.4 Environmental Permit Status

Environmental permits for SNL/TTR include those for hazardous materials storage, public water supply, stormwater, RCRA, and air-quality compliance. The State of Nevada issues permits for these activities directly to DOE, and Navarro Research and Engineering administers them on behalf of the Sandia management and operating contractor. Sandia and Navarro Research and Engineering ensure that all permit conditions are met. Table 2-4 lists permits and registrations in effect at SNL/TTR in 2019.

Table 2-4. SNL/TTR environmental permits, 2019

Permit Type	Permit Number	Issue Date	Expiration Date	Comments
Air Quality				
Class II Air Quality Operation Permit	• AP 8733-0680.03 • FIN A0025	August 2011 (amended with corrections October 2011 and administratively amended to update Surface Area Disturbance Conditions/Fugitive Dust Control Plan 2014)	July 23, 2016 (permit application submitted to NDEP May 2016, and again with modifications in July 2019; renewal is pending NDEP approval	• Welding operation • Carpenter area • Paint booth • Generators (four logged systems) • Surface area disturbance (less than 5 acres)
Class II General Air Quality Operating Permit for Temporary Construction Sources	• API442-3996.04 • FIN A2118 • Air Case 9739	July 30, 2018	May 7, 2022	
Notification of Issuance of the Class II Change of Location	• Approval #2620 • FIN A2118, • API442-3996.04 • Air Case 9740	July 30, 2018	July 30, 2019	
Hazardous Waste (RCRA)				
Hazardous Waste Generator	NV1890011991[a]	January 7, 1993	Indefinite	State of Nevada
Hazardous Waste (Nevada State Fire Marshal)				
Hazardous Materials Permit	• FDID Number: 13007 • Permit Number: 81414	February 28, 2019	February 29, 2020	State of Nevada
Stormwater Construction General Permit				
TTR Test Unit Recovery Operations	• DOE Number: CSW-41616 • SNL Number: CSW-41615	March 24, 2016	Notice of Termination submitted January 17, 2018	State of Nevada Not required due to "Closed Basin" determination
Production Well (Drinking Water)				
Production Well 6	NY-3014-12-NTNC[b]	August 27, 2018	September 30, 2020	State of Nevada
Permit to Operate a Treatment Plant	NY-3014-TP11-12NTNC	August 27, 2018	September 30, 2020	State of Nevada
Water Conservation Plan	Reviewed and approved by Nevada Department of Conservation and Natural Resources, Division of Water Resources	February 25, 2016	February 24, 2021	State of Nevada Required by NRS540.131

[a] Generator identification number (not a permit number).
[b] The State of Nevada renews the permit for Production Well 6 (NV-3014-12NTNC) annually.
DOE = U.S. Department of Energy
FDID = Fire Department Identification
NDEP = Nevada Division of Environmental Protection
RCRA = Resource Conservation and Recovery Act
SNL = Sandia National Laboratories
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TTR = Tonopah Test Range

2.5 Environmental Performance

Environmental performance is measured as progress toward achieving site environmental objectives, meeting or exceeding compliance, and contributing to corporate and contract performance goals. Results are tracked and reported internally through the ES&H Assurance Dashboard, the management review process, and management reports.

Criteria for performance evaluation were set forth in the *Fiscal Year 2019 DOE/NNSA Strategic Performance Evaluation Measurement Plan (PEMP)* (DOE/NNSA 2019). Subsequently, DOE National Nuclear Security Administration Sandia Field Office prepared the *FY2019 Performance Evaluation Summary* (DOE/NNSA/SFO 2020), assessing the management and operating contractor performance for October 1, 2018, through September 30, 2019. The performance evaluation is the annual DOE National Nuclear Security Administration report card that ascribes a rating to six key performance goals and an overall rating. Sandia received a rating of excellent in three of the six goals: Reduce Nuclear Security Threats; DOE and Strategic Partnership Projects Mission Objectives; and Science, Technology and Engineering. A rating of very good was received in the three remaining categories: Manage the Nuclear Weapons Mission, Operations and Infrastructure, and Leadership. Sandia received an overall rating of very good.

Per DOE, *occurrences* are defined as "events or conditions that adversely affect, or may adversely affect, DOE (including the National Nuclear Security Administration) or contractor personnel, the public, property, the environment, or the DOE mission."

2.5.1 Audits, Appraisals, and Inspections in 2019

Environmental programs are routinely subjected to audits, appraisals, inspections, and/or verifications. Table 2-5 summarizes the 2019 audits, including the findings, notices of violation, and other environmental occurrences. The Sandia internal audit group also conducts assessments, including reviews of implementation of applicable policies, processes, or procedures; evaluations of corrective action validation assessments; and surveillances and walkthroughs. Self-assessments evaluate performance and compliance and identify deficiencies and opportunities for improvement as well as noteworthy practices and lessons learned.

Table 2-5. Environmental-related audits, appraisals, inspections, and violations, 2019

Appraising Entity	Title	Date	Summary
Environmental Systems	Fiscal Year 2020 Environmental Management System Assessment of the Tonopah Test Range	November 11, 2019–December 23, 2019	EMS implementation at SNL/TTR is consistent with the ISO 14001:2015 standard, and environmental aspects are properly managed

EMS = Environmental Management System
ISO = International Organization for Standardization
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

2.5.2 Occurrence Reporting in 2019

Under DOE O 232.2A, *Occurrence Reporting and Processing of Operations Information*, the current order for occurrence reporting, *occurrences* are defined as "events or conditions that adversely affect, or may adversely affect, DOE (including the National Nuclear Security Administration) or contractor personnel, the public, property, the environment, or the DOE mission." Events or conditions meeting the criteria thresholds identified in this order or determined to be recurring through performance analysis are occurrences. Whereas some environmental releases may not meet DOE O 232.2A reporting thresholds, they may still be reportable to outside agencies.

Occurrences that met DOE O 232.2A criteria were entered into the DOE Occurrence Reporting and Processing System database. Corrective actions and closure of occurrence reports are also tracked in the database. For this *Annual Site Environmental Report*, the Occurrence Reporting and

Processing System database was queried for SNL/TTR occurrences in the following reporting criteria groups (as defined by DOE O 232.2A):

- Group 5, Environmental
- Group 9, Noncompliance Notifications
- Group 10, Management Concerns and Issues (with identified environmental impact)
- Any occurrence that involved a Sandia environmental program

Qualifying occurrences that took place within a building are not provided in this report.

During 2019, no occurrences met the query criteria for reporting in the *Annual Site Environmental Report*.

Chapter 3. SNL/TTR Environmental Programs

Coyote (*Canis latrans*)

OVERVIEW ■ Sandia personnel take the responsibility of protecting the environment seriously. Numerous program teams monitor the air, water, and soil at SNL/TTR to help prevent pollution and conserve natural resources.

Sandia personnel collect data at SNL/TTR to determine and report the impact of existing operations on the environment. These environmental program activities meet or exceed federal, state, and local environmental requirements, as well as DOE directives in Sandia's Prime Contract. Presidential executive orders and DOE guidance documents are also used to establish program criteria.

The current environmental programs and focus areas include:

- Air Quality Compliance Program
- Chemical Information System
- Environmental Life-Cycle Management Program
- Environmental Restoration Project
- NEPA Program
- Oil Storage Program
- Terrestrial Surveillance Program
- Waste Management Program
- Water quality programs

The Ecology Program is presented in Chapter 4.

3.1 Air Quality Compliance Program

Air Quality Compliance Program personnel support Sandia in ensuring that operations comply with air quality regulations promulgated by the state and federal government in accordance with the Clean Air Act and the Clean Air Act Amendments of 1990. Program personnel also ensure that operations are compliant with regulatory requirements and the SNL/TTR Class II Air Quality Operating Permit issued by the State of Nevada. In Nye County, the Nevada Department of Environmental Protection implements air quality regulations and standards established by the EPA and the State of Nevada.

3.1.1 Nonradiological Air Emissions

The Class II Air Quality Operating Permit for SNL/TTR requires emission reports from the following permitted significant nonradionuclide sources: a portable screen, a paint booth, a welding shop, a carpentry area, and generators. In 2019, emissions from the permitted sources complied with permitted limits. Table 3-1 summarizes the permitted source emission data for 2019.

Table 3-1. Permitted source emission data, 2019

Carbon Monoxide	Hazardous Air Pollutant	Nitrogen Oxide	Particulate Matter with a Diameter ≤ 10 µm	Sulfur Dioxide	Volatile Organic Compound
1.11E-01	3.61E-03	4.58E-01	3.42E-02	2.57E-02	2.43E-02

Note: All units are in tons per year.

3.1.2 Radionuclide Air Emissions

EPA tracks radionuclide air emissions in accordance with 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities," and has set a maximally exposed individual radiological dose limit of 10 mrem/year resulting from all radiological air emissions produced from any DOE facility. Radionuclide emission releases at SNL/TTR and annual dose assessments are reported in the *Radionuclide National Emission Standards for Hazardous Air Pollutants Annual Report for Calendar Year 2019, Sandia National Laboratories, Tonopah Test Range* (SNL/NM 2019c).

Currently, operations at SNL/TTR do not involve activities that release radioactive emissions from either point sources (stacks and vents). However, diffuse radiological emissions are produced from the resuspension of americium, plutonium, and other radionuclides that are present at the Clean Slate environmental restoration sites (see Section 3.4.2).

Initial radionuclide NESHAP compliance activities included calculating the dose from resuspension of the Clean Slate source term to a maximally exposed individual using the 1988 Clean Air Act Assessment Package dose code. The resuspension calculations were conservative and demonstrated the need for air monitoring at the Clean Slate sites (SNL/NM 1995).

Soil removal activities were concluded at Clean Slate II in 2019. In September 2018, remediation activities began at Clean Slate III and continued through 2019. These activities included soil disturbance, excavation, soil removal, and packaging and shipping contaminated soil and debris (see Section 3.4.3). Using soil data derived from the Clean Slate sites (DOE/NV/EMNP 2017a; DOE/NV/EMNP 2017b) provided in Table 3-2, the dose to the maximally exposed individual was determined using the Clean Air Act Assessment Package dose code to evaluate applicability with radiological NESHAP guidelines. Data from an ambient air sampler, Station 400 (Chapman et al. 2020 in progress) (Table 3-3), was compared to the modeled maximally exposed individual to ensure model accuracy. Detailed presentation and discussion of the air monitoring results for the Clean Slate

monitoring stations is provided in an annual report, *Tonopah Test Range Air Monitoring: CY 2019 Meteorological, Radiological, and Wind Transported Particulate Observations* (Chapman et al. 2020 in progress). A summary of air monitoring stations and 2019 results is provided in Appendix A, "SNL/TTR Air Monitoring Stations in 2019."

The Nellis USAF airport, located off-site and to the west of SNL/TTR, is currently used as the location of the maximally exposed individual. The dose to the non-Sandia public maximally exposed individual was calculated to be 1.60E-06 mrem/year from soil data from Clean Slate II and Clean Slate III. The calculated dose from air monitoring data was determined to be 3.20E-11 mrem/year from Station 400. Both values are significantly below the EPA annual dose limit of 10 mrem/year.

Table 3-2. Clean Slate II and Clean Slate III soil sampling results

Source, Name, Location	Description	Source Type	Monitoring Method	Radionuclide	Releases (Curies)
Soil Disturbance at Clean Slate II Site	Approximately 5 acres of soil was disturbed	Area	Calculated	Americium 241	3.82E-08
				Cesium 137	9.20E-11
				Plutonium 238	4.38E-09
				Plutonium 239	4.38E-07
				Plutonium 240	1.03E-07
				Plutonium 241	4.33E-06
				Thorium 232	9.17E-11
				Uranium 234	8.53E-11
				Uranium 235	2.60E-11
				Uranium 238	2.73E-10
Soil Disturbance at Clean Slate III Site	Approximately 16.6 acres of soil was disturbed	Area	Calculated	Americium 241	4.97E-08
				Americium 243	1.08E-09
				Cesium 137	1.31E-11
				Plutonium 238	4.73E-09
				Plutonium 239	5.77E-07
				Plutonium 240	1.35E-06
				Plutonium 241	5.66E-07
				Thorium 232	1.29E-09
				Uranium 234	1.02E-10
				Uranium 235	3.12E-11
				Uranium 238	3.27E-10

Table 3-3. Air monitoring results, 2019

Source, Name, Location	Description	Source Type	Monitoring Method	Radionuclide	Measured Maximum Average (µCi/mL)
Station 400	Quarterly data is averaged	Measured	Periodic (twice quarterly)	Plutonium 238	9.35E-17
				Plutonium 239	9.28E-17

3.1.3 Other Air Quality Monitoring Activities at SNL/TTR

In addition to Sandia environmental program personnel, other entities perform environmental monitoring activities at SNL/TTR as described in the following sections.

U.S. Environmental Protection Agency

The EPA Environmental Monitoring Systems Laboratory in Las Vegas, Nevada, monitored background radiation in the area of SNL/TTR as part of its Off-Site Radiation Monitoring Reports Program (EPA 1999), which is now conducted by Desert Research Institute (DRI).

Desert Research Institute of the Nevada System of Higher Education

DRI personnel train and provide monitoring station managers through the Community Environmental Monitoring Program to collect samples from off-site air monitoring stations at 23 locations within communities surrounding the Nevada National Security Site. These include the towns of Tonopah and Goldfield, which are near SNL/TTR. DRI, the environmental research arm of the Nevada System of Higher Education, maintains the air-monitoring equipment and sends a quarterly sample of collected air filters from each station to Eurofins TestAmerica Laboratories in St. Louis, Missouri, for analysis and reporting of gross alpha activity, gross beta activity, and gamma spectroscopy of individual filters. Stations also record real-time gamma readings measured in a pressurized ion chamber, and an environmental dosimeter is analyzed quarterly to confirm gamma readings.

DRI provides external quality assurance on samples collected at Community Environmental Monitoring Program stations through duplicate sampling of 10 percent of the station samples. Duplicate samples are analyzed at the University of Nevada, Las Vegas radioanalytical laboratory. Data collected at the monitoring stations are reported in the Nevada National Security Site *Annual Site Environmental Report*.

Five DRI portable monitoring stations were in use at SNL/TTR in 2019, modeled in part after the Community Environmental Monitoring Program stations:

- Station 400 is located near the SNL/TTR Range Operations Center.
- Stations 401 and 403 are located near Clean Slate III.
- Stations 404 and 405 are located near Clean Slate II (see Section 3.4.3).

3.2 Chemical Information System

The Chemical Information System is a comprehensive chemical information tool used to track workplace chemical and biological containers by location. The primary drivers for the Chemical Information System are state and federal regulations, including the Emergency Planning and Community Right-to-Know Act. The Chemical Information System compiles information concerning chemical hazards and appropriate protective measures for the workforce, Emergency Management Operations, and other ES&H programs.

The inventory system provides the chemical or product name, its location and quantity, and information about who is responsible for the chemical. Chemical hazards are reported on safety data sheets, and the Chemical Information System currently contains more than 120,000 safety data sheets in its library. This electronic inventory helps chemical users and their managers assess and manage workplace hazards. Easy access to this inventory facilitates availability searches. It also improves the ability to share chemicals and thus help reduce sources, which helps to minimize chemical purchases and waste disposal expenses.

A pre-procurement module, ChemPro, is used to request permission for new chemical purchases. The system runs a series of queries, comparing the requested purchasing information to regulatory limits, and determines whether the requested chemical and volume is approved for use and storage in the specified location. If approved, the requestor is given a chemical approval number, which must be provided to the chemical vendor as part of the purchasing process. ChemPro allows for proactive environmental and safety planning.

3.3 Environmental Life-Cycle Management Program

Environmental Life-Cycle Management Program activities ensure long-term protection of human health and the environment. Using the NEPA process, program personnel review proposed SNL/TTR projects and activities that have the potential to impact the environment. This review provides a process for minimizing adverse environmental impacts from ongoing and future activities. In 2019, environmental impacts of three projects were reviewed and documented.

3.4 Environmental Restoration Project

Environmental restoration activities were initiated at SNL/TTR and the Nevada Test and Training Range in 1980 to address contamination resulting primarily from nuclear weapons testing and related support activities. DOE is responsible for all SNL/TTR and Nevada Test and Training Range environmental restoration sites.

Since 1996, cleanup activities for selected sites located in the State of Nevada have been regulated by the Federal Facility Agreement and Consent Order of 1996, as amended (see Chapter 2). The Order was negotiated between the State of Nevada, DOD, and DOE (DOD, DOE, and State of Nevada 1996).

The Federal Facility Agreement and Consent Order took effect in 1996 and accomplished the following:

- Established a framework for identifying Corrective Action Sites
- Grouped Corrective Action Sites into Corrective Action Units
- Prioritized Corrective Action Units for remediation
- Implemented corrective action activities

Three environmental restoration activities are addressed by Corrective Action Units located at SNL/TTR and the Nevada Test and Training Range:

- Industrial sites activity occurs at sites historically used to support nuclear testing and Sandia activities. Industrial sites include historical septic tank systems, landfills, sewage lagoons, depleted uranium sites, and ordnance testing sites.
- **Long-term monitoring activity occurs** at areas where closed Federal Facility Agreement and Consent Order sites have land use restrictions or contamination left in place and require some form of post-closure monitoring.
- **Soil activity occurs** at areas where nuclear testing has resulted in surface and/or shallow subsurface soil contamination. Soil sites include large-area soil contamination from plutonium dispersal testing.

Environmental restoration site contamination includes radiological constituents (e.g., depleted uranium and plutonium) and nonradiological constituents (e.g., munitions, solvents, pesticides, septic sludge, and heavy metals).

3.4.1 Corrective Action Site Identification

The initial identification, description, and listing of Corrective Action Sites at SNL/TTR and the Nevada Test and Training Range were derived from the Preliminary Assessment and the Federal Facility Preliminary Assessment Review (E&E 1989). Twelve additional potential Corrective Action Sites, not included in the Preliminary Assessment, were identified, thereby increasing the total number of Corrective Action Sites to 70 using the following methods: environmental restoration site inventory processes, ordnance removal activities, geophysical surveys, former worker interviews, archive reviews, site visits, and aerial radiological and multispectral surveys.

In 2019, activities at the Clean Slate and Double Tracks sites (Operation Roller Coaster) continued. These sites are listed under soil Corrective Action Units/Corrective Action Sites in Table 3-4 as CAU 411, CAU 412, CAU 413, and CAU 414. Project 57 (located on Nellis Range 4808A) and Small Boy (located on the Nevada Test and Training Range) are listed as CAU 415 and CAU 541, respectively, in Table 3-4. In previous years, CAU 411, CAU 412, CAU 413, CAU 415, and CAU 541 were closed, and CAU 414 was closed in 2019. A listing of Corrective Action Units/Corrective Action Sites is available in Federal Facility Agreement and Consent Order appendices II, III, and IV (DOD, DOE, and State of Nevada 1996).

Table 3-4. Status of remediation activities at SNL/TTR, 2019

Corrective Action Site Number	Corrective Action Site Description	General Location
CAU 411— *Closed.* Double Tracks plutonium dispersion (NAFR)		
NAFR-23-01	Pu contaminated soil	Nellis Range 71N
CAU 412— *Closed.* Clean Slate I plutonium dispersion (SNL/TTR)		
TA-23-01CS	Pu contaminated soil	Tonopah Test Range
CAU 413—*Closed.* Clean Slate II plutonium dispersion (SNL/TTR)		
TA-23-02CS	Pu contaminated soil	Tonopah Test Range
CAU 414— *Closed.* Clean Slate III plutonium dispersion (SNL/TTR)		
TA-23-03CS	Pu contaminated soil	Tonopah Test Range
CAU 415—*Closed.* Project 57 No. 1 plutonium dispersion (Nevada Test and Training Range)		
NAFR-23-02	Pu contaminated soil	Nellis Range 13
CAU 541—*Closed.* Small Boy		
05-23-04	Atmospheric tests (six), BFa[a] site	BFa, Nevada Test and Training Range
05-45-03	Atmospheric test site, Small Boy	Frenchman Flat, Area 5, Nevada Test and Training Range

[a] BFa is the site name and not an acronym.
CAU = Corrective Action Unit
NAFR = Nellis Air Force Range
Pu = plutonium
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TA = technical area

Air samples were also collected throughout the year at various locations on SNL/TTR and the Nevada Test and Training Range and are summarized in Section 3.4.3.

3.4.2 History of Double Tracks and Clean Slate Sites

Operation Roller Coaster, conducted in May and June 1963, subjected a series of four nuclear devices to chemical explosions, which resulted in plutonium dispersal in surrounding soils. Three of these tests were conducted within the boundaries of SNL/TTR; the fourth was conducted at the Nevada Test and Training Range just west of SNL/TTR. The three Operation Roller Coaster test sites at SNL/TTR are referred to as Clean Slate I, Clean Slate II, and Clean Slate III. The fourth test site is referred to as Double Tracks. In 1996 and 1997, interim corrective actions were performed at

Double Tracks and Clean Slate I. In 2016, DOE completed the remaining corrective actions at Double Tracks and Clean Slate I, and the Nevada Division of Environmental Protection approved the Final Closure Report. These two sites have been determined to be Clean Closed as defined in the Federal Facility Agreement and Consent Order. Clean Slate II and Clean Slate III were Clean Closed in 2018 and 2019, respectively. These sites are presently fenced and have radiological signage posted.

DOE is responsible for remediation of these and all other environmental restoration sites at SNL/TTR. DOE and Sandia personnel will continue to be responsible for all other environmental compliance at these sites.

Bighorn Sheep (*Ovis canadensis*)

3.4.3 Environmental Restoration Project Activities in 2019

Soil removal activities were concluded at Clean Slate II in 2019. In September 2018, remediation activities began at Clean Slate III. These activities included soil excavation, soil removal, and packaging and shipping contaminated soil and debris. Approximately 8,250 cubic yards of contaminated soil and debris was shipped to the Nevada National Security Site for disposal in 2019. DOE manages all waste generated from environmental restoration activities at SNL/TTR.

Other environmental restoration activities conducted on the SNL/TTR and the Nevada Test and Training Range sites in 2019 consisted of the annual post-closure inspections of closed and use-restricted industrial sites and the inspections of radiological postings at the Clean Slate and Double Tracks sites. The inspections were conducted during the summer of 2019.

3.4.4 Air Monitoring at Environmental Restoration Sites

Remediation activities were conducted at Clean Slate I in 1997. DRI personnel collected air monitoring data from several locations in the vicinity of Clean Slate I before, during, and after remediation activities. The data were presented to DOE in the form of a draft report (DRI 1997). The report documented the as-left condition at the site but did not require follow-up action.

During 2019, at the request of DOE, DRI maintained five portable environmental monitoring stations at SNL/TTR as part of Project Soils, an environmental restoration activity (Figure 3-1). The primary objective of the monitoring stations is to evaluate whether, and under what conditions, there is wind transport of radiological contaminants from any of the soil Corrective Action Units associated with Operation Roller Coaster at SNL/TTR.

The SNL/TTR monitoring stations collect data on selected meteorological and environmental parameters (e.g., wind speed, wind direction, and airborne particulate concentration as a function of particulate size). In addition, airborne particulate samplers are deployed at each location to collect

particulate samples for radiological analyses. Data are provided to the Western Regional Climate Center for management and incorporation into a SNL/TTR-specific database.

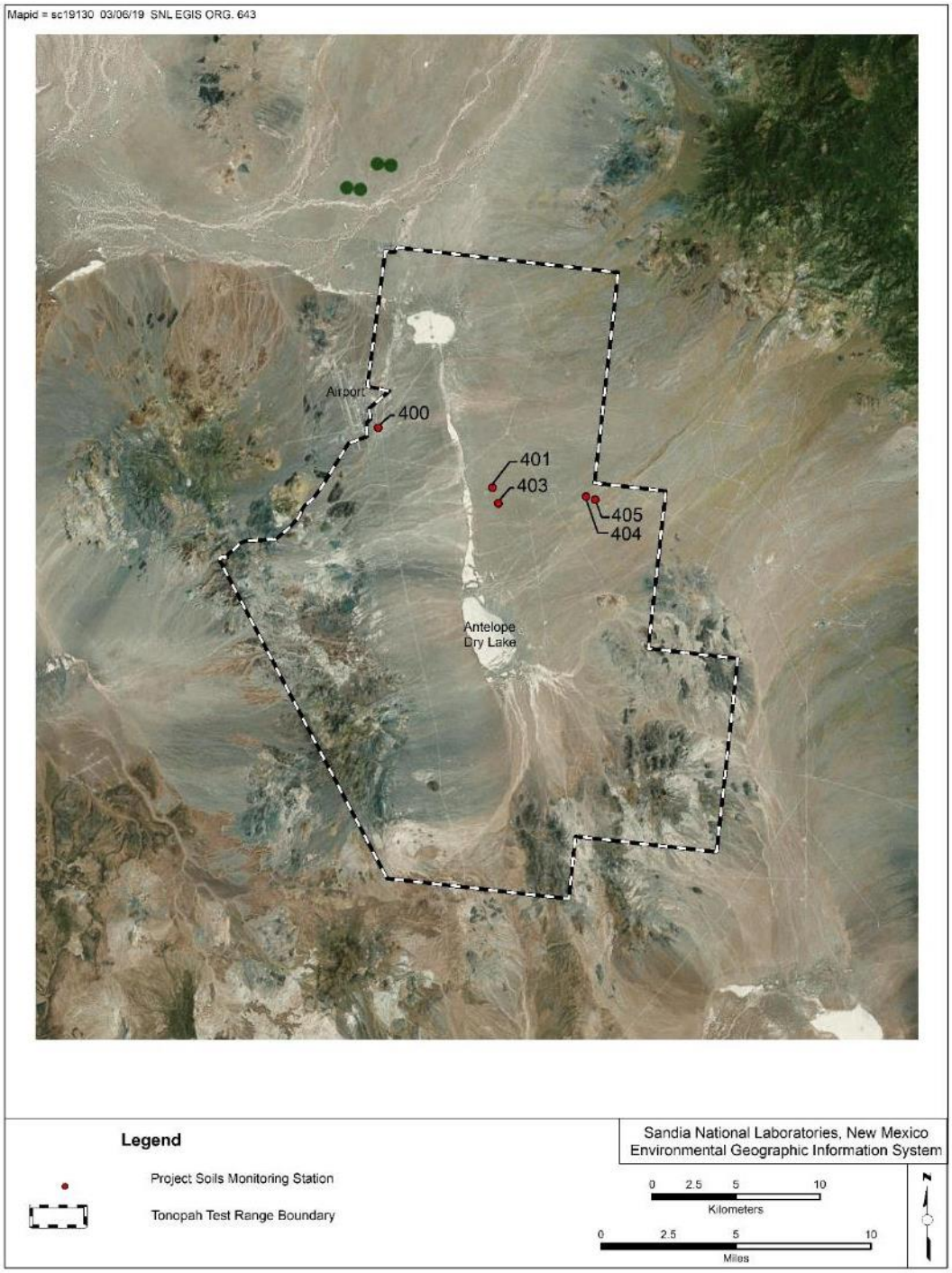

Figure 3-1. Project Soils air monitoring station locations

Monitoring Station Locations

Monitoring Station 400 was established in 2008 and is located in the general vicinity of the SNL/TTR Range Operations Center. It measures potential radionuclide concentrations associated with airborne particulates at the location closest to regular site workers. Station 401 was also installed in 2008 and is located on the fenced perimeter of the north edge of Clean Slate III. Station 401 was relocated on June 6, 2018, from the northwestern boundary of Clean Slate III to the northeastern boundary of Clean Slate III. Station 403, installed in 2017, is also adjacent to Clean Slate III, on the fenced perimeter on the south side. Two monitoring stations were installed at Clean Slate II in 2017; Station 404 is on the fenced perimeter of the north side, and Station 405 is on the fenced perimeter on the south side. The stations at Clean Slate III and Clean Slate II measure the radionuclide concentration associated with airborne particulates at the boundaries of the sites in the predominant downwind directions.

The orientations of the station locations relative to the Clean Slate sites were initially selected based on a review of wind speed and direction data collected at the Tonopah Airport (Engelbrecht et al. 2008) as well as for ease of access. Though the Tonopah Airport wind data are of limited time duration, the topographic setting is more similar to the Clean Slate sites than stations with longer periods of record located within the town of Tonopah. On-site wind direction measurements have since confirmed the appropriateness of the station locations. Figure 3-1 shows the location of the monitoring stations at SNL/TTR.

Monitoring Station Capabilities

Station 400 uses line power to operate the instruments. Stations 401, 403, 404, and 405 are solar-powered with battery backup power; the batteries are recharged during daylight hours by solar panels. All five stations consist of two primary components: an air sampler and an auxiliary meteorological tower.

All five monitoring stations are equipped with continuous air particulate samplers having a flow rate of 1.75 cubic feet per minute. The 4-inch glass-fiber air filters were replaced with 2-inch glass-fiber air filters at all five stations on January 16, 2019, in response to a laboratory equipment change to the 2-inch industry standard filter size. The associated flow rate was reduced from 2 cubic feet per minute to 1.75 cubic feet per minute to accommodate the smaller filters. Filters are collected routinely every two weeks for laboratory analysis. These filters are initially delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas for analyses. Standard analyses include gross alpha and gross beta measurements and gamma spectral analysis; samples may undergo alpha spectral analysis if initial gamma results indicate the presence of americium-241, which could indicate that plutonium particles are being transported. Two samples are selected quarterly from each station to undergo alpha spectroscopy analysis for Pu-238 and Pu-239/240 by Eurofins TestAmerica Laboratories in St. Louis, Missouri.

Detailed presentation and discussion of the air monitoring results for the Clean Slate monitoring stations is provided in an annual report, *Tonopah Test Range Air Monitoring: CY 2019 Meteorological, Radiological, and Wind Transported Particulate Observations* (Chapman et al. 2020 in progress). A summary of air monitoring stations and 2019 results is provided in Appendix A, "SNL/TTR Air Monitoring Stations in 2019."

3.5 National Environmental Policy Act Program

NEPA Program personnel provide technical assistance to ensure that operations comply with NEPA and the National Historic Preservation Act. For proposed projects and activities, project owners complete a NEPA checklist using NEPA Docs software to assess potential environmental impacts.

After a NEPA checklist is completed, NEPA Program personnel review projects and activities for conformance with existing DOE NEPA documents and determinations. Other applicable environmental subject matter experts also review proposed projects and activities to determine and communicate any applicable permitting and/or other requirements.

Personnel from SNL/TTR and the SNL/NM NEPA team support projects at SNL/TTR, including ES&H preparations for the next series of B61-12 flight tests. This support includes continued collaboration with the DOE National Nuclear Security Administration Sandia Field Office, SNL/TTR, SNL/NM, and Los Alamos National Laboratory personnel.

In 2019, the NEPA team completed ten NEPA checklists for SNL/TTR, eight of which were transmitted to the DOE National Nuclear Security Administration Sandia Field Office for review and completion.

TTR sunrise

3.6 Oil Storage Program

The Oil Storage Program supports regulatory compliance associated with the management, operation, and maintenance of oil storage containers and equipment at SNL/TTR. As required by 40 CFR 112, *Oil Pollution Prevention*, and the Clean Water Act, SNL/TTR personnel maintain and implement a Spill Prevention, Control, and Countermeasure Plan (SNL/NM 2014b), which describes the oil storage facilities at the SNL/TTR site and the mitigation controls in place to prevent inadvertent discharges of oil.

In 2019, the inventory of oil storage containers operating under the SNL/TTR Spill Prevention, Control, and Countermeasure Plan included eight stationary aboveground storage tanks, two mobile refuelers (one truck and one trailer), a bulk storage area for drums, a transformer storage area, and numerous mobile generators. These oil storage containers and equipment are inspected monthly, per the SNL/TTR Spill Prevention, Control, and Countermeasure Plan. Any issues identified during the

inspections are corrected promptly or are tracked via the work request process. No underground oil storage containers are in use at SNL/TTR.

The SNL/TTR Spill Prevention, Control, and Countermeasure Plan received a comprehensive five-year review in 2019, as required by 40 CFR 112, *Oil Pollution Prevention*.

During the review and amendment process, it was determined that SNL/TTR oil storage facilities are not subject to 40 CFR 112 regulation due to the location of all oil storage containers and equipment within a hydrologically closed basin with no potential to impact waters of the United States. As a result, implementation and maintenance of the SNL/TTR Spill Prevention, Control, and Countermeasure Plan was terminated at the end of 2019. While no further Oil Storage Program support will be required at SNL/TTR beginning in 2020, site personnel will continue to perform monthly inspections of oil storage containers and equipment to ensure a continued operational condition and to monitor for potential spills or releases to the environment as a best management practice.

There were no reportable oil spills or releases at SNL/TTR in 2019.

3.7 Terrestrial Surveillance Program

Terrestrial Surveillance Program personnel collect environmental media (soil) samples, which are analyzed for radiological constituents, as required. As a best management practice, samples are also collected to analyze metals.

In addition to the environmental media samples collected, ambient external gamma radiation levels are measured using environmental dosimeters. These surveillance activities are conducted at designated locations that are on-site, off-site, and around the perimeter of SNL/TTR. Soil sampling is conducted annually, and the dosimeters are collected and exchanged quarterly.

Terrestrial surveillance began at SNL/TTR in 1992. A large-scale baseline sampling was conducted from 1994 through 2005 and reported in *Chemical Analyses of Soil Samples Collected from the Sandia National Laboratories, Tonopah Test Range Environs, 1994–2005* (SNL/NM 2006). In 2000, a single analytical laboratory was contracted, which provided lower detection capabilities than those previously available for many of the metals.

Soil is loose, unconsolidated mineral or organic materials on the immediate surface of the earth that support plant growth. *Sediment* is particles or aggregates derived from rocks, soil, or biological material that is subsequently transported and deposited. *Vegetation* is plant life or the total plant cover of an area.

3.7.1 Regulatory Criteria

The Terrestrial Surveillance Program is designed and conducted to address DOE O 458.1, Admin Change 3, *Radiation Protection of the Public and the Environment,* which establishes standards and requirements to protect the public and the environment from undue risk from radiation associated with radiological activities under the control of DOE.

The Terrestrial Surveillance Program is also conducted to satisfy implementation of Sandia's EMS, which is certified to ISO 14001:2015, *Environmental Management Systems – Requirements with Guidance for Use*. Reporting is done in accordance with DOE O 231.1B, Admin Change 1, *Environment, Safety and Health Reporting*.

3.7.2 Sample Locations and Media

Terrestrial Surveillance Program personnel use three sample location classifications: on-site, perimeter, and off-site (the latter previously referred to as "community" locations). Sampling locations have been selected based on locations of previous and ongoing activities. Environmental dosimeters, deployed and collected quarterly, are used to measure cumulative ambient external radiation dose and to approximate the dose potentially received from natural and unnatural sources.

The on-site sample locations (Table 3-5, Figure 3-2) are in areas of known contamination: corrective action sites and areas of potential release (sites with current outdoor testing activities). In 2019, soil sampling location S-51 was discontinued (discussed in Section 3.7.5).

Table 3-5. SNL/TTR on-site terrestrial surveillance locations, sample media, and parameters

Surveillance Location	Location Number	Sample Location	Soil[a]	Dosimeter[b]
Range Operations Center	S-40	Wastewater monitoring station	X[c]	
	S-41	"Danger Powerline Crossing" sign	X[c]	
	S-42	Main Road/Edward's Freeway	X[c]	
	S-43	Range Operation Center (southwest corner)	X[c]	
	S-44	Range Operation Center (northeast corner)	X[c]	
	S-45	Storage shelters 03-38 and 03-39	X[c]	
	S-46	Sand Building	X[c]	
	S-47	Generator storage area	X[c]	
South Plume Area	S-49	North/south Mellan Airstrip–southwest of S-48	X[d]	
	S-50	North/south Mellan Airstrip–signpost	X[d]	
	S-51	North/south Mellan Airstrip–northeast of S-50	Location discontinued in 2019	
	S-52	Northeast of Mellan Airstrip	X[d]	
Various on-site	S-01	Antelope Lake area fence, cultural area sign	X[d]	X
	S-02	North/south Mellan Airstrip (south fencepost)	X[d]	X
	S-03	Dosimeter at Clean Slate I	X[d]	X
	S-04	Dosimeter at Clean Slate III	X[d]	X
	S-09	Roller Coaster Decontamination Area	X[d]	X
	S-10	Browns Road/Denton Freeway	X[d]	X
	S-13	Area 3 between Building 100 and "Caution" sign		X
	S-14	Area 3 control point southwest side of fence		X
	S-15	Moody Avenue by cattle guard and entrance to chow hall and airport		X
	S-16	Area 9, near Well 7		X
	S-17	Main Lake–south, near Neutron Bunkers		X
	S-38	Mellan Hill–Rock Mound/Orange Block	X[d]	
	S-39	Mellan Hill–north	X[d]	
	S-53	Main Road/Lake Road southeast	X[d]	

[a] Soil samples are analyzed for radionuclides by gamma spectroscopy annually.
[b] Dosimeters are analyzed for dose from ambient gamma radiation.
[c] Soil samples are analyzed for Target Analyte List metals every five years (not sampled in 2019).
[d] Soil samples are analyzed for Target Analyte List metals annually.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

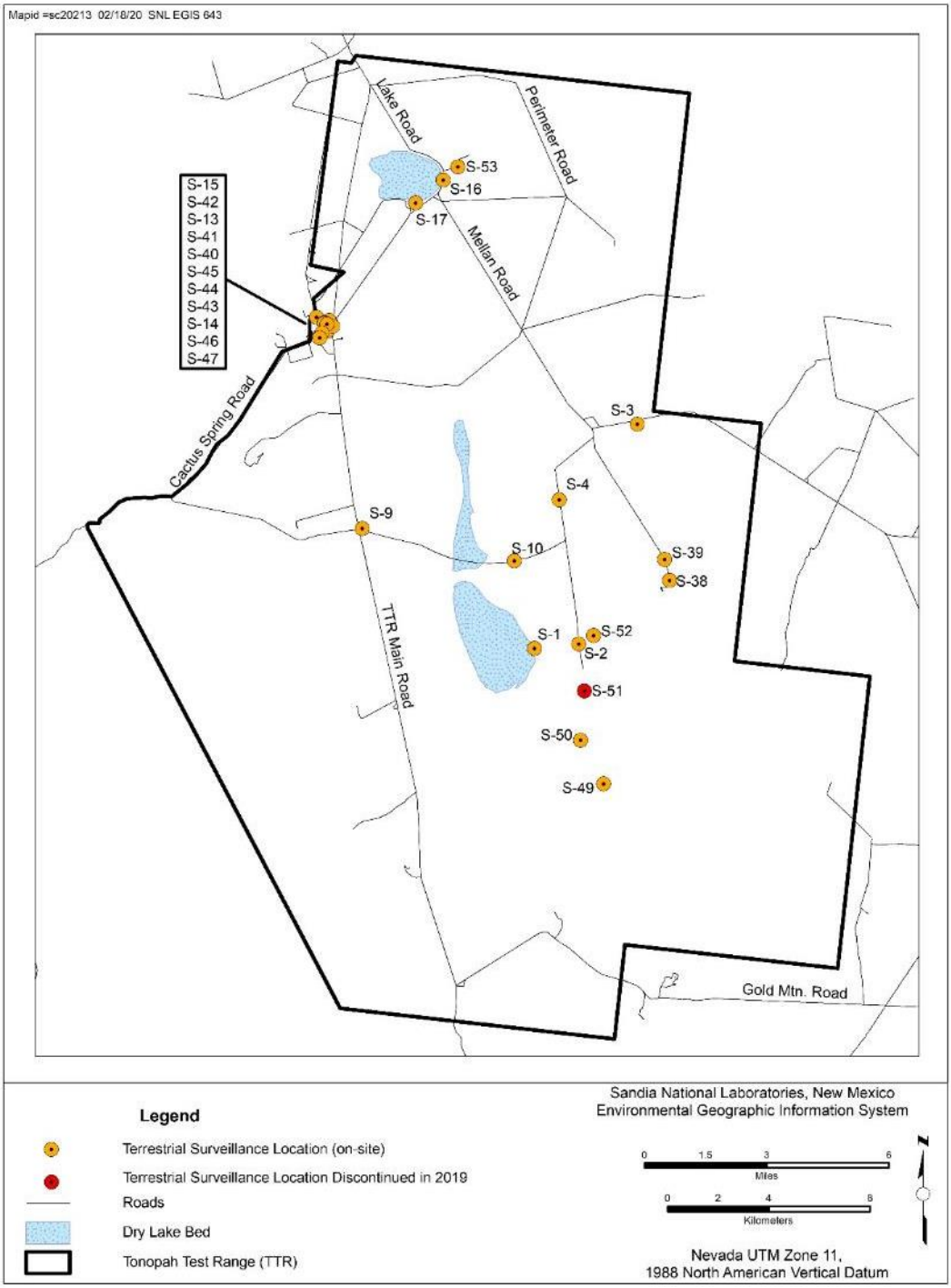

Figure 3-2. SNL/TTR on-site terrestrial surveillance locations

Perimeter sample locations (Table 3-6, Figure 3-3) are located around the boundaries of SNL/TTR. Off-site sample locations (Table 3-7, Figure 3-4) are in remote areas, areas near local population, and along major roadways.

