

# ERRATA SHEET

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Corrections apply to: *2018 Annual Site Environmental Report for Sandia National Laboratories, Tonopah Test Range, Nevada, and Kaula'i Test Facility, Hawai'i*

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Location	Reads	Should Read
Appendix A, page 111, line 21-23	Between December 20, 2017, and December 19, 2018, 26 air particulate filter samples were collected and analyzed by gamma spectroscopy for gross alpha and gross beta activity.	Between December 20, 2017, and December 19, 2018, 26 air particulate filter samples were collected and analyzed for gross alpha and gross beta activity. Gamma spectroscopy was also performed on the samples.
Appendix A, page 113, line 8-10	Between December 20, 2017, and December 19, 2018, 25 air particulate filter samples were collected and analyzed by gamma spectroscopy for gross alpha and gross beta activity.	Between December 20, 2017, and December 19, 2018, 25 air particulate filter samples were collected and analyzed for gross alpha and gross beta activity. Gamma spectroscopy was also performed on the samples.
Appendix A, page 114, line 17-19	Between December 20, 2017, and December 19, 2018, 24 air particulate filter samples were collected and analyzed by gamma spectroscopy for gross alpha and gross beta activity.	Between December 20, 2017, and December 19, 2018, 24 air particulate filter samples were collected and analyzed for gross alpha and gross beta activity. Gamma spectroscopy was also performed on the samples.
Appendix A, page 115, line 14-16	Between December 20, 2017, and December 19, 2018, 26 air particulate filter samples were collected and analyzed by gamma spectroscopy for gross alpha and gross beta activity.	Between December 20, 2017, and December 19, 2018, 26 air particulate filter samples were collected and analyzed for gross alpha and gross beta activity. Gamma spectroscopy was also performed on the samples.



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ANNUAL SITE ENVIRONMENTAL REPORT

2018



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# 2018 Annual Site Environmental Report for Sandia National Laboratories, Tonopah Test Range, Nevada, and Kaua‘i Test Facility, Hawai‘i

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National Nuclear Security Administration  
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## 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 for Sandia are committed to safeguarding the environment reassessing 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, monitoring programs in place at SNL/TTR and SNL/KTF during calendar year 2018. 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 Kaua'i Test Facility, *Annual Site Environmental Report* presents summary data regarding environmental performance and compliance with environmental standards and requirements. In addition, the U.S. Department of Energy 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 as well as to include information that is important to you. Please provide feedback, comments, questions, or requests for copies of this report to:

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*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
<b>C</b>	
CAU	Corrective Action Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
<b>D</b>	
DoD	United States Department of Defense
DOE	United States Department of Energy
DOECAP	DOE Consolidated Audit Program
DRI	Desert Research Institute
<b>E</b>	
EO	executive order
EISA	Energy Independence and Security Act
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
<b>F</b>	
FAST	Federal Automotive Statistical Tool
FDID	Fire Department Identification
FY	fiscal year
<b>H</b>	
HDOH	Hawai'i Department of Health
<b>I</b>	
IOC	inorganic compound
ISO	International Organization for Standardization
<b>K</b>	
KTF	Kaua'i Test Facility
<b>M</b>	
MBTA	Migratory Bird Treaty Act
MDA	minimal detectable activity
MDC	minimum detectable concentration
MDL	method detection limit
<b>N</b>	
N/A	not applicable
NAC	Nevada Administrative Code

Term	Definition
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
<b>P</b>	
PCB	polychlorinated biphenyl
pH	potential of hydrogen
PL	Public Law
PM <sub>10</sub>	particulate matter that has a diameter equal to or less than 10 microns
PQL	practical quantitation limit
Pu	plutonium
<b>R</b>	
RCRA	Resource Conservation and Recovery Act
<b>S</b>	
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
<b>T</b>	
TA	technical area
TTR	Tonopah Test Range
<b>U</b>	
U.S.	United States
USAF	United States Air Force
USC	United States Code
<b>V</b>	
VOC	volatile organic compound