Table 3-6. SNL/TTR perimeter terrestrial surveillance locations, sample media, and parameters

Surveillance Location	Location Number	Sample Location	Soil[a,b]	Dosimeter[c]
Perimeter	P-05	Operation and Maintenance Complex–Site 4 entrance gate		X
	P-06	Cedar Pass Road guard station	X	X
	P-07	On-base housing–south of power pole 55-11		X
	P-08	On-base housing (main guard gate/power pole CP17)	X	X
	P-11	Cactus Springs (dosimeter south of P-35)	X	X
	P-12	Dosimeter at "U.S. Government Property" sign	X	X
	P-34	Operation and Maintenance Complex–Owan Drive post	X	
	P-35	Cactus Springs (north fencepost)	X	
	P-36	On-base housing (northeast fence line)	X	
	P-37	On-base housing (guard station)	X	

[a] Soil samples are analyzed for radionuclides by gamma spectroscopy annually.
[b] Soil samples are analyzed for Target Analyte List metals every five years (not sampled in 2019).
[c] Dosimeters are analyzed for dose from ambient gamma radiation.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
U.S. = United States

Table 3-7. SNL/TTR off-site terrestrial surveillance locations, sample media, and parameters

Surveillance Location	Location Number[a]	Sample Location	Soil[b,c]	Dosimeter[d]
Off-site	C-19	Mining Museum, north Goldfield		X
	C-20	State Road 6 rest area	X	
	C-21	State roads 6 and 95 Ely rest area	X	X
	C-22	Rocket	X	X
	C-23	Alkali and Silver Peak turnoff	X	
	C-24	Cattle guard	X	
	C-25	Tonopah Rangers Station	X	
	C-26	Gabbs Pole Line Road	X	
	C-27	State roads 6 and 376 junction	X	
	C-28	Stone Cabin and Willow Creek on State Road 6	X	
	C-29	State roads 6 and 375 junction	X	
	C-30	State Road 375 ranch cattle gate	X	
	C-31	Golden Arrow and Silver Bow on State Road 6	X	
	C-32	Mile marker 6 on Sandia Drive	X	
	C-33	Mile marker 10 on Sandia Drive	X	

[a] Off-site samples were previously called "community" samples, thus the *C* label in the location number (maintained for the database).
[b] Soil samples are analyzed for radionuclides by gamma spectroscopy annually.
[c] Soil samples are analyzed for Target Analyte List metals every five years (not sampled in 2019).
[d] Dosimeters are analyzed for dose from ambient gamma radiation.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

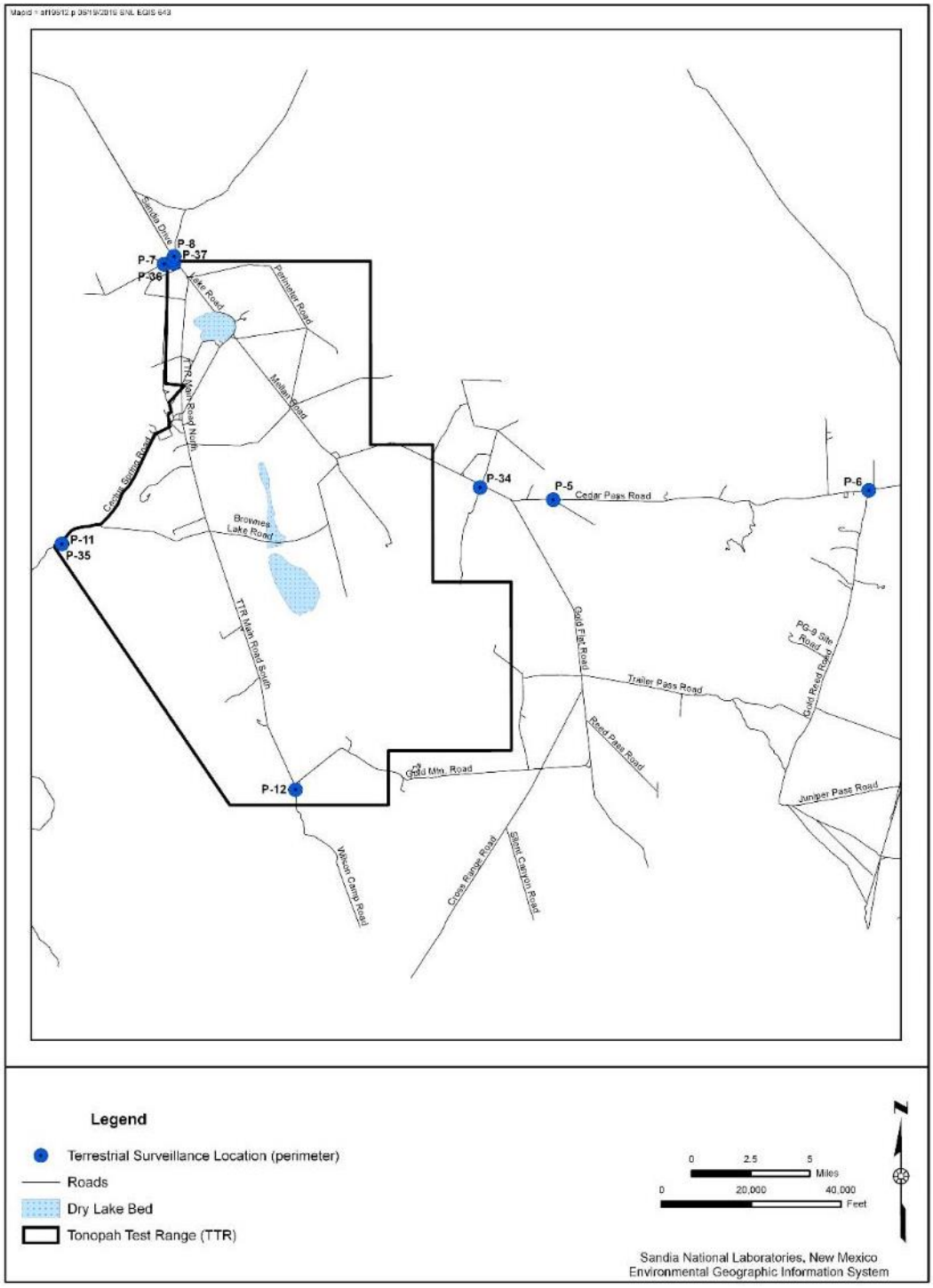

Figure 3-3. SNL/TTR perimeter terrestrial surveillance locations

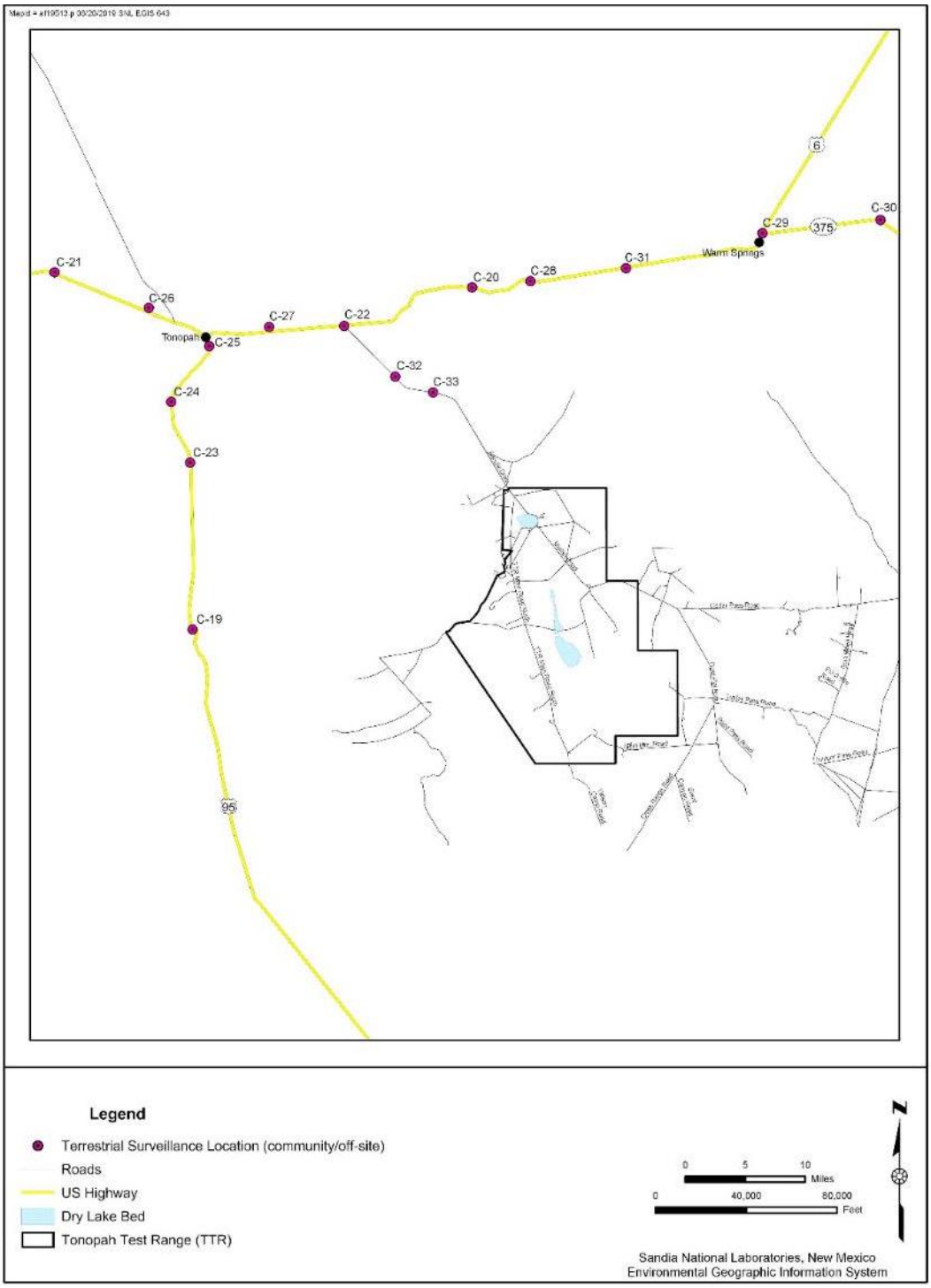

Figure 3-4. SNL/TTR off-site terrestrial surveillance locations

3.7.3 Field Methods, Analytical Parameters, and Quality Control Procedures

All samples were collected in accordance with applicable field operating procedures for soil sampling activities and with the *Quality Assurance Project Plan for Terrestrial Surveillance at Sandia National Laboratories, New Mexico* (SNL/NM 2016).

Off-site laboratories analyzed all samples in accordance with applicable EPA analytical methods. All chemical data were reviewed and qualified in accordance with *Data Validation Procedure for Chemical and Radiochemical Data* (SNL/NM 2014a).

Soil samples were analyzed for modified Target Analyte List metals and radiological parameters, including gamma-emitting radionuclides and plutonium. Details of the radiological parameters pertinent to SNL/TTR are as follows:

- **Gamma-emitting radionuclides:** Gamma spectroscopy is used to detect the emission of gamma radiation from radioactive materials. Radionuclide identification is possible by measuring the spectrum of gamma energies associated with a sample, since each radionuclide has a unique and consistent series of gamma emissions. Cesium-137 is an example of a long-lived gamma emitter that is prevalent in the environment at SNL/TTR (as fallout from historical nuclear weapons testing in that area). Other gamma emitters of interest at SNL/TTR are americium-241 and depleted uranium from past explosives testing.
- **Plutonium:** Due to past explosives testing, plutonium is present in some limited areas at SNL/TTR. One indicator of the presence of weapons-grade plutonium is the radionuclide americium-241. Isotopic plutonium analysis is performed on any sample for which gamma spectroscopy identified americium-241 in concentrations greater than its minimum detectable activity.

In 2019, the use of optically stimulated luminescent dosimeters was employed to measure ionizing radiation. The dosimeters are issued and analyzed by an accredited off-site laboratory.

Field-quality control samples collected at SNL/TTR included triplicate environmental samples. These samples were prepared in accordance with applicable field operating procedures. Laboratory-quality control samples were prepared and analyzed as specified in accordance with established methods.

The *environment* is the sum of all external conditions affecting an organism's life, development, and survival.

3.7.4 Data Analysis and Methodology

The statistical analyses methodology performed on sample results is being revised. Therefore, general statistics, population comparisons, and trend analysis were not conducted. However, comparisons of results for samples collected in 2019 to available reference values and previous years were made.

There are no regulatory limits with which to compare concentrations of radiological constituents in surface soils.

Environmental dosimeter data may be compared to established natural background (terrestrial and cosmic) radiation levels in the non-urban areas of Nevada. Levels in these areas are elevated when compared to much of the United States due to the higher elevation and the presence of radionuclides in the soil and bedrock. The radiation dose from natural background sources (indoor radon not included) in non-urban areas of Nevada is 71 mrem/year (Mauro and Briggs 2005).

Analytical results for metals in soil samples may be compared to values in the following references (presented in Table 3-8):

- Local and regional soil concentrations (Dragun and Chekiri 2005)
- EPA risk-based soil screening levels (EPA 2019)
- United States surface soil concentrations (Kabata-Pendias 2000)

Table 3-8. Comparison reference values for metals in soil at SNL/TTR

Analyte	Nevada Soil Concentrations[a]		EPA Risk-Based Soil Screening Levels[b]		U.S. Soil Concentrations[c]	
	Lower Limit (mg/kg)	Upper Limit (mg/kg)	Residential (mg/kg)	Industrial (mg/kg)	Lower Limit (mg/kg)	Upper Limit (mg/kg)
Aluminum	5,000	100,000	77,000	1,100,000	4,500	100,000
Antimony	< 1.0	1.0	31	470	0.25	0.60
Arsenic	2.9	24	0.68	3.0	1	93
Barium	150	3,000	15,000	220,000	20	1,500
Beryllium	ND	5.0	160	2,300	0.04	2.54
Cadmium	ND	11	—	—	0.41	0.57
Calcium	600	320,000	—	—	—	—
Chromium (III)	7.0	150	120,000	1,800,000	7	1,500
Cobalt	ND	20	23	350	3	50
Copper	7.0	150	3,100	47,000	3	300
Iron	1,000	100,000	55,000	820,000	5,000	50,000
Lead	ND	70	400	800	10	70
Magnesium	300	100,000	—	—	—	—
Manganese	30	5,000	1,800	26,000	20	3,000
Nickel	5.0	50	1,500	22,000	5	150
Potassium	1,900	63,000	—	—	—	—
Selenium	< 0.1	1.1	390	5,800	0.10	4.0
Silver	0.5	5.0	390	5,800	0.20	3.2
Sodium	500	100,000	—	—	—	—
Strontium	100	1,500	47,000	700,000	7	1,000
Thallium	—	—	0.78	12	0.02	2.8
Uranium	1.9	4.2	16	230	0.30	10.7
Vanadium	30	150	390	5,800	0.7	98
Zinc	25	128	23,000	350,000	13	300

[a] Dragun and Chekiri 2005.
[b] EPA (Target Hazard Quotient = 1.0) 2019.
[c] Kabata-Pendias 2000.
— = not available
EPA = U.S. Environmental Protection Agency
ND = not detected
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
U.S. = United States

3.7.5 Terrestrial Surveillance Program Results in 2019

The following Terrestrial Surveillance Program activities occurred in 2019:

- The annual sampling of soil at on-site locations occurred in June 2019 at designated locations.
- Environmental dosimeters were deployed, collected, and analyzed at designated locations quarterly. The results are reported as an estimated annual dose rate.

The analytical results for radiological (including environmental dosimeters) and nonradiological parameters for the 2019 sampling events are provided in Appendix B, "SNL/TTR Terrestrial Surveillance Analytical Results in 2019."

Radiological Results

Radiological analyses were performed on soil samples. In 2019, there was one soil sample with results for americium-241 and plutonium-239/240 that either exceeded or were near the maximums of previous years. Location S-09 is near a closed and restricted corrective action unit and has consistently had detections of americium-241 by gamma spectroscopy and subsequent analysis of plutonium-239/240 by alpha spectroscopy.

The americium-241 result for S-09 was 69.4 pCi/g (the previous maximum for the data set 2000–2018 was 3.56 pCi/g). Two duplicate samples were also collected at S-09 with values of 0.75 pCi/g and 1.28 pCi/g. The plutonium-239/240 result for S-09 was 380 pCi/g (the data set maximum is an estimated value of 1,200 pCi/g), and the duplicate sample results were 12.9 pCi/g and 6.81 pCi/g. This variation in results from duplicate samples of the same year and from samples from year to year is consistent with the hot particle theory, where the presence of americium-241 or plutonium-239/240 in a heterogeneous soil sample can fluctuate greatly. These results are consistent with previous years and are expected, given the history of the area.

All other sample results were within historical ranges.

Dosimeter Results

Table 3-9 shows the average dose rate summary statistics. The 2019 dosimeter data is presented, but trend analyses will not be performed until several more years of data are available. The average annual dose rates are higher than the established non-urban Nevada value of 71 mrem/year (Mauro and Briggs 2005). The difference may be attributed to a variety of elevations, proximity to bedrock, and the statistical nature of radioactivity.

Table 3-9. SNL/TTR dosimeter dose rate summary statistics by location classification, 2019

Location Classification	Number of Observations	Mean (mrem/ year)	Median (mrem/ year)	Standard Deviation (mrem/ year)	Minimum (mrem/ year)	Maximum (mrem/ year)
On-site	11	90	90	14	63	106
Perimeter	6	91	91	9	77	104
Off-site	3	79	83	21	56	97

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Nonradiological Results

Nonradiological parameters include modified Target Analyte List metals. All metals results were compared to values from the references listed in Section 3.7.4 and provided in Table 3-9 and to data from previous years.

In 2019, one sample result for metals exceeded the EPA Regional Soil Screening Level for arsenic. The sample from S-39 had a result of 3.98 mg/kg, exceeding the EPA value of 3.0 mg/kg. The result is within other reference soil concentrations provided in Table 3-9 and is within the historical range of values for the site. No further investigation is warranted. All other results for metals at the remaining locations were within values in Table 3-9 and historical ranges.

Additional Activities and Variances

Terrestrial Surveillance Program sampling in 2019 was conducted with the following variances:

- Location S-51 was discontinued to reduce density of sampling locations in the area. Nearby sampling locations S-1, S-2, and S-52 (Figure 3-2) provide adequate coverage for the area.
- Location P-11 was not sampled in 2019 due to access restriction.

3.8 Waste Management Program

Navarro Research and Engineering manages all waste generated at SNL/TTR—which excludes any waste generated by environment restoration activities—under the Waste Management Program. Waste categories include radioactive waste, RCRA hazardous waste, other chemical waste, and nonhazardous solid waste. Waste minimization and recycling efforts are integrated into Waste Management Program activities.

Waste generated and shipped from SNL/TTR to approved facilities in 2019 is presented in Table 3-10 and Table 3-11, respectively. All regulated waste was shipped off-site to permitted treatment, storage, and disposal facilities.

Table 3-10. SNL/TTR waste generated, 2019

Waste Type	Weight (pounds)
Radioactive waste	0
Total non-RCRA-regulated waste	1,635
Total recycled materials	17,470
Total RCRA hazardous waste	312
Toxic Substances Control Act waste (asbestos)	2,200
Toxic Substances Control Act waste (PCB)	86

PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Table 3-11. SNL/TTR waste shipped, 2019

Waste Type/Facility	Weight (pounds)
Battery recycling (National Automotive Parts Association and Veolia)	2475[a]
Construction debris (USAF Construction Landfill)	7,492,000[b]
Sanitary landfill (USAF Sanitary Landfill)	34860
Tires (Lunas Tire Recycling)	0

[a]This total is also included in the "Total recycled materials" total located in Table 3-10.
[b] Roller Coaster Construction Pond Renovation
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
USAF = U.S. Air Force

Waste Minimization

SNL/TTR personnel are committed to achieving significant reductions in the amount of chemical and hazardous wastes generated on-site. Waste minimization includes recycling and recovering the following materials:

- Antifreeze (on-site recycling unit)
- E-waste, including computers, monitors, radios, and electronics
- Fluorescent and sodium bulbs
- Freon (on-site recovery unit)
- Fuels and oil
- Lead acid batteries
- Mercury-containing equipment
- Solvents
- Tires

Recyclables and used oil are sent for recycling or are disposed of through a waste disposal contractor. Recycled or energy-recovered quantities shipped off-site in 2019 are presented in Table 3-12.

Table 3-12. SNL/TTR material recycled or energy-recovered and shipped off-site, 2019

Recycled or Energy-Recovered Waste	Shipped (pounds)
Antifreeze	0
Automotive type batteries	2,475
Mercury-containing articles	0
Non-PCB light ballasts	587
Tires	0
Universal waste batteries	132
Universal waste lamps	128
Used oil	14,148
Used oil filters	0
Total	**17,470[a]**

[a] Weights have been rounded to the nearest integer.
PCB = polychlorinated biphenyl
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Radioactive Waste Management

There were no radioactive waste shipments in 2019.

3.9 Water Quality Programs

The SNL/TTR water quality programs focus on monitoring potable water, conserving water, sampling wastewater effluent, and implementing Stormwater Pollution Prevention Plan requirements.

3.9.1 Drinking Water

SNL/TTR personnel use three active wells: Production Well 6, Well 7, and the Roller Coaster Well. The most active are Production Well 6 and the Roller Coaster Well. Production Well 6 is a public water system well that supplies drinking water to the Main Compound in Area 3 and the Area 3 Fire Protection Water Distribution System. Production Well 6 is the only well at SNL/TTR that has been sampled for contaminants. Outlying areas and buildings without water service use bottled water. The

other wells are not used for potable purposes (construction and dust suppression only), and there are no regulatory sampling requirements for them.

All public water system drinking water sampling and quality assurance practices were conducted in accordance with requirements set by the Nevada Division of Environmental Protection. Analytes are sampled at different intervals, as shown in Table 3-13. The Nevada Division of Environmental Protection currently provides public monitoring and reporting requirements for each public water system around March annually. The public water system at SNL/TTR is permitted by the Nevada Division of Environmental Protection as a Non-Transient, Non-Community Water System under identification number NV003014. The well water is sampled and analyzed routinely per Nevada Division of Environmental Protection requirements to demonstrate conformance with primary drinking water standards.

The State of Nevada maintains information on the SNL/TTR public water system—including water system details, sample schedules, sample results, and any violation or enforcement actions—at the following location:

https://ndwis.ndep.nv.gov/DWW/JSP/WaterSystemDetail.jsp?tinwsys_is_number=296666&tinwsys_st_code=NV&wsnumber=NV0003014

Sampling parameters include (but are not limited to) total coliform, arsenic, nitrates, total trihalomethanes and haloacetic aids, lead and copper, phthalate, and secondary inorganic compounds (aluminum, copper [free], iron, magnesium, manganese, methylene blue active substances foaming agent [surfactant], odor, potential of hydrogen [pH], silver, total dissolved solids, and zinc).

Table 3-13. SNL/TTR routine production well parameters

Analyte	Reporting Frequency
Arsenic	Quarterly
Coliform, total	Quarterly
Dioxin	As required by NDEP, usually every three years
Disinfectant, residual	Quarterly (checked daily)
Di(2-ethylhexyl) phthalate (DEHP) *also known as* Bis(2-ethylhexyl) phthalate	As required by NDEP, usually every three years
Ethyl benzene	Annually
IOCs Phase II, IOCs Phase V, nitrite, nitrate and nitrite (total) SOCs Phase II, SOCs Phase V, VOCs Phase I and II, VOCs Phase V	As required by NDEP, usually every three years
Lead and copper	As required by NDEP, usually every three years
Nitrate	Annually
Secondary (13) drinking water standards	As required by NDEP, usually every three years
Total trihalomethanes and haloacetic acids (5)	Annually
Total xylene	Annually

IOC = inorganic compound
NDEP = Nevada Division of Environmental Protection
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
SOC = synthetic organic compound
VOC = volatile organic compound

A Nevada Division of Environmental Protection-permitted treatment system for arsenic removal (permit number NV-3014 TP-11-12NTNC) is utilized at SNL/TTR. The arsenic removal system has performed well since the installation of a carbon dioxide (pH adjustment) system in June 2008. The untreated water is maintained between 6.5 and 7.0 on the pH scale for efficient and effective operation of the arsenic removal system.

Summary of Production Well Monitoring Activities and Results in 2019

In 2019, no SNL/TTR public water system Drinking Water Public Notice warnings were issued, and all sample results were below the Nevada Division of Environmental Protection maximum contaminant levels established for the substances monitored.

Four arsenic compliance samples were collected from the Area 3 Distribution System for analysis in 2019. The maximum contaminant level for arsenic in drinking water is 10 ppb as a running annual average. The maximum running annual average for arsenic in the drinking water at SNL/TTR occurred during the first quarter of 2019 and was 5.57 ppb. The arsenic removal media was changed out in June 2018, and it usually lasts approximately five years before needing to be replaced.

During 2019, Production Well 6 produced 924,000 gallons of water that was chlorinated and sent to the elevated water storage tower. This equals an average monthly production of approximately 77,000 gallons during 2019. Daily production during 2019 averaged approximately 2,500 gallons.

3.9.2 Septic Tank Systems

Septic tank systems are sampled as needed. DOE owns five septic tank systems located on-site at SNL/TTR: 36-01, 09-52 (inactive/never used), 24-01, Firing Range, and SNL/TTR Main Gate (Point Able Guard Station). The USAF currently occupies the facilities using the septic tanks at 36-01, the Firing Range, and at the SNL/TTR Main Gate. The only septic tank being used by Sandia personnel at this time is located at Building 24-01. Sewage from these locations flows into septic tank systems and associated drain fields. None of these systems required maintenance, sampling, or pumping in 2019. All other remaining septic tank systems have been closed or are undergoing closure and are being addressed by Environmental Restoration Project personnel.

3.9.3 Stormwater

The SNL/TTR site is primarily a closed basin, with runoff evaporating or infiltrating to the ground. The State of Nevada has determined that there are no industrial activities at SNL/TTR that require permitting. Currently, stormwater sampling is not required at SNL/TTR.

New construction activities that exceed one acre of soil disturbance require permitting under the Construction General Permit. In 2016, SNL/TTR personnel submitted a Notice of Intent to operate under Nevada Stormwater Construction General Permit NVR100000 for a project titled "TTR Test Unit Recovery Operations." A Stormwater Pollution Prevention Plan was developed for construction activities; following completion of the project, a Notice of Termination was submitted to the Nevada Division of Environmental Protection in January 2018.

Wastewater is the spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

3.9.4 Wastewater

Wastewater discharges from activities conducted at facilities in the Main Compound at Area 3 go to the USAF facultative sewage lagoon for treatment. The USAF is responsible for the National Pollutant Discharge Elimination System permit for wastewater discharges. The USAF takes samples from the headwater end of the lagoon. In the past, Sandia personnel provided quarterly sampling results to the USAF for inclusion in their USAF Discharge Monitoring Report; however, the National Pollutant Discharge Elimination System permit was modified in 1997, and quarterly data is no longer required.

As a best management practice, SNL/NM personnel sample Area 3 wastewater annually at the point where wastewater leaves SNL/TTR property and enters the USAF system. All sampling and quality

assurance practices were conducted in accordance with program-specific sampling and analysis plans and Quality Assurance Plans (see Chapter 5).

During 2019, there were no excursions or violations of concentration limits. The 24-hour composite wastewater samples are collected on an annual basis, and the following parameters are analyzed:

- Chemical oxygen demand
- Metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc)
- Oil and grease
- pH
- Phenolic compounds (phenol-containing compounds are not used at SNL/TTR)
- Semivolatile organic compounds
- Total cyanide (cyanide-containing compounds are not used at SNL/TTR)
- Total petroleum hydrocarbons
- Total suspended solids
- Tritium, gamma spectroscopy, and gross alpha and gross beta
- Volatile organic compounds

The analytical results for wastewater sampled at Area 3 are provided in Appendix C, "SNL/TTR Wastewater Sampling Results in 2019."

3.9.5 Water Conservation

The State Water Resources Division regulations require a water conservation plan for permitted water systems and major water users in Nevada (DOE/NV 1992). The SNL/TTR Water Conservation Plan provides education, conservation measures, and an estimate of the amount of water that may be conserved each year as a result of the adoption of this plan. To date, the amount of water estimated to be conserved has been met. The plan must be updated every five years (the next revision is due in March 2021).

Chapter 4. SNL/TTR Ecology Program

Great Basin Fritillary (*Speyeria egleis*)

OVERVIEW ■ Ecology Program personnel monitor biota as an element of the overall environmental monitoring process. Ecological data is collected on plants and wildlife to support documentation, land use decisions, and ecological and wildlife awareness campaigns to ensure safe work environments and sustainable decision-making strategies. Ecology Program personnel help operations comply with wildlife regulations and laws by providing biological evaluations and surveys in support of site activities.

At SNL/TTR, Ecology Program personnel support site activity and project compliance with wildlife requirements by providing biological evaluations and inventory surveys. The surveys, primarily for birds, are conducted in late spring to measure species diversity, abundance, and land use patterns. As part of the Avian Protection Plan for SNL/TTR, utility poles associated with Sandia projects are also surveyed for any potential risks to birds that may roost or nest on the poles.

The data are used to support NEPA documentation, land use decisions, ecological and wildlife awareness campaigns, and sustainable decision-making strategies, and to help ensure safe work environments.

4.1 Ecological Setting

The topography at SNL/TTR is characterized by a broad, flat valley with two north- and south-trending mountain ranges: the Cactus Mountain Range to the west (occurring mostly within the boundaries of SNL/TTR) and the Kawich Mountain Range to the east. Cactus Flat is the name given to the valley floor where the main operational area of SNL/TTR is located. To the south, the landscape consists of low hills and outcrops. Elevations range from 5,347 feet at the valley floor to 7,482 feet at Cactus Peak (USAF 1997).

The area north of the SNL/TTR boundary is comprised of public lands administered by the U.S. Bureau of Land Management and the U.S. Forest Service. The land is currently used to graze cattle. There is a substantial irrigated farming operation north of SNL/TTR. To the east of SNL/TTR is the Nevada Wild Horse Range, which is administered by the Bureau of Land Management (USAF 1997).

SNL/TTR, in general, is situated within the Great Basin biogeographic province, as described by Brown (Brown 1982). A biogeographic province is a large region characterized as distinct from other regions, mostly based on different dominant vegetation and wildlife habitat types.

4.1.1 Vegetation

Most of the SNL/TTR vegetation can be subdivided into several general types. The vegetation of the lower elevation portions, such as Cactus Flat, is primarily dwarf shrub and saltbrush shrubland (with a vegetation height of less than or equal to 1.6 ft) and is typified by shadscale (*Atriplex confertifolia*), budsage (*Artemisia spinescens*), winter fat (*Krasheninnikovia lanata*), and Indian ricegrass (*Achnatherum hymenoides*). Intermediate elevation slopes are dominated by Great Basin mixed desert scrub, and the shrub cover tends to be taller (greater than or equal to 1.6 ft), with some grassland characterized by various species of horsebrush (*Tetradymia spp.*), rabbitbrush (*Chrysothamnus viscidiflorus* and *Ericameria nauseosa*), hopsage (*Grayia spinosa*), shadscale, and budsage. As the elevation increases, Joshua tree (*Yucca brevifolia*) and junipers (*Juniperus spp.*) start to show up and increase in abundance. The understory becomes that of black sagebrush (*Artemisia nova*) and rabbitbrush.

Surface water at Cactus Spring, Antelope Springs, and Roller Coaster Pond can support emergent vegetation and a few deciduous trees. The Roller Coaster Construction Pond was modified in late winter/early spring of 2019. The vegetation was removed, the pond was excavated, and a liner was installed. The deciduous trees surrounding the pond remain.

A *biogeographic province* is a large region characterized as distinct from other regions, mostly based on different dominant vegetation and wildlife habitat types.

4.1.2 Wildlife

The wildlife that is known to occur at SNL/TTR is fairly typical of the Great Basin biogeographic province. There are no sites with fish at SNL/TTR, except for the potential presence at the Roller Coaster Construction Pond. The Roller Coaster Construction Pond was modified and stocked with Goldfish (*Carassius sp.*) and Mosquitofish (*Gambusia sp.*).

A notable species is feral horses (*Equus ferus*), often called wild horses or mustangs. Horses were introduced to the area in the seventeenth and eighteenth centuries. Though wild horses compete with livestock and wildlife for limited forage, they are protected under the Wild Free-Roaming Horses and Burros Act (PL 92-195).

The bird species typically found in the valley floor are those associated with the sagebrush community and include Horned Lark (*Eremophila alpestris*), Common Raven (*Corvus corax*), Sagebrush Sparrow (*Artemisiospiza nevadensis*), Sage Thrasher (*Oreoscoptes montanus*), Green-tailed Towhee (*Pipilo chlorurus*), Mourning Dove (*Zenaida macroura*), and Common Nighthawk (*Chordeiles minor*).

From the valley floor, going up in elevation, the vegetation changes to include Joshua trees and junipers, and the bird diversity increases. Common birds in this zone include Loggerhead Shrikes (*Lanius ludovicianus*), Mourning Doves (*Zenaida macroura*), Black-throated Sparrows (*Amphispiza bilineata*), Scott's Orioles (*Icterus parisorum*), Western Kingbirds (*Tyrannus verticalis*), and Ash-throated

Flycatchers (*Myiarchus cinerascens*). Several of these species can be observed nesting in the Joshua trees. At even higher elevations, where there are steep rocky slopes, Chukars (*Alectoris chukar*) (introduced into the area) and Rock Wrens (*Salpinctes obsoletus*) can be encountered. Common Ravens are widespread across all of SNL/TTR.

Although SNL/TTR is a high desert, the playas will have standing water if there is plenty of precipitation. During seasonal migrations—should the playas have water—ducks, geese, and water birds can be found at these playas and at the man-made retention ponds. A few waterfowl and other water birds may breed at the small permanent man-made bodies of water. At Roller Coaster Construction Pond, the freshwater habitat attracts several bird species that would not otherwise be found at SNL/TTR. Common Yellowthroats (*Geothlypis trichas*) and Bullock's Orioles (*Icterus bullockii*) are known to nest at this pond. Other bird species that have been encountered at this pond, and potentially could nest there, include Western Kingbird, Vermilion Flycatcher (*Pyrocephalus rubinus*), Western Wood Pewee (*Contopus sordidulus*), and Red-winged Blackbird (*Agelaius phoeniceus*).

Several raptor species are known to use the SNL/TTR area for hunting, roosting, and breeding. Some of these birds include Red-tailed Hawks (*Buteo jamaicensis*), Golden Eagles (*Aquila chrysaetos*), Prairie Falcons (*Falco mexicanus*), American Kestrels (*Falco sparverius*), Barn Owls (*Tyto alba*), Great Horned Owls (*Bubo virginianus*), Swainson's Hawks (*Buteo swainsoni*), and Ferruginous Hawks (*Buteo regalis*).

Reptile species that have been observed include Coachwhip (*Masticophis flagellum*), Western Patch-nosed Snake (*Salvadora hexalepis*), Great Basin Gopher Snake (*Pituophis catenifer deserticola*), Sagebrush Lizard (*Sceloporus graciosus*), Long-nosed Leopard Lizard (*Gambelia wislizenii*), and Great Basin Rattlesnake (*Crotalus oreganus lutosus*).

Mule Deer (*Odocoileus hemionus*), Pronghorn (*Antilocapra americana*), Desert Bighorn (*Ovis canadensis nelsoni*), Mountain Lion (*Puma concolor*), and feral horses are the notable large mammal species that occur at SNL/TTR. In general, Mule Deer, Desert Bighorn, and Mountain Lions reside in the higher elevations of the mountain ranges. Pronghorn are usually seen in the open, short-grass and scattered brush habitat of the valley floor. Feral horses are more opportunistic and are found in practically all habitat types within the SNL/TTR area.

Common medium-sized mammals found within the SNL/TTR area include Coyote (*Canis latrans*), American Badger (*Taxidea taxus*), Black-tailed Jackrabbit (*Lepus californicus*), Bobcat (*Lynx rufus*), and Kit Fox (*Vulpes macrotis*).

The smaller mammals and rodents that are common at SNL/TTR include Desert Cottontail (*Sylvilagus audubonii*), White-tailed Antelope Squirrel (*Ammospermophilus leucurus*), Merriam's Kangaroo Rat (*Dipodomys merriami*), Desert Woodrat (*Neotoma lepida*), and Deer Mouse (*Peromyscus spp.*).

Six species of bats have been identified as occurring at the DOD Nevada Test and Training Range (USAF 1997). These bat species are likely to be found at SNL/TTR. All these bat species primarily use caves, abandoned mines, trees, and buildings for roosts; they include Long-legged Myotis (*Myotis volans*), Fringe Myotis (*Myotis thysanodes*), California Myotis (*Myotis californicus*), Canyon Bat (*Parastrellus hespereus*), Townsend's Big-eared Bat (*Corynorhinus townsendii*), and Pallid Bat (*Antrozous pallidus*).

4.2 Avian Surveillance

Avian surveys were established in 2004 to monitor patterns of bird richness and abundance in the basic habitats found within the DOE-controlled land at SNL/TTR. There are eight bird survey locations; see Table 4-1 for location and habitat descriptions. Six of these locations consist of driving routes and/or transects, and two locations are single points. One of the single-point locations is the

Roller Coaster Construction Pond; the other is in association with office and maintenance buildings. The modifications made at the Roller Coaster Construction Pond in 2019 were performed in the non-nesting season.

Surveys were conducted annually from 2004 through 2019 (with the exception of six years) during late spring/early summer (mid-May through June). Scheduling conflicts (e.g., restricted site access during testing activities) prevented surveys in 2006, 2013, 2014, 2015, 2017, and again in 2018. In 2019, survey locations were revisited, and bird counts were conducted opportunistically; see Figure 4-1 for 2019 bird counts by species. From all survey years, 114 species of birds have been recorded at SNL/TTR. Table 4-2 lists those bird species and the survey locations where they were encountered. It should be noted that some of the species listed were seen in other places at SNL/TTR that are not covered by the bird surveys. Many of the waterfowl and most of the water birds were seen on the various playas when rain or snow events produced standing water.

Avian surveys were established in 2004 to monitor patterns of bird richness and abundance in the basic habitats found within the DOE-controlled land at SNL/TTR.

During the 10 years that these surveys have been conducted, two bird species have been encountered at every survey location at least once (Horned Lark and Common Raven). Both species are year-round residents. Horned Larks are the most abundant species at SNL/TTR. On average across the 10 years and all the survey locations, 64 Horned Larks were encountered per year. Common Ravens, being large black birds, are quite conspicuous and are likely to be seen or heard practically every day. However, their overall abundance is much lower than that of Horned Larks. On average across the 10 years, 8.5 Common Ravens were encountered per year.

As these surveys were conducted in late spring, many of the species encountered were migrants. As seen in Table 4-2, a large percentage of the total number of species encountered during these surveys were found at the Roller Coaster Construction Pond (76 of the 114 bird species [67 percent]) and at Cactus Spring (34 of the 114 species [30 percent]). The surface water along with the associated emergent vegetation and tall deciduous trees provide for major stop habitat for migrant birds as well as for the resident birds.

Table 4-1. SNL/TTR bird survey locations and habitat descriptions

Approximate Location of the Bird Surveys	Habitat Description
Antelope Peak	Scattered Joshua tree/juniper and mixed desert shrub
Antelope Spring	Mixed desert scrub, some grassland
Area 3	Buildings and other structures
Area 9	Dwarf shrub
Area 49	Dwarf shrub
Cactus Spring	Scattered Joshua tree/juniper and mixed desert shrub **Note:** An ephemeral spring with emergent vegetation and two deciduous trees is close to one point of this survey.
Mellon Airstrip	Dwarf shrub
Roller Coaster Construction Pond	Small open water pond with emergent vegetation and numerous deciduous trees

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Bullocks Oriole (*Icterus bullockii*) on a Joshua tree (*Yucca brevifolia*)

Figure 4-1. SNL/TTR total counts for all bird survey locations, 2019

Table 4-2. SNL/TTR bird species encountered (all years)

Common Name	Scientific Name	MA	AP	AS	CS	A9	A49	A3	CP	Other
Gadwall	*Anas strepera*								●	●
Cinnamon Teal	*Anas cyanoptera*								●	
Northern Shoveler	*Anas clypeata*								●	
Northern Pintail	*Anas acuta*								●	●
Green-winged Teal	*Anas crecca*								●	●
Canvasback	*Aythya valisineria*									●
Redhead	*Aythya americana*									●
Bufflehead	*Bucephala albeola*									●
Chukar	*Alectoris chukar*		●		●					
Eared Grebe	*Podiceps nigricollis*									●
Horned Grebe	*Podiceps auritus*									●
Eurasian Collared-Dove	*Streptopelia decaocto*							●	●	
White-winged Dove	*Zenaida asiatica*							●	●	
Mourning Dove	*Zenaida macroura*				●			●	●	
Calliope Hummingbird	*Selasphorus calliope*				●					
Virginia Rail	*Rallus limicola*								●	
Sora	*Porzana carolina*								●	
American Coot	*Fulica americana*								●	
Black-necked Stilt	*Himantopus mexicanus*								●	●
American Avocet	*Recurvirostra americana*								●	●
Killdeer	*Charadrius vociferus*					●			●	
Spotted Sandpiper	*Actitis macularia*								●	●
Wilson's Phalarope	*Phalaropus tricolor*								●	●
Bonaparte's Gull	*Chroicocephalus philadelphia*									●
Ring-billed Gull	*Larus delawarensis*									●
Herring Gull	*Larus argentatus*									●
Great Egret	*Ardea alba*								●	●
Snowy Egret	*Egretta thula*								●	●
Black-crowned Night-Heron	*Nycticorax nycticorax*								●	
White-faced Ibis	*Plegadis chihi*									●
Turkey Vulture	*Cathartes aura*	●				●		●	●	
Sharp-shinned Hawk	*Accipiter striatus*								●	
Cooper's Hawk	*Accipiter cooperii*								●	
Swainson's Hawk	*Buteo swainsoni*		●				●	●		●
Red-tailed Hawk	*Buteo jamaicensis*		●			●	●	●	●	●
Ferruginous Hawk	*Buteo regalis*									●
Golden Eagle	*Aquila chrysaetos*				●		●			●
Great Horned Owl	*Bubo virginianus*					●		●		
Burrowing Owl	*Athene cunicularia*									●
Belted Kingfisher	*Megaceryle alcyon*								●	
Ladder-backed Woodpecker	*Picoides scalaris*				●					

Table continued on next page

Table 4-2. SNL/TTR bird species encountered (all years) (continued)

Common Name	Scientific Name	MA	AP	AS	CS	A9	A49	A3	CP	Other
American Kestrel	*Falco sparverius*		●							●
Prairie Falcon	*Falco mexicanus*	●	●	●					●	
Olive-sided Flycatcher	*Contupus cooperi*		●						●	
Western Wood-pewee	*Contopus sordidulus*		●	●	●				●	
Gray Flycatcher	*Empidonax wrightii*				●				●	
Dusky Flycatcher	*Empidonax oberholseri*				●				●	
Pacific-slope Flycatcher	*Empidonax difficilis*								●	
Black Phoebe	*Sayornis nigricans*								●	
Say's Phoebe	*Sayornis saya*	●				●		●		
Vermilion Flycatcher	*Pyrocephalus rubinus*								●	
Ash-throated Flycatcher	*Myiarchus cinerascens*					●				
Cassin's Kingbird	*Tyrannus vociferans*					●				
Western Kingbird	*Tyrannus verticalis*					●	●	●		
Loggerhead Shrike	*Lanius ludovicianus*		●	●	●	●	●			
Cassin's Vireo	*Vireo cassinii*								●	
Warbling Vireo	*Vireo gilvus*								●	
Common Raven	*Corvus corax*	●	●	●	●	●	●	●		●
Horned Lark	*Eremophila alpestris*	●	●	●	●	●	●	●	●	●
Tree Swallow	*Tachycineta bicolor*							●	●	●
Violet-green Swallow	*Tachycineta thalassina*					●		●	●	●
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*							●	●	●
Cliff Swallow	*Petrochelidon pyrrhonota*							●	●	●
Barn Swallow	*Hirundo rustica*							●		●
Juniper Titmouse	*Baeolophus ridgwayi*		●							
Rock Wren	*Salpinctes obsoletus*		●	●	●					
Canyon Wren	*Catherpes mexicanus*		●		●					
House Wren	*Troglodytes aedon*								●	
Blue-gray Gnatcatcher	*Polioptila caerulea*								●	
Ruby-crowned Kinglet	*Regulus calendula*				●		●		●	
Hermit Thrush	*Catharus guttatus*								●	
American Robin	*Turdus migratorius*				●				●	
Northern Mockingbird	*Mimus polyglottos*		●	●	●	●				
Sage Thrasher	*Oreoscoptes montanus*		●	●	●					
European Starling	*Sturnus vulgaris*							●	●	
American Pipit	*Anthus rubescens*				●				●	
House Sparrow	*Passer domesticus*							●		●
House Finch	*Carpodacus mexicanus*			●	●			●		
Pine Siskin	*Carduelis pinus*				●					
Orange-crowned Warbler	*Leiothlypis celata*								●	
Nashville Warbler	*Leiothlypis ruficapilla*								●	
Virginia's Warbler	*Oreothlypis virginiae*								●	

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Table 4-2. SNL/TTR bird species encountered (all years) (continued)

Common Name	Scientific Name	MA	AP	AS	CS	A9	A49	A3	CP	Other
Yellow Warbler	*Setophaga petechia*				●				●	
Yellow-rumped Warbler	*Setophaga coronata*	●	●		●		●		●	
Black-throated Gray Warbler	*Setophaga nigrescens*								●	
Townsend's Warbler	*Setophaga townsendi*				●				●	
Northern Waterthrush	*Parkesia noveboracensis*								●	
Palm Warbler	*Setophaga palmarum*								●	
MacGillivray's Warbler	*Geothlypis tolmiei*								●	
Common Yellowthroat	*Geothlypis trichas*								●	
Wilson's Warbler	*Cardellina pusilla*				●				●	
Green-tailed Towhee	*Pipilo chlorurus*		●							
Spotted Towhee	*Pipilo maculatus*								●	
Cassin's Sparrow	*Peucaea cassinii*		●							
Chipping Sparrow	*Spizella passerina*				●				●	
Brewer's Sparrow	*Spizella breweri*	●	●	●	●				●	
Vesper Sparrow	*Pooecetes gramineus*				●		●			
Lark Sparrow	*Chondestes grammacus*					●		●	●	
Black-throated Sparrow	*Amphispiza bilineata*		●	●	●	●	●			
Sagebrush Sparrow	*Artemisiospiza nevadensis*	●		●		●	●			
Savannah Sparrow	*Passerculus sandwichensis*	●							●	
Lincoln's Sparrow	*Melospiza lincolnii*								●	
White-crowned Sparrow	*Zonotrichia leucophrys*	●	●		●				●	
Summer Tanager	*Piranga rubra*								●	
Western Tanager	*Piranga ludoviciana*		●						●	
Black-headed Grosbeak	*Pheucticus melanocephalus*				●				●	
Blue Grosbeak	*Passerina caerulea*								●	
Lazuli Bunting	*Passerina amoena*			●					●	
Red-winged Blackbird	*Agelaius phoeniceus*								●	
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	●							●	
Brewer's Blackbird	*Euphagus cyanocephalus*				●				●	
Great-tailed Grackle	*Quiscalus mexicanus*							●	●	
Brown-headed Cowbird	*Molothrus ater*								●	
Bullock's Oriole	*Icterus bullockii*				●		●		●	
Scott's Oriole	*Icterus parisorum*		●		●					

A3 = Area 3
A9 = Area 9
A49 = Area 49
AP = Antelope Peak
AS = Antelope Spring
CP = Roller Coaster Construction Pond
CS = Cactus Spring
MA = Mellon Airstrip
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Biota is the animal and plant life of a given region; *biotic* is relating to or resulting from living organisms.

4.3 Federally Listed and State-Listed Threatened and Endangered Species and Species of Concern

As stated in Chapter 2, the purpose of the Endangered Species Act is to protect all animal, plant, and insect species that are federally listed as threatened or endangered. The State of Nevada has its own regulations for the protection of various species of plants and animals (Nevada Administrative Code 504).

Currently there are no known federally listed threatened or endangered species found at SNL/TTR. The only federally listed species found at the Nevada Test and Training Range is the Mojave Desert Tortoise (*Gopherus agassizii*) (USAF 1997), which is not found at SNL/TTR. Table 4-3 lists federally protected species under the ESA that are known to occur in Nye County, Nevada.

There are, however, a few plant and animal species protected by the State of Nevada that occur at SNL/TTR, including several cacti and succulents, such as cottontop cactus (*Echinocactus polycephalus*), spinystar/beehive cactus (*Escobaria vivipara*), and branched pencil cholla (*Cylindropuntia ramosissima*). Table 4-3 includes those species that may potentially occur in Nye County, Nevada, and those species that have been observed at SNL/TTR.

Activities at SNL/TTR that could potentially impact protected species are addressed in the NEPA process. Coordination with state and/or federal officials and the implementation of any requisite mitigation would occur prior to initiating these activities.

Table 4-3. Federally listed and state-listed endangered and threatened species and State of Nevada protected species potentially occurring in Nye County, Nevada

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
Plants				
Amargosa niterwort	*Nitrophila mohavensis*	Endangered	Endangered	
armored hedgehog cactus	*Echinocereus engelmannii var. armatus*	—	Protected	
Ash Meadows blazingstar	*Mentzelia leucophylla*	Threatened	Endangered	
Ash Meadows gumweed	*Grindelia fraxinopratensis*	Threatened	Endangered	
Ash Meadows milkvetch	*Astragalus phoenix*	Threatened	Endangered	
Ash Meadows mousetails	*Ivesia kingii var. eremica*	Threatened	Endangered	
Ash Meadows sunray	*Enceliopsis nudicaulis var. corrugata*	Threatened	Endangered	
Blaine pincushion	*Sclerocactus blainei*	—	Protected	
branched pencil cholla	*Cylindropuntia ramosissima*	—	Protected	✓
cottontop cactus	*Echinocactus polycephalus*	—	Protected	✓
Desert pincushion	*Escobaria vivipara var. deserti*	—	Protected	
Clokey pincushion	*Escobaria vivipara var. rosea*	—	Protected	
Eastwood milkweed	*Asclepias eastwoodiana*	—	Protected	✓
Joshua tree	*Yucca brevifolia*	—	Protected	✓
Mojave barrel cactus	*Ferocactus cylindraceus var. lecontei*	—	Protected	
mountain cactus	*Pediocactus simpsonii*	—	Protected	
Nye pincushion cactus	*Sclerocactus nyensis*	—	Protected	
old-man prickly-pear/grizzlybear cactus	*Opuntia erinacea var. erinacea*	—	Protected	✓
hermit cactus	*Sclerocactus polyancistrus*	—	Protected	✓
sand/sagebrush cholla	*Grusonia pulchella*	—	Protected	✓

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Table 4-3. Federally listed and state-listed endangered and threatened species and State of Nevada protected species potentially occurring in Nye County, Nevada (continued)

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
Plants (continued)				
silver cholla	*Cylindropuntia echinocarpa*	—	Protected	✓
Sodaville milkvetch	*Astragalus lentiginosus var. sesquimetralis*	—	Endangered	
spring-loving centaury	*Centaurium namophilum*	Threatened	Endangered	
sunnyside green gentian	*Frasera gypsicola*	—	Endangered	
Williams combleaf	*Polyctenium williamsiae*	—	Endangered	
Animals				
Invertebrates				
Ash Meadows Naucorid	*Ambrysus amargosus*	Threatened	—	
Fishes				
Ash Meadows Amargosa Pupfish	*Cyprinodon nevadensis mionectes*	Endangered	Threatened	
Ash Meadows Speckled Dace	*Rhinichthys osculus nevadensis*	Endangered	Endangered	
Big Smoky Valley Speckled Dace	*Rhinichthys osculus lariversi*	—	Sensitive	
Big Smoky Valley Tui Chub	*Gila bicolor spp. 8*	—	Sensitive	
Devils Hole Pupfish	*Cyprinodon diabolis*	Endangered	Endangered	
Lahontan Cutthroat Trout	*Oncorhynchus clarkii henshawi*	Threatened	Game	
Moapa Dace	*Moapa coriacea*	Endangered	Endangered	
Monitor Valley Speckled Dace	*Rhinichthys osculus spp. 5*	—	Sensitive	
Moorman White River Springfish	*Crenichthys baileyi thermophilus*	—	Protected	
Oasis Valley Speckled Dace	*Rhinichthys osculus spp. 6*	—	Sensitive	
Railroad Valley Springfish	*Crenichthys nevadae*	Threatened	Threatened	
Railroad Valley Tui Chub	*Gila bicolor spp. 7*	—	Sensitive	
Warm Springs Amargosa Pupfish	*Cyprinodon nevadensis pectoralis*	Endangered	Endangered	
White River Desert Sucker	*Catostomus clarkii intermedius*	—	Protected	
White River Spinedace	*Lepidomeda albivallis*	Endangered	Endangered	
Reptiles/Amphibians				
Amargosa Toad	*Anaxyrus nelsoni*	—	Protected	
Columbia Spotted Frog (Great Basin pop.)	*Rana luteiventris pop. 3*	Candidate	Protected	
Banded Gila Monster	*Heloderma suspectum cinctum*	—	Protected	
Mojave Desert Tortoise	*Gopherus agassizii*	Threatened	Threatened	
Northern Leopard Frog	*Lithobates pipiens*	—	Protected	
Sonoran Mountain Kingsnake	*Lampropeltis pyromelana*	—	Protected	
Mammals				
Allen's Big-eared Bat	*Idionycteris phyllotis*	—	Protected	
American Pika	*Ochotona princeps*	—	Protected	
Ash Meadows Montane Vole	*Microtus montanus nevadensis*	—	Sensitive	
California Leaf-nosed Bat	*Macrotus californicus*	—	Sensitive	
Dark Kangaroo Mouse	*Microdipodops megacephalus*	—	Protected	
Fringed Myotis	*Myotis thysanodes*	—	Protected	
Mexican Free-tailed Bat	*Tadarida brasiliensis*	—	Protected	

Table continued on next page

Table 4-3. Federally listed and state-listed endangered and threatened species and State of Nevada protected species potentially occurring in Nye County, Nevada (continued)

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
Animals (continued)				
Mammals (continued)				
Pale Kangaroo Mouse	*Microdipodops pallidus*	—	Protected	
Pallid Bat	*Antrozous pallidus*	—	Protected	
Palmer's Chipmunk	*Neotamias palmeri*	—	Sensitive	
Spotted Bat	*Euderma maculatum*	—	Threatened	
Townsend's Big-eared Bat	*Corynorhinus townsendii*	—	Sensitive	
Western Red Bat	*Lasiurus blossevillii*	—	Sensitive	
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	—	Endangered	
Brewer's Sparrow	*Spizella breweri*	—	Sensitive	✓
Golden Eagle	*Aquila chrysaetos*	—	Sensitive	✓
Loggerhead Shrike	*Lanius ludovicianus*	—	Sensitive	✓
Northern Goshawk	*Accipiter gentilis*	—	Sensitive	
Peregrine Falcon	*Falco peregrinus*	—	Endangered	
Sage Thrasher	*Oreoscoptes montanus*	—	Sensitive	✓
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	Endangered	
Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened	Sensitive	
Ridgeway's (Yuma) Rail	*Rallus obsoletus yumanensis*	Endangered	Endangered	

— = no designation
ESA = Endangered Species Act
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Chapter 5. SNL/TTR Quality Assurance

Pronghorn (*Antilocapra americana*)

OVERVIEW ■ Sandia quality assurance teams monitor environmental impacts of the work done at SNL/TTR. Personnel in various programs collect environmental samples and analyze them for radiological and nonradiological constituents. Quality control samples are sent to contract laboratories to ensure that the samples meet statistically established control criteria or prescribed acceptance control limits.

Sandia personnel take responsibility and assume accountability for implementing quality assurance for operations—as specified in ISO 9001, *Quality Management Systems—Requirements* (ISO 2008), DOE O 414.1D, *Quality Assurance* (DOE O 414.1D Admin Change 1), Attachment 1, "Contractor Requirements Document"; and 10 CFR Part 830, *Nuclear Safety Management* (10 CFR 830), Subpart A, "Quality Assurance"—via policy statements and processes, and by executing the actions specified in those policies and processes. Sandia management is responsible for ensuring the quality of the company's products; for assessing its operations, programs, projects, and business systems; and for identifying deficiencies and effecting continuous improvements.

5.1 Environmental Monitoring for Quality Assurance

Environmental monitoring (which includes sampling) is conducted in accordance with program-specific sampling and analysis plans, work plans, or quality assurance plans, which contain applicable quality assurance elements. These documents meet appropriate federal, state, and local requirements for conducting sampling and analysis activities. Personnel in various programs collect environmental samples and submit them for analysis of radiological and nonradiological constituents. Sandia personnel (and contractors) follow quality assurance measures described in this section. DRI personnel follow their own quality control measures for activities they perform.

Project sampling and analysis plans (or equivalent) include critical elements, such as procedures for collecting samples, preserving and handling samples, controlling samples, controlling laboratory

quality, setting required limits of detection, controlling field quality, ensuring health and safety, setting schedules and frequency for sampling, reviewing data, determining data acceptability, and reporting.

5.1.1 Sample Management Office

Sample Management Office personnel are responsible for quality assurance and quality control of samples once field team members relinquish the samples to the Sample Management Office. In addition, Sample Management Office personnel provide guidance and sample management support for field activities. However, program leads are responsible for each program's overall adherence to and compliance with any sampling and analysis activity performed. Sample Management Office personnel, located at SNL/NM, package, ship, and track environmental samples to off-site contracted laboratories.

There are instances when SNL/TTR personnel ship samples directly to off-site laboratories, rather than to the Sample Management Office at SNL/NM. Terrestrial Surveillance Program soil samples collected annually are shipped from SNL/TTR directly to an off-site laboratory.

5.1.2 Contract Laboratory Selection

All off-site contract laboratories are selected based on performance objectives, licenses and accreditations, and appraisals (pre-award assessments) as described in the *Quality Assurance Project Plan for the Sample Management Office* (SNL/NM 2019b). All laboratories must employ EPA test procedures whenever possible; when these are not available, other suitable and validated test procedures are applied. Laboratory instruments must be calibrated in accordance with established procedures, methods, and the Sample Management Office Statement of Work for Analytical Laboratories (SNL/NM 2018). All calibrations and detection limits must be verified before analyzing samples and reporting data. Once a laboratory has passed an initial appraisal and has been awarded a contract, Sample Management Office personnel are responsible for continuously monitoring laboratory performance to ensure that the laboratory meets its contractual requirements during annual audits.

Sample Management Office contract laboratories perform work in compliance with the Sample Management Office Statement of Work for Analytical Laboratories. Contract laboratories are required to participate in applicable DOE and EPA programs for blind audit check sampling to monitor the overall accuracy of analyses routinely performed on SNL/TTR samples. These contract laboratories are required to participate in the DOE Mixed Analyte Performance Evaluation Program. Contract laboratories also participate in commercial vendor programs designed to meet the evaluation requirements given in the proficiency testing section (Chapter II) of the National Environmental Laboratory Accreditation Conference Standard (NELAC 2003).

5.1.3 Quality Control for Samples

Project-specified quality control samples are submitted to contract laboratories in order to meet project data quality objectives and sampling and analysis plan requirements. Various field quality control samples may be collected to assess the data's quality and final usability. Errors, some of which are unavoidable, can be introduced into the sampling process, including potential contamination of samples in the field or during transportation. In addition, sample results can be affected by the variability present at each sample location.

With each sample batch, laboratory quality control samples are prepared concurrently at defined frequencies and analyzed in accordance with established methods. Contract laboratory personnel determine the analytical accuracy, precision, contamination, and matrix effects associated with each analytical measurement.

Quality control sample results are compared either to control criteria that is statistically established or to prescribed acceptance control limits. Analytical results generated concurrently with quality control sample results within established limits are considered acceptable. If quality control analytical results exceed control limits, the results are qualified and corrective action is initiated if warranted. Reanalysis is then performed for samples in the analytical batch as specified in the Statement of Work and contract laboratory procedures. Quality control sample summaries are included in analytical reports prepared by contract laboratory personnel.

Environmental dosimetry is provided by optically stimulated luminescence technology. Dosimeters are issued and analyzed by an accredited off-site laboratory and measure x-ray, gamma, and beta radiation. Quality control dosimeters are used, and standard laboratory procedures are followed for processing all dosimeters.

5.1.4 Data Validation and Records Management

Sample collection, analysis request and chain of custody documentation, and measurement data are reviewed and validated for each sample collected. Analytical data reported by contract laboratories are reviewed to assess laboratory and field precision, accuracy, completeness, representativeness, and comparability with respect to each particular program's method of compliance and data quality objectives.

The data are validated at a minimum of three levels as follows:

- The analytical laboratory validates data according to the laboratory's quality assurance plan, standard operating procedures, and client-specific requirements.
- Sample Management Office personnel review the analytical reports, corresponding sample collection, and analysis request and chain of custody documentation for completeness and laboratory contract compliance.
- A program lead reviews program objectives, regulatory compliance, and project-specific data quality requirements, and makes the final decision regarding the data's usability and reporting.

In addition, Terrestrial Surveillance Program data are validated to detailed method-specific requirements.

5.2 Sample Management Office Activities in 2019

Sample Management Office activities in 2019 included sample packaging, shipping, and tracking to off-site contracted laboratories, and reviewing all data deliverables for compliance with contract and data quality requirements.

5.2.1 Sample Handling and Analyses

In 2019, Sample Management Office personnel processed 155 samples in support of the SNL/TTR Terrestrial Surveillance Program. Of the 155 samples, 16 samples were submitted as field and analytical quality control samples to assist with data validation and decision-making.

In 2019, Sample Management Office personnel processed 155 samples in support of the SNL/TTR Terrestrial Surveillance Program.

During 2019, General Engineering Laboratories in Charleston, South Carolina, was employed to analyze SNL/TTR soil samples, and Landauer, Inc., in Glenwood, Illinois, was employed to analyze environmental dosimeters.

5.2.2 Laboratory Quality Assurance Assessments and Validation

In 2019, Sample Management Office personnel continued independent assessments and validation of National Environmental Laboratory Accreditation Conference-approved laboratories used by Sandia personnel. Specific checks were made for documentation completeness, proper equipment calibration, proper laboratory practices, and batch quality control data.

5.2.3 Quality Assurance Audits

The Sample Management Office participates in the DOE Consolidated Audit Program (DOECAP), which ensures that subcontracted commercial analytical environmental laboratories are audited on their ability to provide data results that are valid, reliable, and defensible. In 2018, DOECAP revised the manner in which audits of commercial environmental laboratories are conducted. Commercial laboratories are to use the assessment process provided by one of three approved third-party accrediting bodies unless separate arrangements are made with DOECAP. The accrediting bodies conduct assessments using the requirements of the DOD/DOE *Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (DOD/DOE 2019).

In 2019, DOECAP and/or the accrediting bodies conducted assessments at nine Sample Management Office contract laboratories using *Quality Systems Manual* requirements. The audit reports, laboratory responses, and closure letters are all posted on and tracked through the DOECAP website. Decisions regarding sample distribution to contract laboratories were based on audit information, including corrective actions, if needed.

No findings for SNL/TTR samples were issued in 2019 in DOECAP assessment reports or other applicable DOE programs.

Chapter 6. SNL/TTR Cultural Resource Program

Askania camera tower at SNL/TTR (a historic structure)

OVERVIEW ■ Cultural Resource Program personnel coordinate cultural resource compliance, including review of archaeological resources and historic buildings. Actions that could adversely affect cultural resources are analyzed initially in a NEPA checklist review. DOE is responsible for ensuring that impacts to cultural resources are assessed and appropriate actions are taken to mitigate those impacts.

The Cultural Resource Program is primarily focused on long-term preservation and protection of cultural resources and cultural resource compliance to ensure the heritage of the area and of the landscape. Long-term preservation and protection practices also ensure that data is available to make proper land use decisions and to assist with environmental planning. The Cultural Resource Program is composed of two main parts: archeological resources and historic buildings.

Cultural resources can be defined as physical evidence or places of past human activity: a site, an object, a landscape, a structure, or a natural feature of significance to a group of people traditionally associated with it.

One hundred and eighty-five archaeological surveys, mostly linear surveys (occurring along roads and utility lines, as well as multiple transect surveys on large blocks of land), have been performed between 1979 and 2019. Currently, 220 historical sites (sites having cultural heritage value) are recorded, and 12 have been recommended as eligible under the National Register of Historic Places.

6.1 History and Location

Over the years, a number of theoretical frameworks have been proposed to define traditions and value systems in southern Nevada. The framework for the prehistoric period covers the time from the earliest documented human occupation of the area (ca. 13,000 BP) until the earliest European exploration of the area (ca. AD 1600). This time range is divided into six periods: Lake Mohave

(12,000–7000 BP), Pinto (7500–4000 BP), Gypsum (4000 BP–AD 400), Saratoga Springs (AD 400–1150), Late Prehistoric (AD 1150–1600), and Protohistoric (AD 1600–ca. 1830).

In geochronology (determining the age of rocks, fossils, and sediments), an epoch is longer than an age but shorter than a period.

The Lake Mohave period corresponds to the earliest known human occupation of the area, encompassing the terminal Pleistocene and early Holocene epochs. This includes the Paleo-Indian period and the Early Archaic period. The Lake Mohave period, and the Pinto and Gypsum periods that follow, constitute the period of human occupation of North America before the adoption of agriculture in the area.

The groups of humans present during the Paleo-Indian period are generally described as small, highly mobile bands of hunter-gatherers adapted to a climate that was cooler and wetter than the present (Martin and Plog 1973). The Paleoindian period is characterized by a number of distinct traditions of fluted projectile points, including Clovis, Folsom, Agate Basin, and Hell Gap arrowheads (Jennings 1980). The Early Archaic period is generally characterized by an economy focusing on the exploitation of wild plant and animal resources. The Archaic tradition in the Great Basin was initially described as a period of relatively stable foraging referred to as the Desert Culture (Jennings and Norbeck 1955).

The Pinto period is coterminous (occurring at the same time) with the Middle Archaic period in southern Nevada. The hallmark of the Pinto period was stone tools, characterized by leaf-shaped knives, scrapers, and projectile points (arrowheads) with bifurcated, expanding stems, shallow basal notches, and bulbous tangs (Ezzo 1996).

Chert biface

The Late Archaic period, also referred to as the Gypsum period, was marked by warmer, more temperate conditions, which led to an increase in the availability of large game animals as well as increased plant resources (Roth 2012).

The Saratoga Springs period corresponds to a time of significant and far-reaching cultural changes in southern Nevada (Ezzo 1996). Archaeologists refer to the form of the cultural tradition expressed in southern Nevada and adjacent areas at this time as the Virgin Anasazi. The initial Virgin Anasazi occupation of the area is characterized by the presence of small, highly mobile groups occupying scattered, small sites on a temporary, perhaps seasonal, basis (Ezzo 1996).

With the end of the Virgin Anasazi occupation in southern Nevada, and the practice of small-scale agriculture, the area became the home of peoples who were more mobile and increasingly dependent on hunting and foraging (Ezzo 1996). The Late Prehistoric period also saw the appearance of an identifiable Southern Paiute, or Numic-speaking, people in the Great Basin and southern Nevada. Early explorers and immigrants in the southern and central Great Basin encountered widely scattered groups of hunters and gatherers currently known as the Southern Paiute, Western Shoshone, and Owens Valley Paiute (Fowler 1982; Kelly and Fowler 1986).

The first Spanish explorers to see the Colorado River were the men of Francisco de Coronado's expedition in the 1540s. Coming north from New Spain (present-day Mexico), these explorers were seeking mineral wealth. One of the first explorers through the area was Jedediah Strong Smith. As part owner of the Rocky Mountain Fur Company, he began to explore Utah and Nevada in August 1826, looking for waters that were well stocked with beaver. Smith traveled along the Virgin River in the fall of 1826, passing through the area of present-day Bunkerville, continuing south to the Virgin River's convergence with the Colorado River, and traveling into Mexican California. Smith passed through Clark County again along the same route in 1827; however, his second meeting with the Mojave Indians was much less friendly, and Smith, along with other survivors of an attack, returned back to California. Mining was an important historic-age activity in the region, and, by 1910, small mining camps were established in the Kawich (Golden Arrow and Silverbow) and Cactus (Wellington, Antelope Springs, and Cactus Spring) ranges, as well as in the Trappman Hills (Wilson's Camp and Trappman's Camp). Older mining ventures at Nixon and Gold Reed are less than 12 miles away to the southeast. These early twentieth-century mining locales lie on opposing flanks of the Kawich Range at a pass just north of Quartzite Mountain.

In anticipation of entering World War II, the United States military expanded its air forces training and support facilities from 1939 to 1941. In 1940, the U.S. Army surveyed Las Vegas Airport, open since 1928, for use as a gunnery school. The city of Las Vegas purchased the airfield in 1941 and leased it to the U.S. Army; it was renamed the Las Vegas Army Air Field, and gunnery training began there in 1942. Construction immediately began to accommodate training and housing at the airfield, and several auxiliary fields were added.

In December 1946, the base was placed on stand-by status; it reopened in 1949 to provide advanced pilot training. It was renamed Nellis Air Force Base in 1950. Over time, operations expanded to include flight testing and an aircraft evaluation center. Later, the Nevada Test and Training Range was added to provide aerial gunnery and bombing training, and the Nevada Test Site for nuclear testing was sited within Nellis Air Force Base boundaries in 1951.

Similar to the early Nellis Air Force Base history, the Tonopah site where Sandia now maintains a test range was brought into military service in anticipation of United States involvement in World War II. In October 1940, a 69 × 90-mile area near Tonopah, Nevada, was transferred to the War Department for development as a gunnery range. After construction and preparation, the Tonopah Army Air Field opened in 1942 as a training field. Eight bombardment squadrons and 12 fighter squadrons were trained there by 1943, when the base was expanded to host B-24 Liberator training. The range also hosted some guided bomb testing activities before the war ended.

In August 1945, Tonopah Army Air Field was placed on inactive status; two years later it was declared excess. The airfield was turned over to the town of Tonopah as the Tonopah Airport, and the test and training space to the southeast was incorporated into Nellis Air Force Base.

In July 1945, Los Alamos Scientific Laboratory in New Mexico underwent a reorganization that gathered ordnance engineering activities into Z Division. This group was expected to grow, and there was no room in Los Alamos. A site selection effort resulted in the choice of Albuquerque Army Air Field near Albuquerque, New Mexico, which was not too far from Los Alamos and near an airfield to support testing. On July 14, 1945, the U.S. Corps of Engineers requested transfer of jurisdiction for Albuquerque Army Air Field. The transfer of the Air Base and all leased facilities occurred on July 21, 1945 (Furman 1990). The site was then referred to as Sandia Base.

SNL/TTR was established in the 1950s (SNL/NM 2017).

> SNL's early testing activities included ballistic studies of weapon shapes—dropping test devices from aircraft to determine how and where they fell. Drop tests were also used to test the operation of weapon subsystems in flight. In its first months as Z Division, the lab established a practice bombing range west of Los Lunas, New Mexico. . . .
>
> While arrangements were under way at the Los Lunas range, the MED received permission to let Z Division use the Salton Sea Test Base as well. The U.S. Navy established a test range identified as the Naval Auxiliary Air Station at the Salton Sea in southern California during WWII. In June 1946, the U.S. Navy's buildings at the site were transferred to the U.S. Army for use as a bombing range by Z Division.
>
> Sitting approximately 200 feet below sea level and offering excellent testing weather for most of the year, the Salton Sea site allowed Z Division to test ballistic performance in dense, sea-level atmospheric conditions unavailable in New Mexico. It had a water impact area and, later, a land target. SNL used the site until 1960.
>
> By the mid-1950s, the Salton Sea Test Base experienced tension between a growing number of weapon programs requiring testing and general population growth in the area. . . .
>
> The AEC and SNL launched a search for a new test site. . . . A temporary site was established in 1954 on the bed of Yucca Lake, within the AEC's Nevada Test Site, while scouting continued for an area that could accommodate low altitude as well as high-altitude approaches. . . .
>
> An area known as Cactus Flats in the northwestern section of the Las Vegas Bombing and Gunnery Range (now Nellis Air Force Base) presented a series of dry lake beds stretching north-south in a long valley between the Cactus Range to the west and the Kawich Range to the east. . . . The Air Force authorized AEC use of the property for SNL for five years beginning November 9, 1956. Approximately 35 miles southeast of Tonopah, Nevada, the site was named Tonopah Test Range.
>
> In the fall of 1956, SNL selected Pork Lake, the northernmost in the string of lake beds, as the primary impact point for drop tests and began construction of facilities. . . .

> Testing began on February 4, 1957, with drop tests done both during the day and at night. By the summer, testing included rocket launches. Rocket testing was added to the site as part of the preparation for the Operation Hardtack series of nuclear test shots in the Pacific in 1958.

Flights would be tracked along the east and west sides of the dry lake beds, concentrating on the main target in the dry lakebed at the north end. Ultimately, additional targets and stations would be added toward the south. To support ground-launched tests and to develop diagnostic rockets to support high-altitude nuclear testing, Sandia personnel created rocket launch capability at SNL/TTR (SNL/NM 2017). Demand for both drop and rocket testing continued, and site capabilities were extended in response. Expansion continued at the range (SNL/NM 2017).

> . . . The AEC approved an expansion and improvement program for the site in early 1959. The USAF also extended the permit for SNL's operations until March 31, 1969. On September 1, 1960, TTR was named SNL's permanent test range and the Salton Sea Test Base range was closed.
>
> The range expansion was swift and extensive. Additional tracking and data capture stations were added along the line of flight to the target, support facilities at the Control Point were expanded, the weather station at the Control Point was moved to the west side of the range . . . and a Control Tower was added. The target impact area on Pork Lake was supplemented with a concrete hard target.

Over time, additional modifications and improvements have been made as equipment has been upgraded and replaced.

6.2 Regulatory Criteria

Ensuring compliance with these federal requirements (Chapter 2) supports the long-term preservation and protection of cultural resources, prevents mission delays, and maintains the trust and strong relationship with DOE and the Nevada Historic Preservation Division.

6.3 Archaeological Resources

The Sandia archaeologist manages cultural resources and helps Sandia personnel and DOE maintain compliance with the National Historic Preservation Act, Section 106. This ensures that cultural resources and their historic and cultural heritage are preserved and protected. The Sandia archaeologist reviews NEPA checklists that include land disturbances and provides recommendations for monitoring field activities at SNL/TTR to ensure archeological resources are not adversely impacted. The Sandia archaeologist also makes site eligibility recommendations for inclusion in the National Register of Historic Places.

The archaeological work at SNL/TTR is primarily focused on preserving and protecting cultural resources long-term. This is intended to ensure the heritage of the area and of the landscape. Long-term preservation and protection also ensure that data are available to make appropriate land use and environmental planning decisions at SNL/TTR.

6.3.1 Field Methods

Archaeological personnel conduct pedestrian surveys (walking the natural landscape on foot) and record prehistoric and historic sites in accordance with Bureau of Land Management guidelines (BLM 2004), as required by the Nevada State Historic Preservation Office. In addition, the

archaeologist provides recommendations regarding the potential effect of proposed undertakings on prehistoric and historic properties. These include recommendations regarding the eligibility for nomination to the National Register of Historic Places for Cultural Properties and Historic Preservation and project mitigation.

A pedestrian survey lightly impacts surface soils. Survey transects are spaced 50 feet apart, with no more than 40 acres surveyed per person per day. All cultural resources that are at least 50 years old are recorded on field forms. Archaeological sites are defined by the presence of either a cultural feature or 10 or more artifacts that are at least 50 years old and are separated by no more than 66 feet. Areas where cultural materials are sparse (fewer than 10 items) and are at least 50 years old are recorded as isolated occurrences. The archaeologist generates a Nevada Intermountain Antiquities Computer System form for the archaeological sites in Nevada. Archaeological sites are mapped both manually on graph paper and digitally. Digital maps are created using a global positioning system unit with sub-meter accuracy. Each map includes the site boundary and the locations of the datum, any features identified, artifact concentrations, important or diagnostic artifacts, drainages or other landscape features, and topographic contours. Each site, including any cultural features or tools, is photographed. All artifacts are analyzed in the field unless more than 50 artifacts of a given class (e.g., lithic [stone], prehistoric ceramic, or historic) are present, in which case a sample of at least 50 are analyzed. Lithic and prehistoric ceramic artifacts are analyzed using standard in-field techniques. Ceramics, projectile points, and other diagnostic artifacts are identified by type and cultural affiliation when sufficient attributes for a reliable determination are present. Isolated occurrences and their location are recorded and analyzed. The archaeologist writes all reports of findings and associated documentation.

6.3.2 Archaeological Assessments and Analysis in 2019

In 2019, Sandia's archaeologist completed one pedestrian survey, reviewing four outdoor projects and surveying more than four acres. The survey was conducted on withdrawn lands administered by DOE and managed by Sandia personnel, who operate the range under a USAF permit with the DOE. The findings from the survey resulted in a memo identifying cultural resource concerns to DOE.

6.4 Historic Buildings

The Sandia historian surveys and assesses historic buildings and makes recommendations to DOE regarding National Register of Historic Places eligibility for SNL/TTR properties.

6.4.1 Methods

Although the historian does provide internal input on proposed projects as requested, most historic building assessments are triggered by the NEPA process. While a NEPA checklist is in subject matter expert review, the historian reviews the project details, reviews existing photographs and documents of the facilities involved, conducts any additional research in the archives or building drawings collection needed to understand the property's past and current role in SNL/TTR operations, and evaluates the building's history within the themes (i.e., weapon design, field testing, environmental testing, weapon assembly, military liaison, stockpile surveillance, non-weapons research, and administration/community) provided by the 2005 context statement (Section 6.4.2), which provides the framework for evaluating a property for historical significance (SNL/NM 2005a). Note is made of any previous surveys and resulting determinations as to the property's National Register of Historic Places eligibility.

If there are any questions regarding the proposed work and its potential impact on a building, the historian discusses the matter with the project owner and the NEPA specialist. The project owner

may submit renderings of the anticipated appearance of the property after the work is completed, and the historian may suggest alternate locations, materials, or methods so as to avoid adverse effects on the property.

The context statement completed in 2005 is actively used in historic building assessments and recommendations as the background against which properties are evaluated. Any recommendation that a property is historic includes the relevant established Nevada theme under which it falls as well as its period of significance.

Once the property is understood in context, the historian makes a recommendation as to whether it is eligible for the National Register of Historic Places, summarizing past determinations and any subsequent changes to the property. The historian also makes a recommendation as to whether the proposed work will have an adverse effect on any historic properties or districts, including the property where the work is occurring. Information regarding the property, photographs, maps, a description of the proposed work, any impacts, and the overall recommendation on eligibility are captured on a Nevada Architectural Resource Assessment form. The Architectural Resource Assessment form is submitted as an attachment to the NEPA checklist for DOE review and use in consultation with the Nevada State Historic Preservation Office.

6.4.2 Previous Building Surveys, Assessments, and Determinations

In the spring of 2002, the Sandia historian began to assess properties at SNL/TTR, with an initial focus on buildings scheduled for demolition in 2003 and 2004. The assessments were completed and submitted to DOE on Nevada Architectural Resource Assessment forms (SNL/NM 2003). In consultation with the Nevada State Historic Preservation Office, DOE determined that none of the properties were historic, and Sandia proceeded with demolition.

The historian also prepared a context statement for the site (SNL/NM 2004). The context statement concentrated on the Cold War as the primary time period and focus of TTR's built environment within the State of Nevada's established themes. The period of significance for Tonopah was 1956–1989. The historian continued the historic building survey for the remainder of properties at the site through 2005, including archival research, photo documentation, and preparation of Architectural Resource Assessment forms. Additional support and architectural evaluations were provided by a consulting firm, e²M, which resulted in a revised context statement, survey document, and completed Architectural Resource Assessment forms (SNL/NM 2005a; SNL/NM 2005b; SNL/NM 2005c).

In 2010, due to the age of the survey documents, the assessment was reviewed, and the properties were reconsidered. The existing property lists and the status of the buildings remained unchanged. The conclusions of the survey were affirmed. The recommendation was to include key and representative facilities as contributing elements in a SNL/TTR historic district (Table 6-1).

In 2011, DOE completed consultation with the Nevada State Historic Preservation Office, reaching an agreement regarding the SNL/TTR historic district. The district includes 60 structures and represents the key functions included in testing at the site during the Cold War. In 2012, DOE provided the Nevada State Historic Preservation Office with samples of the documentation created to mitigate the effect of future demolition of properties within the district. The Nevada State Historic Preservation Office reviewed the sample documentation and agreed with its suitability. In 2016, DOE met with the Nevada State Historic Preservation Office to finalize details of a memorandum of agreement covering the SNL/TTR historic district and mitigative efforts for future demolition and renovation at the site. In 2018, DOE again met with the Nevada State Historic Preservation Office in an attempt to finalize the approach and details of the agreement, which is not yet signed. DOE continues to proceed with Section 106 of the National Historic Preservation Act consultation

on projects that will affect SNL/TTR properties, whether they are contributing elements to the historic district or not.

Table 6-1. Contributing elements of the SNL/TTR historic district

Historic Resource	Function	Construction	Location
02-00	Askania camera tower	1956	Station 2
02-01	ME-16 tracking telescope	1958	Station 2
03-32	Water tank	1961	Station 3
03-33	Water tank	1962	Station 3
03-50	Engineering tag / physical security office	1956	Station 3
03-51	Administration building	1962	Station 3
03-53	Generator building	1965	Station 3
03-54	Machine shop	1960	Station 3
03-55	Photo optics building	1965	Station 3
03-56	Telescope repair and offices	1965	Station 3
03-57	Operations and control	1980	Station 3
03-62	Welding shop	1960	Station 3
03-65	Radio shop and offices	1960	Station 3
09-04	Camera tower	1970s	Station 9
09-10	Camera tower	1970	Station 9
09-11	Camera tower	1970	Station 9
09-19	Camera tower	1965	Station 9
09-22	Underground room	ca. 1970	Station 9
09-25	Storage igloo	1960	Station 9
09-26	Storage igloo	1960	Station 9
09-27	Storage igloo	1960	Station 9
09-28	Storage igloo	1960	Station 9
09-29	Storage igloo	1960	Station 9
09-30	Storage igloo	1960	Station 9
09-31	Storage igloo	1960	Station 9
09-32	Storage igloo	1960	Station 9
09-33	Storage igloo	1960	Station 9
09-34	Storage igloo	1960	Station 9
09-50	Fire control bunker	1957	Station 9
09-51	Fire control bunker	1964	Station 9
09-52	Assembly building (9A)	1956	Station 9
09-54	Assembly building	1960	Station 9
09-55	Assembly building	1964	Station 9
09-56	Explosive bunker	1960	Station 9
09-57	Explosive bunker	1960	Station 9
09-59	Explosive bunker	1960	Station 9
09-60	Gun control bunker	1971	Station 9
09-63	Special storage facility (bunker)	1986	Station 9
Launcher 2	Missile launcher	1956	Station 9
Launcher 3	Missile launcher	1956	Station 9
Launcher 4	Missile launcher	1956	Station 9

Table continued on next page

Table 6-1. Contributing elements of the SNL/TTR historic district (continued)

Historic Resource	Function	Construction	Location
Launcher 5	Missile launcher	1956	Station 9
13-00	ME-16 tracking telescope	1977	Area 13
16-00	ME-16 tracking telescope	1960	Area 16
22-00	Contraves camera tower	1960	Area 22 (removed)
24-00	Radar antenna building	1971	Station 24
24-01	Radar lab and office	1961/1975	Station 24
24-02	LA-24 telescope	1970	Station 24
24-03	Teletrac antenna	1970	Station 24
24-04	Bore site tower	1962	Station 24
24-09	Rohn Tower	1962	Station 24
24-10	Antenna tower platform	1970	Station 24
24-11	Antenna support tower	1970	Station 24
24-52	Bore site storage	Date Unknown	Station 24
24-53	Communications building	1960	Station 24
32-01	Main gate guardhouse	1982	Main Gate
Rocket sign	TTR sign	1960	Beyond main gate
Hard target	Target	1960	Main target area
ME-16 tracking telescope	Tracking telescope	1958	N/A
Contraves camera	Contraves camera	1960s	N/A

N/A = not applicable
SNL/TTR = Sandia National Laboratories/Tonopah Test Range
TTR = Tonopah Test Range

6.4.3 Historic Building Assessments in 2019

In 2018, it was discovered that two SNL/TTR towers (12-00 and 22-00) had been removed in 2017 without DOE approval. DOE had not completed consultation with the Nevada State Historic Preservation Office regarding demolition of the towers. Tower 22-00 was part of the previously determined SNL/TTR Historic District; Tower 12-00 was recommended as not historic. Sandia personnel performed a root cause analysis and implemented corrective actions to prevent such an occurrence in the future. The Sandia historian prepared a Historic American Building Survey/ Historic American Engineering Record report documenting the history and architectural features of Tower 22-00. As a result, in 2019, DOE submitted a letter describing the incident, the report on Tower 22-00, and Architectural Resource Assessment forms for both towers to the Nevada State Historic Preservation Officer and the Federal Advisory Council on Historic Preservation. No response was received from either entity, and DOE considers the matter closed.

In 2019, the historian also provided DOE with updated Nevada Architectural Resource Assessment forms for the proposed demolition of Tower 02-00 and Dome 02-01, which are no longer in use. DOE remains in consultation with the Nevada State Historic Preservation Office regarding the proposed demolition of Tower 02-00 and the preparation of a memorandum of agreement detailing what documentation is necessary prior to the undertaking. The historian has assembled photographs for the documentation.

PART TWO

SANDIA NATIONAL LABORATORIES
KAUAʻI TEST FACILITY, HAWAIʻI

Chapter 7. SNL/KTF Introduction

The coast of Kaua'I

OVERVIEW ■ The Kaua'i Test Facility has been an active rocket-launching facility since 1962. Sandia National Laboratories personnel support a variety of missions, including research and development, operational training, and test and evaluation. Launch projects are conducted for various government agencies or organizations on a noninterference basis.

This *Annual Site Environmental Report* was prepared in accordance with and as required by DOE per DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*. This report is made available to the public in electronic form at the following website:

https://www.sandia.gov/news/publications/environmental_reports/

Sandia National Laboratories (hereinafter referred as Sandia) is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the DOE National Nuclear Security Administration. Sandia personnel manage and operate the Kaua'i Test Facility (KTF) in Hawai'i for DOE. The DOE National Nuclear Security Administration Sandia Field Office in Albuquerque, New Mexico, administers the contract and oversees contractor operations.

Part Two of this *Annual Site Environmental Report* summarizes the environmental protection and monitoring programs in place for Sandia National Laboratories, Kaua'i Test Facility (SNL/KTF) during calendar year 2019. While all 2019 program activities are performed continuously, they are reported on a calendar year basis unless otherwise noted (programs based on the fiscal year operate from October 1 through September 30, annually).

7.1 Purpose

Sandia personnel—providing the synergy and interdependence between a nuclear deterrence mission and broader national security missions to forge a robust capability base and empower solutions to

complex national security problems—anticipate and resolve emerging national security challenges, innovate and discover new technologies to strengthen the nation's technological superiority, create value through products and services that solve important national security challenges, and inform the national debate for which technology policy is critical to preserving security and freedom throughout the world. Information about recent technologies developed at Sandia National Laboratories can be found at the following website:

http://www.sandia.gov/news/index.html

7.1.1 Operating Contract and DOE Directives

The Prime Contract for management and operations of Sandia defines the corporation's contractual obligations. The DOE directives that pertain to environmental protection and management at SNL/KTF are as follows:

- DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting,* ensures that DOE receives information about events that have affected or could adversely affect the health, safety, and security of the public or workers, the environment, the operation of DOE facilities, or DOE credibility. This *Annual Site Environmental Report* is prepared in accordance with this directive.
- DOE O 232.2A, *Occurrence Reporting and Processing of Operations Information*, requires timely notification to the DOE complex about events that could adversely affect the health and safety of the public or workers, the environment, DOE missions, or DOE credibility.
- DOE O 435.1, Change 1, *Radioactive Waste Management*, ensures that all radioactive waste is managed in a manner that is protective of worker and public health and safety and of the environment. Under this directive, contractors who manage and operate DOE facilities are required to plan, document, execute, and evaluate the management of DOE radioactive waste.
- DOE O 436.1, *Departmental Sustainability*, places environmental management systems and site sustainability at the forefront of environmental excellence. Sandia personnel implement this directive through an ISO 14001-certified EMS at the primary operating locations of SNL/NM and SNL/CA. Although it is not part of the scope of the certification, Sandia personnel at SNL/KTF follow the management approach of the ISO 14001 standard (ISO 2004).

7.2 History

A brief history of Sandia National Laboratories and of operations on Kaua'i are provided below. For more details see Chapter 12.

7.2.1 Sandia National Laboratories

On November 1, 1949, Sandia Corporation, a wholly owned subsidiary of Western Electric, began managing and operating Sandia Laboratory. In 1979, Congress recognized the facility as a national laboratory. From 1993 to mid-2017, Sandia Corporation was a wholly owned subsidiary of Martin Marietta (Lockheed Martin Corporation). In May 2017, the managing and operating contractor changed its name to National Technology & Engineering Solutions of Sandia, LLC (NTESS), a wholly owned subsidiary of Honeywell International Inc.

7.2.2 Sandia National Laboratories, Kaua'i, Hawai'i

SNL/KTF has been an active rocket launching facility since 1962. Later construction, completed in March 2005, extended the Missile Service Tower to support DOE and the Missile Defense Agency. The most recent construction has been an upgrade of the launch field power system. From 1992 to 2019, SNL/KTF personnel have supported 111 launches from SNL/KTF, the Pacific Missile Range Facility, and other mission assets.

The SNL/KTF launch field was originally designed to accommodate 40 launchpads, but only 15 pads were constructed. Of these, 11 have had their launchers removed. Beyond the original plan, two additional launchpads were constructed: one at Pad 41 (Kokole Point [Figure 7-1]) and one at Pad 42 (Missile Service Tower). In addition to rocket launchpad sites, facilities include missile and payload assembly buildings, launch operations and data acquisition facilities, maintenance shops, and a trailer dock compound for administration and other office processing.

7.3 Location Description

SNL/KTF is located on the western coast of Kauaʻi, Hawaiʻi. SNL/KTF is a tenant of the DOD Pacific Missile Range Facility and is located within the boundaries of the Pacific Missile Range Facility. SNL/KTF is bounded on the north and east by agricultural fields, on the northwest and southwest by the Pacific Ocean, and on the south by the Pacific Missile Range Facility (Figure 7-1).