## Units of Measure

Unit	Definition
Bq/m <sup>3</sup>	Becquerel per cubic meter
Ci/m	curies per meter
°F	degrees Fahrenheit
kg	kilogram
kW	kilowatt
m	meter
μ	micron
μCi/mL	microcuries per milliliter
μg/L	micrograms per liter
μg/m <sup>3</sup>	micrograms per cubic meter

Unit	Definition
μm	micrometer (micron)
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mph	miles per hour
mR	milliroentgen
mrem/year	millirems per year
mR/year	milliroentgen 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	analyte detected in the blank
H	analytical holding time was exceeded
J	estimated value, the analyte concentration fell above the effective MDL and below the effective PQL
N	a spike was outside control limits
U	analyte was analyzed for, but not detect

### Data Validation Qualifier

Term	Definition
BD	below detection limit as used in radiochemistry to identify results that are not statistically different from zero
J	associated value is an estimated quantity
J+	associated numerical value is an estimated quantity with a suspected positive base
J-	associated numerical value is an estimated quantity with a suspected negative base
None	no data validation for corrected gross alpha activity
R	data are unusable
U	analyte was analyzed for but was not detected; the associated numerical value is the sample quantitation limit
UJ	analyte was analyzed for but was not detected; the associated value is an estimate and may be inaccurate or imprecise

# Executive Summary



Pronghorn (*Antilocapra americana*) at Tonopah Test Range

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 2018.

## Environmental Management System

Sandia has a robust Environmental Management System in place to help personnel fulfill their responsibilities to protect the environment, prevent pollution, and conserve natural resources. SNL/TTR and SNL/KTF personnel follow the management approach of the International Organization for Standardization 14001:2004 standard, as verified by an internal assessment in 2017 and 2018, respectively. These assessments are conducted every three years. The Environmental Management System 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 2018, including Scope 1 and Scope 2 greenhouse gas emissions and water use efficiency and management.

## Environmental Performance

Environmental performance is tracked through measures and indicators and reported as part of an overall performance evaluation. During the most recent evaluation, Sandia earned an excellent overall rating, and two items related to environmental programs were noted.

## 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 was one DOE reportable occurrence at SNL/TTR in 2018.

**Air Quality Compliance Program.** Program personnel support Sandia in complying with air quality regulations. In 2018, emissions from permitted sources were in compliance with permitted limits for nonradiological air emissions.

**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 2018, 12 projects were reviewed, and the environmental impacts were documented.

**Oil Storage Program.** Oil storage containers and equipment are managed, operated, and maintained to support compliance with regulations. In 2018, 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. In 2018, there were no reportable oil spills or releases.

**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 2018, the primary radionuclides released from the sites were isotopes of plutonium. Calculated doses were well below the 10 mrem/year standards set by the U.S. Environmental Protection Agency and DOE.

**Terrestrial Surveillance Program.** Surveillance activities are conducted at designated locations. Soil is sampled for various parameters. In 2018, results of the sampling events were below comparison reference values, except for americium-241. Environmental dosimeters used to measure 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 2018 included regulated and nonregulated waste, recycled materials, and polychlorinated biphenyl waste. 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 2018, 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 2018.

## Executive Summary

Additional programs and activities that provide services, support compliance, and facilitate Sandia missions at SNL/TTR included the following.

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

**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.

**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.

### ***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 2018.

**Air Quality Compliance Program.** Program personnel support Sandia in complying with air quality regulations. In 2018, activities followed permitted operating limits.

**National Environmental Policy Act Program.** Program personnel coordinate with DOE to ensure compliance and provide technical assistance in project planning. In 2018, five projects were reviewed, and the environmental impacts were documented. The Kaua'i Test Facility Site-Wide Environmental Assessment draft was completed.

**Oil Storage Program.** Oil storage containers and equipment are managed, operated, and maintained to support compliance with regulations. In 2018, there were four drums, one aboveground fuel storage tank, and three generator base tanks at SNL/KTF. There were no reportable oil spills or releases in 2018.