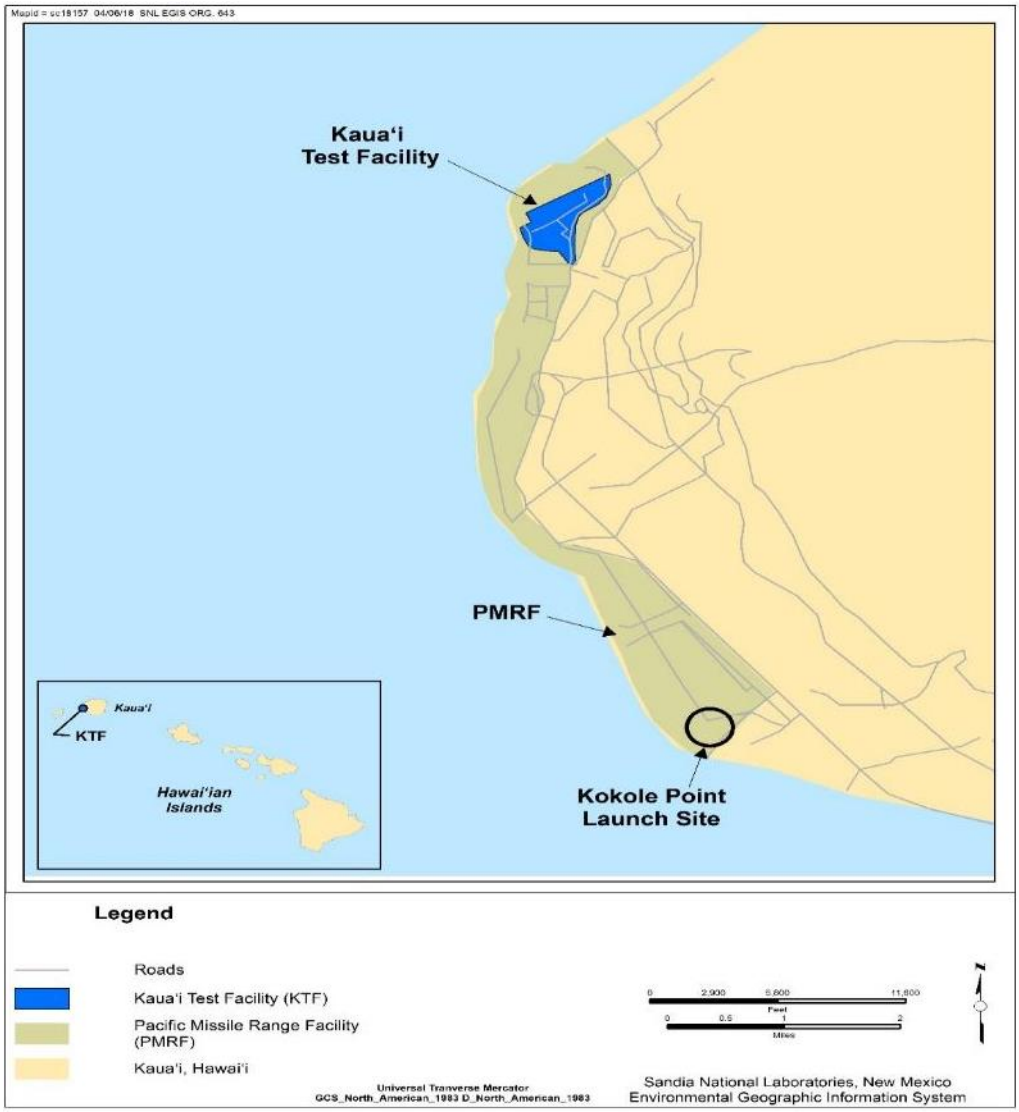

Figure 7-1. KTF location on Kauaʻi, Hawaiʻi

7.4 Demographics

There were 15 permanent on-site personnel at SNL/KTF in 2019. During campaign operations when rocket launches occurred, approximately 100 additional people worked there. The closest towns are Kekaha and Waimea, with populations of 3,537 and 1,855, respectively (Census 2012b), located approximately 10 miles southeast of the site.

7.5 Activities and Facilities

SNL/KTF facilities and personnel support a variety of missions, including research and development, operational training, and testing and evaluation. Personnel conduct launch projects for other organizations or government agencies on a noninterference basis. SNL/KTF provides a high-quality integrated facility for conducting a wide range of test operations. These operations support materials research, components development, advanced reentry-vehicle technologies, water entry-and-recovery systems, missile defense testing, and onboard-sensor research and development testing. Resources are available for assembling, testing, and launching instrumented rockets and rocket payloads; receiving, recording, and processing telemetry; and transferring data with remote airborne and ship-borne instrumentation platforms. Operations do not (currently or in the past) involve radioactive materials.

The administrative area of SNL/KTF, known as the Main Compound, and the launch field are located within fenced areas near the North Nohili access road at the Pacific Missile Range Facility. Inside the compound, several trailers and structures are connected with a network of concrete docks and covered walkways. Most of these facilities are used during mission operations to support customers, defense contractor personnel, and technical staff from SNL/NM; general maintenance activities are performed during noncampaign operations. In addition, there are permanent buildings and shelters in the Main Compound and launch field, some of which are in use year-round to support and maintain SNL/KTF facilities.

Current remote facilities include Mount Haleakala (Maui), where there is one building. In 2015, a Mount Haleakala Advanced Actions Decontamination and Demolition Pre-Action Study was signed as SNL/KTF personnel no longer support missions at this site. During FY 2019, extensive decontamination and demolition work was done at the Mount Haleakala facility in support of transferring the property to the Federal Aviation Administration (part of the U.S. Department of Transportation). The decontamination and demolition work is expected to be completed in 2020. The Kokole Point launch complex and associated facilities were transferred to the U.S. Navy in 2013.

SNL/KTF, located on the island of Kaua'i, exists as a facility within the boundaries of the U.S. Department of Defense Pacific Missile Range Facility.

7.5.1 Rocket Launches in 2019

SNL/KTF personnel supported seven rocket launches in 2019. The launches—covered by the SNL/KTF Environmental Assessment published in July 1992 (DOE/AL 1992), and the U.S. Navy Hawai'i Range Complex Environmental Impact Statement (U.S. Navy 2008)—included the following:

- January 31, 2019, Aegis Ballistic Missile Defense, AMDR-CZ2 (launched from the Pacific Missile Range Facility)
- April 23, 2019, Sandia National Laboratories, High Operation Tempo Flight 2 (launched from SNL/KTF)

- April 24, 2019, Sandia National Laboratories, High Operation Tempo Flight 3 (launched from SNL/KTF)
- August 28, 2019, Sandia National Laboratories, High Operation Tempo Flight 4 (launched from SNL/KTF)
- August 28, 2019, Sandia National Laboratories, High Operation Tempo Flight 5 (launched from SNL/KTF)
- November 13, 2019, Naval Sea Systems Command, JTX-06 Event 1 (launched from SNL.KTF)
- November 20, 2019, Naval Sea Systems Command, JTX-06 Event 2 (launched from SNL.KTF)

7.6 Environmental Setting

Kauaʻi is the oldest, northernmost, and fourth-largest island of the main island chain within the volcanic Hawaiʻian Archipelago. Kauaʻi's varied geographic and topographic features include Waimea Canyon, cliffs of the Na Pali Coast, twin peaks of the old volcano (Mount Kawaikini and Mount Waialeale, elevation 5,243 feet and 5,148 feet, respectively), the Alakaʻi Swamp, the flat-lying coastal Mana Plain, and the Barking Sands dune field (SNL/NM 1992).

Kauaʻi is the oldest, northernmost, and fourth-largest island of the main island chain within the volcanic Hawaiʻian Archipelago.

The low-lying coastal Mana Plain flanks the western slope of the island, forming gentle slopes from the volcanic uplands to the coastal margin (U.S. Navy 2010). The area is relatively flat, ranging in elevation from approximately 5 to 20 feet above mean sea level. Beach dunes parallel to the Pacific Ocean rise above the launch field to a maximum elevation of approximately 100 feet above mean sea level. SNL/KTF is bounded to the north and northwest by these beach dunes, to the west by the Pacific Ocean, and to the east by a drainage-ditch network and numerous agricultural fields.

7.6.1 Geology

Kauaʻi consists of a single massive shield volcano, located at the island's center, which built up from the sea floor by many thousands of thin flows of basaltic lava. The volcanic deposits are now deeply eroded and partly veneered with subsequent volcanic flows. Volcanic rocks exposed on the western half of the island are the oldest and are composed of Pliocene basaltic flows of the Waimea Volcanic Series (U.S. Navy 2010).

Toward the end of the growth of the shield volcano, a period of collapse, faulting, erosion, and subsequent volcanism affected the original surface. The collapse created a broad caldera that is 10 to 12 miles across. Erosion has since destroyed the original surface, and the Alakaʻi Swamp occupies slightly dissected remnants.

The rocks of Kauaʻi are all volcanic except for minor amounts of sediments derived from the volcanic rocks by erosion, and a narrow, discontinuous fringe of calcareous reef and beach deposits (MacDonald, Davis, and Cox 1960). The Mana Plain is composed of a wedge of terrestrial and marine sediments (alluvium, lagoon, beach, and dune deposits) that overlie the volcanic basement (DOE 1992).

7.6.2 Surface and Groundwater Hydrology

There are no natural surface water drainages on SNL/KTF, as the sand at the surface is too permeable for rainwater to accumulate and travel laterally (DOE 1992).

The three geologic units (volcanic bedrock, alluvium, and dune deposits) underlying SNL/KTF constitute three different but hydraulically connected aquifers. The groundwater from all three units tends to be brackish, not potable, and is not suitable for irrigation (DOE 1992). No groundwater wells are located on SNL/KTF.

7.6.3 Ecology

A description of the ecological setting including vegetation types, wildlife, protected species, and threatened and endangered species at the Pacific Missile Range Facility and SNL/KTF is detailed in Chapter 9.

7.6.4 Climate

The climate at SNL/KTF is typical of maritime subtropical islands. Average yearly temperatures range between 84°F and 66°F. August is the warmest month of the year, with daytime highs averaging 87°F and lows averaging 69°F. January is the coolest month, with daytime highs averaging 79°F and lows averaging 62°F. The region is strongly influenced by the Pacific subtropical high-pressure system. There are two main seasons in tropical and subtropical areas: a wet season and a dry or windy season.

SNL/KTF is located on the lee side of the island, which reduces the amount of annual rainfall as compared to the eastern and mountainous areas of Kauaʻi. The lee side exhibits desert-like conditions, with an average annual rainfall of approximately 23 inches. The wet season generally starts in October and extends into March. June to August are the driest months of the year, when well less than one inch of rain is recorded on average for each month (WRRC 2020).

Winds are mostly from easterly directions on Kauaʻi. The northeast and southeast trade winds generally blow between 15 and 25 miles an hour. This global subtropical trade-wind pattern occasionally becomes disrupted in the winter when cool, wet systems approach the island from the west or northwest. Relative humidity ranges from 60 to 70 percent in the summer to near 80 percent during the wet season. Direct hits from typhoons or hurricanes are rare in the Hawaiʻian Islands, though damage from nearby storms may occur. The most destructive hurricane to hit Kauaʻi was Hurricane Iniki in September 1992.

Chapter 8. SNL/KTF Compliance Summary

SNL/KTF, Raccoon Butterflyfish (*Chaetodon lunula*) off the coast of Kaua'i

OVERVIEW ■ Sandia operations at SNL/KTF comply with federal, state, and local environmental regulations, statutes, executive orders, and DOE directives. Regular audits, appraisals, and inspections identify areas for improvement as well as noteworthy practices.

Sandia operations at SNL/KTF comply with federal, state, and local environmental requirements, including DOE directives and presidential executive orders. As part of this compliance, personnel adhere to strict reporting and permitting requirements.

All SNL/KTF operations and activities, including those that are part of environmental programs, are performed in accordance with the ES&H policy, which includes the following statement:

> Sandia integrates environmental, safety and health throughout the lifecycle of its operations to ensure the:
> - Protection of Members of the Workforce by providing a safe and healthful workplace.
> - Protection of the environment by preventing or minimizing pollution and waste, pursuing sustainable resource use, and protecting biodiversity and ecosystems.
> - Protection of the public through the prevention or minimization of releases of hazardous materials.
> - Satisfaction of contractual requirements.
> - Establishment, measurement, and monitoring of ES&H objectives to enhance performance and drive continual improvement.

An Integrated Safety Management System is used to incorporate safety into management and work practices at all levels so that missions are accomplished while protecting the worker, the public, and the environment. Thus, management of safety functions becomes an integral part of mission accomplishment and meets requirements outlined by DOE. The following five core functions guide the integration of safety into all work practices: define the scope of work, analyze the hazards, develop and implement hazard controls, perform work within controls, and provide feedback and continuous improvement.

8.1 Environmental Management System

Sandia management takes the responsibility of protecting the environment seriously and requires employees, contractors, and visitors to adhere to the ES&H policy. There is a continuing cycle of planning, implementing, evaluating, and improving the EMS. The EMS facilitates the identification of the environmental aspects and impacts of Sandia's activities, products, and services; identification of risks and opportunities that could impact the environment; evaluation of applicable compliance obligations; establishment of environmental objectives; and, creation of plans to achieve those objectives and monitor their progress.

DOE O 436.1, *Departmental Sustainability*, provides requirements for managing sustainability. Sandia personnel implement this order through an ISO 14001-certified EMS. Sandia National Laboratories received initial ISO 14001:2004 certification in June 2009. In 2015, the SNL/NM and Sandia National Laboratories, California (SNL/CA) site-specific certifications were integrated into a multi-site ISO 14001:2004 certification. In 2018, the EMS was recertified under the new ISO 14001:2015 (ISO 2015). SNL/KTF operations do not need to be included in the certification, provided that an internal assessment is conducted every three years to ensure that personnel follow the EMS requirements. In January 2018, an EMS ISO 14001:2004 assessment was conducted at SNL/KTF. Additional information can be found at the following external EMS website:

www.sandia.gov/about/environment/environmental_management_system/index.html

The EMS provides the following benefits:

- Improved environmental performance
- Enhanced compliance with environmental regulations
- Strengthened pollution prevention efforts
- Improved resource conservation
- Increased environmental efficiencies and reduced costs
- Enhanced image with the public, regulators, and potential new hires
- Heightened awareness of environmental issues and responsibilities

For FY 2019, air emissions, hazardous materials use, and hazardous waste generation were identified as the top three significant aspects for Sandia operations. When significant aspects and negative impacts have been identified, environmental objectives—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts.

Aspects are any elements of activities, products, or services that can interact with the environment, and *impacts* are any changes in the environment, whether adverse or beneficial, wholly or partially resulting from activities, products, or services.

8.2 Site Sustainability Plan

A Site Sustainability Plan is prepared annually to assist DOE in meeting its sustainability goals and the broader sustainability program set forth in EO 13834, *Efficient Federal Operations* (EO 13834). Sandia's most recent plan, *Fiscal Year 2020 Site Sustainability Plan* (SNL/NM 2019a), describes the performance status for FY 2019. Additional information about pollution prevention activities is provided in Chapter 8.

Sustainability goals are being met or exceeded in several key areas. Table 8-1 presents performance status for several selected key areas (SNL/NM 2019a).

Table 8-1. Site Sustainability Plan performance status for key areas

DOE Goal/Sandia Objective	Sandia Performance Status through FY 2019
Clean and Renewable Energy	
Renewable electric energy should account for not less than 7.5% of a total agency electric consumption by FY 2013 and each year thereafter.	Met this objective by purchasing renewable energy credits. In FY 2019, renewable energy credit purchases accounted for 18.4% of electric consumption.
Electronic Stewardship	
Purchases: 95% of eligible acquisitions each year are EPEAT-registered products.	Met this objective with 98.3% of eligible electronics acquisitions being EPEAT-registered products in FY 2019.
Fleet Management	
75% of light duty vehicle acquisitions must consist of alternative fuel vehicles.	Met this objective in FY 2019.
Greenhouse Gas Reduction	
Year-over-year Scope 1 and Scope 2 greenhouse gas emissions reduction from an FY 2008 baseline. Year-over-year Scope 3 greenhouse gas emissions reduction from an FY 2008 baseline.	Reduced Scope 1 and Scope 2 greenhouse gas emissions by 46% relative to an FY 2008 baseline. However, between FY 2018 to FY 2019, emissions increased by 29%. Scope 3 greenhouse gas decreased by 12.7% in FY 2019 relative to the FY 2008 baseline.
Organizational Resilience	
Discuss overall integration of climate resilience in emergency response, workforce, and operations procedures and protocols.	Began to meet this objective by developing a Climate Change Vulnerability Assessment. The assessment will be integrated into future emergency response operations and building plans.
Pollution Prevention and Waste Reduction	
Reduce at least 50% of nonhazardous solid waste sent to treatment and disposal facilities. Reduce construction and demolition materials and debris sent to treatment and disposal facilities. Year-over-year reduction; no set target.	Met this objective by diverting 61% of nonhazardous solid waste. Reduced construction and demolition waste by 23% through diversion.
Sustainable Acquisition	
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring that BioPreferred and biobased provisions and clauses are included in all applicable contracts.	Implemented efforts to improve the promotion of sustainable acquisition and procurement, including establishing a process to ensure that the appropriate provisions are included in all applicable contracts.
Sustainable Buildings	
Comply with the revised guiding principles for High Performance and Sustainable Buildings for at least 15% (by building count) of existing buildings greater than 5,000 gross square feet by FY 2020, with annual progress thereafter.	Met this objective with 20.98% of buildings achieving compliance with the guiding principles.
Sustainable Energy Management	
Reduce energy intensity in goal-subject buildings by 30% relative to an FY 2003 baseline and by 1% year-over-year thereafter.	Did not meet this objective. Energy intensity increased from FY 2018 to FY 2019.
Water Use Efficiency and Management	
Reduce potable water intensity by 20% relative to an FY 2007 baseline by FY 2015 and 0.5% year-over-year thereafter.	Achieved 20.1% reduction in FY 2019 relative to an FY 2007 baseline.

DOE = U.S. Department of Energy EPEAT = Electronic Product Environmental Assessment Tool FY = fiscal year

8.3 Environmental Compliance

DOE directives listed in the Management and Operating Contract for Sandia National Laboratories as well as applicable federal, state, and local laws and regulations define the primary contractual obligations for management and operation of SNL/KTF. Directives that pertain to environmental protection and management are discussed in Chapter 6. In 2019, the management and operating contractor adhered to the requirements cited in Section 8.3.1 for SNL/KTF operations as stated in compliance status.

On May 17, 2018, EO 13834, *Efficient Federal Operations,* affirms that agencies shall meet such statutory requirements in a manner that increases efficiency, optimizes performance, eliminates unnecessary use of resources, and protects the environment. Section 8 of the new executive order revokes EO 13693, *Planning for Federal Sustainability in the Next Decade*.

8.3.1 Federal Requirements

Federal environmental requirements applicable to operations at SNL/KTF, along with the compliance status, follows.

Environmental Planning

National Environmental Policy Act (NEPA) of 1969

This act requires federal agencies to assess and consider human health and environmental issues associated with proposed actions, be aware of the potential environmental impacts associated with these actions, and include this information in early project planning and decision-making. Review of federally funded proposed actions is conducted in accordance with 10 CFR 1021, *National Environmental Policy Act Implementing Procedures*.

Compliance Status

NEPA checklists are prepared for proposed projects and activities to assess potential environmental consequences. After completion of a NEPA checklist, NEPA Program personnel review projects for compliance with existing DOE NEPA documents and determinations. When required, a NEPA checklist is forwarded to DOE for review and determination.

Section 9.6 provides information on NEPA activities.

Environmental Restoration

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and amended in 1986

Also known as the "Superfund," this act establishes liability compensation, cleanup, and emergency response requirements for inactive hazardous waste sites. In addition, CERCLA requires federal facilities to report hazardous substance spills to the National Response Center. The Superfund Amendments and Reauthorization Act (SARA) of 1986 establishes additional reporting requirements that are addressed under "Chemical Management."

Compliance Status

EPA designated ongoing oversight of SNL/KTF to the State of Hawai'i, Department of Health, Hazard Evaluation and Emergency Response Office. EPA recommended continued reevaluation for environmental contamination due to ongoing activities at the rocket-launching facility at SNL/KTF (EPA 1996).

Environmental restoration sites located on-site at SNL/KTF have been closed through the regulatory process.

Hazardous Waste

Federal Facility Compliance Act of 1992

This act requires federal facilities to comply with all federal, state, and local requirements for hazardous and solid waste, including full compliance with the restrictions and prohibitions on extended storage of wastes that do not meet the applicable hazardous waste treatment standards.

Compliance Status

SNL/KTF operations do not generate mixed waste, and no mixed waste is currently stored on-site; therefore, these requirements are not applicable at SNL/KTF.

Resource Conservation and Recovery Act (RCRA), enacted in 1976

This act and the Hawai'i Revised Statutes regulate the generation, transportation, treatment, storage, and disposal of hazardous and nonhazardous solid wastes (References, "State of Hawai'i Environmental Regulations").

Note: Under the conditionally exempt or very small-quantity generator designation, hazardous waste must be shipped off-site for treatment and/or disposal at an EPA-permitted facility.

Compliance Status

Some hazardous waste is generated through normal operations at SNL/KTF. The site is classified as a conditionally exempt or very small-quantity generator and is subject to the applicable requirements.

Section 9.9 provides information on waste management.

Radiation Protection

Atomic Energy Act of 1946 (42 USC § 2011 et seq.)

This act promotes the proper management of source, special nuclear, and byproduct nuclear materials.

Compliance Status

SNL/KTF operations do not (currently or in the past) involve radioactive materials (Section 7.5); therefore, these requirements are not applicable at SNL/KTF.

Air Quality

Clean Air Act of 1970, as amended

This comprehensive federal law regulates air emissions from stationary and mobile sources. The act calls for the EPA to describe and track air pollutants from stationary and mobile sources and to establish ambient air quality standards.

Air pollutants from stationary and mobile sources at SNL/KTF are regulated by Hawai'i Administrative Rules, Title 11, Chapter 60.1, "Air Pollution Control," under the jurisdiction of the Hawai'i State Department of Health, Clean Air Branch (References, "State of Hawai'i Environmental Regulations"*)*.

Ambient air quality at SNL/KTF is regulated by Hawai'i Administrative Rules, Title 11, Chapter 59, "Ambient Air Quality Standards," under the jurisdiction of the Hawai'i State Department of Health, Clean Air Branch (References, "State of Hawai'i Environmental Regulations"*)*.

Compliance Status

Clean Air Act compliance is achieved by adherence to permit requirements.

Section 9.1 provides information on air quality compliance.

Water Quality

Clean Water Act of 1972 and amendments

This act established a permitting structure and regulatory direction to protect the "waters of the United States" by restoring and maintaining the chemical, physical, and biological integrity of United States waters; protecting fish, wildlife, and recreation; and reducing pollutant discharges.

Compliance Status

In 2019, wastewater was managed under three state-registered septic tanks.

Section 9.10 provides information on water quality compliance.

Energy Independence and Security Act of 2007, Section 438 of the Clean Water Act

This act requires federal agencies to manage stormwater runoff from federal development projects for the protection of water resources.

Compliance Status

There are no stormwater compliance requirements for SNL/KTF (Section 9.10.1); therefore, these requirements are not applicable at SNL/KTF.

Oil Pollution Act of 1990 (§ 311) (with implementing regulations in 40 CFR 112, Oil Pollution Prevention) and the Clean Water Act

This act establishes requirements for the prevention of, preparedness for, and response to oil discharges at specific non-transportation-related facilities to prevent oil from reaching navigable waters of the United States and adjoining shorelines, and to contain discharges of oil. The act requires the development and implementation of a Spill Prevention, Control, and Countermeasure Plan.

Compliance Status

Oil storage container and equipment operations at SNL/KTF are conducted in compliance with the Pacific Missile Range Facility Spill Prevention, Control, and Countermeasure Plan.

Section 9.7 provides information on the Oil Storage Program.

Safe Drinking Water Act of 1974, as amended, and National Division of Environmental Protection public water system regulations

This act was established to protect the quality of drinking water in the United States, focusing on all waters actually or potentially designed for drinking use, whether from aboveground or underground sources.

Compliance Status

All drinking water at SNL/KTF is either supplied by the Pacific Missile Range Facility drinking water system.

Underground and Aboveground Storage Tanks

Under the authority of the Hawai'i Revised Statutes and with delegated authority from EPA under RCRA, the Hawai'i State Department of Health administers the underground storage tank regulatory program in Hawai'i. As a result, the single SNL/KTF underground storage tank is permitted and regulated under the Hawai'i Administrative Rules, Title 11, Chapter 281, "Underground Storage Tanks" (References, "State of Hawai'i Environmental Regulations"*).*

Compliance Status

Underground and aboveground storage tank compliance is achieved by adherence to permit requirements.

Section 9.7 provides information regarding oil storage.

Chemical Management

Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986

EPCRA, also known as the Superfund Amendments and Reauthorization Act (SARA) Title III, requires reporting of toxic chemicals used and released by federal, state, and local governments and industry. These provisions help increase the public's knowledge of and access to information on chemicals at a facility, their uses, and releases into the environment. The Emergency Release Notification requirements were established under Section 304 of EPCRA. The Toxic Release Inventory reporting requirement was established under Section 313 of EPCRA.

Compliance Status

In 2019, there were no reportable quantity releases of extremely hazardous substances requiring notification under Section 304.

In 2019, no releases resulting from SNL/KTF operations met the threshold requiring a Toxic Release Inventory report under Section 313 of EPCRA.

Table 8-2 provides further detail on applicable EPCRA requirements.

Federal Insecticide, Fungicide, and Rodenticide Act, enacted in 1910 and amended in 1972

This act governs the registration, distribution, sale, and use of pesticides in the United States.

Compliance Status

All herbicides, rodenticides, and insecticides used at SNL/KTF follow EPA requirements and are applied in accordance with applicable label guidelines and regulations.

Toxic Substances Control Act, enacted in 1976 and later amended

This act regulates the manufacture, processing, distribution, use, and disposal of specific chemical substances and/or mixtures.

Compliance Status

At SNL/KTF, compliance with the Toxic Substances Control Act primarily involves managing asbestos-containing materials and PCBs. There are no PCB-contaminated transformers at SNL/KTF. Asbestos-containing materials and abatement-related activities are conducted in accordance with applicable regulatory requirements, as needed.

Section 9.9 provides information on asbestos management.

Pollution Prevention

Pollution Prevention Act of 1990

This act declares as national policy that pollution should be prevented or reduced at the source (42 USC § 13101 et seq.). A toxic chemical source reduction and recycling report is required for facilities that meet the reporting requirements under EPCRA, Section 313.

Compliance Status

See the previous EPCRA discussion under "Chemical Management."

Natural Resources

Endangered Species Act of 1973, amended in 1982

This act applies to both private individuals and federal agencies. Section 7 of the Endangered Species Act requires consultation with the U.S. Fish and Wildlife Service to ensure that actions are not likely to harm or jeopardize the continued existence of federally listed species or result in the destruction or adverse modification of designated critical habitat.

Compliance Status

Activities with the potential to impact identified endangered species were managed through the NEPA process. In 2019, protected species clearance surveys were conducted as needed, and no endangered species were identified.

Chapter 10 provides information about threatened or endangered species potentially occurring on Kauaʻi.

EO 11988 of 1977, Floodplain Management, as amended

This executive order requires federal agencies to consider impacts associated with the occupancy and modification of floodplains; reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains.

Compliance Status

Portions of SNL/KTF are within designated floodplains (Hawaiʻi DLNR 2019).

EO 11990 of 1977, Protection of Wetlands, as amended

This executive order requires federal agencies to minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands.

Compliance Status

There are no designated wetlands within the operational area of SNL/KTF.

Fish and Wildlife Conservation Act (PL 96-366), enacted in 1980, and the Lacey Act Amendments (PL 97-79), enacted in 1981

These acts were established to ensure that wildlife receives equal consideration with other natural resources when managing ecosystems.

As stated in 16 USC § 2901, the purpose is: "(1) to provide technical assistance to the States for the development, revision, and implementation of conservation plans and programs for nongame fish and wildlife; and (2) to encourage all Federal departments and agencies to utilize their statutory and administrative authority, to the maximum extent practicable and consistent with each agency's statutory responsibilities, to conserve and to promote conservation of nongame fish and wildlife and their habitats."

In 2013, DOE and the Department of Interior's Fish and Wildlife Service entered a *Memorandum of Understanding, Responsibilities of Federal Agencies to Protect Migratory Birds,* to enhance collaboration in promoting the conservation of migratory bird populations (DOE and FWS 2013). This strengthens migratory bird conservation between the two federal agencies in coordination with state, tribal, and local governments.

Compliance Status

Fish and wildlife conservation compliance is achieved through avian surveys, as needed. In 2019, no surveys were conducted.

Chapter 10 presents information on the Ecology Program avian surveillance activities conducted in previous years.

Migratory Bird Treaty Act (MBTA) of 1918 (and amendments)

This act implemented the 1916 Convention for the Protection of Migratory Birds. The original statute implemented the agreement between the United States and Great Britain (for Canada), and later amendments implemented treaties between the United States and Mexico, the United States and Japan, and the United States and Russia.

The MBTA prevents taking, killing, possessing, transporting, and importing migratory birds, their eggs, parts, or nests. Federal institutions are not exempt from the MBTA.

Compliance Status

An avian protection plan is in place that provides procedures that address potential impacts to migratory birds known to occur in the area. In 2019, no avian surveys were conducted, as planned activities at the site did not require a survey.

Chapter 10 provides information on Ecology Program avian surveillance activities conducted in previous years.

Sikes Act of 1960 (PL 86-97), enacted in 1960, and the amendments of 1986 (PL 99-561) and 1997 (PL 105-85 Title XXIX), was reauthorized in 2013

This act protects and enhances fish, wildlife, and other natural resources that exist on and are associated with military lands in the United States.

Compliance Status

In 2019, compliance was achieved by adherence with the Memorandum of Understanding between DOE and the U.S. Fish and Wildlife Service.

Chapter 10 provides information on the Ecology Program.

Quality Assurance

DOE Order 414.1D (DOE O 414.1D Admin Change 1), Quality Assurance

This order is an addition to 10 CFR 830**,** *Nuclear Safety Management***,** Subpart A, "Quality Assurance." The purpose of the order is to achieve quality in all work and ensure that products and services meet or exceed customer requirements and expectations.

Compliance Status

All environmental sampling and analysis that was conducted in 2019 conformed to applicable quality assurance plans.

Chapter 11 provides information on quality assurance.

Cultural Resources

AFI 32-7065, Cultural Resources Management Program

This Air Force Instruction establishes guidelines for managing and protecting cultural resources on property affected by Air Force operations in the United States.

Compliance Status

Cultural Resource Program personnel ensure the review, oversight, and documentation of cultural resources at SNL/KTF. When appropriate, these activities are coordinated with DOD. In 2019, no projects included coordination between DOE and DOD.

Chapter 12 provides information on the Cultural Resource Program.

American Indian Religious Freedom Act, enacted in 1978 and amended in 1994

This act protects the rights of Native Americans to exercise their traditional religions by ensuring access to sites, the use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites.

Compliance Status

Planning through the NEPA process identifies potential impacts to cultural resource sites, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, no activities required interaction with any Native Hawai'ians.

Chapter 12 provides information on the Cultural Resource Program.

Archaeological Resources Protection Act, enacted in 1979 and amended in 1988

This act governs disturbance of archeological sites on federal and Indian lands in the United States, and the removal and disposition of archeological collections from those sites.

Compliance Status

Planning through the NEPA process identifies potential impacts to archaeological sites, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, local archaeological monitors (Native Hawai'ians meeting specific criteria) were contracted to monitor all ground disturbance activities.

Chapter 12 provides information on the Cultural Resource Program.

DOE O 144.1, Department of Energy American Indian Tribal Government Interactions and Policy

This order addresses interactions with American Indian Tribal representatives in relation to any DOE proposed work that may involve tribal rights and interests.

Compliance Status

Planning through the NEPA process identifies proposed work that may involve tribal rights and interests. No proposed work involved tribal rights and interests and, accordingly, no interactions occurred in 2019.

DODI 4710.02, DOD Interactions with Federally Recognized Tribes

This DOD instruction implements DOD policy, assigns responsibilities, and provides procedures for DOD interactions with federally recognized tribes.

Compliance Status

Cultural Resource Program personnel ensure the review, oversight, and documentation of cultural resources at SNL/KTF. When appropriate, these activities are coordinated with DOD. In 2019, no projects included coordination between DOE, DOD and Native American tribes.

Chapter 12 provides information on the Cultural Resource Program.

DODI 4715.16, Cultural Resources Management

This DOD instruction outlines DOD policy and assigns responsibilities for complying with applicable federal statutory and regulatory requirements, executive orders, and presidential memorandums for the integrated management of cultural resources on DOD-managed lands.

Compliance Status

Cultural Resource Program personnel ensure the review, oversight, and documentation of cultural resources at SNL/KTF. When appropriate, these activities are coordinated with DOD. In 2019, no projects included coordination between DOE and DOD.

Chapter 12 provides information on the Cultural Resource Program.

DOE O 430.1C, Real Property Asset Management

This order establishes the approach for the life-cycle management of real property assets that aligns the real property portfolio with DOE mission needs in a safe, secure, cost-effective, and sustainable manner.

Compliance Status

Planning through the NEPA process identifies potential impacts to real property assets, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, no mitigative actions were required.

Chapter 12 provides information on the Cultural Resource Program.

DOE P 141.1, Management of Cultural Resources

This policy ensures that DOE programs, including the National Nuclear Security Administration, and field elements integrate cultural resources management into their missions and activities.

Compliance Status

Cultural Resource Program personnel ensure the review, oversight, and documentation of cultural resources at SNL/KTF. Planning through the NEPA process identifies potential impacts to archaeological sites and historic properties, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, no mitigative actions were required.

Chapter 12 provides information on the Cultural Resource Program.

National Historic Preservation Act, enacted in 1966 and amended in 2000

This act requires federal agencies to identify, record, and protect cultural resources and to assess the impact of proposed projects on historic or culturally important sites, structures, or objects. The regulations in 36 CFR 800, *Protection of Historic Properties* implement the section 106 process for accommodating historic preservation concerns with the needs of Federal undertakings.

Historic buildings and structures may include structures at least 50 years of age that are historically significant or younger structures that are of exceptional significance. Nominations for potentially eligible properties adhere to the implementing regulations in 36 CFR 60, *National Register of Historic Places.*

Compliance Status

Planning through the NEPA process identifies potential impacts to cultural resource sites, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, no historic properties were threatened, and no buildings previously unassessed were modified or demolished.

Chapter 12 provides information on the Cultural Resource Program.

Native American Graves Protection and Repatriation Act, enacted in 1990

This act requires federal agencies and institutions that receive federal funding to inventory their collections, consult with federally recognized Native American entities, and repatriate human remains or cultural items that are discovered or excavated.

Compliance Status

Planning through the NEPA process identifies potential impacts to cultural resource sites, and appropriate documentation is submitted to DOE to support mitigation of adverse effects when necessary. In 2019, no cultural items were discovered or excavated.

Chapter 12 provides information on the Cultural Resource Program.

Table 8-2. SNL/KTF applicable EPCRA reporting requirements

Section	EPCRA Section Title	Description
301–303	Emergency Planning	Prepare an annual report that lists chemical inventories above the reportable Threshold Planning Quantities listed in 40 CFR 355, Appendix B, including the location of the chemicals and emergency contacts.
304	Emergency Release Notification	Provide notification of reportable quantity releases of extremely hazardous substances, as defined by CERCLA, to the required entities.
311–312	Hazardous Chemical Inventory	Report on Community Right-to-Know requirements for (1) all hazardous chemicals present at a facility at any one time in amounts equal to or greater than 10,000 pounds and (2) all extremely hazardous substances present at a facility in amounts equal to or greater than 500 pounds or the Threshold Planning Quantity, whichever is lower. A safety data sheet must be available for hazardous chemicals present at the facility.
313	Toxic Release Inventory	Submit a Toxic Release Inventory report to the required entities for facilities that release toxic chemicals listed in SARA Title III over a threshold value.

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
EPCRA = Emergency Planning and Community Right-to-Know Act
SARA = Superfund Amendments and Reauthorization Act
SNL/KTF = Sandia National Laboratories, Kaua'i Test Facility

Sunset in Hawai'i

8.4 Environmental Permit Status

Environmental permits for SNL/KTF include those for a wastewater system, diesel generators, and an underground storage tank issued by the State of Hawai'i. Table 8-3 lists the applicable environmental permits in effect at SNL/KTF in 2019.

Table 8-3. SNL/KTF environmental permits, 2019

Permit Type	Permit Number	Issue Date	Expiration Date	Regulatory Agency
Individual wastewater system	File #4056-SNL, TMK: (4) 1-2-002:013	December 1, 2004	Not applicable	State of Hawai'i Department of Health
Noncovered source permit (two stand-by diesel generators)	NSP 0429-01-N	September 28, 2015	September 27, 2020	State of Hawai'i Department of Health
Underground storage tank (2,500 gallons)	P-2016-064	June 8, 2016	June 8, 2021	State of Hawai'i Department of Health

SNL/KTF = Sandia National Laboratories, Kaua'i Test Facility

8.5 Environmental Performance

Environmental performance is measured as progress toward achieving site environmental objectives, meeting or exceeding compliance, and contributing to corporate and contract performance goals. Results are tracked and reported internally through the ES&H Assurance Dashboard, the management review process, and management reports.

Criteria for performance evaluation were set forth in the *Fiscal Year 2019 DOE/NNSA Strategic Performance Evaluation Measurement Plan (PEMP)* (DOE/NNSA 2019). Subsequently, the DOE National Nuclear Security Administration Sandia Field Office prepared the *FY2019 Performance Evaluation Summary* (DOE/NNSA 2020), assessing the management and operating contractor performance for October 1, 2018, through September 30, 2019. The performance evaluation is the annual DOE National Nuclear Security Administration report card that ascribes a rating on six key performance goals and an overall rating. Sandia received a rating of excellent in three of the six categories: Reduce Nuclear Security Threats; DOE and Strategic Partnership Projects Mission Objectives; and Science, Technology and Engineering. A rating of very good was received in the three remaining categories: Manage the Nuclear Weapons Mission, Operations and Infrastructure, and Leadership. Sandia received an overall rating of very good.

8.5.1 Audits, Appraisals, and Inspections in 2019

Environmental programs are routinely subjected to audits, appraisals, inspections, and/or verifications by external agencies. Table 8-4 summarizes the 2019 audits, including the findings, notices of violation, and other environmental occurrences. The Sandia internal audit group also conducts assessments, including reviews of implementation of applicable policies, processes, or procedures; evaluations of corrective action validation assessments; and surveillances and walkthroughs. Self-assessments evaluate performance and compliance and identify deficiencies and opportunities for improvement as well as noteworthy practices and lessons learned.

Table 8-4. Environmental-related audits, appraisals, inspections, and violations, 2019

Appraising Agency	Title/Description	Date	Summary
Hawai'i State Department of Health Petroleum Storage Tank Bureau	Underground Storage Tank Compliance Inspection	September 2019	No violations

8.5.2 Occurrence Reporting in 2019

Under DOE O 232.2A, *Occurrence Reporting and Processing of Operations Information*, the current order for occurrence reporting, *occurrences* are defined as "events or conditions that adversely affect, or may adversely affect, DOE (including the National Nuclear Security Administration) or contractor personnel, the public, property, the environment, or the DOE mission." Events or conditions meeting the criteria thresholds identified in this order or determined to be recurring through performance analysis are occurrences. Whereas some environmental releases may not meet DOE O 232.2A reporting thresholds, they may still be reportable to outside agencies.

Per DOE, an *occurrence* is defined as "one or more (i.e., recurring) events or conditions that adversely affect, or may adversely affect, DOE or contractor personnel, the public, property, the environment, or the DOE mission."

Occurrences that met DOE O 232.2A criteria were entered into the DOE Occurrence Reporting and Processing System database. Corrective actions and closure of occurrence reports are also

tracked in the database. For this *Annual Site Environmental Report*, the Occurrence Reporting and Processing System database was queried for SNL/KTF occurrences in the following reporting criteria groups (as defined by DOE O 232.2A):

- Group 5, Environmental
- Group 9, Noncompliance Notifications
- Group 10, Management Concerns and Issues (with identified environmental impact)
- Any occurrence that involved a Sandia environmental program

Qualifying occurrences that took place within a building are not provided in this report.

There were no DOE O 232.2A reportable occurrences at SNL/KTF in 2019.

Chapter 9. SNL/KTF Environmental Programs

Hanalei Bay, Kaua'i

OVERVIEW ■ Sandia personnel take the responsibility of protecting the environment seriously. Numerous program teams monitor the environment and perform activities at SNL/KTF to help prevent pollution and conserve natural resources.

Sandia personnel collect data at SNL/KTF to determine and report the impact of existing operations on the environment. These environmental program activities meet or exceed federal, state, and local environmental requirements, as well as DOE directives in Sandia's Prime Contract. Presidential executive orders and DOE guidance documents are also used to establish program criteria.

The current environmental programs and focus areas include:

- Air Quality Compliance Program
- Chemical Information System
- Environmental Life-Cycle Management Program
- Environmental Restoration Project
- Meteorology Program
- NEPA Program
- Oil Storage Program
- Terrestrial Surveillance Program
- Waste Management Program
- Water Quality programs

The Ecology Program is presented in Chapter 10.

9.1 Air Quality Compliance Program

As required, the 2019 Annual Emissions Report for air emissions was submitted to the State of Hawai'i (DOE/NNSA 2019). The annual fee was submitted to the State of Hawai'i for 2019, as required by the Noncovered Source Permit. All operations at SNL/KTF followed permitted operating limits.

The two diesel-fired power generators at SNL/KTF are permitted for operation by the State of Hawai'i under a Noncovered Source Permit (Hawai'i DOH 2015). These generators are subject to the provisions of the following federal regulations (the specific requirements of these standards are detailed in special conditions within the permit):

- 40 CFR 60, *Standards of Performance for New Stationary Sources,* Subpart A, "General Provisions"
- 40 CFR 60, *Standards of Performance for New Stationary Sources*, Subpart IIII, "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines"

Rocket launches are considered mobile sources of air emissions, and rocket launch emissions are included in the review against Toxic Release Inventory reporting thresholds.

In addition, two monitoring reports for the Noncovered Source Permit were submitted to the State of Hawai'i for 2019 operations within required timelines (DOE/NNSA 2019; DOE/NNSA 2017). The highest total combined operating hours for a rolling 12-month period was 822.6 hours, which occurred in the period from December 2018 to January 2019.

9.2 Chemical Information System

The Chemical Information System is a comprehensive chemical information tool used to track workplace chemical and biological containers by location. The primary drivers for the Chemical Information System are state and federal regulations, including the Emergency Planning and Community Right-to-Know Act. The Chemical Information System compiles information concerning chemical hazards and appropriate protective measures for the workforce, Emergency Management Operations, and other ES&H programs.

The inventory system provides the chemical or product name, its location and quantity, and information about who is responsible for the chemical. Chemical hazards are reported on safety data sheets, and the Chemical Information System currently contains more than 120,000 safety data sheets in its library. This electronic inventory helps chemical users and their managers assess and manage workplace hazards. Easy access to this inventory facilitates availability searches. It also improves the ability to share chemicals and thus help reduce sources, which helps to minimize chemical purchases and waste disposal expenses.

A pre-procurement module, ChemPro, is used to request permission for new chemical purchases. The system runs a series of queries, comparing the requested purchasing information to regulatory limits and determines whether the requested chemical and volume is approved for use and storage in the specified location. If approved, the requestor is given a chemical approval number, which must be provided to the chemical vendor as part of the purchasing process. ChemPro allows for proactive environmental and safety planning.

9.3 Environmental Life-Cycle Management Program

Environmental Life-Cycle Management Program activities ensure long-term protection of human health and the environment. Using the NEPA process, program personnel review proposed SNL/KTF projects and activities that have the potential to impact the environment. This review

provides a process for minimizing adverse environmental impacts from ongoing and future activities. In 2019, environmental impacts of two projects were reviewed and documented.