**Terrestrial Surveillance Program.** Surveillance activities are conducted to analyze surface soil at SNL/KTF approximately every five years. In 2018, soil samples were collected at designated locations. In 2018, results of the sampling events indicated several exceedances of comparison reference values.

**Waste Management Program.** In 2018, asbestos abatement was conducted at the Mount Haleakala site on Maui.

**Water Quality Program.** Drinking water is obtained through commercial suppliers. In 2018, the three on-site septic tanks were inspected, and one was pumped. There were no compliance issues.

Other programs and activities that provide services, support compliance, and facilitate Sandia missions at SNL/KTF included the following.

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

**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.

**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.

# PART ONE



## SANDIA NATIONAL LABORATORIES TONOPAH TEST RANGE, NEVADA

# Chapter 1. SNL/TTR Introduction



Sunrise at Tonopah Test Range

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**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.

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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:

*<http://www.sandia.gov/news/publications/environmental/index.html>*

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 2018. While all 2018 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 Mission

Sandia National Laboratories—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—anticipates and resolves emerging national security challenges, innovates and discovers new technologies to strengthen the nation’s technological superiority, creates value through products and services that solve important national security challenges, and informs 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 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](#)). This implementation is verified through an internal assessment conducted every three years. An SNL/TTR assessment was conducted in 2017.
- [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

On November 1, 1949, Sandia Corporation, a wholly owned subsidiary of Western Electric, began managing 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, Sandia became a wholly owned subsidiary of Honeywell International Inc.

Prior to 1957, 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.

In Nevada, President Franklin Delano Roosevelt had withdrawn approximately 5,000 square miles of federal land in 1940. In 1950, the Nellis Bombing and Gunnery Range (now referred to as Nevada Test and Training Range) was established as part of Nellis Air Force Base. In 1951, the site was named the Nevada Test Site and supported nuclear testing from 1951 to 1992 (NSTec 2017).

Sandia personnel identified Cactus Flats, located in the northwest corner of the Nellis Bombing and Gunnery Range near the town of Tonopah, as a temporary site for testing ballistic and nonnuclear features of atomic weapons (SNL/NM 1996). Initially known as Tonopah Ballistics Range, the site was open, dry, and isolated and had been used as a bombing site during World War II (SNL/NM 1996). In 1956, a land use permit was obtained from the United States Air Force (USAF). In 1957, TTR was established for the U.S. Atomic Energy Commission (now DOE) and became operational for testing new weapon systems.

The facilities built at SNL/TTR were 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.

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In 1940, President Franklin Delano Roosevelt withdrew approximately 5,000 square miles of federal land in Nevada to establish what is now the Nevada Test and Training Range, which is part of Nellis Air Force Base.  
.....

Today, the Nellis Air Force Base Complex includes several auxiliary small arms ranges and the Nevada Test and Training Range, which is divided into the North Range and the South Range (Figure 1-1). The Nevada National Security Site, formerly known as the Nevada Test Site, is located between the North Range and South Range. The entire Nellis Air Force Base Complex is comprised of approximately three million acres. SNL/TTR is located 32 miles southeast of Tonopah, Nevada.

In April 2002, the USAF and the National Nuclear Security Administration signed a land use permit, “Department of the Air Force Permit to the National Nuclear Security Administration to Use Property Located on the Nevada Test and Training Range, Nevada” (USAF/DOE/NNSA 2002). The permit is valid from April 26, 2002, until October 5, 2019. This permit reduced the size of SNL/TTR from approximately 335,655 acres to approximately 179,200 acres.

### 1.3 Location Description

SNL/TTR is located on approximately 280 square miles (179,200 acres) of withdrawn land (withheld from the public domain) (Figure 1-1), 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.