9.4 Environmental Restoration Project

All environmental restoration sites at SNL/KTF have been closed through the regulatory process. On September 30, 1996, the EPA granted a Site Evaluation Accomplished determination for the three environmental restorations sites identified in 1995 (EPA 1996). This confirmed that SNL/KTF operations met all Comprehensive Environmental Response, Compensation, and Liability Act requirements and no additional sampling or remediation would be necessary at the three sites.

9.5 Meteorology Program

Due to the infrequency of launches, no formal meteorological monitoring equipment is in place for SNL/KTF. On-site meteorological instruments are used during test periods only to characterize ground-level and atmospheric wind conditions that will affect a rocket's flight. Climatic information, representative of SNL/KTF, is obtained from Pacific Missile Range Facility personnel, and severe weather notifications are automatically issued by the Pacific Missile Range Facility Emergency Operations Center to all SNL/KTF resident personnel.

9.6 National Environmental Policy Act Program

NEPA Program personnel provide technical assistance to ensure that operations comply with NEPA and the National Historic Preservation Act. For proposed projects and activities, project owners complete a NEPA checklist using NEPA Docs software to assess potential environmental impacts.

After a NEPA checklist is completed, NEPA Program personnel review projects and activities for conformance with existing DOE NEPA documents and determinations. Other applicable environmental subject matter experts also review proposed projects and activities to determine and communicate any applicable permitting and/or other requirements.

In 2019, NEPA Program personnel supported several customers with associated programmatic activities performed at either SNL/KTF or the Pacific Missile Range Facility and provided support for decontamination and demolition of various facilities.

In addition, the NEPA team completed seven NEPA checklists for SNL/KTF, six of which were transmitted to the DOE National Nuclear Security Administration Sandia Field Office for review and completion. Further, the NEPA team completed a draft of the Kauaʻi Test Facility Site-Wide Environmental Assessment and submitted in December 2018 for a 30-day public comment period. The environmental assessment analyzed the potential effects of a proposal to continue operations at the facility, increase the number of annual single rocket launches from the facility, and implement replacement and modernization of facilities to sustain and enhance launch capabilities. In March 2019, the DOE issued a Finding of No Significant Impact.

9.7 Oil Storage Program

The Oil Storage Program supports regulatory compliance associated with the management, operation, and maintenance of oil storage containers and equipment at SNL/KTF. Aboveground oil storage containers at SNL/KTF operate under the Pacific Missile Range Facility Spill Prevention, Control, and Countermeasure Plan (DoN 2017), as required by 40 CFR 112, *Oil Pollution Prevention* (40 CFR 112) and the Clean Water Act. The Pacific Missile Range Facility Spill Prevention, Control,

and Countermeasure Plan describes the oil storage facilities at the SNL/KTF site and the mitigation controls in place to prevent inadvertent discharges of oil.

The SNL/KTF inventory of oil storage containers operating under the Pacific Missile Range Facility Spill Prevention, Control, and Countermeasure Plan included:

- Four 55-gallon drums used for collecting and storing oil
- One stationary aboveground diesel fuel storage tank (10,000 gallons)
- Two stationary diesel fuel generator base tanks (300 gallons each)
- One portable diesel fuel generator base tank (192 gallons)

In 2019, the aging 10,000-gallon aboveground diesel fuel storage tank was replaced with a new 10,000-gallon aboveground diesel fuel storage tank.

In addition to aboveground oil storage containers at SNL/KTF, a single underground gasoline storage tank (2,500 gallons) is maintained on-site and is subject to regulation under the Hawai'i Administrative Rules, Title 11, Chapter 281, *Underground Storage Tanks*. The underground storage tank is permitted with the State of Hawai'i, Department of Health. The tank leak detection system equipment is inspected and functionally tested annually in accordance with requirements.

In 2019, the Hawai'i State Department of Health performed a compliance inspection on the SNL/KTF underground storage tank. No violations were identified.

There were no reportable oil spills or releases at SNL/KTF in 2019.

9.8 Terrestrial Surveillance Program

Terrestrial Surveillance Program personnel collect environmental media (soil) samples at SNL/KTF approximately every five years. Environmental surveillance began at SNL/KTF in 1994 and continued in 1999, 2002, 2007, 2012, and 2018. Sampling activities were not conducted in 2019. Previous sampling results can be found in earlier Annual Site Environmental Reports.

9.9 Waste Management Program

Some hazardous waste is generated through normal operations at SNL/KTF. The site is classified as a conditionally exempt small-quantity generator or very small quantity generator, and personnel follow applicable requirements. EPA Region 9 and the Hawai'i State Department of Health issued a generator identification (HI-0000-363309) to Sandia on September 23, 1994.

At SNL/KTF, compliance with the Toxic Substances Control Act primarily involves management of asbestos and PCBs. The transformers on the SNL/KTF site have been tested and are free of PCBs (IT 1993). Asbestos abatement-related activities are conducted in accordance with applicable regulatory requirements, as needed.

The SNL/NM asbestos management team conducted a comprehensive asbestos survey in July 2008. One hundred and ten cubic yards of asbestos-containing materials were identified at SNL/KTF, and 91 cubic yards were identified at the Mount Haleakala site on Maui.

In 2018, asbestos abatement was concluded at the Mount Haleakala site on Maui. No additional asbestos-containing materials were removed in 2019.

9.10 Water Quality Programs

Water quality-related programs at SNL/KTF ensure compliance with local, state, and federal requirements. There are no drinking water or groundwater monitoring wells at SNL/KTF. All drinking water at SNL/KTF is either supplied by the Pacific Missile Range Facility public water system.

9.10.1 Stormwater Program

Stormwater runoff is directed into two French drains and four area drains with pumping systems. Stormwater permits, inspections, and sampling are not required.

9.10.2 Wastewater Discharge Program

Activities at SNL/KTF produce only sanitary sewage, which is directed into three DOE-owned and state-registered septic tanks; all the tanks are currently in use and do not impact any protected waters. The first septic tank was built in 1965 and was replaced in 2004. Two additional septic tanks were built in 1990 to serve other areas. The septic tank systems are pumped periodically and inspected by licensed, state-certified contractors. No contaminants have been identified above the reporting limits from past sampling events. During 2019, all three septic tank systems were inspected with one tank being pumped.

Wastewater is the spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

9.10.3 Water Quality Program Results

In 2019, there were no compliance issues with respect to any state or federal water pollution regulations at SNL/KTF.

Chapter 10. SNL/KTF Ecology Program

Hawai'ian Goose (*Branta sandvicensis*)

OVERVIEW ■ Ecology Program personnel monitor biota as an element of the overall environmental monitoring process. Ecological data is collected on plants and wildlife to support documentation, land use decisions, and ecological and wildlife awareness campaigns to ensure safe work environments and sustainable decision-making strategies. Ecology Program personnel help operations comply with wildlife regulations and laws by providing biological evaluations and surveys in support of site activities.

At SNL/KTF, Ecology Program personnel support site activity and project compliance with wildlife requirements by providing biological evaluations and surveys. Ecology Program personnel conduct limited biological inventory surveys at SNL/KTF.

The island of Kaua'i has numerous species protected by the Endangered Species Act. Many of these are forest species for whom SNL/KTF has little or no suitable habitat. These species would not likely occur at SNL/KTF; however, their historical or future occurrence at SNL/KTF cannot be ruled out. Table 10-1 presents the Endangered Species Act and Migratory Bird Treaty Act list of threatened or endangered species that may occur on Kaua'i.

In 2018, the U.S. Fish and Wildlife Service issued biological and conference opinions for the Pacific Missile Range Facility (USFWS 2018) and for SNL/KTF as a tenant. These biological opinions contain measures to mitigate the impact of proposed activities.

10.1 Vegetation

There are seven recognized vegetation types on the undeveloped portions of the Pacific Missile Range Facility, which include SNL/KTF: kiawe/koa-haole scrub, a`ali`i-nama scrub, pohinahina, naupaka dune, strand, drainage-way wetlands, and ruderal (plant species that are first to colonize

disturbed areas) vegetation. Kiawe/koa-haole and a`ali`i-nama scrub are the dominant vegetation types in the undeveloped portions of the Pacific Missile Range Facility and SNL/KTF. Kiawe/koa-haole is the dominant vegetation type present in the relatively undisturbed areas of the sand dunes associated with SNL/KTF and Polihale State Park as well as along the cliff face in a restrictive easement area. Due to off-highway vehicle restrictions, sand dune-related vegetation within the Pacific Missile Range Facility and SNL/KTF boundary is less disturbed than vegetation in Polihale State Park. A well-developed native strand community exists along the shoreline. Common plants that inhabit the sandy beach habitat on Kauaʻi include beach naupaka, pohinahina, pohuehue, milo, and hau.

The composition of the kiawe/koa-haole vegetation community can vary from pure stands of kiawe to pure stands of koa-haole or any combination of the two. The kiawe trees often attain a height of 45 feet or more. The understory is commonly koa-haole except where the kiawe trees form a canopy. The height of the koa-haole depends to a large degree on the presence or absence of the kiawe trees. Ground cover varies and may consist of pure stands of Guinea grass (*Panicum maximum*), lantana (*Lantana camara*), or clove basil (*Ocimum gratissimum*). However, the most common ground cover is mixed forbs (herbaceous flowering plants that are not a grass) and grasses.

The majority of SNL/KTF is occupied by an open, woody scrub or ruderal community of plants, which is mowed regularly. The open scrub community is mostly comprised of introduced species, although there are some Hawaiʻian taxa to be found along the roads. These are worthy of mention because, even in such highly disturbed areas as roadways, the native plants can and do persist. Taken together, the open scrub communities occupy most of the land area.

Two wetlands areas exist along parts of the coastline west of SNL/KTF. The U.S. Fish and Wildlife Service has classified these areas as Marine System, Subtidal Subsystem, Reef Class, Coral Subclass, and Subtidal. There is also a wetlands area to the south of SNL/KTF along Nohili Ditch, which is classified as Riverine System, Lower Perennial Subsystem, Open Water/Unknown Bottom Class, Permanent, Non-Tidal, and Excavated. There is potential for aquatic vegetation types and accompanying waterbird species to be present on or near SNL/KTF property during wet periods. Ditches along the eastern edge of SNL/KTF and several reservoirs on the Mana Plain, including the Mana Base Pond near the entrance to the Pacific Missile Range Facility, serve as waterbird habitats and sanctuaries.

Two federally listed plant species have been observed north of, but not on, the Pacific Missile Range Facility. Ohai (*Sesbania tomentosa*), a spreading shrub, is a federally endangered species that has been observed in the sand dunes to the north of the Pacific Missile Range Facility in Polihale State Park and could potentially occur on the installation, including SNL/KTF. Lau`ehu (*Panicum niihauense*), an endangered species of rare grass, has been observed near Queens Pond, also north of the Pacific Missile Range Facility.

Biota is the animal and plant life of a given region; *biotic* is relating to or resulting from living organisms.

10.2 Wildlife

Numerous birds, mammals, and reptiles have been observed and documented at and near SNL/KTF. Species that are listed as protected, threatened, or endangered are noted.

10.2.1 Birds

More than 50 species of birds have been identified in the general Pacific Missile Range Facility area, although not specifically at SNL/KTF. Endemic species include: Hawai'ian Coot (*Fulica alai*), Hawai'ian Stilt (*Himantopus mexicanus knudseni*), Hawai'ian Gallinule (formerly Hawai'ian Moorhen) (*Gallinula galleta sandvicensis*), Hawai'ian Duck (*Anas wyvilliana*), Hawai'ian Petrel (*Petrodroma sandwichensis*), Newell's Shearwater (*Puffinus auricularis newelli*), and Hawai'ian Short-eared Owl (*Asio flammeus sandwichensis*). Common introduced (non-native) species include the Red-crested Cardinal (*Paroaria coronata*), Common Myna (*Acridotheres tristis),* Java Sparrow (*Lonchura oryzivora),* Zebra Dove (*Geopelia striata*), House Sparrow (*Passer domesticus*), and African Silverbill (*Euodice cantans*). Past wildlife surveys of birds and mammals conducted at SNL/KTF found 20 species of birds throughout the facility.

Bird species protected under the Migratory Bird Treaty Act that have been observed at SNL/KTF include the Black-crowned Night-Heron (*Nycticorax nycticorax*), Ruddy Turnstone (*Arenaria interpres)*, Brown Noddy (*Anous stolidus*), Great Frigatebird (*Fregata minor*), and Laysan Albatross (*Diomedea immutabilis*). The Laysan Albatross use the lawn-like ruderal vegetation areas for courtship and nesting. Up to six pairs of Laysan Albatross have been observed in the SNL/KTF area. Other species known to exist within or near SNL/KTF are Band-rumped Storm Petrel (*Oceanodroma castro*), Wedge-tailed Shearwater (*Puffinus pacificus chlororyncus*), Pacific Golden Plover (*Pluvialis fulva*), Wandering Tattler (*Heteroscelus incanus*), Sanderling (*Calidris alba*), and Barn Owl (*Tyto alba*).

Five of the bird species observed at SNL/KTF are federally listed as endangered: Hawai'ian Duck, Hawai'ian Petrel, Hawai'ian Gallinule, Hawai'ian Coot, and Hawai'ian Stilt. Additionally, Newell's Shearwater, observed at the Pacific Missile Range Facility, is federally listed as threatened. These species all have special protections under the Endangered Species Act as administered by the U.S. Fish and Wildlife Service.

The Hawai'ian Duck, Hawai'ian Coot, Hawai'ian Gallinule, and Hawai'ian Stilt use wetlands habitat (such as the Nohili Ditch system, ditch systems along the eastern edge of SNL/KTF, and several reservoirs on the Mana Plain) for breeding, nesting, and feeding.

The Newell's Shearwater is a pelagic (open sea) species that once nested on all the major Hawai'ian Islands. However, it has become extinct on the islands of Hawai'i, Maui, Molokai, and Oahu due to the introduction of the mongoose in the late 1800s. Kaua'i provides the last Hawai'ian habitat for this federally listed threatened species.

Newell's Shearwater nest during the spring and summer months (April to November) in the interior mountains of Kaua'i. Nestlings leave the breeding grounds in October and November, departing by themselves shortly after nightfall and heading for the open ocean, guided by the reflection of moonlight on the water. Being inexperienced and naturally attracted to bright lights, they have a tendency to collide with trees, utility lines, buildings, and automobiles. The most critical period for Newell's Shearwaters' flight accidents is one week before and one week after the new moon in October and in November.

The Hawai'ian Petrel may traverse the area from their nesting grounds to the sea. Fledging of the Hawai'ian Petrel occurs in October, slightly earlier than for the Newell's Shearwater.

Mitigation measures that are oriented toward minimizing fallout for the Newell's Shearwater will also benefit Wedge-tailed Shearwater, Hawai'ian Petrel, and Band-rumped Storm Petrel, thus reducing potential adverse effects caused to those species as well (PMRF 2015).

10.2.2 Mammals

Thirteen species of mammals are known to occur on the island of Kauaʻi. Eleven of these species are exotic (Tomich 1986). Past surveys found mammal species such as feral dogs (*Canis lupus familiaris*), feral cats (*Felis catus*), and small rodents (*Muroidea spp.*) within SNL/KTF. Feral dogs are known to roam the areas around SNL/KTF. At least four species of rodents are expected to be present at SNL/KTF: House Mouse (*Mus musculus*), Norway Rat (*Rattus norvegicus*), Roof Rat (*Rattus rattus*), and Pacific Rat (*Rattus exulans*).

The Hawaiʻian Hoary Bat (*Lasiurus cinereus semotus*) is protected under the Endangered Species Act as endangered. The species is most common in regions between sea level and 4,000 feet that receive 20 to 90 inches of rain per year. This bat species uses trees or, possibly, rock shelters for roosting (Baldwin 1950). The Hawaiʻian Hoary Bat has been recorded at the Pacific Missile Range Facility, and it is known to feed offshore and to occur at the Polihale State Park north of SNL/KTF.

The Humpback Whale (*Megaptera novaeangliae*) is protected under the Endangered Species Act as endangered. It is a migratory species that winters in tropical waters near coasts and islands and spends summers in temperate or subtropical waters (Johnson and Wolman 1984).

An *exotic* species, which may be invasive or noninvasive, is not native to the environment.

The Hawaiʻian Monk Seal (*Monachus schauinslandi*) is protected under the Endangered Species Act as endangered and is one of two mammals endemic to Hawaiʻi. Hawaiʻian Monk seals use sandy beaches to give birth and use vegetation behind beaches for shelter. Hawaiʻian Monk seals are only occasionally reported around the main Hawaiʻian Islands (USFWS 1984) although they have been observed at the Pacific Missile Range Facility (The Traverse Group 1988).

The False Killer Whale (*Pseudorca crassidens*) is protected under the Endangered Species Act as endangered. They are large members of the dolphin family that have been sighted off the west coast of Kaua'i near the Pacific Missile Range Facility and were documented during a marine species survey in 2012 (NASA 2013).

10.2.3 Reptiles

Of the five species of marine turtles listed on the Endangered Species Act that are known to occur near SNL/KTF, only two are considered residents while the other three may just pass through. Currently, no listed terrestrial reptiles or amphibians are expected to occur within the vicinity of SNL/KTF.

The Green Sea Turtle (*Chelonia mydas*) is protected under the Endangered Species Act as threatened. The species inhabits pelagic habitat as juveniles and benthic (deep sea) habitat around all the Hawaiʻian Islands as adults. Adult turtles are known to rest along ledges and in caves and to forage in shallow intertidal and subtidal waters around the main islands. The turtles use sandy beaches for nesting during the summer months. Hatchlings emerge between July and October. Green Sea Turtles occasionally nest at the southern end of the Pacific Missile Range Facility and north of Kokole Point (Balazs, Forsyth, and Kam 1987).

Thirty-two Green Sea Turtles have been observed during surveys of the shoreline at SNL/KTF. Turtles were observed foraging near the mouth of the Nohili Ditch and at a resting area further offshore at the same point along the coast (Brock 1990).

The Hawksbill Turtle is relatively rare and while there are no known reports of Hawksbills nesting near the Pacific Missile Range Facility, they have been reported in the open waters off of Kaua'i.

10.3 Federally Listed and State-Listed Threatened and Endangered Species

Federally listed and state-listed threatened and endangered species potentially occurring on Kauaʻi can be found in Table 10-1.

Table 10-1. Federally listed and state-listed threatened and endangered species potentially occurring on Kauaʻi

Common Name	Scientific Name	Federal Status	State Status
Plants			
Ferns and Allies			
Pendant kihi fern	*Adenophorus periens*	Endangered	Endangered
No common name	*Asplenium diellaciniatum*	Endangered	Endangered
No common name	*Asplenium dielmannii*	Endangered	Endangered
No common name	*Asplenium dielpallidum*	Endangered	Endangered
Pauoa	*Ctenitis squamigera*	Endangered	Endangered
Asplenium-leaved diellia	*Asplenium dialerectum*	Endangered	Endangered
No common name	*Deparia kaalaana*	Endangered	Endangered
Molokai twinsorus fern	*Diplazium molokaiense*	Endangered	Endangered
Kauai digit fern	*Doryopteris angelica*	Endangered	Endangered
Palapalai aumakua	*Dryopteris crinalis var. podosorus*	Endangered	Endangered
Kilau (Hohiu)	*Dryopteris glabra var. pusilla*	Endangered	Endangered
Wawaeʻiole	*Huperzia mannii*	Endangered	Endangered
Wawaeʻiole	*Huperzia nutans*	Endangered	Endangered
Ihiʻihi	*Marsilea villosa*	Endangered	Endangered
Flowering Plants			
Liliwai	*Acaena exigua*	Endangered	Endangered
Blunt chaff flower	*Achyranthes mutica*	Endangered	Endangered
Mahoe	*Alectryon macrococcus*	Endangered	Endangered
Paʻiniu	*Astelia waialealae*	Endangered	Endangered
Koʻokoʻolau	*Bidens campylotheca ssp. pentamera*	Endangered	Endangered
Hawai'I lady's nightcap	*Bonamia menziesii*	Endangered	Endangered
Olulu	*Brighamia insignis*	Endangered	Endangered
ʻAwikiwiki	*Canavalia napaliensis*	Endangered	Endangered
ʻAwikiwiki	*Canavalia pubescens*	Endangered	Endangered
Papala	*Charpentiera densiflora*	Endangered	Endangered
Haha	*Cyanea asarifolia*	Endangered	Endangered
Haha	*Cyanea dolichopoda*	Endangered	Endangered
Haha	*Cyanea eleeleensis*	Endangered	Endangered
Haha	*Cyanea kolekoleensis*	Endangered	Endangered
Haha	*Cyanea kuhihewa*	Endangered	Endangered
Haha	*Cyanea recta*	Threatened	Threatened
Haha	*Cyanea remyi*	Endangered	Endangered
Haha	*Cyanea rivularis*	Endangered	Endangered
Haha	*Cyanea undulata*	Endangered	Endangered
Coastal flatsedge	*Cyperus pennatiformis*	Endangered	Endangered
Puʻukaʻa	*Cyperus trachysanthos*	Endangered	Endangered
Mapele	*Cyrtandra cyaneoides*	Endangered	Endangered
Haʻiwale	*Cyrtandra limahuliensis*	Threatened	Threatened
Haʻiwale	*Cyrtandra oenobarba*	Endangered	Endangered
Haʻiwale	*Cyrtandra paliku*	Endangered	Endangered

Table continued on next page

Table 10-1. Federally listed and state-listed threatened and endangered species potentially occurring on Kaua'I (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Flowering Plants (continued)			
No common name	*Delissea rhytidosperma*	Endangered	Endangered
No common name	*Delissea undulata*	Endangered	Endangered
Na'ena'e	*Dubautia imbricata ssp. imbricata*	Endangered	Endangered
Na'ena'e	*Dubautia kalalauensis*	Endangered	Endangered
Na'ena'e	*Dubautia kenwoodii*	Endangered	Endangered
Na'ena'e (Koholapehu)	*Dubautia latifolia*	Endangered	Endangered
Na'ena'e	*Dubautia pauciflorula*	Endangered	Endangered
Na'ena'e	*Dubautia plantaginea ssp. magnifolia*	Endangered	Endangered
Na'ena'e	*Dubautia waialealae*	Endangered	Endangered
'Akoko	*Euphorbia eleanoriae*	Endangered	Endangered
'Akoko	*Euphorbia haeleeleana*	Endangered	Endangered
'Akoko	*Euphorbia halemanui*	Endangered	Endangered
'Akoko	*Euphorbia remyi var. kauaiensis*	Endangered	Endangered
'Akoko	*Euphorbia remyi var. remyi*	Endangered	Endangered
Heau	*Exocarpos luteolus*	Endangered	Endangered
Mehamehame	*Flueggea neowawraea*	Endangered	Endangered
Nanu	*Gardenia remyi*	Endangered	Endangered
Nohoanu	*Geranium kauaiense*	Endangered	Endangered
Smoothfruit chewstick	*Gouania meyenii*	Endangered	Endangered
Honohono	*Haplostachys haplostachya*	Endangered	Endangered
No common name	*Hesperomannia lydgatei*	Endangered	Endangered
Kaua'i hau kuahiwi	*Hibiscadelphus distans*	Endangered	Endangered
Wood's hau kuahiwi	*Hibiscadelphus woodii*	Endangered	Endangered
Ma'o hau hele (Native yellow hibiscus)	*Hibiscus brackenridgei*	Endangered	Endangered
Clay's hibiscus	*Hibiscus clayi*	Endangered	Endangered
Koki'o ke'oke'o	*Hibiscus waimeae ssp. hannerae*	Endangered	Endangered
Hilo ischaemum	*Ischaemum byrone*	Endangered	Endangered
Aupaka	*Isodendrion laurifolium*	Endangered	Endangered
Aupaka	*Isodendrion longifolium*	Threatened	Threatened
Kula wahine noho	*Isodendrion pyrifolium*	Endangered	Endangered
'Ohe	*Joinvillea ascendens ascendens*	Endangered	Endangered
Kamapua'a	*Kadua (=Hedyotis) fluviatilis*	Endangered	Endangered
'Awiwi	*Kadua cookiana*	Endangered	Endangered
No common name	*Kadua haupuensis*	Endangered	Endangered
Na' Pali beach starviolet	*Kadua st.-johnii*	Endangered	Endangered
No common name	*Keysseria (=Lagenifera) erici*	Endangered	Endangered
No common name	*Keysseria (=Lagenifera) helenae*	Endangered	Endangered
Koki'o	*Kokia Kaua'iensis*	Endangered	Endangered
Kamakahala	*Labordia helleri*	Endangered	Endangered
No common name	*Labordia lorenciana*	Endangered	Endangered
Kamakahala	*Labordia lydgatei*	Endangered	Endangered
Kamakahala	*Labordia pumila*	Endangered	Endangered
Kamakahala	*Labordia tinifolia var. wahiawaensis*	Endangered	Endangered
Round pepperweed	*Lepidium orbiculare*	Endangered	Endangered
Nehe	*Lipochaeta fauriei*	Endangered	Endangered

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Table 10-1. Federally listed and state-listed threatened and endangered species potentially occurring on Kaua'I (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Flowering Plants (continued)			
Nehe	*Lipochaeta micrantha*	Endangered	Endangered
Niihau lobelia	*Lobelia niihauensis*	Endangered	Endangered
Lehua makanoe	*Lysimachia daphnoides*	Endangered	Endangered
Wailua River yellow loosestrife	*Lysimachia filifolia*	Endangered	Endangered
Wailua River yellow loosestrife	*Lysimachia iniki*	Endangered	Endangered
Broad-leaf yellow loosestrife	*Lysimachia pendens*	Endangered	Endangered
Shiny-leaf yellow loosestrife	*Lysimachia scopulensis*	Endangered	Endangered
Veined yellow loosestrife	*Lysimachia venosa*	Endangered	Endangered
Alani	*Melicope degeneri*	Endangered	Endangered
Alani	*Melicope haupuensis*	Endangered	Endangered
Alani	*Melicope knudsenii*	Endangered	Endangered
Alani	*Melicope pallida*	Endangered	Endangered
Alani	*Melicope paniculata*	Endangered	Endangered
Alani	*Melicope puberula*	Endangered	Endangered
Alani	*Melicope quadrangularis*	Endangered	Endangered
Uhi uhi	*Mezoneuron kavaiense*	Endangered	Endangered
Kolea	*Myrsine fosbergii*	Endangered	Endangered
Kolea	*Myrsine knudsenii*	Endangered	Endangered
Kolea	*Myrsine linearifolia*	Threatened	Threatened
Kolea	*Myrsine mezii*	Endangered	Endangered
ʻAiea	*Nothocestrum latifolium*	Endangered	Endangered
ʻAiea	*Nothocestrum peltatum*	Endangered	Endangered
Lau ʻehu	*Panicum niihauense*	Endangered	Endangered
Makou	*Peucedanum sandwicense*	Threatened	Threatened
Mt. Kahili phyllostegia	*Phyllostegia helleri*	Endangered	Endangered
Waimea phyllostegia	*Phyllostegia knudsenii*	Endangered	Endangered
Red-leaf phyllostegia	*Phyllostegia renovans*	Endangered	Endangered
Kauai phyllostegia	*Phyllostegia waimeae*	Endangered	Endangered
Fuzzystem phyllostegia	*Phyllostegia wawrana*	Endangered	Endangered
Hoʻawa	*Pittosporum napaliense*	Endangered	Endangered
Kuahiwi laukahi	*Plantago princeps*	Endangered	Endangered
No common name (Hawaii bog orchid)	*Platanthera holochila*	Endangered	Endangered
Pilo kea lau liʻi	*Platydesma rostrata*	Endangered	Endangered
Mann's bluegrass	*Poa mannii*	Endangered	Endangered
Hawaiʻian bluegrass	*Poa sandvicensis*	Endangered	Endangered
Kauai bluegrass	*Poa siphonoglossa*	Endangered	Endangered
No common name	*Polyscias bisattenuata*	Endangered	Endangered
No common name	*Polyscias flynnii*	Endangered	Endangered
False ʻohe	*Polyscias racemosa*	Endangered	Endangered
ʻIhi	*Portulaca villosa*	Endangered	Endangered
Wahane	*Pritchardia Aylmer-robinsonii*	Endangered	Endangered
Loʻulu (=Naʻenaʻe)	*Pritchardia hardyi*	Endangered	Endangered
Loʻulu	*Pritchardia napaliensis*	Endangered	Endangered
Loʻulu	*Pritchardia viscosa*	Endangered	Endangered
Kopiko	*Psychotria grandiflora*	Endangered	Endangered

Table continued on next page

Table 10-1. Federally listed and state-listed threatened and endangered species potentially occurring on Kaua'I (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Flowering Plants (continued)			
Kopiko	*Psychotria hobdyi*	Endangered	Endangered
Kaulu	*Pteralyxia Kaua'iensis*	Endangered	Endangered
Makou	*Ranunculus mauiensis*	Endangered	Endangered
No common name	*Remya Kaua'iensis*	Endangered	Endangered
Kalalau Valley remya	*Remya montgomeryi*	Endangered	Endangered
No common name	*Santalum involutum*	Endangered	Endangered
Dwarf naupaka	*Scaevola coriacea*	Endangered	Endangered
Awiwi	*Schenkia sebaeoides*	Endangered	Endangered
Ma'oli'oli	*Schiedea apokremnos*	Endangered	Endangered
Kalalau schiedea	*Schiedea attenuata*	Endangered	Endangered
Heller's schiedea	*Schiedea helleri*	Endangered	Endangered
Kauai schiedea	*Schiedea kauaiensis*	Endangered	Endangered
Kuawawaenohu	*Schiedea lychnoides*	Endangered	Endangered
Papery schiedea	*Schiedea membranacea*	Endangered	Endangered
Valley schiedea	*Schiedea nuttallii*	Endangered	Endangered
Canyon schiedea	*Schiedea spergulina var. leiopoda*	Endangered	Endangered
No common name	*Schiedea spergulina var. spergulina*	Threatened	Threatened
Laulihilihi	*Schiedea stellarioides*	Endangered	Endangered
No common name	*Schiedea viscosa*	Endangered	Endangered
Ohai	*Sesbania tomentosa*	Endangered	Endangered
No common name	*Sicyos lanceoloideus*	Endangered	Endangered
Kauai catchfly	*Silene lanceolata*	Endangered	Endangered
Popolo ku mai	*Solanum incompletum*	Endangered	Endangered
Popolo	*Solanum nelsonii*	Endangered	Endangered
'Aiakeakua, popolo	*Solanum sandwicense*	Endangered	Endangered
Hawai'I scaleseed	*Spermolepis hawaiiensis*	Endangered	Endangered
Kalalau Valley stenogyne	*Stenogyne campanulata*	Endangered	Endangered
Keal's stenogyne	*Stenogyne kealiae*	Endangered	Endangered
No common name	*Vigna o-wahuensis*	Endangered	Endangered
Wahiawa stream violet	*Viola helenae*	Endangered	Endangered
Nani wai'ale'ale	*Viola Kaua'iensis var. wahiawaensis*	Endangered	Endangered
Skottsberg's false ohelo	*Wikstroemia skottsbergiana*	Endangered	Endangered
Dwarf iliau	*Wilkesia hobdyi*	Endangered	Endangered
No common name	*Xylosma crenatum*	Endangered	Endangered
A'e	*Zanthoxylum hawai'iense*	Endangered	Endangered
Animals			
Mammals			
Hawai'ian Hoary Bat	*Lasiurus cinereus semotus*	Endangered	Endangered
Humpback Whale	*Megaptera novaeangliae*	Endangered	Endangered
Hawai'ian Monk Seal	*Neomonachus schauinslandi*	Endangered	Endangered
False Killer Whale	*Pseudorca crassidens*	Endangered	Endangered
Birds			
Koloa (Hawai'ian Duck)	*Anas wyvilliana*	Endangered	Endangered
Pueo (Hawai'ian Short-eared Owl)	*Asio flammeus sandwichensis*	-	Endangered
Nēnē (Hawai'ian Goose)	*Branta sandvicensis*	Threatened	Endangered

Table continued on next page

Table 10-1. Federally listed and state-listed threatened and endangered species potentially occurring on Kaua'I (continued)

Common Name	Scientific Name	Federal Status	State Status
Animals (continued)			
Birds (continued)			
'Alae ke'oke'o (Hawai'ian Coot)	*Fulica americana alai*	Endangered	Endangered
'Alae 'ula (Hawai'ian Gallinule)	*Gallinula galeata sandvicensis*	Endangered	Endangered
Nuku pu'u (Honeycreeper)	*Hemignathus hanapepe*	Endangered	Endangered
Kaua'i 'Akialoa (Honeycreeper)	*Akioloa stejnegeri*	Endangered	Endangered
Kaua'i 'amakihi	*Hemignathus kauaiensis*	—	Endemic
'Anianiau	*Hemignathus parvus*	—	Endemic
Ae'o (Hawai'ian Stilt)	*Himantopus mexicanus knudseni*	Endangered	Endangered
'Akeke'e (Kaua'i Akepa)	*Loxops caeruleirostris*	Endangered	Endangered
Kaua'i 'o'o (Honeyeater)	*Moho braccatus*	Endangered	Endangered
Kāma'o (Large Kaua'i Thrush)	*Myadestes myadestinus*	Endangered	Endangered
Puaiohi (Small Kaua'i Thrush)	*Myadestes palmeri*	Endangered	Endangered
Band-rumped Storm Petrel	*Oceanodroma castro*	Endangered	Endangered
Short-tailed Albatross	*Phoebastria albatrus*	Endangered	Endangered
Laysan Albatross	*Phoebastria immutabilis*	—	Indigenous
'Akikiki (Kaua'i Creeper)	*Oreomystis bairdi*	Endangered	Endangered
'I'iwi	*Drepanis coccinea*	Threatened	Vulnerable
'O'u (Honeycreeper)	*Psittirostra psittacea*	Endangered	Endangered
Hawai'ian Petrel	*Pterodroma sandwichensis*	Endangered	Endangered
Newell's Townsend's Shearwater	*Puffinus auricularis newelli*	Threatened	Endangered
Kioea (Bristle-thighed Curlew)	*Numenius tahitiensis*	—	Indigenous
Reptiles			
Loggerhead Sea Turtle	*Caretta caretta*	Threatened	Threatened
Green Sea Turtle	*Chelonia mydas*	Threatened	Threatened
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Endangered
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	Endangered
Olive Ridley Sea Turtle	*Lepidochelys olivacea*	Threatened	Threatened
Snails			
Newcomb's Snail	*Erinna newcombi*	Threatened	Threatened
Arachnids			
Kaua'i Cave Wolf or Pe'e maka 'ole Spider	*Adelocosa anops*	Endangered	Endangered
Insects			
Hawai'ian picture-wing fly	*Drosophila musaphilia*	Endangered	Endangered
Hawai'ian Picture-wing Fly	*Drosophila sharpi*	Endangered	Endangered
Pacific Hawai'ian Damselfly	*Megalagrion pacificum*	Endangered	Endangered
Crustaceans			
Kaua'i cave amphipod	*Spelaeorchestia koloana*	Endangered	Endangered

— = no designation for federal status
ssp. = subspecies
var. = variety

Chapter 11. SNL/KTF Quality Assurance

Napali coast of Kaua'i

OVERVIEW ■ Sandia quality assurance teams monitor environmental impacts of the work done at SNL/KTF. Personnel in various programs collect environmental samples and analyze them for nonradiological constituents. Quality control samples are sent to contract laboratories to ensure that the samples meet statistically established control criteria or prescribed acceptance control limits.

Sandia personnel take responsibility and assume accountability for implementing quality assurance for operations—as specified in ISO 9001, *Quality Management Systems—Requirements* (ISO 2008); the Contractor Requirements Document of DOE O 414.1D, Quality Requirements (DOE O 414.1D Admin Change 1), Attachment 1, "Contractor Requirements Document"; and 10 CFR 830, *Nuclear Safety Management* (10 CFR 830), Subpart A, "Quality Assurance"—via policy statements and processes, and by executing the actions specified in those policies and processes. Sandia management is responsible for ensuring the quality of the company's products; for assessing its operations, programs, projects, and business systems; and for identifying deficiencies and effecting continuous improvements.

11.1 Environmental Monitoring for Quality Assurance

Environmental monitoring (which includes sampling) is conducted in accordance with program-specific sampling and analysis plans, work plans, or quality assurance plans, which contain applicable quality assurance elements. These documents meet appropriate federal, state, and local requirements for conducting sampling and analysis activities. Personnel in various programs collect environmental samples and submit them for analysis of radiological and nonradiological constituents.

Project sampling and analysis plans (or equivalent) include critical elements, such as procedures for collecting samples, preserving and handling samples, controlling samples, controlling laboratory quality, setting required limits of detection, controlling field quality, ensuring health and safety,

setting schedules and frequency for sampling, reviewing data, determining data acceptability, and reporting.

11.1.1 Sample Management Office

Sample Management Office personnel are responsible for quality assurance and quality control of samples once field team members relinquish the samples to the Sample Management Office. In addition, Sample Management Office personnel provide guidance and sample management support for field activities. However, program leads are responsible for each program's overall adherence to and compliance with any sampling and analysis activity performed. Sample Management Office personnel, located at SNL/NM, package, ship, and track environmental samples to off-site contract laboratories.

There are instances when SNL/KTF personnel ship samples directly to off-site laboratories, rather than to the Sample Management Office at SNL/NM. Terrestrial Surveillance Program soil samples are shipped from SNL/KTF directly to an off-site laboratory.

11.1.2 Contract Laboratory Selection

All off-site contract laboratories are selected based on performance objectives, licenses and accreditations, and appraisals (pre-award assessments) as described in the *Quality Assurance Project Plan for the Sample Management Office* (SNL/NM 2019b). All laboratories must employ EPA test procedures whenever possible; when these are not available, other suitable and validated test procedures are applied. Laboratory instruments must be calibrated in accordance with established procedures, methods, and the Sample Management Office Statement of Work for Analytical Laboratories (SNL/NM 2018). All calibrations and detection limits must be verified before analyzing samples and reporting data. Once a laboratory has passed an initial appraisal and has been awarded a contract, Sample Management Office personnel are responsible for continuously monitoring laboratory performance to ensure that the laboratory meets its contractual requirements during annual audits.

Sample Management Office contract laboratories perform work in compliance with the Sample Management Office Statement of Work for Analytical Laboratories. Contract laboratories are required to participate in applicable DOE and EPA programs for blind audit check sampling to monitor the overall accuracy of analyses routinely performed on SNL/KTF samples. These contract laboratories are required to participate in the DOE Mixed Analyte Performance Evaluation Program. Contract laboratories also participate in commercial vendor programs designed to meet the evaluation requirements given in the proficiency testing section (Chapter II) of the National Environmental Laboratory Accreditation Conference Standard (NELAC 2003).

11.1.3 Quality Control for Samples

Project-specified quality control samples are submitted to contract laboratories in order to meet project data quality objectives and sampling and analysis plan requirements. Various field quality control samples may be collected to assess the data's quality and final usability. Errors, some of which are unavoidable, can be introduced into the sampling process, including potential contamination of samples in the field or during transportation. In addition, sample results can be affected by the variability present at each sample location.

With each sample batch, laboratory quality control samples are prepared concurrently at defined frequencies and analyzed in accordance with established methods. Contract laboratory personnel determine the analytical accuracy, precision, contamination, and matrix effects associated with each analytical measurement.

Quality control sample results are compared either to statistically established control criteria or to prescribed acceptance control limits. Analytical results generated concurrently with quality control sample results within established limits are considered acceptable. If quality control analytical results exceed control limits, the results are qualified and corrective action is initiated if warranted. Reanalysis is then performed for samples in the analytical batch as specified in the Statement of Work and contract laboratory procedures. Quality control sample summaries are included in analytical reports prepared by contract laboratory personnel.

11.1.4 Data Validation and Records Management

Sample collection, analysis request and chain of custody documentation, and measurement data are reviewed and validated for each sample collected. Analytical data reported by contract laboratories are reviewed to assess laboratory and field precision, accuracy, completeness, representativeness, and comparability with respect to each particular program's method of compliance and data quality objectives.

The data are validated at a minimum of three levels:

- The analytical laboratory validates data according to the laboratory's quality assurance plan, standard operating procedures, and client-specific requirements.
- Sample Management Office personnel review the analytical reports, corresponding sample collection, and analysis request and chain of custody documentation for completeness and laboratory contract compliance.
- A program lead reviews program objectives, regulatory compliance, and project-specific data quality requirements, and makes the final decision regarding the data's usability and reporting.

In addition, Terrestrial Surveillance Program data are validated to detailed method-specific requirements.

11.2 Sample Management Office Activities in 2019

Sample Management Office activities in 2019 included sample packaging, shipping, and tracking to off-site contracted laboratories, and reviewing all data deliverables for compliance with contract and data quality requirements.

11.2.1 Sample Handling and Analyses

In 2019, no samples were collected for the Terrestrial Surveillance Program or other environmental programs or projects at SNL/KTF.

11.2.2 Laboratory Quality Assurance Assessments and Validation

In 2019, Sample Management Office personnel continued independent assessments and validation of National Environmental Laboratory Accreditation Conference-approved laboratories used by Sandia personnel. Specific checks were made for documentation completeness, proper equipment calibration, proper laboratory practices, and batch quality control data.

11.2.3 Quality Assurance Audits

The Sample Management Office participates in DOECAP, which ensures that subcontracted commercial analytical environmental laboratories are audited on their ability to provide data results that are valid, reliable, and defensible. In 2018, DOECAP revised the manner in which audits of commercial environmental laboratories are conducted. Commercial laboratories are to use the assessment process provided by one of three approved third-party accrediting bodies unless separate

arrangements are made with DOECAP. The accrediting bodies conduct assessments using the requirements of the DOD/DOE *Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (DOD/DOE 2019).

In 2019, DOECAP and/or the accrediting bodies conducted assessments at nine Sample Management Office contract laboratories using *Quality Systems Manual* requirements. The audit reports, laboratory responses, and closure letters are all posted on and tracked through the DOECAP website. Decisions regarding sample distribution to contract laboratories were based on audit information, including corrective actions, if needed.

No findings for SNL/KTF samples were issued in 2019 in DOECAP assessment reports or other applicable DOE programs.

Chapter 12. SNL/KTF Cultural Resource Program

Rocket launcher at Kaua‘i Test Facility

OVERVIEW ■ Cultural Resource Program personnel coordinate cultural resource compliance, including review of archaeological sites and historic buildings. Actions that could adversely affect cultural resources are analyzed initially in a NEPA checklist review. DOE is responsible for ensuring that impacts to cultural resources are assessed and appropriate actions are taken to mitigate those impacts.

The Cultural Resource Program is primarily focused on long-term preservation and protection of cultural resources and cultural resource compliance to ensure the heritage of the area and of the landscape. Long-term preservation and protection practices also ensure that data is available to make proper land use decisions and to assist with environmental planning. The Cultural Resource Program is composed of two main parts: archeological resources and historic buildings.

Cultural resources can be defined as physical evidence or places of past human activity: a site, an object, a landscape, a structure, or a natural feature of significance to a group of people traditionally associated with it.

Approximately six archaeological surveys have been performed between 1976 and 2019. Monitoring of all construction activities has been required in the areas from Kekaha to the south and Polihale to the north of the Pacific Missile Range Facility, as well as in intermediate areas.

Much of the knowledge regarding traditional land use patterns at SNL/KTF is based on what was recorded at the time of, and shortly after, western contact. Early records (such as journals kept by travelers and missionaries) documented Hawai‘ian traditions from that time, and archaeological investigations have assisted with understanding the past. Kaua‘i consists of six moku (land divisions that section off portions of the island): Kona, Puna, Ko‘olau, Halele‘a, Napali, and Waimea (Moffat and Fitzpatrick 1995). Ahupua‘a (smaller land divisions within the moku) incorporate the natural

resources necessary for traditional subsistence strategies. SNL/KTF is located in the ahupua'a of Waiawa, which is in the Kona district of Kaua'i. The traditional and historical setting at SNL/KTF consists of three major historical periods on the island:

- Pre-Contact Period (before 1778) to Early Historic Period (after 1778)
- Contact (to 1850)
- Māhele (during the mid-1800s)

A *moku* is a land division that sections off portions of the island.