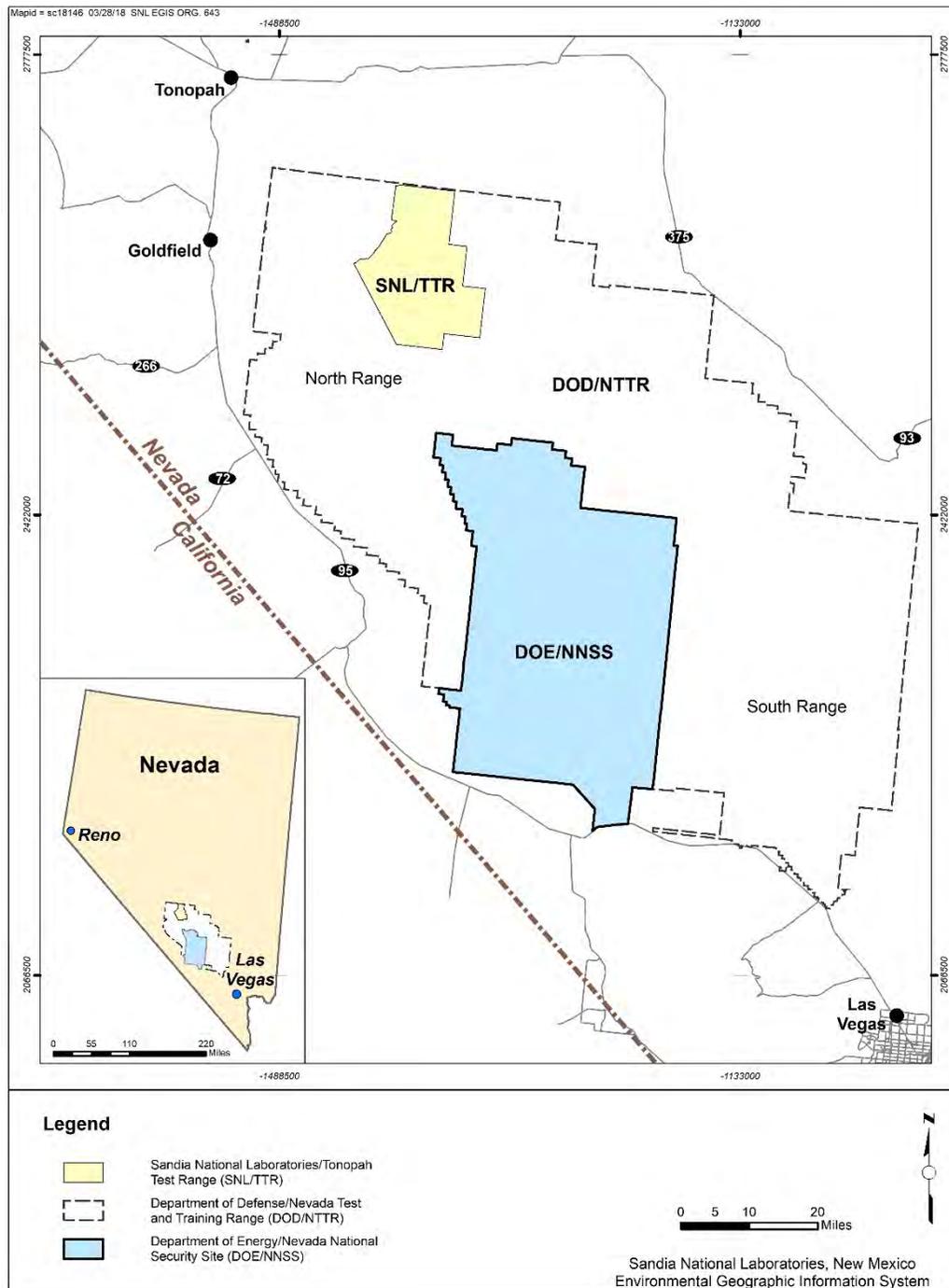


Figure 1-1. SNL/TTR location within the boundaries of the Nevada Test and Training Range

## 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, population 644,644 (Census 2019), 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 reside 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).