Recent archaeological work within and near Barking Sands on the Mānā Plain led to the identification of prehistoric habitation and multiple types of features made by and utilized by humans (i.e., a fire pit, bedrock mortars, and shelters). Archaeological and historical records of the area revealed that Native Hawai'ians used five environmental zones during traditional (Contact and Māhele) times in the western region of Kaua'i: coastal and beach dunes, marshlands, cliff slopes, valleys, and upper mountain slopes. Archaeological studies along the coast and further inland revealed habitation, religious, and agricultural sites that date from AD 1120–1310 (Sweeney 1994).

12.1 History and Location

Private plane pilots used a pasture near Barking Sands, Kaua'i, as a landing field in the 1920s. In 1928, the Territorial Aeronautical Commission had the area surveyed and took control of the landing field via executive order. One of three landing fields on Kaua'i, the Barking Sands Landing Field (also identified as Mana Airport), was intended as a stopover for transpacific flights.

In the lead up to United States involvement in World War II, the military improved and expanded the facilities at Barking Sands. In 1940, the U.S. Army requested the Mana Airport for military use and began developing the site. The Hawai'ian Army National Guard used Barking Sands and continued construction, while the Army acquired additional land to expand the site.

In May 1942, Barking Sands was designated an Army Air Force station. The U.S. Navy also began using Barking Sands in 1944. In 1945, with the war in Europe over and the United States. focused on the Pacific, flying at the base increased markedly, slowing down only with the war's end.

The U.S. Air Force took over Barking Sands in 1948, renaming it Bonham Air Force Base. In 1954, Bonham Air Force Base was declared excess although no disposal action was taken. Subsequently, the Navy leased the base and it was transferred from the Air Force to the Navy in 1966. It is now known as the Pacific Missile Range Facility, a 7.5-mile-long, 0.5-mile-wide strip of coastal land.

In 1962, Sandia set up a rocket-launching facility at the far north end of the site. Since Sandia did not have a Pacific location for launching rockets, the Atomic Energy Commission obtained permission to use space at Bonham, near Barking Sands. Sandia engineers surveyed the site and planned for 40 launchpads. It was an ideal site, located on the northwest side of Kaua'i where Sandia personnel could take advantage of existing tracking radar systems.

Meant to be temporary, Sandia's site supported rocket launches for the Operation Dominic nuclear test series to be based in the Pacific at the Christmas and Johnston islands. Sandia launched diagnostic rockets to support analysis of the high-altitude nuclear shots in the series. Sandia personnel were able to launch a dozen instrumentation rockets simultaneously with small rockets launched from Johnston Island 700 miles away.

Sandia operations in Kaua'i were expected to end after Operation Dominic concluded in 1962. However, when ratifying the 1963 Limited Test Ban Treaty, the United States Congress placed conditions—safeguards—on its approval. The United States needed to maintain a readiness to resume nuclear testing should another nation break the treaty or should the United States have an imperative to test nuclear weapons. As part of the support for the Readiness Program, Sandia personnel maintained the test range on Kaua'i, establishing a permit with the Navy to continue using the SNL/KTF site at the Pacific Missile Range Facility. Although the readiness requirement was dropped in the 1970s, Sandia's rocket-launching activities have continued.

12.2 Regulatory Criteria

Ensuring compliance with federal requirements (Chapter 8) supports the long-term preservation and protection of cultural resources, prevents mission delays, and maintains the trust and strong relationship with DOE and the Hawai'i State Historic Preservation Division.

12.3 Archaeological Resources

The Sandia archaeologist manages cultural resources and helps Sandia personnel and DOE maintain compliance with National Historic Preservation Act, Section 106, requirements. This ensures that cultural resources and their historic and cultural heritage are preserved and protected. The archaeologist reviews NEPA checklists that include land disturbances and provides recommendations for monitoring field activities at SNL/KTF. The archaeologist also makes eligibility recommendations for inclusion in the National Register of Historic Places. In addition, the archaeologist recommends local, including native, Hawai'ian cultural resource management firms permitted to work in the area.

The archaeological work at SNL/KTF is primarily focused on preserving and protecting cultural resources long-term. This is intended to ensure the heritage of the area and of the landscape. Long-term preservation and protection also ensure that data are available to make appropriate land use and environmental planning decisions at SNL/KTF.

12.3.1 Field Methods

Local archaeological personnel that hold the state-required permits to conduct archaeological work in Hawai'i at SNL/KTF are contracted to conduct pedestrian surveys and monitor all work that will disturb land. In addition, the contracted archaeological personnel provide recommendations regarding the potential effect of proposed undertakings on prehistoric and historic properties. These include recommendations regarding the eligibility for nominating sites to the National Register of Historic Places for Cultural Properties and Historic Preservation and project mitigation.

The contracted archeological personnel write all reports of findings and associated documentation and provide them to the Sandia archaeologist to review. The reports are then provided to DOE.

12.3.2 Archaeological Assessments and Analysis in 2019

In 2019, Sandia contracted a local archaeological firm to complete one monitoring project. Sandia's archaeologist reviewed two outdoor projects and recommended the use of an archaeological monitor for any ground-disturbing activities.

12.4 Historic Buildings

Since 2006, environmental planning and cultural resources management at SNL/KTF has included historic building assessments and compliance with National Historic Preservation Act, Section 106,

requirements. The Sandia historian conducts historic building assessments and makes recommendations to DOE regarding National Register of Historic Places eligibility for SNL/KTF properties.

12.4.1 Methods

Although the historian does provide internal input on proposed projects as requested, most historic building assessments are triggered by the NEPA process. While a NEPA checklist is in subject matter expert review, the historian reviews the project details, reviews existing photographs and documents of the facilities involved, conducts any additional research in the archives or building drawings collection needed to understand the property's past and current role in SNL/KTF operations, and evaluates the building's history. Note is made of any previous assessments and resulting determinations as to the property's National Register of Historic Places eligibility.

If there are any questions regarding the proposed work and its potential impact on a building, the historian discusses the matter with the project owner and the NEPA specialist. The project owner may submit renderings of the anticipated appearance of the property after the work is completed, and the historian may suggest alternate locations, materials, or methods so as to avoid adverse effects on the property.

Once the property is understood in context, the historian makes a recommendation as to whether it is eligible for the National Register of Historic Places, summarizing past determinations and any subsequent changes to the property. The historian also makes a recommendation as to whether the proposed work will have an adverse effect on any historic properties or districts, including the property where the work is occurring. Information regarding the property, photographs, a description of the proposed work, any impacts, and the overall recommendation on eligibility are captured on a Hawai'i Historic Resources Inventory form. The Historic Resources Inventory is submitted as an attachment to the NEPA checklist for DOE review and to support consultation with the Hawai'i State Historic Preservation Office.

12.4.2 Previous Building Surveys, Assessments, and Determinations

The Sandia historian conducted a historic building survey of SNL/KTF in 2006. This survey serves as the basis for understanding the properties at the site and for generating the Hawai'i Historic Resources Inventory forms as properties face renovation or demolition. No site-wide assessment or historic context statement (providing the framework for evaluating a property for historic significance) exists. No sitewide consultation has occurred.

For each project undertaken since 2006—including minor repair activities, large-scale renovations, and demolition—DOE, in consultation with the Hawai'i State Historic Preservation Office, has determined that the properties involved are not eligible for the National Register of Historic Places. This is largely because the SNL/KTF property lacks details for its earliest history.

12.4.3 Historic Building Assessments in 2019

In 2019, an interior office renovation was proposed for Building K669, and the NEPA checklist for the project triggered a historic building assessment. The historian completed a Historic Resources Inventory form for Building K669, attached it to the NEPA checklist, and submitted the documentation to DOE. The recommendation was that the building is not eligible for the National Register of Historic Places and that the proposed renovations would not have an adverse effect on any historic properties.

Appendix A. SNL/TTR Air Monitoring Stations in 2019

Cactus Peak, Tonopah Test Range

A.1 Introduction

During 2019, DRI maintained five portable air monitoring stations at SNL/TTR as part of Project Soils, an environmental restoration activity (Chapman et al. 2020 in progress). The monitoring stations collect data on selected meteorological and environmental parameters (e.g., wind speed and direction, and airborne particulate concentration as a function of particulate size). In addition, airborne particulate samplers are deployed at each location to collect particulate samples for radiological analyses. Station 400 is located near the SNL/TTR Range Operations Center. Stations 401 and 403 are located near Clean Slate III. Stations 404 and 405 are located near Clean Slate II (see Figure 3-1).

A.2 Air Monitoring Station Capabilities and Results

The air monitoring stations are equipped with multiple environmental monitoring systems (Table A-1). All stations have an air sampler that collects airborne dust particles continuously. Filters are recovered, and new filters are deployed every two weeks. The meteorological instruments at all stations include the following sensors: an anemometer (wind speed), a wind direction vane, a tipping bucket rain gauge, a temperature and relative humidity probe, a soil moisture probe, a soil temperature probe, and an ambient air particulate size profiler. Additional sensors are present at select stations.

Table A-1. Radiological, meteorological, and environmental sensors deployed at the SNL/TTR air monitoring stations

Instrument or Measurement	Station 400	Station 401	Station 403	Station 404	Station 405
Wind speed	✓	✓	✓	✓	✓
Wind direction	✓	✓	✓	✓	✓
Precipitation	✓	✓	✓	✓	✓
Temperature	✓	✓	✓	✓	✓
Relative humidity	✓	✓	✓	✓	✓
Solar radiation	✓	N/A	✓	✓	✓
Barometric pressure	✓	N/A	✓	✓	✓
Soil temperature	✓	✓	✓	✓	✓
Soil moisture	✓	✓	✓	✓	✓
Airborne particle size profiler	✓	✓	✓	✓	✓
Continuous airborne particle collector	✓	✓	✓	✓	✓
Saltation sensor	N/A	✓	✓	✓	✓
Gamma radiation pressurized ionization chamber	✓	✓	✓	N/A	N/A
MiniVol (manually activated low-volume air sampler)	✓	N/A	N/A	N/A	N/A

N/A = not applicable
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

At the remote monitoring stations (all except Station 400 at the Range Operation Center), power for the air sampler and meteorological station is provided by a solar array and a battery bank, mounted on a trailer. DRI personnel constructed this mobile version of a solar-powered air sampler based on a design currently being used by the USAF at the Nevada Test and Training Range. Internal airflow monitoring and self-adjustment capabilities allow the air sampler to maintain a near-constant flow rate as it collects samples. An internal totalizer computes the volume of air passed through the collection filter during the run time.

Data from the sensors are stored on a data logger and transmitted through a Geostationary Operational Environmental Satellite transmitter to the Western Regional Climate Center. Collectively, the data are used to evaluate the transport of soil material by saltation and suspension as related to environmental conditions, including association of high wind events with concentrations of suspended material and radionuclide concentrations.

Regular quality assurance procedures include ensuring sensor functionality, calibrating air volume passing through the air sampler monthly, and performing data quality checks on the Western Regional Climate Center database.

Descriptions of additional capabilities of the individual monitoring stations and monitoring results are presented in the following sections.

Station 400: Range Operations Center

Station 400 is a portable station with all monitoring and sampling systems mounted on a 7-foot by 14-foot trailer. The station is located approximately 100 yards south–southwest of the Range Operations Center.

Station 400: Capabilities

Station 400 includes the environmental monitoring systems and sensors described in Table A-1. This station also has a pressurized ionization chamber that undergoes regular quality checks for response to a gamma source. The atmospheric sensors additionally include a pyranometer (solar radiation) and barometer. In addition to the real-time instruments and continuous air sampler, Station 400 is equipped with a MiniVol (Airmetrics, Springfield, Oregon), a manually activated low-volume air sampler that can collect air samples on quartz and Teflon filter media, which allows for different types of chemical and elemental analyses. This air sampler is intended to run in the event of a nearby wildfire or in conditions of extreme dust storms, during which there may be value in distinguishing the relative contribution of organic and inorganic constituents. The station configuration as currently deployed is shown in Figure A-1.

Figure A-1. Station 400, located near the Range Operations Center, includes an array of devices to measure radiological and meteorological conditions

Station 400: Air Sampling Results

Station 400 is equipped with a continuous air particulate sampler from which a 2-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, monthly for batch processing. Between December 19, 2018, and December 18, 2019, 26 air particulate filter samples were collected and analyzed for gross alpha and gross beta activity. Gamma spectroscopy was also performed on the samples. Table A-2 and Table A-3 provide gross alpha and gross beta results for Station 400 for 2019.

The following naturally occurring radionuclides were identified and measured on Station 400 filters: beryllium-7 (22 samples), potassium-40 (1 sample), lead-210 (19 samples), lead-212 (2 samples), bismuth-214 (10 samples), and lead-214 (1 sample).

Table A-2. Gross alpha results for monitoring stations, 2019

Station Location	Number of Samples	Concentration ($\times 10^{-15}$ µCi/mL [3.7×10^{-5} Bq/m^3])			
		Mean	Standard Deviation	Minimum	Maximum
400	26	1.76	0.66	0.41	3.20
401	23	4.36	4.42	0.52	19.19
403	25	2.50	1.27	0.41	5.71
404	26	2.09	0.76	0.38	3.82
405	25	1.96	0.66	0.45	2.95

Table A-3. Gross beta results for monitoring stations, 2019

Station Location	Number of Samples	Concentration ($\times 10^{-14}$ µCi/mL [3.7×10^{-4} Bq/m^3])			
		Mean	Standard Deviation	Minimum	Maximum
400	26	1.46	0.47	0.75	2.98
401	23	1.35	0.45	0.54	2.87
403	25	1.58	0.55	0.76	3.44
404	26	1.65	0.55	0.82	3.59
405	25	1.59	0.52	0.88	3.23

Station 401: Clean Slate III

Station 401 consists of a solar-powered air sampler (sampler and solar panels) mounted on a 7-foot by 14-foot trailer and includes a portable meteorological tower. Station 401 was relocated on June 6, 2018, from the northwestern boundary of Clean Slate III to the northeastern boundary of Clean Slate III in advance of remediation operations within the contamination area. The relocation, approximately 1,400 feet east along the perimeter road, removed the station from an area of vehicle traffic, site operations, and transportation staging associated with the remediation.

Station 401: Capabilities

Station 401 includes the environmental monitoring systems and sensors described in Table A-1. This station also has a pressurized ionization chamber that undergoes regular quality checks for response to a gamma source. Station 401 includes a saltation sensor to evaluate the frequency of saltation events as a function of wind speed and wind direction measured by the meteorological equipment. The configuration of the solar-powered air sampler, saltation sensor, and portable meteorological tower prior to the June 6, 2018, relocation is shown in Figure A-2.

Figure A-2. Station 401, located along the north fence that bounds the Clean Slate III contamination area, includes a solar-powered air sampler, saltation sensor, and meteorological tower (background, center, and foreground, respectively)

Station 401: Air Sampling Results

Station 401 is equipped with a continuous air particulate sampler from which a 2-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, monthly for batch processing. Between December 19, 2018, and December 18, 2019, 23 air particulate filter samples were collected and analyzed for gross alpha and gross beta activity. Gamma spectroscopy was also performed on the samples. Due to air sampler malfunction, no sample was available for analysis for the period of June 19 to July 31, 2019. Table A-2 and Table A-3 provide gross alpha and gross beta results for Station 401 for 2019.

In 2019, the gamma spectroscopy analyses, which are conducted prior to the alpha spectrometry tests, detected americium-241 in four samples at Station 401 for the filters deployed during January 28 to February 12 (1.92×10^{-15} µCi/mL), February 27 to March 13 (3.21×10^{-15} µCi/mL), April 24 to May 9 (1.01×10^{-15} µCi/mL), and October 23 to November 6 (1.86×10^{-15} µCi/mL), which automatically flagged these samples for alpha spectrometry analysis for plutonium isotopes.

The following naturally occurring radionuclides were also identified and measured by gamma spectroscopy on Station 401 filters: beryllium-7 (20 samples), lead-210 (19 samples), lead-212 (7 samples), lead-214 (3 samples), bismuth-214 (3 samples), and actinium-228 (1 sample).

Station 402: Clean Slate I

Station 402 no longer exists. It operated at Clean Slate I between May 2011 and April 2017, when it was moved to a new location at Clean Slate III and renamed Station 403.

Station 403: Clean Slate III

In April 2017, DRI established Station 403 at the south end of Clean Slate III and installed a portable meteorological tower.

Station 403: Capabilities

Station 403 includes the environmental monitoring systems and sensors described in Table A-1. This station also has a pressurized ionization chamber that undergoes regular quality checks for response to a gamma source. The atmospheric sensors additionally include a pyranometer and barometer. Station 403 has a saltation sensor to evaluate the frequency of saltation events as a function of wind speed and wind direction measured by the meteorological equipment. The configuration of the solar-powered air sampler and portable meteorological tower is shown in Figure A-3.

Figure A-3. Station 403, located along the south fence that bounds the Clean Slate III contamination area, includes a solar-powered air sampler and meteorological tower

Station 403: Air Sampling Results

Station 403 is equipped with a continuous air particulate sampler from which a 2-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, monthly for batch processing. Between December 19, 2018, and December 18, 2019, 25 air particulate filter samples were collected and analyzed for gross alpha and gross beta activity. Gamma spectroscopy was also performed on the samples. Due to air sampler malfunction, no sample was available for analysis for the period of May 9 to May 23, 2019. Table A-2 and Table A-3 contain gross alpha and gross beta results for Station 403 for 2019.

The following naturally occurring radionuclides were identified and measured on Station 403 filters: beryllium-7 (22 samples), lead-210 (18 samples), lead-212 (4 samples), bismuth-214 (6 samples), bismuth-210 (1 sample), and lead-214 (1 sample).

Station 404: Clean Slate II

In April 2017, DRI established Station 404 at the north end of Clean Slate II and installed a portable meteorological tower.

Station 404: Capabilities

Station 404 includes the environmental monitoring systems and sensors described in Table A-1. This station additionally has a pyranometer, barometer, and saltation sensor. The configuration of the air sampler and portable meteorological tower is shown in Figure A-4.

Figure A-4. Station 404, located along the north fence that bounds the Clean Slate II contamination area, includes a solar-powered air sampler and meteorological tower

Station 404: Air Sampling Results

Station 404 is equipped with a continuous air particulate sampler from which a 2-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, monthly for batch processing. Between December 19, 2018, and December 18, 2019, 26 air particulate filter samples were collected and analyzed for gross alpha and gross beta activity. Gamma spectroscopy was also performed on the samples. Table A-2 and Table A-3 provide gross alpha and gross beta results for Station 404 for 2019.

The following naturally occurring radionuclides were identified and measured: beryllium-7 (22 samples), lead-210 (19 samples), lead-212 (4 samples), lead-214 (1 sample), and bismuth-214 (3 samples).

Station 405: Clean Slate II

In April 2017, DRI established Station 405 at the southeastern edge of Clean Slate II and installed a portable meteorological tower.

Station 405: Capabilities

Station 404 includes the environmental monitoring systems and sensors described in Table A-1. This station additionally has a pyranometer, barometer, and saltation sensor. The configuration of the air sampler, saltation sensor, and portable meteorological tower is shown in Figure A-5.

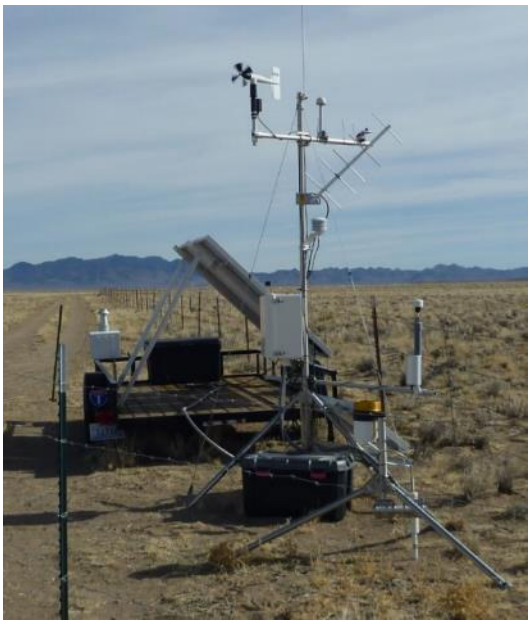

Figure A-5. Station 405, located along the eastern fence that bounds the Clean Slate II contamination area, includes a solar-powered air sampler, meteorological tower, and saltation sensor (left, center, and right, respectively)

Station 405: Air Sampling Results

Station 405 is equipped with a continuous air particulate sampler from which a 2-inch glass-fiber air filter sample is collected every two weeks. Samples are delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, monthly for batch processing. Between December 19, 2018, and December 18, 2019, 25 air particulate filter samples were collected and analyzed for gross alpha and gross beta activity. Gamma spectroscopy was also performed on the samples. Due to air sampler malfunction, no sample was available for analysis for the period of March 27–April 11, 2019. Table A-2 and Table A-3 provide gross alpha and gross beta results for Station 405 for 2018.

The following naturally occurring radionuclides were identified and measured on Station 405 filters: beryllium-7 (20 samples), lead-210 (21 samples), lead-212 (6 samples), bismuth-214 (4 samples), and actinium-228 (1 sample).

A.3 Alpha Spectrometry Results

Air filters collected in 2019 underwent alpha spectrometry analysis for plutonium (Pu) isotopes. Every quarter, after gross alpha spectroscopy analyses were completed, two filters from each station were selected and submitted to Eurofins TestAmerica Laboratories, Inc. for alpha spectrometry analysis. These quarterly samples for each station include the sample with the highest gross alpha

result plus one random sample. Note that the gamma spectroscopy analyses, which are conducted prior to the alpha spectrometry tests, detected americium-241 in three samples for 2019 at Station 401 for the filters deployed during January 28–February 12, February 27–March 13, and April 24–May 9, which automatically flagged these samples for alpha spectrometry analysis for plutonium isotopes.

Table A-4 and Table A-5 summarize the alpha spectrometry results for Pu-238 and Pu-239/240 for all stations in 2019. Neither Pu-238 nor Pu-239/240 were detected on any filters from Station 400. Pu-238 was detected on one sample from the Clean Slate II monitoring stations (404 and 405), and Pu-238 was detected on 4 samples from the Clean Slate III stations (401 and 403). Pu-239/240 was detected on 12 samples from the Clean Slate II stations (6 each from 404 and 405), and Pu-239/240 was detected on 14 samples collected from the Clean Slate III stations (8 from 401 and 6 from 403).

Table A-4. Plutonium-238 alpha spectrometry results, 2019

Station Number	Number of Samples Analyzed	Number of Samples > MDC Pu-238	Quarters with Pu-238 Detected	Pu-238 Concentration ($\times 10^{-16}$ µCi/mL [3.7×10^{-6} Bq/m^3])			
				Mean	Standard Deviation	Minimum	Maximum
400	8	0	N/A	N/A	N/A	N/A	N/A
401	8	3	1,2	1.56	0.64	0.82	1.93
403	8	1	1	0.35	N/A	0.35	0.35
404	8	0	N/A	N/A	N/A	N/A	N/A
405	8	1	2	0.11	N/A	0.11	0.11

MDC = minimum detectable concentration
N/A = not applicable
Pu = plutonium

Table A-5. Plutonium-239/240 alpha spectrometry results, 2019

Station Number	Number of Samples Analyzed	Number of Samples > MDC Pu-239/240	Quarters with Pu-239/240 Detected	Pu-239/240 Concentration ($\times 10^{-16}$ µCi/mL [3.7×10^{-6} Bq/m^3])			
				Mean	Standard Deviation	Minimum	Maximum
400	8	0	N/A	N/A	N/A	N/A	N/A
401	8	8	1, 2,3,4	110.40	120.39	2.94	301.75
403	8	6	1,2,3,4	39.26	43.75	2.20	102.72
404	8	6	1, 2, 4	4.32	6.62	0.60	17.62
405	8	6	1, 2, 4	1.95	1.65	0.72	5.09

MDC = minimum detectable concentration
N/A = not applicable
Pu = plutonium

A.4 Air Particulate Migration

At Station 400 (near the Range Operations Center), wind speeds of 15 mph or less were observed 91.2 percent of the time during 2019; wind speeds exceeded 30 mph for 30 minutes during the year; and there were no sustained winds over 35 mph. Slightly higher wind speeds were observed at Station 401 (Clean Slate III), where winds of 15 mph or less were observed 89.8 percent of the

time, and wind speed exceeded 30 mph for approximately 5 hours and 20 minutes during 2019. At Station 403 (at the south end of Clean Slate III), wind speeds of 15 mph or less were observed 93 percent of the time, and winds over 30 mph were not recorded. Stations 404 and 405, at the north and south ends of Clean Slate II, respectively, recorded winds below 15 mph for 92.4 and 92.1 percent of the time, respectively. Winds over 30 mph at stations 404 and 405 occurred for a total of 10 minutes and 0 minutes, respectively, during the recorded time.

Figure A-6 shows the average respirable particulate matter (having a diameter equal to or less than 10 μ [PM_{10}]) concentrations for 5 mph wind speed intervals at the five stations operating during the year. The PM_{10} concentrations increased exponentially as wind speed increased at all stations for wind speeds up to 30 mph. At high wind speeds, PM_{10} concentrations are highly dependent on nearby dust sources, which can result in a significant increase of airborne particulate matter. PM_{10} concentrations at all stations were less than approximately 12 μg/m³ for wind speeds below 15 mph. At Station 400, PM_{10} concentration peaked at 69 μg/m³ for wind speeds over 30 mph. At Station 401, PM_{10} concentration increased to 807 μg/m³ for wind speeds over 30 mph. PM_{10} concentration at Station 403 peaked at 304 μg/m³ for wind speeds over 25 mph. At Station 404, the highest average PM_{10} concentration of 87 μg/m³ was observed for winds over 25 mph. PM_{10} concentration at Station 405 peaked at 49 μg/m³ for winds over 30 mph.

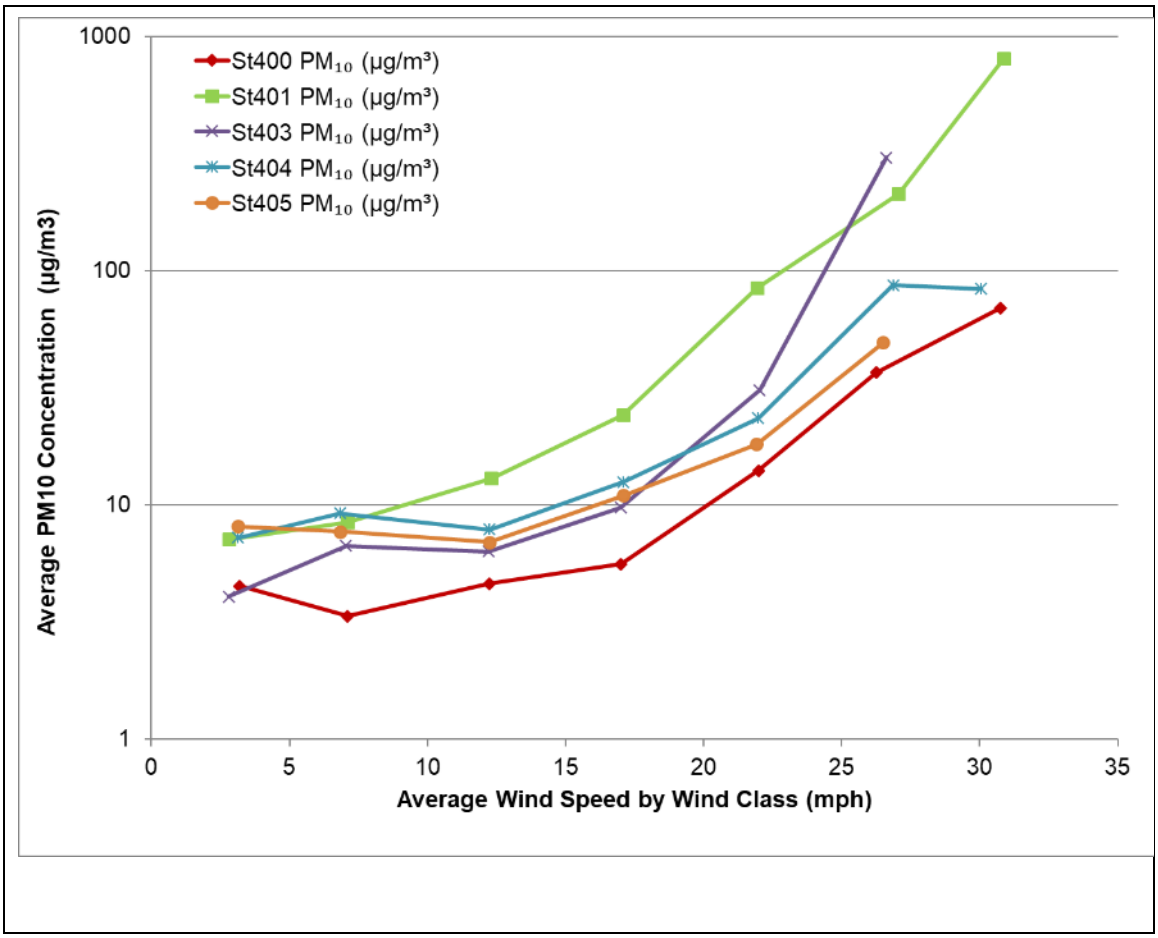

Figure A-6. Wind speed and log-normal PM_{10} trends for stations 400, 401, 403, 404, and 405 for January 1–December 31, 2019

Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2019

Johnson's fishhook cactus (*Echinomastus johnsonii*)

Table B-1. Radiological results for off-site soil sampling locations at SNL/TTR, 2019

Location	Analyte	Activity (pCi/g)	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
C-20	Americium-241	−0.00894 ± 0.0195	0.0326	U	BD	HASL-300
	Cesium-137	0.0413 ± 0.0256	0.024		J	HASL-300
	Uranium-235	0.0997 ± 0.123	0.103	U	BD	HASL-300
	Uranium-238	1.41 ± 0.605	0.326		None	HASL-300
C-21	Americium-241	0.0279 ± 0.0561	0.098	U	BD	HASL-300
	Cesium-137	0.058 ± 0.0222	0.0203		J	HASL-300
	Uranium-235	0.0184 ± 0.114	0.107	U	BD	HASL-300
	Uranium-238	1.52 ± 1.2	0.831		J	HASL-300
C-22	Americium-241	0.00267 ± 0.0641	0.128	U	BD	HASL-300
	Cesium-137	0.0475 ± 0.0294	0.0208		J	HASL-300
	Uranium-235	0.0722 ± 0.115	0.108	U	BD	HASL-300
	Uranium-238	1.58 ± 1.36	0.982		J	HASL-300
C-23	Americium-241	0.0198 ± 0.0716	0.127	U	BD	HASL-300
	Cesium-137	0.135 ± 0.0284	0.0215		None	HASL-300
	Uranium-235	0.04 ± 0.136	0.107	U	BD	HASL-300
	Uranium-238	2.64 ± 1.66	0.941		J	HASL-300
C-24	Americium-241	0.0304 ± 0.0825	0.141	U	BD	HASL-300
	Cesium-137	0.309 ± 0.0365	0.0212		None	HASL-300
	Uranium-235	0.0613 ± 0.131	0.124	U	BD	HASL-300
	Uranium-238	2.57 ± 1.72	1.07		J	HASL-300

Table continued on next page

Table B-1. Radiological results for off-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Activity (pCi/g)	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
C-25	Americium-241	−0.0562 ± 0.12	0.19	U	BD	HASL-300
	Cesium-137	0.167 ± 0.0296	0.0247		None	HASL-300
	Uranium-235	0.0631 ± 0.146	0.14	U	BD	HASL-300
C-26	Americium-241	−0.00136 ± 0.0495	0.0966	U	BD	HASL-300
	Cesium-137	0.139 ± 0.0262	0.0198		None	HASL-300
	Uranium-235	0.00897 ± 0.119	0.105	U	BD	HASL-300
	Uranium-238	1.21 ± 1.13	0.798		J	HASL-300
C-27	Americium-241	−0.0243 ± 0.0486	0.0809	U	BD	HASL-300
	Cesium-137	0.421 ± 0.0433	0.0196		None	HASL-300
	Uranium-235	0.0241 ± 0.0696	0.108	U	BD	HASL-300
	Uranium-238	1.39 ± 0.972	0.69		J	HASL-300
C-28	Americium-241	0.0171 ± 0.0346	0.0647	U	BD	HASL-300
	Uranium-235	0.0154 ± 0.114	0.0944	U	BD	HASL-300
	Uranium-238	1.07 ± 0.81	0.539		J	HASL-300
C-29	Americium-241	0.0775 ± 0.0968	0.169	U	BD	HASL-300
	Cesium-137	0.0735 ± 0.0244	0.0206		None	HASL-300
	Uranium-235	0.0871 ± 0.14	0.13	U	BD	HASL-300
	Uranium-238	1.14 ± 1.45	1.33	U	BD	HASL-300
C-29 DU1	Americium-241	0.0297 ± 0.0625	0.107	U	BD	HASL-300
	Cesium-137	0.0641 ± 0.0193	0.0186		None	HASL-300
	Uranium-235	0.195 ± 0.147	0.122		J	HASL-300
	Uranium-238	1.17 ± 1.11	0.825		J	HASL-300
C-29 DU2	Americium-241	0.0521 ± 0.0924	0.16	U	BD	HASL-300
	Cesium-137	0.0725 ± 0.0226	0.0207		None	HASL-300
	Uranium-235	0.127 ± 0.141	0.106	X	R	HASL-300
	Uranium-238	1.71 ± 1.59	1.2		J	HASL-300
C-30	Americium-241	0.0222 ± 0.0425	0.0805	U	BD	HASL-300
	Cesium-137	0.188 ± 0.0326	0.0164		None	HASL-300
	Uranium-235	0.0697 ± 0.0909	0.0951	U	BD	HASL-300
	Uranium-238	1.22 ± 0.986	0.662		J	HASL-300
C-31	Americium-241	−0.0293 ± 0.065	0.109	U	BD	HASL-300
	Cesium-137	0.0257 ± 0.0163	0.016		J	HASL-300
	Uranium-235	0.0639 ± 0.111	0.0951	U	BD	HASL-300
C-32	Americium-241	0.0253 ± 0.0463	0.0773	U	BD	HASL-300
	Cesium-137	0.0916 ± 0.0207	0.0193		None	HASL-300
	Uranium-235	−0.0173 ± 0.0688	0.108	U	BD	HASL-300
	Uranium-238	1.78 ± 1.16	0.642		J	HASL-300

Table continued on next page

Table B-1. Radiological results for off-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Activity (pCi/g)	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
C-33	Americium-241	0.0205 ± 0.0205	0.022	U	BD	HASL-300
	Cesium-137	0.0665 ± 0.0252	0.024		J	HASL-300
	Uranium-235	0.118 ± 0.079	0.0766		J	HASL-300
	Uranium-238	1.29 ± 0.453	0.219		None	HASL-300

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95 percent probability that the measured activity is accurately quantified above the critical level
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Laboratory Data Qualifier
U = The analyte was absent or below the method detection limit.

Data Validation Qualifier
BD = The associated value was below the detection limit as used in radiochemistry to identify results that are not statistically different from zero.
J = The associated value was an estimated quantity.
None = There was no data validation for corrected gross alpha activity.

Table B-2. Radiological results for perimeter soil sampling locations at SNL/TTR, 2019

Location	Analyte	Activity (pCi/g)	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
P-06	Americium-241	0.0379 ± 0.0734	0.128	U	BD	HASL-300
	Cesium-137	0.482 ± 0.0455	0.0182		None	HASL-300
	Uranium-235	0.00762 ± 0.135	0.119	U	BD	HASL-300
	Uranium-238	1.52 ± 1.27	0.981		J	HASL-300
P-08	Americium-241	0.00683 ± 0.0471	0.0899	U	BD	HASL-300
	Cesium-137	0.0386 ± 0.0194	0.0198		J	HASL-300
	Uranium-235	0.0891 ± 0.108	0.0944	U	BD	HASL-300
	Uranium-238	1.92 ± 1.34	0.711		J	HASL-300
P-12	Americium-241	0.0241 ± 0.0326	0.054	U	BD	HASL-300
	Cesium-137	0.182 ± 0.0258	0.0178		None	HASL-300
	Uranium-235	0.112 ± 0.0851	0.0938		J	HASL-300
	Uranium-238	1.49 ± 0.844	0.49		None	HASL-300
P-12 DU1	Americium-241	0.0186 ± 0.0457	0.0812	U	BD	HASL-300
	Cesium-137	0.178 ± 0.0246	0.0176		None	HASL-300
	Uranium-235	0.0156 ± 0.113	0.103	U	BD	HASL-300
	Uranium-238	2.41 ± 1.85	1.46		J	HASL-300
P-12 DU2	Americium-241	0.295 ± 0.234	0.176	X	R	HASL-300
	Cesium-137	0.189 ± 0.0357	0.0261		None	HASL-300
	Uranium-235	0.0399 ± 0.101	0.175	U	BD	HASL-300
	Uranium-238	0.906 ± 10.8	0.682	X	R	HASL-300
P-34	Americium-241	−0.0647 ± 0.116	0.204	U	BD	HASL-300
	Cesium-137	0.23 ± 0.0417	0.0289		None	HASL-300
	Uranium-235	0.0791 ± 0.167	0.202	U	BD	HASL-300
	Uranium-238	0.961 ± 2.17	1.61	U	BD	HASL-300
P-35	Americium-241	−0.0585 ± 0.0762	0.113	U	BD	HASL-300
	Cesium-137	0.334 ± 0.0425	0.0286		None	HASL-300
	Uranium-235	0.0311 ± 0.0995	0.164	U	BD	HASL-300
	Uranium-238	1.46 ± 1.29	0.975		J	HASL-300
P-36	Americium-241	0.0463 ± 0.04	0.0618	U	BD	HASL-300
	Cesium-137	0.0324 ± 0.0224	0.0206		J	HASL-300
	Uranium-235	0.201 ± 0.122	0.115		J	HASL-300
	Uranium-238	1.06 ± 0.771	0.535		J	HASL-300

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Table B-2. Radiological results for perimeter soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Activity (pCi/g)	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
P-37	Americium-241	−0.0173 ± 0.031	0.0565	U	BD	HASL-300
	Cesium-137	0.0363 ± 0.0175	0.022		J	HASL-300
	Uranium-235	0.0234 ± 0.0662	0.114	U	BD	HASL-300
	Uranium-238	1.65 ± 0.796	0.518		None	HASL-300

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95 percent probability that the measured activity is accurately quantified above the critical level
MDL = method detection limit
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Laboratory Data Qualifier
U = The analyte was absent or below the method detection limit.
X = The data was rejected due to the peak not meeting identification criteria.

Data Validation Qualifier
BD = The associated value was below the detection limit as used in radiochemistry to identify results that are not statistically different from zero.
J = The associated value was an estimated quantity.
None = There was no data validation for corrected gross alpha activity.
R = The data are unusable.

Table B-3. Radiological results for on-site soil sampling locations at SNL/TTR, 2019

Location	Analyte	Activity (pCi/g)	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-02	Americium-241	0.0888 ± 0.0768	0.077	X	R	HASL-300
	Cesium-137	0.207 ± 0.0381	0.0252		None	HASL-300
	Uranium-235	0.0329 ± 0.108	0.125	U	BD	HASL-300
	Uranium-238	1.12 ± 0.924	0.678		J	HASL-300
S-03	Americium-241	0.0966 ± 0.116	0.2	U	BD	HASL-300
	Cesium-137	0.187 ± 0.0379	0.031		None	HASL-300
	Uranium-235	0.13 ± 0.182	0.174	U	BD	HASL-300
	Uranium-238	1 ± 1.93	1.56	U	BD	HASL-300
S-03 DU1	Americium-241	0.26 ± 0.252	0.209	X	R	HASL-300
	Cesium-137	0.209 ± 0.0419	0.0326		None	HASL-300
	Uranium-235	0.0787 ± 0.116	0.0892	U	BD	HASL-300
	Uranium-238	3.17 ± 2.17	1.62		J	HASL-300
S-03 DU2	Americium-241	0.119 ± 0.0386	0.028	X	R	HASL-300
	Cesium-137	0.244 ± 0.0292	0.0184		None	HASL-300
	Uranium-235	0.253 ± 0.282	0.218	X	R	HASL-300
	Uranium-238	1.68 ± 0.55	0.278		None	HASL-300
S-04	Americium-241	−0.00733 ± 0.0859	0.161	U	BD	HASL-300
	Cesium-137	0.218 ± 0.0348	0.0226		None	HASL-300
	Uranium-235	0.0809 ± 0.157	0.12	U	BD	HASL-300
	Uranium-238	0.141 ± 1.47	1.21	U	BD	HASL-300
S-09	Americium-241	69.4 ± 5.31	0.195		None	HASL-300
	Cesium-137	0.143 ± 0.0215	0.0157		None	HASL-300
	Plutonium-238	2.17 ± 0.455	0.317		None	HASL-300, Pu
	Plutonium-239/240	380 ± 29.4	0.411		None	HASL-300, Pu
	Uranium-235	0.0123 ± 0.106	0.0982	U	BD	HASL-300
	Uranium-238	1.17 ± 1.04	0.877		J	HASL-300
S-09 DU1	Americium-241	0.752 ± 0.113	0.0873		None	HASL-300
	Cesium-137	0.132 ± 0.0219	0.0201		None	HASL-300
	Plutonium-238	0.0794 ± 0.0504	0.0632		J	HASL-300, Pu
	Plutonium-239/240	6.81 ± 0.581	0.0819		None	HASL-300, Pu
	Uranium-235	0.108 ± 0.122	0.117	U	BD	HASL-300
	Uranium-238	1.78 ± 1.04	0.756		J	HASL-300
S-09 DU2	Americium-241	1.28 ± 0.15	0.0633		None	HASL-300
	Cesium-137	0.127 ± 0.0216	0.0186		None	HASL-300
	Plutonium-238	0.101 ± 0.0506	0.0652		J	HASL-300, Pu
	Plutonium-239/240	12.9 ± 1.03	0.0845		None	HASL-300, Pu
	Uranium-235	0.0987 ± 0.102	0.107	U	BD	HASL-300
	Uranium-238	1.69 ± 0.727	0.554		None	HASL-300

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Table B-3. Radiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Activity (pCi/g)	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-10	Americium-241	0.0164 ± 0.0155	0.025	U	BD	HASL-300
	Cesium-137	0.0629 ± 0.0247	0.0244		J	HASL-300
	Uranium-235	0.08 ± 0.0872	0.0863	U	BD	HASL-300
	Uranium-238	1.74 ± 0.614	0.239		None	HASL-300
S-38	Americium-241	0.103 ± 0.0847	0.12	U	BD	HASL-300
	Cesium-137	0.134 ± 0.0229	0.0171		None	HASL-300
	Uranium-235	0.047 ± 0.108	0.112	U	BD	HASL-300
	Uranium-238	1.3 ± 1.02	0.925		J	HASL-300
S-39	Cesium-137	0.293 ± 0.0366	0.0214		None	HASL-300
	Uranium-235	0.093 ± 0.107	0.111	U	BD	HASL-300
	Uranium-238	2.02 ± 1.56	0.862		J	HASL-300
S-40	Americium-241	−0.00481 ± 0.0303	0.0519	U	BD	HASL-300
	Cesium-137	0.0897 ± 0.019	0.0204		None	HASL-300
	Uranium-235	0.0531 ± 0.109	0.0979	U	BD	HASL-300
	Uranium-238	1.54 ± 0.71	0.465		None	HASL-300
S-41	Americium-241	−0.0308 ± 0.0466	0.0786	U	BD	HASL-300
	Cesium-137	0.0443 ± 0.0174	0.018		J	HASL-300
	Uranium-235	0.188 ± 0.141	0.0952		J	HASL-300
	Uranium-238	1.45 ± 1.07	0.664		J	HASL-300
S-42	Americium-241	−0.00218 ± 0.0448	0.0778	U	BD	HASL-300
	Cesium-137	0.411 ± 0.0447	0.0178		None	HASL-300
	Uranium-235	0.025 ± 0.121	0.0954	U	BD	HASL-300
	Uranium-238	1.12 ± 0.968	0.656		J	HASL-300
S-43	Americium-241	−0.0205 ± 0.0401	0.0668	U	BD	HASL-300
	Cesium-137	0.0274 ± 0.0181	0.0183		J	HASL-300
	Uranium-238	1.6 ± 1.06	0.589		J	HASL-300
S-44	Americium-241	−0.0194 ± 0.0409	0.07	U	BD	HASL-300
	Cesium-137	0.042 ± 0.0292	0.0304		J	HASL-300
	Uranium-235	0.129 ± 0.138	0.131	U	BD	HASL-300
	Uranium-238	1.79 ± 1.04	0.636		J	HASL-300
S-45	Americium-241	−0.00798 ± 0.0532	0.0871	U	BD	HASL-300
	Cesium-137	0.0429 ± 0.0208	0.0213		J	HASL-300
	Uranium-235	0.0948 ± 0.128	0.117	U	BD	HASL-300
	Uranium-238	1.52 ± 0.947	0.731		J	HASL-300
S-46	Americium-241	0.0199 ± 0.0536	0.101	U	BD	HASL-300
	Cesium-137	0.0465 ± 0.0193	0.0229		J	HASL-300
	Uranium-235	0.133 ± 0.118	0.108		J	HASL-300
	Uranium-238	1.3 ± 1.04	0.806		J	HASL-300

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Table B-3. Radiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Activity (pCi/g)	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-47	Americium-241	−0.0205 ± 0.0356	0.0653	U	BD	HASL-300
	Cesium-137	0.105 ± 0.0225	0.0187		None	HASL-300
	Uranium-235	0.0222 ± 0.111	0.0971	U	BD	HASL-300
	Uranium-238	1.36 ± 0.867	0.575		J	HASL-300
S-49	Americium-241	0.4 ± 0.0939	0.0815		None	HASL-300
	Cesium-137	0.321 ± 0.0377	0.019		None	HASL-300
	Plutonium-238	0.0536 ± 0.0246	0.0348		J	HASL-300, Pu
	Plutonium-239/240	0.895 ± 0.107	0.045		None	HASL-300, Pu
	Uranium-235	0.0514 ± 0.121	0.104	U	BD	HASL-300
	Uranium-238	1.46 ± 1.02	0.705		J	HASL-300
S-49 DU1	Americium-241	0.404 ± 0.103	0.0681		None	HASL-300
	Cesium-137	0.372 ± 0.0376	0.0173		None	HASL-300
	Plutonium-238	0.017 ± 0.0178	0.0331	U	BD	HASL-300, Pu
	Plutonium-239/240	1.96 ± 0.186	0.0429		None	HASL-300, Pu
	Uranium-235	0.0861 ± 0.117	0.0964	U	BD	HASL-300
	Uranium-238	1.17 ± 0.776	0.595		J	HASL-300
S-49 DU2	Americium-241	0.797 ± 0.146	0.116		None	HASL-300
	Cesium-137	0.376 ± 0.04	0.0197		None	HASL-300
	Plutonium-238	0.0438 ± 0.0291	0.0404		J	HASL-300, Pu
	Plutonium-239/240	4.23 ± 0.377	0.0523		None	HASL-300, Pu
	Uranium-235	0.155 ± 0.152	0.112		J	HASL-300
	Uranium-238	2.14 ± 1.26	0.928		J	HASL-300
S-50	Americium-241	0.167 ± 0.0402	0.0334		None	HASL-300
	Cesium-137	0.456 ± 0.049	0.0266		None	HASL-300
	Plutonium-238	0.0195 ± 0.0121	0.0155		J	HASL-300, Pu
	Plutonium-239/240	0.134 ± 0.0238	0.0201		None	HASL-300, Pu
	Uranium-235	0.0386 ± 0.142	0.111	U	BD	HASL-300
	Uranium-238	1.13 ± 0.497	0.341		None	HASL-300
S-52	Americium-241	0.0262 ± 0.0706	0.139	U	BD	HASL-300
	Cesium-137	0.148 ± 0.0252	0.0218		None	HASL-300
	Uranium-235	0.0954 ± 0.114	0.106	U	BD	HASL-300
	Uranium-238	1.4 ± 1.36	1.02		J	HASL-300

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Table B-3. Radiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Activity (pCi/g)	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-53	Americium-241	0.00299 ± 0.0164	0.0279	U	BD	HASL-300
	Cesium-137	0.206 ± 0.03	0.0193		None	HASL-300
	Uranium-235	0.0831 ± 0.101	0.0868	U	BD	HASL-300
	Uranium-238	1.69 ± 0.552	0.267		None	HASL-300

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95 percent probability that the measured activity is accurately quantified above the critical level
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Laboratory Data Qualifier
U = The analyte was absent or below the method detection limit.
X = The data was rejected due to the peak not meeting identification criteria.

Data Validation Qualifier
BD = The associated value was below the detection limit as used in radiochemistry to identify results that are not statistically different from zero.
J = The associated value was an estimated quantity.
None = There was no data validation for corrected gross alpha activity.
R = The data are unusable.

Table B-4. Environmental dosimeter measurements at SNL/TTR, 2019

Location Class	Location Number	First Quarter (68 Days)		Second Quarter (112 Days)		Third Quarter (71 Days)		Fourth Quarter (98 Days)	
		Gross Exposure (mrem)	Net Exposure (mrem)	Gross Exposure (mrem)	Net Exposure (mrem)	Gross Exposure (mrem)	Net Exposure (mrem)	Gross Exposure (mrem)	Net Exposure (mrem)
Off-Site	C-19	40.1	10.6	56.6	20.9	44.5	12.9	46.7	11.4
	C-21	45.4	16	68.8	33	53.4	21.9	61	25.6
	C-22	48.4	19	62.8	27.1	48.2	16.6	56.1	20.7
Perimeter	P-05	47	17.5	66.3	30.6	61.4	29.8	61	25.7
	P-06	47.8	18.3	67	31.3	48.9	17.3	57.2	21.9
	P-07	46.7	17.2	64.4	28.7	52.1	20.5	57.8	22.5
	P-08	41.7	12.2	61.3	25.6	50.8	19.2	54.9	19.6
	P-11	46.3	16.9	66.2	30.4	53.3	21.7	59.7	24.4
	P-12	49.2	19.7	66.9	31.2	54.1	22.6	56.5	21.2
On-Site	S-01	42.7	13.3	Not collected	Not collected	52.4	20.8	63.7	28.4
	S-02	44.2	14.8	70.8	35.1	54.1	22.6	59.4	24
	S-03	46.7	17.2	69.8	34	55.8	24.2	61.2	25.8
	S-04	46.8	17.4	69.9	34.2	57	25.4	64.1	28.7
	S-09	43.2	13.7	66.2	30.5	51.2	19.7	55.5	20.1
	S-10	44.8	15.3	67.2	31.5	Not collected	Not collected	58.3	22.9
	S-13	43.4	13.9	66	30.3	55.6	24.1	57.4	22
	S-14	45.4	15.9	65.1	29.4	51.3	19.8	56	20.6
	S-15	47.8	18.3	72.2	36.5	55.4	23.9	62	26.6
	S-16	45.6	16.2	68	32.3	52.6	21.1	60.7	25.3
	S-17	47.4	17.9	64.3	28.6	52.1	20.6	57.6	22.2

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-02	Aluminum	7,680	4.34	9.54		J	SW-846 3050B/6020B
	Antimony	0.335	0.315	1.91	J	J+	SW-846 3050B/6010D
	Arsenic	2.27	0.323	0.954		None	SW-846 3050B/6020B
	Barium	81.4	0.0954	0.763		J	SW-846 3050B/6020B
	Beryllium	0.425	0.0191	0.0954		None	SW-846 3050B/6020B
	Cadmium	0.0874	0.0191	0.191	J	None	SW-846 3050B/6020B
	Calcium	2,380	12.8	38.2	*	None	SW-846 3050B/6020B
	Chromium	3.57	0.191	0.573		None	SW-846 3050B/6020B
	Cobalt	2.29	0.0573	0.191		None	SW-846 3050B/6020B
	Copper	3.74	0.063	0.382		None	SW-846 3050B/6020B
	Iron	6,660	63	191		J	SW-846 3050B/6020B
	Lead	7.84	0.0954	0.382		None	SW-846 3050B/6020B
	Magnesium	2,380	1.91	5.73		None	SW-846 3050B/6020B
	Manganese	285	1.91	9.54		J	SW-846 3050B/6020B
	Nickel	3.72	0.0954	0.382		None	SW-846 3050B/6020B
	Potassium	2,880	153	573		None	SW-846 3050B/6020B
	Selenium	0.566	0.344	0.954	JN	J	SW-846 3050B/6020B
	Silver	0.0954	0.0954	0.477	U	None	SW-846 3050B/6010D
	Sodium	259	15.9	49.7		None	SW-846 3050B/6020B
	Thallium	0.136	0.134	0.382	J	None	SW-846 3050B/6020B
	Uranium	0.751	0.0126	0.0382		None	SW-846 3050B/6020B
	Vanadium	7.8	0.286	3.82	N	J	SW-846 3050B/6020B
	Zinc	27.1	0.763	3.82		J	SW-846 3050B/6020B
S-03	Aluminum	7,100	4.14	9.11		J	SW-846 3050B/6020B
	Antimony	0.317	0.317	1.92	U	None	SW-846 3050B/6010D
	Arsenic	3.71	0.308	0.911		None	SW-846 3050B/6020B
	Barium	95.1	0.0911	0.729		J	SW-846 3050B/6020B
	Beryllium	0.361	0.0182	0.0911		None	SW-846 3050B/6020B
	Cadmium	0.128	0.0182	0.182	J	None	SW-846 3050B/6020B
	Calcium	2,270	12.2	36.4	*	None	SW-846 3050B/6020B

Table continued on next page

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-03	Chromium	4.24	0.182	0.546		None	SW-846 3050B/6020B
	Cobalt	2.56	0.0546	0.182		None	SW-846 3050B/6020B
	Copper	4.75	0.0601	0.364		None	SW-846 3050B/6020B
	Iron	6,480	60.1	182		J	SW-846 3050B/6020B
	Lead	8.49	0.0911	0.364		None	SW-846 3050B/6020B
	Magnesium	2,540	1.82	5.46		None	SW-846 3050B/6020B
	Manganese	297	1.82	9.11		J	SW-846 3050B/6020B
	Nickel	3.78	0.0911	0.364		None	SW-846 3050B/6020B
	Potassium	2,580	146	546		None	SW-846 3050B/6020B
	Selenium	0.642	0.328	0.911	JN	J	SW-846 3050B/6020B
	Silver	0.0962	0.0962	0.481	U	None	SW-846 3050B/6010D
	Sodium	263	14.8	46.1		None	SW-846 3050B/6020B
	Thallium	0.128	0.128	0.364	U	None	SW-846 3050B/6020B
	Uranium	0.723	0.012	0.0364		None	SW-846 3050B/6020B
	Vanadium	10.3	0.273	3.64	N	J	SW-846 3050B/6020B
	Zinc	20.4	0.729	3.64		J	SW-846 3050B/6020B
S-03 DU1	Aluminum	7,570	4.28	9.4		J	SW-846 3050B/6020B
	Antimony	0.325	0.325	1.97	U	None	SW-846 3050B/6010D
	Arsenic	3.17	0.318	0.94		None	SW-846 3050B/6020B
	Barium	90.8	0.094	0.752		J	SW-846 3050B/6020B
	Beryllium	0.411	0.0188	0.094		None	SW-846 3050B/6020B
	Cadmium	0.136	0.0188	0.188	J	None	SW-846 3050B/6020B
	Calcium	2,550	12.6	37.6	*	None	SW-846 3050B/6020B
	Chromium	4.62	0.188	0.564		None	SW-846 3050B/6020B
	Cobalt	2.67	0.0564	0.188		None	SW-846 3050B/6020B
	Copper	4.98	0.062	0.376		None	SW-846 3050B/6020B
	Iron	7,190	62	188		J	SW-846 3050B/6020B
	Lead	8.2	0.094	0.376		None	SW-846 3050B/6020B
	Magnesium	2,710	1.88	5.64		None	SW-846 3050B/6020B

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Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-03 DU1	Manganese	313	1.88	9.4		J	SW-846 3050B/6020B
	Nickel	4.04	0.094	0.376		None	SW-846 3050B/6020B
	Potassium	2,730	150	564		None	SW-846 3050B/6020B
	Selenium	0.664	0.338	0.94	JN	J	SW-846 3050B/6020B
	Silver	0.0986	0.0986	0.493	U	None	SW-846 3050B/6010D
	Sodium	232	15.2	47.5		None	SW-846 3050B/6020B
	Thallium	0.132	0.132	0.376	U	None	SW-846 3050B/6020B
	Uranium	0.768	0.0124	0.0376		None	SW-846 3050B/6020B
	Vanadium	11.8	0.282	3.76	N	J	SW-846 3050B/6020B
	Zinc	22	0.752	3.76		J	SW-846 3050B/6020B
S-03 DU2	Aluminum	8,400	4.38	9.62		J	SW-846 3050B/6020B
	Antimony	0.32	0.32	1.94	U	None	SW-846 3050B/6010D
	Arsenic	3.4	0.325	0.962		None	SW-846 3050B/6020B
	Barium	100	0.0962	0.769		J	SW-846 3050B/6020B
	Beryllium	0.435	0.0192	0.0962		None	SW-846 3050B/6020B
	Cadmium	0.153	0.0192	0.192	J	None	SW-846 3050B/6020B
	Calcium	2,560	12.9	38.5	*	None	SW-846 3050B/6020B
	Chromium	4.63	0.192	0.577		None	SW-846 3050B/6020B
	Cobalt	2.77	0.0577	0.192		None	SW-846 3050B/6020B
	Copper	4.93	0.0635	0.385		None	SW-846 3050B/6020B
	Iron	7,460	63.5	192		J	SW-846 3050B/6020B
	Lead	8.81	0.0962	0.385		None	SW-846 3050B/6020B
	Magnesium	2,710	1.92	5.77		None	SW-846 3050B/6020B
	Manganese	327	1.92	9.62		J	SW-846 3050B/6020B
	Nickel	4.04	0.0962	0.385		None	SW-846 3050B/6020B
	Potassium	2,690	154	577		None	SW-846 3050B/6020B
	Selenium	0.588	0.346	0.962	JN	J	SW-846 3050B/6020B
	Silver	0.0971	0.0971	0.485	U	None	SW-846 3050B/6010D
	Sodium	236	15.6	48.7		None	SW-846 3050B/6020B

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Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-03 DU2	Thallium	0.135	0.135	0.385	U	None	SW-846 3050B/6020B
	Uranium	0.748	0.0127	0.0385		None	SW-846 3050B/6020B
	Vanadium	12.1	0.288	3.85	N	J	SW-846 3050B/6020B
	Zinc	23.2	0.769	3.85		J	SW-846 3050B/6020B
S-04	Aluminum	7,180	4.46	9.8		J	SW-846 3050B/6020B
	Antimony	0.322	0.322	1.95	U	None	SW-846 3050B/6010D
	Arsenic	3.16	0.331	0.98		None	SW-846 3050B/6020B
	Barium	103	0.098	0.784		J	SW-846 3050B/6020B
	Beryllium	0.436	0.0196	0.098		None	SW-846 3050B/6020B
	Cadmium	0.155	0.0196	0.196	J	None	SW-846 3050B/6020B
	Calcium	2,770	13.1	39.2	*	None	SW-846 3050B/6020B
	Chromium	3.37	0.196	0.588		None	SW-846 3050B/6020B
	Cobalt	2.21	0.0588	0.196		None	SW-846 3050B/6020B
	Copper	4.23	0.0647	0.392		None	SW-846 3050B/6020B
	Iron	7,050	64.7	196		J	SW-846 3050B/6020B
	Lead	6.77	0.098	0.392		None	SW-846 3050B/6020B
	Magnesium	2,700	1.96	5.88		None	SW-846 3050B/6020B
	Manganese	420	1.96	9.8		J	SW-846 3050B/6020B
	Nickel	3.04	0.098	0.392		None	SW-846 3050B/6020B
	Potassium	3,410	157	588		None	SW-846 3050B/6020B
	Selenium	0.644	0.353	0.98	JN	J	SW-846 3050B/6020B
	Silver	0.0977	0.0977	0.488	U	None	SW-846 3050B/6010D
	Sodium	370	15.1	47.3		None	SW-846 3050B/6020B
	Thallium	0.137	0.137	0.392	U	None	SW-846 3050B/6020B
	Uranium	0.702	0.0129	0.0392		None	SW-846 3050B/6020B
	Vanadium	9.18	0.294	3.92	N	J	SW-846 3050B/6020B
	Zinc	23.3	0.784	3.92		J	SW-846 3050B/6020B
S-09	Aluminum	14,100	45.2	99.4		J	SW-846 3050B/6020B
	Antimony	0.319	0.319	1.93	U	None	SW-846 3050B/6010D

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Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-09	Arsenic	3.63	0.336	0.994		None	SW-846 3050B/6020B
	Barium	157	0.0994	0.795		J	SW-846 3050B/6020B
	Beryllium	0.679	0.0199	0.0994		None	SW-846 3050B/6020B
	Cadmium	0.14	0.0199	0.199	J	None	SW-846 3050B/6020B
	Calcium	7,450	13.3	39.8	*	None	SW-846 3050B/6020B
	Chromium	7.28	0.199	0.596		None	SW-846 3050B/6020B
	Cobalt	5.82	0.0596	0.199		None	SW-846 3050B/6020B
	Copper	7.6	0.0656	0.398		None	SW-846 3050B/6020B
	Iron	13,100	65.6	199		J	SW-846 3050B/6020B
	Lead	11.9	0.0994	0.398		None	SW-846 3050B/6020B
	Magnesium	5,980	1.99	5.96		None	SW-846 3050B/6020B
	Manganese	436	1.99	9.94		J	SW-846 3050B/6020B
	Nickel	6.58	0.0994	0.398		None	SW-846 3050B/6020B
	Potassium	4,820	159	596		None	SW-846 3050B/6020B
	Selenium	0.808	0.358	0.994	JN	J	SW-846 3050B/6020B
	Silver	0.0965	0.0965	0.483	U	None	SW-846 3050B/6010D
	Sodium	233	14.7	46		None	SW-846 3050B/6020B
	Thallium	0.204	0.139	0.398	J	None	SW-846 3050B/6020B
	Uranium	0.677	0.0131	0.0398		None	SW-846 3050B/6020B
	Vanadium	18.7	0.298	3.98	N	J	SW-846 3050B/6020B
	Zinc	35.5	0.795	3.98		J	SW-846 3050B/6020B
S-09 DU1	Aluminum	15,000	44.8	98.4		J	SW-846 3050B/6020B
	Antimony	0.329	0.329	1.99	U	None	SW-846 3050B/6010D
	Arsenic	4.34	0.333	0.984		None	SW-846 3050B/6020B
	Barium	180	0.0984	0.787		J	SW-846 3050B/6020B
	Beryllium	0.728	0.0197	0.0984		None	SW-846 3050B/6020B
	Cadmium	0.416	0.0197	0.197		None	SW-846 3050B/6020B
	Calcium	8,370	13.2	39.4	*	None	SW-846 3050B/6020B
	Chromium	8.21	0.197	0.591		None	SW-846 3050B/6020B

Table continued on next page

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-09 DU1	Cobalt	7.04	0.0591	0.197		None	SW-846 3050B/6020B
	Copper	8.61	0.065	0.394		None	SW-846 3050B/6020B
	Iron	14,700	65	197		J	SW-846 3050B/6020B
	Lead	13.1	0.0984	0.394		None	SW-846 3050B/6020B
	Magnesium	6,710	1.97	5.91		None	SW-846 3050B/6020B
	Manganese	467	1.97	9.84		J	SW-846 3050B/6020B
	Nickel	7.28	0.0984	0.394		None	SW-846 3050B/6020B
	Potassium	4,870	157	591		None	SW-846 3050B/6020B
	Selenium	0.801	0.354	0.984	JN	J	SW-846 3050B/6020B
	Silver	0.0996	0.0996	0.498	U	None	SW-846 3050B/6010D
	Sodium	182	15.8	49.3		None	SW-846 3050B/6020B
	Thallium	0.202	0.138	0.394	J	None	SW-846 3050B/6020B
	Uranium	0.828	0.013	0.0394		None	SW-846 3050B/6020B
	Vanadium	21.1	0.295	3.94	N	J	SW-846 3050B/6020B
	Zinc	39.2	0.787	3.94		J	SW-846 3050B/6020B
S-09 DU2	Aluminum	14,200	42.4	93.1		J	SW-846 3050B/6020B
	Antimony	0.313	0.313	1.89	U	None	SW-846 3050B/6010D
	Arsenic	3.87	0.315	0.931		None	SW-846 3050B/6020B
	Barium	185	0.0931	0.745		J	SW-846 3050B/6020B
	Beryllium	0.785	0.0186	0.0931		None	SW-846 3050B/6020B
	Cadmium	0.171	0.0186	0.186	J	None	SW-846 3050B/6020B
	Calcium	8,590	12.5	37.2	*	None	SW-846 3050B/6020B
	Chromium	8.65	0.186	0.559		None	SW-846 3050B/6020B
	Cobalt	8.18	0.0559	0.186		None	SW-846 3050B/6020B
	Copper	8.65	0.0615	0.372		None	SW-846 3050B/6020B
	Iron	13,200	61.5	186		J	SW-846 3050B/6020B
	Lead	13.3	0.0931	0.372		None	SW-846 3050B/6020B
	Magnesium	7,280	1.86	5.59		None	SW-846 3050B/6020B
	Manganese	530	1.86	9.31		J	SW-846 3050B/6020B

Table continued on next page

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-09 DU2	Nickel	7.63	0.0931	0.372		None	SW-846 3050B/6020B
	Potassium	4,450	149	559		None	SW-846 3050B/6020B
	Selenium	0.923	0.335	0.931	JN	J	SW-846 3050B/6020B
	Silver	0.0947	0.0947	0.473	U	None	SW-846 3050B/6010D
	Sodium	165	15.9	49.6		None	SW-846 3050B/6020B
	Thallium	0.214	0.13	0.372	J	None	SW-846 3050B/6020B
	Uranium	0.776	0.0123	0.0372		None	SW-846 3050B/6020B
	Vanadium	20.5	0.279	3.72	N	J	SW-846 3050B/6020B
	Zinc	41.5	0.745	3.72		J	SW-846 3050B/6020B
S-10	Aluminum	11,400	42.8	94.2		J	SW-846 3050B/6020B
	Antimony	0.329	0.329	2	U	None	SW-846 3050B/6010D
	Arsenic	3.46	0.318	0.942		None	SW-846 3050B/6020B
	Barium	138	0.0942	0.753		J	SW-846 3050B/6020B
	Beryllium	0.657	0.0188	0.0942		None	SW-846 3050B/6020B
	Cadmium	0.14	0.0188	0.188	J	None	SW-846 3050B/6020B
	Calcium	5,520	12.6	37.7	*	None	SW-846 3050B/6020B
	Chromium	6.2	0.188	0.565		None	SW-846 3050B/6020B
	Cobalt	3.5	0.0565	0.188		None	SW-846 3050B/6020B
	Copper	6.88	0.0621	0.377		None	SW-846 3050B/6020B
	Iron	8,970	62.1	188		J	SW-846 3050B/6020B
	Lead	8.64	0.0942	0.377		None	SW-846 3050B/6020B
	Magnesium	4,660	1.88	5.65		None	SW-846 3050B/6020B
	Manganese	387	1.88	9.42		J	SW-846 3050B/6020B
	Nickel	5.38	0.0942	0.377		None	SW-846 3050B/6020B
	Potassium	4,010	151	565		None	SW-846 3050B/6020B
	Selenium	0.706	0.339	0.942	JN	J	SW-846 3050B/6020B
	Silver	0.0998	0.0998	0.499	U	None	SW-846 3050B/6010D
	Sodium	406	15.6	48.8		None	SW-846 3050B/6020B
	Thallium	0.182	0.132	0.377	J	None	SW-846 3050B/6020B

Table continued on next page

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-10	Uranium	0.911	0.0124	0.0377		None	SW-846 3050B/6020B
	Vanadium	14.4	0.282	3.77	N	J	SW-846 3050B/6020B
	Zinc	31	0.753	3.77		J	SW-846 3050B/6020B
S-38	Aluminum	11,300	42.5	93.5		J	SW-846 3050B/6020B
	Antimony	0.671	0.32	1.94	J	J+	SW-846 3050B/6010D
	Arsenic	3.67	0.316	0.935		None	SW-846 3050B/6020B
	Barium	93.7	0.0935	0.748		J	SW-846 3050B/6020B
	Beryllium	0.524	0.0187	0.0935		None	SW-846 3050B/6020B
	Cadmium	0.0821	0.0187	0.187	J	None	SW-846 3050B/6020B
	Calcium	16,300	125	374	*	None	SW-846 3050B/6020B
	Chromium	5.47	0.187	0.561		None	SW-846 3050B/6020B
	Cobalt	2.72	0.0561	0.187		None	SW-846 3050B/6020B
	Copper	4.97	0.0617	0.374		None	SW-846 3050B/6020B
	Iron	7,990	61.7	187		J	SW-846 3050B/6020B
	Lead	7.49	0.0935	0.374		None	SW-846 3050B/6020B
	Magnesium	4,520	1.87	5.61		None	SW-846 3050B/6020B
	Manganese	185	0.187	0.935		J	SW-846 3050B/6020B
	Nickel	4.98	0.0935	0.374		None	SW-846 3050B/6020B
	Potassium	3,730	150	561		None	SW-846 3050B/6020B
	Selenium	0.581	0.336	0.935	JN	J	SW-846 3050B/6020B
	Silver	0.0969	0.0969	0.484	U	None	SW-846 3050B/6010D
	Sodium	287	15.6	48.6		None	SW-846 3050B/6020B
	Thallium	0.175	0.131	0.374	J	None	SW-846 3050B/6020B
	Uranium	0.675	0.0123	0.0374		None	SW-846 3050B/6020B
	Vanadium	11.3	0.28	3.74	N	J	SW-846 3050B/6020B
	Zinc	21.8	0.748	3.74		J	SW-846 3050B/6020B
S-39	Aluminum	9,850	43.3	95.2		J	SW-846 3050B/6020B
	Antimony	0.311	0.311	1.88	U	None	SW-846 3050B/6010D
	Arsenic	3.98	0.322	0.952		None	SW-846 3050B/6020B

Table continued on next page

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-39	Barium	135	0.0952	0.762		J	SW-846 3050B/6020B
	Beryllium	0.485	0.019	0.0952		None	SW-846 3050B/6020B
	Cadmium	0.172	0.019	0.19	J	None	SW-846 3050B/6020B
	Calcium	4,360	12.8	38.1	*	None	SW-846 3050B/6020B
	Chromium	5.43	0.19	0.571		None	SW-846 3050B/6020B
	Cobalt	3.3	0.0571	0.19		None	SW-846 3050B/6020B
	Copper	6.08	0.0629	0.381		None	SW-846 3050B/6020B
	Iron	8,470	62.9	190		J	SW-846 3050B/6020B
	Lead	9.44	0.0952	0.381		None	SW-846 3050B/6020B
	Magnesium	4,250	1.9	5.71		None	SW-846 3050B/6020B
	Manganese	484	1.9	9.52		J	SW-846 3050B/6020B
	Nickel	5.11	0.0952	0.381		None	SW-846 3050B/6020B
	Potassium	3,560	152	571		None	SW-846 3050B/6020B
	Selenium	0.758	0.343	0.952	JN	J	SW-846 3050B/6020B
	Silver	0.0942	0.0942	0.471	U	None	SW-846 3050B/6010D
	Sodium	452	14.9	46.6		None	SW-846 3050B/6020B
	Thallium	0.158	0.133	0.381	J	None	SW-846 3050B/6020B
	Uranium	0.934	0.0126	0.0381		None	SW-846 3050B/6020B
	Vanadium	14.1	0.286	3.81	N	J	SW-846 3050B/6020B
	Zinc	31.3	0.762	3.81		J	SW-846 3050B/6020B
S-49	Aluminum	11,300	45.1	99.2		J	SW-846 3050B/6020B
	Antimony	0.315	0.315	1.91	U	None	SW-846 3050B/6010D
	Arsenic	2.67	0.335	0.992		None	SW-846 3050B/6020B
	Barium	220	0.992	7.94		J	SW-846 3050B/6020B
	Beryllium	0.491	0.0198	0.0992		None	SW-846 3050B/6020B
	Cadmium	0.188	0.0198	0.198	J	None	SW-846 3050B/6020B
	Calcium	5,880	13.3	39.7	*	None	SW-846 3050B/6020B
	Chromium	5.24	0.198	0.595		None	SW-846 3050B/6020B
	Cobalt	3.12	0.0595	0.198		None	SW-846 3050B/6020B

Table continued on next page

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-49	Copper	5.77	0.0655	0.397		None	SW-846 3050B/6020B
	Iron	7,730	65.5	198		J	SW-846 3050B/6020B
	Lead	14.6	0.0992	0.397		None	SW-846 3050B/6020B
	Magnesium	4,340	1.98	5.95		None	SW-846 3050B/6020B
	Manganese	489	1.98	9.92		J	SW-846 3050B/6020B
	Nickel	4.7	0.0992	0.397		None	SW-846 3050B/6020B
	Potassium	5,800	159	595		None	SW-846 3050B/6020B
	Selenium	0.634	0.357	0.992	JN	J	SW-846 3050B/6020B
	Silver	0.0954	0.0954	0.477	U	None	SW-846 3050B/6010D
	Sodium	781	15.9	49.7		None	SW-846 3050B/6020B
	Thallium	0.155	0.139	0.397	J	None	SW-846 3050B/6020B
	Uranium	0.616	0.0131	0.0397		None	SW-846 3050B/6020B
	Vanadium	11.8	0.298	3.97	N	J	SW-846 3050B/6020B
	Zinc	28.4	0.794	3.97		J	SW-846 3050B/6020B
S-49 DU1	Aluminum	11,200	44.3	97.3		J	SW-846 3050B/6020B
	Antimony	0.308	0.308	1.87	U	None	SW-846 3050B/6010D
	Arsenic	2.84	0.329	0.973		None	SW-846 3050B/6020B
	Barium	315	0.973	7.78		J	SW-846 3050B/6020B
	Beryllium	0.517	0.0195	0.0973		None	SW-846 3050B/6020B
	Cadmium	0.244	0.0195	0.195		None	SW-846 3050B/6020B
	Calcium	6,280	13	38.9	*	None	SW-846 3050B/6020B
	Chromium	5.48	0.195	0.584		None	SW-846 3050B/6020B
	Cobalt	3.91	0.0584	0.195		None	SW-846 3050B/6020B
	Copper	6.71	0.0642	0.389		None	SW-846 3050B/6020B
	Iron	7,830	64.2	195		J	SW-846 3050B/6020B
	Lead	11.9	0.0973	0.389		None	SW-846 3050B/6020B
	Magnesium	4,960	1.95	5.84		None	SW-846 3050B/6020B
	Manganese	964	1.95	9.73		J	SW-846 3050B/6020B
	Nickel	5.81	0.0973	0.389		None	SW-846 3050B/6020B

Table continued on next page

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-49 DU1	Potassium	6,110	156	584		None	SW-846 3050B/6020B
	Selenium	0.795	0.35	0.973	JN	J	SW-846 3050B/6020B
	Silver	0.0933	0.0933	0.466	U	None	SW-846 3050B/6010D
	Sodium	775	15.8	49.3		None	SW-846 3050B/6020B
	Thallium	0.39	0.136	0.389		None	SW-846 3050B/6020B
	Uranium	0.663	0.0128	0.0389		None	SW-846 3050B/6020B
	Vanadium	14.2	0.292	3.89	N	J	SW-846 3050B/6020B
	Zinc	32.4	0.778	3.89		J	SW-846 3050B/6020B
S-49 DU2	Aluminum	10,800	44.1	96.9		J	SW-846 3050B/6020B
	Antimony	0.319	0.319	1.93	U	None	SW-846 3050B/6010D
	Arsenic	2.44	0.328	0.969		None	SW-846 3050B/6020B
	Barium	219	0.969	7.75		J	SW-846 3050B/6020B
	Beryllium	0.463	0.0194	0.0969		None	SW-846 3050B/6020B
	Cadmium	0.178	0.0194	0.194	J	None	SW-846 3050B/6020B
	Calcium	5,620	13	38.8	*	J-	SW-846 3050B/6020B
	Chromium	4.48	0.194	0.581		None	SW-846 3050B/6020B
	Cobalt	3.07	0.0581	0.194		None	SW-846 3050B/6020B
	Copper	5.69	0.064	0.388		None	SW-846 3050B/6020B
	Iron	7,430	64	194		J	SW-846 3050B/6020B
	Lead	11.2	0.0969	0.388		None	SW-846 3050B/6020B
	Magnesium	4,260	1.94	5.81		None	SW-846 3050B/6020B
	Manganese	546	1.94	9.69		J	SW-846 3050B/6020B
	Nickel	4.85	0.0969	0.388		None	SW-846 3050B/6020B
	Potassium	5,730	155	581		None	SW-846 3050B/6020B
	Selenium	0.728	0.349	0.969	JN	J	SW-846 3050B/6020B
	Silver	0.0965	0.0965	0.483	U	None	SW-846 3050B/6010D
	Sodium	855	15.6	48.8		None	SW-846 3050B/6020B
	Thallium	0.166	0.136	0.388	J	None	SW-846 3050B/6020B
	Uranium	0.514	0.0128	0.0388		None	SW-846 3050B/6020B

Table continued on next page

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-49 DU2	Vanadium	11.2	0.291	3.88	N	J	SW-846 3050B/6020B
	Zinc	27.1	0.775	3.88		J	SW-846 3050B/6020B
S-50	Aluminum	8,020	4.28	9.4		J-	SW-846 3050B/6020B
	Antimony	0.322	0.322	1.95	U	None	SW-846 3050B/6010D
	Arsenic	2.5	0.318	0.94		None	SW-846 3050B/6020B
	Barium	181	0.094	0.752		J	SW-846 3050B/6020B
	Beryllium	0.393	0.0188	0.094		None	SW-846 3050B/6020B
	Cadmium	0.161	0.0188	0.188	J	None	SW-846 3050B/6020B
	Calcium	3,950	12.6	37.6	*	J-	SW-846 3050B/6020B
	Chromium	4.02	0.188	0.564		None	SW-846 3050B/6020B
	Cobalt	2.54	0.0564	0.188		None	SW-846 3050B/6020B
	Copper	4.97	0.062	0.376		None	SW-846 3050B/6020B
	Iron	6,940	62	188		J	SW-846 3050B/6020B
	Lead	10.5	0.094	0.376		None	SW-846 3050B/6020B
	Magnesium	3,180	1.88	5.64		None	SW-846 3050B/6020B
	Manganese	384	1.88	9.4		J	SW-846 3050B/6020B
	Nickel	3.98	0.094	0.376		None	SW-846 3050B/6020B
	Potassium	5,390	150	564		None	SW-846 3050B/6020B
	Selenium	0.772	0.338	0.94	JN	J	SW-846 3050B/6020B
	Silver	0.0975	0.0975	0.487	U	None	SW-846 3050B/6010D
	Sodium	553	15.3	47.7		None	SW-846 3050B/6020B
	Thallium	0.132	0.132	0.376	U	None	SW-846 3050B/6020B
	Uranium	0.491	0.0124	0.0376		None	SW-846 3050B/6020B
	Vanadium	11.4	0.282	3.76	N	J	SW-846 3050B/6020B
	Zinc	26.7	0.752	3.76		J	SW-846 3050B/6020B
S-52	Aluminum	6,770	4.5	9.9		J	SW-846 3050B/6020B
	Antimony	0.312	0.312	1.89	U	None	SW-846 3050B/6010D
	Arsenic	2.68	0.335	0.99		None	SW-846 3050B/6020B
	Barium	93.4	0.099	0.792		J	SW-846 3050B/6020B

Table continued on next page

Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-52	Beryllium	0.336	0.0198	0.099		None	SW-846 3050B/6020B
	Cadmium	0.124	0.0198	0.198	J	None	SW-846 3050B/6020B
	Calcium	2,000	13.3	39.6	*	None	SW-846 3050B/6020B
	Chromium	3.24	0.198	0.594		None	SW-846 3050B/6020B
	Cobalt	2.13	0.0594	0.198		None	SW-846 3050B/6020B
	Copper	3.84	0.0653	0.396		None	SW-846 3050B/6020B
	Iron	5,660	65.3	198		J	SW-846 3050B/6020B
	Lead	7.08	0.099	0.396		None	SW-846 3050B/6020B
	Magnesium	2,150	1.98	5.94		None	SW-846 3050B/6020B
	Manganese	290	1.98	9.9		J	SW-846 3050B/6020B
	Nickel	3	0.099	0.396		None	SW-846 3050B/6020B
	Potassium	2,330	158	594		None	SW-846 3050B/6020B
	Selenium	0.603	0.356	0.99	JN	J	SW-846 3050B/6020B
	Silver	0.0945	0.0945	0.473	U	None	SW-846 3050B/6010D
	Sodium	141	15.1	47.3		None	SW-846 3050B/6020B
	Thallium	0.139	0.139	0.396	U	None	SW-846 3050B/6020B
	Uranium	0.736	0.0131	0.0396		None	SW-846 3050B/6020B
	Vanadium	7.93	0.297	3.96	N	J	SW-846 3050B/6020B
	Zinc	20.8	0.792	3.96		J	SW-846 3050B/6020B
S-53	Aluminum	5,470	4.32	9.49		J-	SW-846 3050B/6020B
	Antimony	0.316	0.316	1.92	U	None	SW-846 3050B/6010D
	Arsenic	2.71	0.321	0.949		None	SW-846 3050B/6020B
	Barium	160	0.0949	0.759		J	SW-846 3050B/6020B
	Beryllium	0.297	0.019	0.0949		None	SW-846 3050B/6020B
	Cadmium	0.105	0.019	0.19	J	None	SW-846 3050B/6020B
	Calcium	5,830	12.7	38	*	J-	SW-846 3050B/6020B
	Chromium	4.26	0.19	0.569		None	SW-846 3050B/6020B
	Cobalt	1.73	0.0569	0.19		None	SW-846 3050B/6020B
	Copper	3.57	0.0626	0.38		None	SW-846 3050B/6020B

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Table B-5. Nonradiological results for on-site soil sampling locations at SNL/TTR, 2019 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-53	Iron	4,870	62.6	190		J	SW-846 3050B/6020B
	Lead	5	0.0949	0.38		None	SW-846 3050B/6020B
	Magnesium	2,350	1.9	5.69		None	SW-846 3050B/6020B
	Manganese	182	0.19	0.949		J-	SW-846 3050B/6020B
	Nickel	2.43	0.0949	0.38		None	SW-846 3050B/6020B
	Potassium	2,670	152	569		None	SW-846 3050B/6020B
	Selenium	0.606	0.342	0.949	JN	J	SW-846 3050B/6020B
	Silver	0.0958	0.0958	0.479	U	None	SW-846 3050B/6010D
	Sodium	373	14.7	45.9		None	SW-846 3050B/6020B
	Thallium	0.133	0.133	0.38	U	None	SW-846 3050B/6020B
	Uranium	0.525	0.0125	0.038		None	SW-846 3050B/6020B
	Vanadium	8.69	0.285	3.8	N	J	SW-846 3050B/6020B
	Zinc	16	0.759	3.8		J	SW-846 3050B/6020B

MDL = method detection limit
PQL = practical quantitation limit
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Laboratory Data Qualifier
* = A replicate was outside limits.
J = An estimated value, the analyte concentration was above the effective MDL and below the effective PQL.
N = A spike was outside limits.
U = The analyte was absent or below the method detection limit.

Data Validation Qualifier
J = The associated value was an estimated quantity.
J+ = The associated numerical value was an estimated quantity with a suspected positive base.
J- = The associated numerical value is an estimated quantity with a suspected negative base.
None = There was no data validation for corrected gross alpha activity.

Appendix C. SNL/TTR Wastewater Sampling Results in 2019

Old times at Tonopah Test Range

Table C-1. Sanitary outfalls of inorganic analyses, June 2019

Station	Date Collected	Analyte	Result (mg/L)	MDL (mg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	12-Jun-2019	Aluminum	0.183	0.0193		EPA 200.8
		Arsenic	0.00304	0.002	J	EPA 200.8
		Boron	0.712	0.052	B	EPA 200.8
		Cadmium	0.000346	0.0003	J	EPA 200.8
		Chemical oxygen demand	396	8.95		EPA 410.4
		Chromium		0.003	U	EPA 200.8
		Copper	0.199	0.0003		EPA 200.8
		Cyanide, total	0.0103	0.00167		EPA 335.4
		Grease and oil	23.9	1.32	N	EPA 1664A/1664B
		Lead	0.00313	0.0005		EPA 200.8
		Mercury		0.000067	U	EPA 245.1/245.2
		Molybdenum	0.00435	0.0002		EPA 200.8
		Nickel	0.00376	0.0006		EPA 200.8
		pH	9.01	0.01	H	SM 4500 H-B
		Phenol	0.0971	0.00167	B	SW-846 9066
		Selenium		0.002	U	EPA 200.8
		Silica gel treated n-hexane extractable	1.52	1.25	JN	EPA 1664A/1664B
		Silver	0.000778	0.0003	J	EPA 200.8
		Solids, total suspended	158	11.4		SM 2540D
		Zinc	0.296	0.0033	B	EPA 200.8

MDL = method detection limit
pH = potential of hydrogen
PQL = practical quantitation limit
TTR = Tonopah Test Range

Laboratory Data Qualifier
B = The analyte was detected in the blank.
H = The analytical holding time was exceeded.
J = An estimated value, the analyte concentration was above the effective MDL and below the effective PQL.
N = A spike was outside limits.
U = The analyte was absent or below the method detection limit.

Table C-2. Sanitary outfalls of radiological analyses, June 2019

Station	Date Collected	Analyte	Activity (pCi/L)	MDA (pCi/L)	Laboratory Data Qualifiers	Analytical Method
TTR	12-Jun-2019	Actinium-228	11.8 ± 17.5	14.5	U	EPA 901.1
		Alpha, gross	−0.131 ± 1.32	2.49	U	EPA 900.0/SW846 9310
		Americium-241	16.4 ± 20.5	19.7	U	EPA 901.1
		Beryllium-7	5.82 ± 13.9	25.1	U	EPA 901.1
		Beta, gross	28.7 ± 2.22	2.35		EPA 900.0/SW-846 9310
		Bismuth-212	30.2 ± 29.1	38.2	U	EPA 901.1
		Bismuth-214	−4.33 ± 6.79	6.85	U	EPA 901.1
		Cesium-137	0.0694 ± 1.7	3.02	U	EPA 901.1
		Cobalt-60	−0.132 ± 1.68	3.11	U	EPA 901.1
		Lead-212	0.834 ± 5.73	6.4	U	EPA 901.1
		Lead-214	−6.48 ± 7.26	6.79	U	EPA 901.1
		Neptunium-237	−1.23 ± 3.17	5.59	U	EPA 901.1
		Potassium-40	9.77 ± 43.3	29.4	U	EPA 901.1
		Radium-223	8.42 ± 32	58.2	U	EPA 901.1
		Radium-224	28.3 ± 34.1	50.9	U	EPA 901.1
		Radium-226	26.4 ± 97	96	U	EPA 901.1
		Radium-228	11.8 ± 17.5	14.5	U	EPA 901.1
		Sodium-22	0.581 ± 1.83	3.45	U	EPA 901.1
		Thorium-227	−7.24 ± 13.1	20.3	U	EPA 901.1
		Thorium-231	57.8 ± 41.7	41.2	X	EPA 901.1
		Thorium-234	232 ± 255	234	U	EPA 901.1
		Tritium	34.2 ± 132	227	U	EPA 906.0 Modified
		Uranium-235	0.524 ± 16.9	20.1	U	EPA 901.1
		Uranium-238	232 ± 255	234	U	EPA 901.1

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95 percent probability that the measured activity is accurately quantified above the critical level
TTR = Tonopah Test Range

Laboratory Data Qualifier
U = The analyte was absent or below the method detection limit.
X = The data was rejected due to the peak not meeting identification criteria.