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

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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 nonnative species to the ecosystem and human disturbance and interactions (through development) within the various habitats.

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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.

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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 in the 90s°F during the day and dropping to the 50s°F at night. January conditions vary from highs in the 40s°F to lows in the 10s°F.

Average annual precipitation at the town of Tonopah Airport (the closest station with 30 or more years of data), elevation 5,426 feet, is 5.08 inches ([WRCC 2018](#)). 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.

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

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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



Pronghorn (*Antilocapra americana*) at Tonopah Test Range

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**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.

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Sandia operations at SNL/TTR are in compliance 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 performs work in a safe and environmentally responsible manner to ensure adequate protection for the Members of the Workforce, the public, and the environment; is accountable for the safe and environmentally responsible performance of work; exercises a degree of care commensurate with the work and the associated hazards; and integrates environment, safety, and health into work planning and execution.

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 prevent pollution and conserve natural resources by adhering to the ES&H policy. An Environmental Management System is used to establish objectives and targets that address environmental impacts and increase operating efficiencies through a continuing cycle of planning, implementing, evaluating, and improving programs and processes.

DOE O 436.1, *Departmental Sustainability*, was established to ensure that environmental management systems and site sustainability (Section 2.2) are at the forefront of environmental excellence. This directive is implemented through an ISO 14001-certified (ISO 2004) Environmental Management System. 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 Environmental Management System was recertified under the new ISO 14001:2015 standard (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 personnel follow the management approach of the ISO standard. An internal assessment of SNL/TTR operations was completed in January 2017. Additional information can be found at the following external Environmental Management System website:

[www.sandia.gov/about/environment/environmental\\_management\\_system/index.html](http://www.sandia.gov/about/environment/environmental_management_system/index.html)

The Environmental Management System 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) 2018, the Environmental Management System identified that natural resource use, hazardous materials use, and hazardous waste generation continue to be the top three significant aspects for Sandia operations. When significant aspects and negative impacts have been identified, objectives and measurable targets—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts.

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*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 the current DOE *Strategic Sustainability Performance Plan* (DOE 2016) goals and the broader sustainability program set forth in EO 13834, *Efficient Federal Operations* (EO 13834). Sandia's most recent plan, *FY 2019 Site Sustainability Plan* (SNL/NM 2018a), describes the performance status for FY 2018. 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 2018a).

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

DOE Strategic Sustainability Performance Plan and Goal/Sandia Objective	Sandia Performance Status through FY 2018
<b>Greenhouse Gas Reduction</b>	
Reduce Scope 1 and Scope 2 greenhouse gas emissions by 50% relative to a FY 2008 baseline by FY 2025. Reduce Scope 3 greenhouse gas emissions by 25% relative to a FY 2008 baseline by FY 2025.	Met this objective by reducing Scope 1 and Scope 2 greenhouse gas emissions by 59% relative to a FY 2008 baseline. The Scope 3 greenhouse gas goal is not on track; emissions have continued to increase in parallel with site population and air travel increases. There was a 39% increase in FY 2018 relative to the FY 2008 baseline.
<b>Sustainable Buildings</b>	
Reduce energy intensity in goal-subject buildings by 25% relative to a FY 2015 baseline by 2025.	Met this objective by reducing energy intensity 3.76% in FY 2018 relative to a FY 2015 revised baseline for goal-subject buildings.
Comply with the revised guiding principles for High Performance and Sustainable Buildings for at least 17% (by building count) of existing buildings greater than 5,000 gross square feet by FY 2025, with progress to 100% thereafter.	Met this objective with 17% of buildings, by gross square feet, achieving 2008 guiding principles and therefore being “grandfathered.”
<b>Clean and Renewable Energy</b>	
Use no less than 10% clean energy in FY 2017, working toward a 25% reduction by FY 2025.	Met this objective by purchasing renewable energy credits in FY 2018.
<b>Water Use Efficiency and Management</b>	
Reduce potable water intensity by 36% relative to a FY 2007 baseline by FY 2025.	Exceeded this objective with a 27% decrease in potable water intensity in FY 2018 relative to an FY 2007 baseline.
<b>Fleet Management</b>	
Acquire light-duty vehicles, 75% of which must be alternative fuel vehicles.	Met this objectives in FY18.
<b>Sustainable Acquisition</b>	
Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring that BioPreferred and biobased provisions and clauses are included in 95% of applicable contracts.	Efforts are underway to improve the promotion of sustainable acquisition and procurement, including establishing a process to ensure that the appropriate provisions are included in 95% of applicable contracts.
<b>Pollution Prevention and Waste Reduction</b>	
Divert at least 50% of nonhazardous solid waste and construction and demolition debris.	Met this objective by diverting 68% of nonhazardous solid waste and 84% of construction and demolition waste from landfills.
<b>Electronic Stewardship</b>	
Purchase eligible acquisitions so that 95% are EPEAT-registered products each year.	Met this objective with 99.93% of eligible electronics acquisitions being EPEAT-registered products in FY 2018.
<b>Organizational Resilience</b>	
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 in FY 2018. This will aide in developing a future climate change resilience plan to meet this objective.

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

FAST = Federal Automotive Statistical Tool  
 FY = fiscal year

## 2.3 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/TTR. Directives that pertain to environmental protection and management are discussed in [Chapter 1](#) with some included herein for specific operational information. In 2018, the management and operating contractor adhered to the requirements cited below for SNL/TTR operations.

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On May 17, 2018, EO 13834, *Efficient Federal Operations*, was signed, affirming 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*.

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### 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 consider human health and environmental issues associated with proposed actions, be aware of the potential environmental impacts associated with these issues and include this information in early project planning and decision-making. NEPA review of federally funded proposed actions is conducted in accordance with 10 Code of Federal Regulations (CFR) 1021, *National Environmental Policy Act Implementing Procedures* (DOE 2011).

##### **Compliance Status**

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 for inactive hazardous waste sites at all federal facilities. CERCLA also establishes a program to report spills of hazardous substances to the National Response Center (with relevant SNL/TTR information included under the heading of Chemical Management).

##### **Compliance Status**

As required by CERCLA, a Preliminary Assessment/Site Inspection was performed for 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 Comprehensive Environmental Response, Compensation, and Liability Act remediation requirements.

#### Hazardous Waste

##### **Federal Facility Agreement and Consent Order**

This Federal Facility Agreement and Consent Order is an ongoing action with the State of Nevada, DOE, and the U.S. Department of Defense (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. The order and pertinent information related to it (including quarterly progress reports) can be found at: <https://ndep.nv.gov/land/department-of-energy-oversight/federal-facility-agreement-consent-order-ffaco>.

### **Compliance Status**

DOE has assumed responsibility for following environmental restoration sites that are subject to the Federal Facility Agreement and Consent Order:

- Nevada National Security Site
- Areas within SNL/TTR
- Areas within the Nevada Test and Training Range
- Central Nevada Test Area
- 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.

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](#).

### **Compliance Status**

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). All organizations at SNL/TTR use the landfill cooperatively.

Section 3.8 summarizes waste management activities during 2018.

## **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 total effective dose of all potential exposure pathways to the public (including air, water, and the food chain) to 100 mrem/year.

**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 can include vehicles, equipment, materials, and trackable property (equipment with an acquisition value of \$10,000 or greater). 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 exposed to radioactive material or 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. This order references the derived concentration technical standards 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 2018 included the following: Radiation Protection Department personnel processed one personal property clearance survey, no trackable property was cleared, 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 regulate air pollutants from stationary and mobile sources and to establish ambient air quality standards.

**Nonradiological 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.

**Radiological 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**

Emissions at SNL/TTR are regulated by State of Nevada air quality regulations.

**Nonradiological emissions.** Emissions reports and permit fees are submitted to the State of Nevada on an annual basis.