Table C-3. Sanitary outfalls of semivolatile organic compounds, June 2019

Station	Date Collected	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	12-Jun-2019	Acenaphthene		0.3	U	EPA 625.1
		Acenaphthylene		0.3	U	EPA 625.1
		Anthracene		0.3	U	EPA 625.1
		Benzidine		3.9	U	EPA 625.1
		Benzo(a)anthracene		0.3	U	EPA 625.1
		Benzo(a)pyrene		0.3	U	EPA 625.1
		Benzo(b)fluoranthene		0.3	U	EPA 625.1
		Benzo(ghi)perylene		0.3	U	EPA 625.1
		Benzo(k)fluoranthene		0.3	U	EPA 625.1
		Bromophenyl phenyl ether, 4-		3	U	EPA 625.1
		Butylbenzyl phthalate		0.3	U	EPA 625.1
		Chloro-3-methylphenol, 4-		3	U	EPA 625.1
		Chloroethoxy)methane, bis(2-		3	U	EPA 625.1
		Chloroethyl)ether, bis(2-		3	U	EPA 625.1
		Chloroisopropyl ether, bis-		3	U	EPA 625.1
		Chloronaphthalene, 2-		0.41	U	EPA 625.1
		Chlorophenol, 2-		3	U	EPA 625.1
		Chlorophenyl phenyl ether, 4-		3	U	EPA 625.1
		Chrysene		0.3	U	EPA 625.1
		Di-n-butyl phthalate		0.3	U	EPA 625.1
		Di-n-octyl phthalate		0.3	U	EPA 625.1
		Dibenz[a,h]anthracene		0.3	U	EPA 625.1
		Dichlorobenzidine, 3,3'-		3	U	EPA 625.1
		Dichlorophenol, 2,4-		3	U	EPA 625.1
		Diethylphthalate		0.3	U	EPA 625.1
		Dimethylphenol, 2,4-		3	U	EPA 625.1
		Dimethylphthalate		0.3	U	EPA 625.1
		Dinitro-o-cresol		3	U	EPA 625.1
		Dinitrophenol, 2,4-		5	U	EPA 625.1
		Dinitrotoluene, 2,4-		3	U	EPA 625.1

Table continued on next page

Table C-3. Sanitary outfalls of semivolatile organic compounds, June 2019 (continued)

Station	Date Collected	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	12-Jun-2019	Dinitrotoluene, 2,6-		3	U	EPA 625.1
		Diphenyl amine		3	U	EPA 625.1
		Diphenylhydrazine, 1,2-		3	U	EPA 625.1
		Ethylhexyl)phthalate, bis(2-	0.31	0.3	J	EPA 625.1
		Fluoranthene		0.3	U	EPA 625.1
		Fluorene		0.3	U	EPA 625.1
		Hexachlorobenzene		3	U	EPA 625.1
		Hexachlorobutadiene		3	U	EPA 625.1
		Hexachlorocyclopentadiene		3	U	EPA 625.1
		Hexachloroethane		3	U	EPA 625.1
		Indeno(1,2,3-c,d)pyrene		0.3	U	EPA 625.1
		Isophorone		3.5	U	EPA 625.1
		Naphthalene		0.3	U	EPA 625.1
		Nitro-benzene		3	U	EPA 625.1
		Nitrophenol, 2-		3	U	EPA 625.1
		Nitrophenol, 4-		3	U	EPA 625.1
		Nitrosodimethylamine, n-		3	U	EPA 625.1
		Nitrosodipropylamine, n-		3	U	EPA 625.1
		Pentachlorophenol		3	U	EPA 625.1
		Phenanthrene		0.3	U	EPA 625.1
		Phenol		3	U	EPA 625.1
		Pyrene		0.3	U	EPA 625.1
		Trichlorobenzene, 1,2,4-		3	U	EPA 625.1
		Trichlorophenol, 2,4,6-		3	U	EPA 625.1

MDL = method detection limit
PQL = practical quantitation limit
TTR = Tonopah Test Range

Laboratory Data Qualifier
J = An estimated value, the analyte concentration was above the effective MDL and below the effective PQL.
U = The analyte was absent or below the method detection limit.

Table C-4. Sanitary outfalls of volatile organic compounds, June 2019

Station	Date Collected	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	12-Jun-2019	Acrolein		1.67	NU	EPA 624.1
		Acrylonitrile		1.67	U	EPA 624.1
		Benzene		0.333	U	EPA 624.1
		Bromodichloromethane		0.333	U	EPA 624.1
		Bromoform		0.333	U	EPA 624.1
		Bromomethane		0.337	U	EPA 624.1
		Carbon tetrachloride		0.333	U	EPA 624.1
		Chlorobenzene		0.333	U	EPA 624.1
		Chloroethane		0.333	U	EPA 624.1
		Chloroethyl vinyl ether, 2-		1.67	U	EPA 624.1
		Chloroform	1.64	0.333		EPA 624.1
		Chloromethane		0.333	U	EPA 624.1
		Dibromochloromethane		0.333	U	EPA 624.1
		Dichlorobenzene, 1,2-		0.333	U	EPA 624.1
		Dichlorobenzene, 1,3-		0.333	U	EPA 624.1
		Dichlorobenzene, 1,4-	3.56	0.333		EPA 624.1
		Dichlorodifluoromethane		0.355	U	EPA 624.1
		Dichloroethane, 1,1-		0.333	U	EPA 624.1
		Dichloroethane, 1,2-		0.333	U	EPA 624.1
		Dichloroethene, 1,1-		0.333	U	EPA 624.1
		Dichloroethene, trans-1,2-		0.333	U	EPA 624.1
		Dichloropropane, 1,2-		0.333	U	EPA 624.1
		Dichloropropene, cis-1,3-		0.333	U	EPA 624.1
		Dichloropropene, trans-1,3-		0.333	U	EPA 624.1
		Ethyl benzene		0.333	U	EPA 624.1
		Methylene chloride		1.67	U	EPA 624.1
		Tetrachloroethane, 1,1,2,2-		0.333	U	EPA 624.1
		Tetrachloroethene		0.333	U	EPA 624.1
		Toluene		0.333	U	EPA 624.1
		Trichloroethane, 1,1,1-		0.333	U	EPA 624.1

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Table C-4. Sanitary outfalls of volatile organic compounds, June 2019 (continued)

Station	Date Collected	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	12-Jun-2019	Trichloroethane, 1,1,2-		0.333	U	EPA 624.1
		Trichloroethene		0.333	U	EPA 624.1
		Trichlorofluoromethane		0.333	U	EPA 624.1
		Vinyl chloride		0.333	U	EPA 624.1

MDL = method detection limit
TTR = Tonopah Test Range

Laboratory Data Qualifier
N = A spike was outside limits.
U = The analyte was absent or below the method detection limit.

Glossary

Wild Horse (*Equus ferus*)

A

abatement The act of reducing the degree or intensity of, or eliminating, pollution.

aboveground storage tank A fixed, stationary, or otherwise permanently installed storage tank that is wholly or partially above the ground surface and used to contain oil of any kind (petroleum, non-petroleum, synthetic, animal, or vegetable).

ambient air Any unconfined portion of the atmosphere: open air, surrounding air.

analyte A substance or chemical constituent undergoing analysis.

antimony A metallic element having four allotropic forms, the most common of which is a hard, extremely brittle, lustrous, silver-white, crystalline material. It is used in a wide variety of alloys, especially with lead in battery plates, and in the manufacture of flameproofing compounds, paint, semiconductor devices, and ceramic products.

appraisal A documented activity performed according to written procedures and specified criteria to evaluate an organization's compliance and conformance with programs, standards, and other requirements contained in orders, laws, and regulations or in other requirements.

aquifer An underground geological formation, or a group of formations, containing water. A source of groundwater for wells and springs.

asbestos A mineral fiber that can pollute air or water and cause cancer or asbestosis when inhaled. Uses for asbestos-containing material include, but are not limited to, electrical and heat insulation, paint filler, reinforcing agents in rubber and plastics (e.g., tile mastic), and cement reinforcement.

aspect Any elements of activities, products, or services that can interact with the environment.

audit (1) An examination of records or financial accounts to check their accuracy. (2) An adjustment or correction of accounts. (3) An examined and verified account.

B

background radiation Relatively constant low-level radiation from environmental sources such as building materials, cosmic rays, and ingested radionuclides in the body.

basin (1) A low-lying area, wholly or largely surrounded by higher land, which ranges from a small, nearly enclosed valley to an extensive, mountain-rimmed depression. (2) An entire area drained by a given stream and its tributaries. (3) An area in which the rock strata are inclined downward from all sides toward the center. (4) An area in which sediments accumulate.

best management practice The preferred method or practice for managing operations.

biogeographic province A large region characterized as distinct from other regions, mostly on the basis of different dominant vegetation and wildlife habitat types.

biota The animal and plant life of a given region.

C

cesium-137 A radioactive isotope of cesium used in radiation therapy and found in atmospheric fallout.

contamination Introduction into water, air, or soil of microorganisms, chemicals, toxic substances, wastes, or wastewater in a concentration that makes the medium unfit for its next intended use. Also applies to the surfaces of objects, buildings, and various household and agricultural-use products.

corrective action (1) EPA requirements for treatment, storage, and disposal facilities handling hazardous waste to undertake corrective actions to clean up spills resulting from failure to follow hazardous waste management procedures or from other mistakes. The process includes cleanup procedures designed to guide treatment, storage, and disposal facilities in avoiding spills. (2) An action identified to correct a finding that, when completed, fixes a problem or prevents its recurrence.

D

data quality objective A strategic, systematic process for planning scientific data collection efforts.

decontamination The removal of adverse substances such as noxious chemicals, harmful bacteria or other organisms, or radioactive material from exposed individuals, rooms and furnishings in buildings, or the exterior environment.

demolition The act or process of wrecking or destroying, especially destruction by explosives.

discharge Any liquid or solid that flows or is placed on or onto any land or into any water. This includes precipitation discharges to storm drains, accidental or intentional spilling, and leaking, pumping, pouring, emitting, emptying, or dumping any material or substance on or into any land or water.

diurnal (1) Relating to or occurring in a 24-hour period; daily. (2) Occurring or active during the daytime rather than at night: diurnal animals.

dosimeter A device used to measure the dose of ionizing radiation received by an individual.

E

ecology The relationship of living things to one another and their environment, or the study of such relationships.

ecosystem A network of living organisms and nonliving components (e.g., air, water, mineral soil, buildings, and roads) that interact to comprise an overall environment.

effluent Wastewater (treated or untreated) that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters.

Electronic Product Environmental Assessment Tool A set of criteria in eight different electronics to determine the environmental attributes of a particular electronic office product. Currently, the tool only targets computer desktops/towers, notebook computers (laptops), and monitors.

environment The sum of all external conditions affecting an organism's life, development, and survival.

environmental assessment An environmental analysis prepared pursuant to NEPA to determine whether a federal action would significantly affect the environment and thus require a more detailed environmental impact statement.

environmental impact statement A document required of federal agencies by NEPA for major projects or legislative proposals that significantly affect the environment. A tool for decision-making, it describes an undertaking's positive and negative effects and cites alternative actions.

environmental management A program designed to maintain compliance with federal, state, and local requirements.

Environmental Management System (EMS) A continuing cycle of planning, evaluating, implementing, and improving processes and actions undertaken to achieve environmental goals.

environmental monitoring The collection and analysis of samples or direct measurements of environmental media such as air, water, and soil.

environmental release Any spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing of into the environment, which may include (but is not limited to) soil, air, and drain systems.

Environmental Restoration A project chartered with assessing and, if necessary, remediating inactive waste sites.

environmental restoration site Any location listed on the environmental restoration site list that has been identified as an area that is (or may be) contaminated—either on or beneath the land surface—as a result of operations. Contaminants may be chemicals, radioactive material, or both.

environmental surveillance A program that includes soil and vegetation surveys, water sampling, and analysis in an attempt to identify and quantify long-term effects of pollutants resulting from operations.

Environment, Safety, and Health (ES&H) A program designed to protect and preserve the environment and to ensure the safety and health of the organization's employees, contractors, visitors, and the public.

ephemeral spring A spring that flows only briefly in the immediate locality in response to precipitation.

F

fault A fracture in the continuity of a rock formation caused by the earth's crust shifting or dislodging, after which adjacent surfaces are displaced relative to one another and parallel to the plane of fracture.

fauna (1) Animals, especially the animals of a particular region or period, considered as a group. (2) A catalog of the animals of a specific region or period.

flora (1) Plants. (2) The plant life characterizing a specific geographic region or environment.

fungicide An agent that destroys fungi or inhibits their growth.

G

gamma radiation Very high-energy and high-frequency electromagnetic radiation that is emitted by the nuclei of radioactive substances during decay, or by the interactions of high-energy electrons with matter. They are similar to but have a shorter wavelength than X-rays.

geology The scientific study of the earth's origin, history, and structure.

greenhouse gas emission An air pollutant comprised of an aggregate group of six greenhouse gases: carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

groundwater The water found beneath the earth's surface in pore spaces and in fractures of rock formations.

H

habitat The place or environment where a plant or animal naturally or normally lives and grows.

hazardous substance (1) Any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive. (2) Any substance that EPA requires to be reported if a designated quantity of the substance is spilled in the waters of the United States or is otherwise released into the environment.

herbicide A chemical pesticide designed to control or destroy plants, weeds, or grasses.

herpetofauna The reptiles and amphibians of a particular region, habitat, or geological period.

I

impact Any changes in the environment, whether adverse or beneficial, wholly or partially resulting from activities, products, or services.

inhalation hazard Risk from materials or chemicals that present a hazard if respired (inhaled) into the lungs.

insecticide A pesticide compound specifically used to kill or prevent the growth of insects.

Integrated Safety Management System (ISMS) A set of guidelines that systematically integrate safety into management and work practices at all levels so missions are accomplished while protecting the worker, the public, and the environment.

L

lagoon (1) A shallow pond where sunlight, bacterial action, and oxygen work to purify wastewater; also used for storing wastewater. (2) A shallow body of water, often separated from the sea by coral reefs or sandbars.

M

maximally exposed individual A member of the public who is located in an area that receives or has the potential to receive the maximum radiological dose from air emissions of a NESHAP radionuclide source. The dose estimates are based on realistic, yet conservative input parameters.

migratory birds All birds listed within the Migratory Bird Treaty Act, 50 CFR 10.13, or which are a mutation or hybrid of any such species, including any part, nest, or egg.

Mixed Analyte Performance Evaluation Program A DOE quality assurance tool for environmental analytical services. It includes radiological, stable inorganic, and organic constituents (i.e., mixed analytes) in the same single-blind sample for analytical performance evaluation. The samples use various matrices, including soils, water, vegetation, and air filters. Program samples are not a mixed waste.

mixed waste Radioactive waste that contains both source material, special nuclear material, or by-product material subject to the Atomic Energy Act of 1954, as amended; also a hazardous component subject to RCRA, as amended.

N

National Emissions Standards for Hazardous Air Pollutants (NESHAP) Emissions standards set by EPA for an air pollutant not covered by National Ambient Air Quality Standards that may cause an increase in fatalities or in serious, irreversible, or incapacitating illness. Primary standards are designed to protect human health; secondary standards are designed to protect public welfare (e.g., building facades, visibility, crops, and domestic animals).

National Environmental Policy Act (NEPA) The basic national charter for protecting the environment. It establishes policy, sets goals, and provides the means for carrying out the act.

National Pollutant Discharge Elimination System (NPDES) A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by EPA, a state, or, where delegated, a tribal government on an Indian reservation.

natural resource A resource (actual or potential) supplied by nature.

nitrate A compound containing nitrogen that can exist in the atmosphere or as a dissolved gas in water and which can have harmful effects on humans and animals. Nitrates in water can cause severe illnesses in infants and domestic animals. A plant nutrient and inorganic fertilizer, nitrate is found in septic systems, animal feedlots, agricultural fertilizers, manure, industrial wastewaters, sanitary landfills, and garbage dumps.

nitrite (1) An intermediate in the process of nitrification. (2) Nitrous oxide salts used in food preservation.

O

occurrence One or more (i.e., recurring) events or conditions that adversely affect, or may adversely affect, DOE or contractor personnel, the public, property, the environment, or the DOE mission. Events or conditions meeting the criteria thresholds identified in this order, or determined to be recurring through performance analysis, are occurrences.

optically stimulated luminescent dosimeter A device used to measure ionizing radiation.

outfall The place where effluent is discharged into receiving waters.

P

PM_{10} Particulate matter that has a diameter equal to or less than 10 microns.

pollutant Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.

polychlorinated biphenyl (PCB) A chemical term limited to the biphenyl molecule that has been chlorinated to varying degrees or any combination of substances that contain such material. Because of their persistence, toxicity, and ecological damage via water pollution, the manufacture of PCBs was discontinued in the United States in 1976.

potable water Water free from impurities present in quantities that are sufficient to cause disease or harmful physiological effects.

Q

quality assurance A system of procedures, checks, audits, and corrective actions to ensure that research design and performance, environmental monitoring and sampling, and other technical and reporting activities are of the highest achievable quality.

quality control A system used to determine analytical accuracy, precision, and contamination when samples are collected and to assess the data's quality and usability.

R

radioactive waste Any waste that emits energy as rays, waves, streams, or energetic particles. Radioactive materials are often mixed with hazardous waste from nuclear reactors, research institutions, or hospitals.

radiological contaminant A radioactive material deposited in any place where it is not desired, particularly where its presence may be harmful.

radionuclide A radioactive particle, man-made (anthropogenic) or natural, with a distinct atomic weight number.

radon A colorless, naturally occurring, radioactive, inert gas formed by the radioactive decay of radium atoms in soil or rocks.

reportable quantity A quantity of material, product compound, or contaminant that is reportable to a regulatory agency when released to the environment.

Resource and Conservation Recovery Act (RCRA) Federal guidance for regulating hazardous chemical waste and nonhazardous solid waste, including hazardous or petroleum products in underground storage tanks.

rodenticide A chemical or agent used to destroy rats or other rodent pests, or to prevent them from damaging food or crops.

ruderal Plant species that are first to colonize disturbed area.

S

saltation The movement of hard particles such as sand over an uneven surface in a turbulent flow of air or water.

Sample Management Office A Sandia office that manages environmental analytical laboratory contracts and assists with processing and tracking samples undergoing chemical and radiochemical analyses performed at these laboratories.

sampling and analysis plan A plan that contains criteria required for conducting sampling activities.

sanitary discharge The portion of liquid effluent exclusive of industrial wastewater and stormwater. It includes the liquid discharges from restrooms and food preparation activities.

sediment Transported and deposited particles or aggregates derived from rocks, soil, or biological material.

semivolatile organic compound An organic chemical compound that volatilizes slowly at a standard temperature (20°C and 1 atmosphere pressure).

soil All loose, unconsolidated mineral or organic materials on the immediate surface of the earth that support plant growth.

solid waste (1) Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility. (2) Any discarded material—including solid, liquid, semisolid, or contained gaseous material—resulting from industrial, commercial, mining, or agricultural operations or from community activities.

stormwater Water runoff from rainfall or snowmelt, including that discharged to the sanitary sewer system.

surface discharge A release of water and water-based compounds to roads, open areas, or confined areas such as reservoirs.

sustainability Those actions taken to maximize energy and water efficiency; minimize chemical toxicity and harmful environmental releases, particularly greenhouse gas; promote renewable and other clean energy development; and conserve natural resources while sustaining assigned mission activities.

T

threatened or endangered species A species present in such small numbers that it is at risk of extinction.

topography The physical features of a surface area, including relative elevations and the position of natural and man-made (anthropogenic) features.

toxic chemical Any chemical listed in EPA regulations under "Emergency Planning and Community Right-to-Know Act of 1986–Section 313: Guidance for Reporting Toxic Chemicals."

transect A sample area (i.e., vegetation) usually in the form of a long continuous strip.

tritium A radioactive hydrogen isotope with an atomic mass of 3 and a half-life of 12.5 years, prepared artificially for use as a tracer and as a constituent of hydrogen bombs.

U

underground storage tank A storage tank installed completely below the ground surface, covered with earth, and used to contain oil of any kind (petroleum, non-petroleum, synthetic, animal, or vegetable).

upstream (1) In the direction opposite the flow of a stream. (2) In or to a position within the production stream closer to manufacturing processes.

U.S. Environmental Protection Agency (EPA) A government agency tasked with protecting human health and the environment.

V

vegetation Plant life or the total plant cover of an area.

volatile organic compound An organic chemical compound with a high vapor pressure at standard temperature (20°C and 1 atmosphere pressure) causing it to evaporate.

W

waste management A method for dealing with the waste from humans and organisms, including minimizing, handling, processing, storing, recycling, transporting, and final disposal.

wastewater The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

water pollution The presence in water of enough harmful or objectionable material to damage the water's quality.

watershed The land area that drains into a stream; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.

water table The level of groundwater.

wetland An area that is saturated by surface water or groundwater, having vegetation adapted for life under those soil conditions, such as swamps, bogs, fens, marshes, and estuaries.

References

Sunset in Tonopah, Nevada

Balazs, G. H., R. G. Forsyth, and A. K. H. Kam. 1987. "Preliminary Assessment of Habitat Utilization by Hawaiian Green Turtles in Their Resident Foraging Pastures." National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum, NOAA-TM-NMFS-SWFC-71. Silver Spring, MD: National Marine Fisheries Service.

Baldwin, P. H. 1950. "Occurrence and Behavior of the Hawaiian Bat." *Journal of Mammalogy*. 31:455-456.

BLM (U.S. Department of the Interior, Bureau of Land Management). 2004. *The Foundations for Managing Cultural Resources, Manual – 8100*. Washington, D.C.: BLM.

Brock, R. E. 1990. *A Survey of the Green Sea Turtle Population Fronting the Kauai Test Facility. Pacific Missile Range. Barking Sands, Kauai: An Analysis of Potential Impacts with Implementation of the Strategic Defense Initiative.* Honolulu, HI: Environmental Assessment Company.

Brown, D. E., ed. 1982. *Desert Plants: Biotic Communities of the American Southwest—United States and Mexico*. 4:1–4. Tucson, AZ: University of Arizona for the Boyce Thompson Southwestern Arboretum.

Census (U.S. Census Bureau). 2012a. *2010 Census of Population and Housing Counts, CPH-2-30, Nevada.* Washington, D.C.: U.S. Government Printing Office.

——. 2012b. *2010 Census of Population and Housing Counts, CPH-2-13, Hawaii.* Washington, D.C.: U.S. Government Printing Office.

——. 2020. *City and Town Population Totals: 2010-2019*. Accessed July 2020. https://www.census.gov/data/tables/time-series/demo/popest/2010s-total-cities-and-towns.html

Chapman, J., G. Nikolich, C. Shadel, G. McCurdy, V. Etyemezian, J. Miller, and S. Mizell. 2018. *Tonopah Test Range Air Monitoring: CY2017 Meteorological, Radiological, and Wind Transported Particulate Observations.* Las Vegas, Nevada: Desert Research Institute. Publication No. 45284, DOE/NV/0003590-25.

Chapman, J., G. Nikolich, J. Goreman, G. McCurdy, J. Miller, and A. Chapman. 2020, in progress. *Tonopah Test Range Air Monitoring: CY2019 Meteorological, Radiological, and Wind Transported Particulate Observations.* Las Vegas, Nevada: Desert Research Institute.

DOD (U.S. Department of Defense) DOE (U.S. Department of Energy). 2019. *Consolidated Quality Systems Manual (QSM) for Environmental Laboratories.*

DOD, DOE, and State of Nevada (U.S. Department of Defense, U.S. Department of Energy, and State of Nevada). 1996. *Federal Facility Agreement and Consent Order (FFACO).* State of Nevada Department of Conservation and Natural Resources, Division of Environmental Protection and the U.S. DOE and the U.S. DOD in the Matter of Federal Facility Agreement and Consent Order. http://ndep.nv.gov/boff/ffco.htm.

DOE (U.S. Department of Energy). 1992. *Kauai Test Facility (KTF) Environmental Assessment, Sandia National Laboratories, Albuquerque, New Mexico.* Albuquerque, NM: DOE, Albuquerque Operations.

DOE/AL (U.S. Department of Energy, Albuquerque Operations Office). 1992. *Kaua'i Test Facility Environmental Assessment*, DOE/EA-0492. Albuquerque, NM: DOE/AL.

DOE/NNSA (U.S. Department of Energy, National Nuclear Security Administration). 2017. *Non-covered Source Permit No. 0429-01-N: First Semi-Annual Monitoring Report for Kaua'i Test Facility.* Albuquerque, NM: DOE/NNSA/SFO.

———. 2019. *Non-covered Source Permit No. 0429-01-N: Calendar Year 2019 Annual Emissions Report and Semi-Annual Monitoring Report for Kaua'i Test Facility.* Albuquerque, NM: DOE/NNSA/SFO.

DOE/NNSA/SFO (U.S. Department of Energy, National Nuclear Security Administration, Sandia Field Office). 2019. *Fiscal Year 2019 DOE/NNSA Strategic Performance Evaluation and Measurement Plan (PEMP).* Albuquerque, NM: DOE/NNSA/SFO.

———. 2020. *FY2019 Performance Evaluation Summary.* Albuquerque, NM: DOE/NNSA/SFO.

DOE/NV (U.S. Department of Energy, Nevada Operations Office). 1992. *Water Conservation Plan for the Tonopah Test Range.* Range 4809. Las Vegas, NV: DOE/NV.

DOE/NV/EMNP (U.S. Department of Energy, Nevada Operations Office, Environmental Management Nevada Program). 2017a. *Corrective Action Decision Document/Corrective Action Plan for Correction Unit 413: Clean Slate II Plutonium Dispersion (TTR) Tonopah Test Range, Nevada*, Revision 0, DOE/NV-1560. Las Vegas, NV: DOE/NV.

———DOE/NV/EMNP. 2017b. *Corrective Action Decision Document/Corrective Action Plan for Correction Unit 414: Clean Slate III Plutonium Dispersion (TTR) Tonopah Test Range, Nevada*, Revision 1, DOE/NV-1578. Las Vegas, NV: DOE/NV.

DOE and FWS (U.S. Department of Energy and U.S. Department of the Interior, Fish and Wildlife Service). 2013. *Memorandum of Understanding, Responsibilities of Federal Agencies to Protect Migratory Birds.* Washington, D.C.: DOE and FWS.

DoN (Department of the Navy). 2017. *Spill Prevention, Control, and Countermeasure Plan, Pacific Missile Range Facility, Kaua'i, Hawai'i.*. Kaua'i, HI: DoN.

Dragun, J., and K. Chekiri. 2005. *Elements in North American Soils.* Amherst, MA: The Association for Environmental Health and Sciences.

DRI (Desert Research Institute). 1991. *Special Nevada Report.* DOE/NV/10715-T1. Prepared by Science Applications International Corporation (SAIC) for the Department of the Air Force.

———. 1997. *Draft Analysis of Ambient Airborne Particulate Matter for Plutonium; Clean Slate 1 During Excavation and Truck Loading, Tonopah Test Range, May 1997–June 1997.* DRI Document Number 6357-683-7562.1D1. Prepared by DRI for the U.S. Department of Energy/Nevada Field Office, Las Vegas, NV.

E&E (Ecology and Environment, Inc.). 1989. *Federal Facility Preliminary Assessment Review.* EPA Region IX, F9-8903-021, NV3570090016. San Francisco, CA: E&E.

Engelbrecht, J. P., I. G. Kavouras, D. Campbell, S. A. Campbell, S. Kohl, and D. Shafer. 2008. *Yucca Mountain Environmental Monitoring System Initiative, Air Quality Scoping Study for Tonopah Airport, Nye County, Nevada*. Letter Report DOE/NV/26383-LTR2008-04. Las Vegas, NV: Desert Research Institute.

EPA (U.S. Environmental Protection Agency). 1996. Transmittal from Michael Ardito, Hawaii State Project Officer for Superfund, EPA Region IX, to Mr. John Gould, U.S. Department of Energy, Albuquerque Operations Office. "Fiscal Closure Letter RE: Kauai Test Facility, EPA ID No. HID984469908." September 1996.

——. 1999. *Off-Site Environmental Monitoring Report: Radiation Monitoring Around United States Nuclear Test Areas, Calendar Year 1997*, EPA/402-R-98-013. Las Vegas, NV: EPA.

ERDA (U.S. Energy Research and Development Administration). 1975. *Environmental Assessment, Tonopah Test Range*. EIA/MA/76-2. Washington, D.C.: ERDA.

Ezzo, J. A. 1996. *A Class I Cultural Resources Survey of the Moapa and Virgin Valleys, Clark County, Nevada.* Technical Series 58. Tucson, AZ: Statistical Research.

Fowler, C. S. 1982. "Settlement Patterns and Subsistence Systems in the Great Basin: The Ethnographic Record." In *Man and Environment in the Great Basin*. Edited by D. B. Madsen and J. F. O'Connell. Washington, D.C.: Society for American Archaeology.

Furman, N. S. *Sandia National Laboratories: The Postwar Decade*. Albuquerque: University of New Mexico Press, 1990.

Hawai'i DLNR (Department of Land and Natural Resources), Engineering Division, National Flood Insurance Program. 2019. Flood Hazard Assessment Tool. Accessed on May 22, 2019. http://GIS.HawaiiNFIP.org/FHAT. Honolulu: HI.

——. 2015. *State of Hawai'i Non-covered Source Permit No. 0429-01-N, Expiration Date September 27, 2020*. Honolulu, HI: DOH. '

ISO (International Organization for Standardization). 2004. ISO 14001. *Environmental Management Systems—Requirements*. Geneva, Switzerland: ISO.

——. 2008. ISO 9001. *Quality Management Systems—Requirements*. Geneva, Switzerland: ISO.

——. 2015. ISO 14001. *Environmental Management Systems—Requirements*. Geneva, Switzerland: ISO.

IT (IT Corporation). 1993. *Tonopah Test Range Polychlorinated Biphenyls Sample Results*. Albuquerque, NM: IT.

Jennings, J. D. 1980. *Cowboy Cave*. Anthropological Papers No. 104. Salt Lake City: University of Utah Press.

Jennings, J. D., and E. Norbeck. 1955. "Great Basin Prehistory: A Review." *American Antiquity* 21:1–11.

Johnson, J. H., and A. A. Wolman. 1984. "The Humpback Whale, Megaptera novaeangliae." *Marine Fisheries Review*. 46(4):30–37.

Kabata-Pendias, A. 2000. *Trace Elements in Soils and Plants*, 3rd ed. Boca Raton, FL: CRC Press, Inc.

Kelly, I. T., and C. S. Fowler. 1986. "Southern Paiute." In Volume 11, *Great Basin*. Edited by W. L. D'Azevedo. In *Handbook of North American Indians*. William C. Sturtevant, general editor. Washington, D.C.: Smithsonian Institution.

MacDonald, G., Davis, D., and Cox., D. 1960. *Geology and Ground-water Resources of the Island of Kauai, Hawaii.* Hawaii Division of Hydrograph, Bulletin 13. Honolulu, HI: Division of Hydrography.

Martin, P. S., and F. Plog. 1973. *The Archaeology of Arizona: A Study of the Southwest Region*. Garden City, NY: Published for the American Museum of Natural History by Doubleday Natural History Press.

Mauro, J., and N. M. Briggs. 2005. *Assessment of Variations in Radiation Exposure in the United States, Prepared for the U.S. Environmental Protection Agency Office of Radiation and Indoor Air*. Contract Number EP-D-05-002, Work Assignment Number 1-03.

Moffat, R. M., and G. L. Fitzpatrick. 1995. *Surveying the Māhele: Mapping the Hawaiian Land Revolution*. Hong Kong: Editions Limited.

NASA (National Aeronautics and Space Administration). 2013. *Final Environmental Assessment Low Density Supersonic Decelerator Technology Demonstration Mission Pacific Missile Range Facility*. NASA Space Technology Mission Directorate: Washington, DC.

NELAC Institute, The. 2003. National Environmental Laboratory Accreditation Conference (NELAC) Standard, EPA/600/R-04/003. Weatherford, TX.

PMRF (Pacific Missile Range Facility). 2015. PACMISRANFAC Notice 10570 Memo Shearwater Fledgling Fallout Season: September 15 through December 15, 2015. Barking Sands, HI: PMRF.

Roth, B. J. 2012. "Paleoindian and Archaic Periods." In *A Prehistoric Context for Southern Nevada*. Edited by H. Roberts and R. V. N. Ahlstrom. Archaeological Report No. 011-05. Las Vegas, NV: HRA, Inc., Conservation Archaeology.

Sandia National Laboratories, New Mexico (SNL/NM). 1982. *Geology of the Nevada Test Site and Nearby Areas—Southern Nevada*. SAND82-2207. Albuquerque, NM: SNL/NM.

———. 1992. *Kauai Test Facility (KTF) Environmental Assessment*. Albuquerque, NM: SNL/NM.

———. 1995. *NESHAP Report for CY 1994, Sandia National Laboratories, Nevada*. Albuquerque, NM: SNL/NM.

———. 1996. *Tonopah Test Range Outpost of Sandia National Laboratories*. SAND1996-0375. Albuquerque, NM: SNL/NM.

———. 2003. *Historical Assessment of Facilities Scheduled for Fiscal Year 2003 Demolition; Sandia National Laboratories' Tonopah Test Range, Nye County, Nevada.* SAND2003-0111. Albuquerque, NM: Sandia National Laboratories.

———. 2004. *Cold War Context Statement: Sandia National Laboratories, Tonopah Test Range*. SAND2004-1648. Albuquerque, NM: Sandia National Laboratories.

———. 2005a. *Cold War Context Statement: Sandia National Laboratories, Tonopah Test Range*. SAND2004-1648P. Albuquerque, NM: Sandia National Laboratories, 2004; rev. 2005.

———. 2005b. *Historic Building Survey, Sandia National Laboratories' Tonopah Test Range, Nye County, Nevada.* Volume I: "Historic Building Survey." SAND2005-5090P. Albuquerque, NM: Sandia National Laboratories.

———. 2005c. *Historic Building Survey, Sandia National Laboratories' Tonopah Test Range, Nye County, Nevada*. Volume II: "Survey and Historic Resource Inventory Forms." SAND2005-5109P. Albuquerque, NM: Sandia National Laboratories.

———. 2006. *Chemical Analyses of Soil Samples Collected from the Sandia National Laboratories, Tonopah Test Range Environs, 1994–2005*. SAND2006-2071 Albuquerque, NM: SNL/NM.

———. 2014a. *Data Validation Procedure for Chemical and Radiochemical Data*. Administrative Operating Procedure (AOP) 00-03, Revision 4. Albuquerque, NM: SNL/NM Sample Management Office.

———. 2014b. *Spill Prevention, Control, and Countermeasure (SPCC) Plan for Tonopah Test Range (TTR)*. PLA 90-12. Albuquerque, NM: SNL/NM.

———. 2016. *Quality Assurance Project Plan for Terrestrial Surveillance at Sandia National Laboratories, New Mexico*, Revision 08, QUA 94-04. Albuquerque, NM: SNL/NM.

———. 2017. *Sandia National Laboratories, Tonopah Test Range, Assembly Building 9B (Building 09-54), Photographs, Written Historical and Descriptive Data.* SAND2017-8976R. Albuquerque, NM: Sandia National Laboratories.

———. 2018. "Sandia National Laboratories/New Mexico Statement of Work for Analytical Laboratories, Revision 7." Albuquerque, NM: SNL/NM.

———. 2019a. *Fiscal Year 2020 Site Sustainability Plan*. Albuquerque, NM: SNL/NM.

———. 2019b. *Quality Assurance Project Plan for the Sample Management Office, Revision 5, SMO-QAPP*. Albuquerque, NM: SNL/NM.

———. 2019c. *Radionuclide National Emission Standards for Hazardous Air Pollutants Annual Report for Calendar Year 2019, Sandia National Laboratories, Tonopah Test Range*. Albuquerque, NM: SNL/NM.

Sweeney, M. 1994. *Archaeological Inventory Survey Pacific Missile Range Facility, Majors Bay Area, Kaua'i, Hawai'i.* Honolulu: International Archeological Research Institute, Inc.

Tomich, Q. 1986. *Mammals in Hawaii*. Honolulu, HI: Bishop Museum Press.

Traverse Group, Inc., The. 1988. *Natural Resources Management Plan.* Barking Sands, HI: Pacific Missile Range Facility.

USAF (U.S. Air Force). 1997. *An Inventory or Rare, Threatened, Endangered, and Endemic Plants and Unique Communities on Nellis Air Force Bombing and Gunnery Range, Clark, Lincoln, and Nye Counties, Nevada.* Legacy Resource Management Program Support Agreement FB4852-94200-071. Las Vegas, NV: USAF.

USAF/NNSA (U.S. Air Force, National Nuclear Security Administration). 2019. *Department of the Air Force Permit to National Nuclear Security Administration for Real Property Located on Nevada Test and Training Range, Nevada*. Tonopah, NV: USAF/NNSA.

U.S. Navy (U.S. Department of the Navy). 2008. *Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) for the Hawai'i Range Complex*. Kaua'i, HI: U.S. Navy.

———. 2010. *Pacific Missile Range Facility Intercept Test Support Environmental Assessment/Overseas Environmental Assessment.* Huntsville, AL: U.S. Navy.

USFWS (U.S. Fish and Wildlife Service). 1984. *Endangered Species Bulletin*. IX: 4. Washington, D.C.: USFWS.

———. 2018. *Biological Opinion of the U.S. Fish and Wildlife Service for the Proposed Base-Wide Infrastructure, Operations, and Maintenance Activities at the Pacific Missile Range Facility, Island of Kaua'i, Hawaii*. 01EPIF00-2015-F-0227. Washington, D.C.: USFWS.

WRCC (Western Regional Climate Center). 2020.*Waimea 947, Hawaii (519629).* Accessed 2020. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?hiwaim. Reno, NV: WRCC.

Analytical Method

DOE (U.S. Department of Energy) Environmental Measurements Laboratory. 1997. *The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300, 28th ed., vol. 1. New York, NY: DOE.

EPA (U.S. Environmental Protection Agency). 1974. *Mercury (Automated Cold Vapor Technique) by Atomic Absorption*, EPA 245.2. Cincinnati, OH: EPA Environmental Monitoring Systems Laboratory Office of Research and Development.

———. 1980. *Prescribed Procedures for the Measurement of Radioactivity in Drinking Water.* EPA 600-4-80-032. Method 900.0, Method 901.1.

———. 1980. *Tritium in Drinking Water*. EPA 906.0 Modified. Cincinnati, OH: EPA Environmental Monitoring Systems Laboratory Office of Research and Development.

——. 1984. *Base/Neutrals and Acids*. EPA 625. Cincinnati, OH: EPA Environmental Monitoring Systems Laboratory Office of Research and Development.

——. 1984. *Purgeables*. EPA 624. Cincinnati, OH: EPA Environmental Monitoring Systems Laboratory Office of Research and Development.

——. 1986 (and updates). *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. SW-846, 3rd ed. Washington, D.C.: EPA.

——. 1993. *The Determination of Chemical Oxygen Demand by Semi-Automated Colorimetry*. EPA 410.4. Cincinnati, OH: EPA Environmental Monitoring Systems Laboratory Office of Research and Development.

——. 1993. *Determination of Total Cyanide by Semi-Automated Colorimetry*. EPA 335.4. Cincinnati, OH: EPA Environmental Monitoring Systems Laboratory Office of Research and Development.

——. 1994. *Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry (CVAA)*. EPA 245.1. Cincinnati, OH: EPA Environmental Monitoring Systems Laboratory Office of Research and Development.

——. 1994. *Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry*. EPA 200.8. Cincinnati, OH: EPA Environmental Monitoring Systems Laboratory Office of Research and Development.

——. 2010. *n-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry*. EPA 1664, Revision B. Washington, D.C.: EPA Office of Water.

——. 2019. *Regional Screening Levels for Chemical Contaminants at Superfund Sites.* Accessed November 2019. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables. Washington, D.C.: EPA.

Rice, E. W., Baird, R. B., Eaton, A. D., and Clesceri, L. S, eds. 2012. "Standard Methods 2540 D, Total Suspended Solids Dried at 103–105°." In *Standard Methods for the Examination of Water and Wastewater*, 22nd ed. Washington, D.C.: American Public Health Association, American Water Works Association, and Water Environment Federation.

——. 2012. "Standard Methods 4500 H-B, pH Value in Water by Potentiometry Using a Standard Hydrogen Electrode."

Code of Federal Regulations

10 CFR 830. *Nuclear Safety Management*.

10 CFR 835. *Occupational Radiation Protection*.

10 CFR 1021. *National Environmental Policy Act Implementing Procedures*.

40 CFR 60. *Standards of Performance for New Stationary Sources*.

40 CFR 61. *National Emission Standards for Hazardous Air Pollutants (NESHAP)*.

40 CFR 110. *Discharge of Oil*.

40 CFR 112. *Oil Pollution Prevention*.

40 CFR 122. *EPA Administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES)*.

40 CFR 141. *National Primary Drinking Water Regulations*.

40 CFR 262. *Standards Applicable to Generators of Hazardous Waste*.

40 CFR 355. *Emergency Planning and Notification*.

DOE Directives

DOE O 144.1, *Department of Energy American Indian Tribal Government Interactions and Policy*.

DOE O 231.1B, Admin Change 1. *Environment, Safety and Health Reporting*. 2012.

DOE O 232.2A. *Occurrence Reporting and Processing of Operations Information*. 2017.

DOE O 414.1D, Admin Change 1. *Quality Assurance*. 2011.

DOE O 435.1, Change 1. *Radioactive Waste Management*. 2001.

DOE O 436.1. *Departmental Sustainability*. 2011.

DOE O 458.1, Admin Change 3. *Radiation Protection of the Public and the Environment*. 2013.

Executive Orders

EO 11988. *Floodplain Management*, as amended (May 24, 1977).

EO 11990. *Protection of Wetlands*, as amended (May 24, 1977).

EO 13834. *Efficient Federal Operations* (May 2018).

Federal Acts and Statutes

American Indian Religious Freedom Act (AIRFA) of 1978 (42 USC §1996).

Archaeological Resources Protection Act (ARPA) of 1979 (16 USC §470aa).

Atomic Energy Act of 1946

Bald and Golden Eagle Protection Act of 1940 (16 USC § 668-668d).

Clean Air Act (CAA) and CAA Amendments of 1990 (42 USC §7401).

Clean Water Act (CWA) of 1977 (The Federal Water Pollution Control Act) (33 USC §1251).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 USC §9601) (Amended by SARA).

Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986 (42 USC §11001 et seq.). (Also known as SARA Title III.)

Endangered Species Act (ESA) (16 USC §1531 et seq.).

Energy Independence and Security Act of 2007.

Federal Facility Compliance Act (FFCA) of 1992 (42 USC §6961).

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 USC §136).

Fish and Wildlife Conservation. 1982. (16 USC §§ 2901–2911).

Fish and Wildlife Conservation Act of 1980 (PL 96-366).

Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 USC §703 et seq.).

National Environmental Policy Act (NEPA) of 1969 (42 USC §4321).

National Historic Preservation Act of 1966, as amended (16 USC §470 et seq.).

Native American Graves Protection and Repatriation Act of 1990.

Oil Pollution Act of 1990.

Pollution Prevention Act of 1990.

Quiet Communities Act of 1978 (42 USC §4901 et seq.).

Resource Conservation and Recovery Act (RCRA) of 1976 (42 USC §6901 et seq.).

Safe Drinking Water Act (SDWA) 1974 (42 USC §300f).

Sikes Act of 1960 (PL 86-97).

Superfund Amendments and Reauthorization Act (SARA) of 1986 (see CERCLA).

Toxic Substances Control Act (TSCA) of 1976 (15 USC §2601 et seq.).

Wild Free-Roaming Horses and Burros Act of 1971 (PL 92-195).

State of Hawai'i Environmental Regulations

Hawai'i Administrative Rules, Title 11, Chapter 23, "Underground Injection Control."

Hawai'i Administrative Rules, Title 11, Chapter 59, "Ambient Air Quality Standards."

Hawai'i Administrative Rules, Title 11, Chapter 281, "Underground Storage Tanks."

State of Nevada Environmental Regulations

Nevada Administration Code (NAC).

Nevada State Legislature.

Sandia National Laboratories