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

Section [3.1](#) 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 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 maintained.

Section [3.6](#) provides information regarding 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 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 chemical usage and releases for federal, state, and local governments and industry. These provisions help increase the public's knowledge and access to information on chemicals at a facility, their uses, and releases into the environment.

#### **Compliance Status**

In 2018, there were no reportable quantity releases of an extremely hazardous substance requiring notification.

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 U.S.

#### **Compliance Status**

All herbicides, rodenticides, and insecticides used at SNL/TTR are EPA approved 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/TTR, compliance with the Toxic Substances Control 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 provides procedures in the event of an encounter with an eagle. In 2018, no eagles 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 2018, biological surveys were conducted as needed and no impact to endangered species were identified.

[Chapter 4](#) provides more information on the endangered species.

**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 furtherance of the provisions of this chapter.”

A Memorandum of Understanding between the U.S. Department of Energy and the U.S. Fish and Wildlife Service Regarding Implementation of Executive Order 13186, “Responsibilities of Federal Agencies to Protect Migratory Birds” was signed in 2013. This strengthens migratory bird conservation through enhanced collaboration between the two federal agencies in coordination with state, tribal, and local governments. This collaboration will contribute substantially to the conservation and management of migratory birds and their habitats.

**Compliance Status**

In 2018, 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 U.S. and Great Britain (for Canada), and later amendments implemented treaties between the U.S. and Mexico, the U.S. and Japan, and the U.S. 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 for bird surveys. In 2018, 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), 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 2018, compliance was achieved by adherence with the Memorandum of Understanding between the U.S. Department of Energy and the U.S. Fish and Wildlife Service.

[Chapter 4](#) presents 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 TTR.

**EO 11988 of 1977, Floodplain Management, as amended**

This act 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.

**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 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.

## Cultural Resources

**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 archaeological sites, and appropriate documentation is undertaken to mitigate adverse effects when necessary. In 2018, there were no activities that required interaction with any Native American tribes.

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

This act governs excavation 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 these sites, and appropriate documentation is undertaken to mitigate adverse effects when necessary. In 2018, several surveys were conducted, and multiple archaeological sites were identified and recorded. No testing or excavation occurred at any of the recorded sites in 2018.

Section 2.4 provides details on the surveys and other compliance activities.

**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.

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.

**Compliance Status**

Planning through the NEPA process identifies potential impacts to these sites, and appropriate documentation is undertaken to mitigate adverse effects when necessary. In 2018, numerous historic building assessments were performed.

Section 2.4 provides details on the assessments and other compliance activities.

**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 these sites, and appropriate documentation is undertaken to mitigate adverse effects when necessary. In 2018, there were no cultural items discovered or excavated.

**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 products and services meet or exceed customer requirements/expectations.

**Compliance Status**

All environmental sampling and analysis that was conducted in 2018 conformed to applicable quality assurance plans.

Chapter 5 provides information on quality assurance.



Bighorn Sheep (*Ovis canadensis*)

**Table 2-2. SNL/TTR applicable EPCRA reporting requirements, 2018**

Section	EPCRA Section Title	Requires Reporting?		Description
		Yes	No	
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. In addition, safety data sheets must be recorded for each chemical entry.

Table continued on next page

**Table 2-2.** SNL/TTR applicable EPCRA reporting requirements, 2018 (continued)

Section	EPCRA Section Title	Requires Reporting?		Description
		Yes	No	
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  
 SARA = Superfund Amendments and Reauthorization Act  
 EPCRA = Emergency Planning and Community Right-to-Know Act  
 SNL/TTR = Sandia National Laboratories, Tonopah Test Range

### 2.3.2 Nevada State Recycling Law and 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
<b>NAC-444, Sanitation</b>	
NAC-444.570 to NAC-444.980, Solid Waste Disposal	<ul style="list-style-type: none"> <li>Disposal of construction debris</li> <li>Disposal of routine nonhazardous solid wastes</li> <li>Disposal of septic sludge</li> <li>Disposal of hazardous waste</li> <li>PCB</li> <li>Asbestos</li> </ul>
<b>NRS-444A, Programs for Recycling</b>	
NRS-444A.010 to NRS-444A.120, Programs for Recycling	<ul style="list-style-type: none"> <li>Recyclables (including waste tires)</li> </ul>
<b>NAC-445A, Water Controls</b>	
NAC-445A.9656 to NAC-445A.9706, Septic Tanks	<ul style="list-style-type: none"> <li>Septic tanks</li> </ul>
NAC-445A.228 to NAC-445A.272, Discharge Permits	<ul style="list-style-type: none"> <li>Surface water runoff</li> </ul>
NAC-445A.450 to NAC-445A. 6731, Public Water Systems	<ul style="list-style-type: none"> <li>Water wells</li> <li>Operator certification</li> <li>Treatment of water</li> <li>Distribution of water</li> <li>Storage structures</li> <li>Water conservation plan</li> </ul>
<b>NAC-445B, Air Controls</b>	
NAC-445B.001 to NAC-445B.3477, Air Pollution	<ul style="list-style-type: none"> <li>Open burning</li> <li>Hazardous air pollutants from stacks and vents</li> <li>Disturbance of soils during construction (particulate matter)</li> <li>Class II operating permit</li> </ul>
NAC-445B.400 to NAC-445B.774, Emissions from Engines	<ul style="list-style-type: none"> <li>Generators</li> <li>Mobile sources</li> </ul>
<b>NAC-459, Hazardous Materials</b>	
NAC-459.9921 to NAC-459.999, Storage Tanks	<ul style="list-style-type: none"> <li>Spill reporting</li> </ul>
<b>NAC-477, State Fire Marshall</b>	
NAC-477.323, Permit to Store Hazardous Material	<ul style="list-style-type: none"> <li>Hazardous material storage</li> </ul>
<b>NAC-504, Wildlife Management and Propagation</b>	
NAC-504	<ul style="list-style-type: none"> <li>Management of all plants and wildlife, including state-listed threatened, endangered, protected, and sensitive species</li> </ul>
<b>NAC-534, Underground Water and Wells</b>	
NAC-534.010 to NAC-534.500, Underground Water and Wells	<ul style="list-style-type: none"> <li>Drilling, construction, operation, and plugging (abandonment) of wells and boreholes</li> </ul>

**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

PCB = polychlorinated biphenyl

NRS = Nevada Revised Statute

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

## 2.4 Cultural Resources

Cultural resources are protected at SNL/TTR. NEPA Program personnel coordinate cultural resources compliance; this includes archeological sites and historic buildings. Actions that could adversely affect cultural resources are analyzed initially in a NEPA checklist review. The DOE National Nuclear Security Administration Sandia Field Office is responsible for ensuring that impacts to cultural resources are assessed and appropriate actions are taken to mitigate impacts. In 2018, multiple activities were assessed and determined to have an impact on cultural resources at SNL/TTR.

### 2.4.1 Archaeological Assessments

In 2018, the Sandia archaeologist completed two surveys at SNL/TTR, which included reviewing five outdoor projects and surveying more than 30 acres. The surveys—conducted around Area 3, Area 9, and Antelope Lake Road—resulted in two cultural reports, which were submitted to DOE following Nevada state guidelines. The reports identified archaeological resources that had been noted during pedestrian surveys, thus an additional report was prepared for DOE to use in consultation with the Nevada State Historic Preservation Officer. Consultation is occurring.

### 2.4.2 Historic Building Assessment

In 2011, DOE completed consultation with the Nevada State Historic Preservation Office, reaching an agreement for 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 SNL/TTR Historic 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.

In 2018, it was discovered that two SNL/TTR phototheodolite 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. Sandia personnel performed a root cause analysis and implemented corrective actions to prevent such an occurrence in the future. Tower 22-00 was part of the SNL/TTR Historic District; DOE had not reached a final determination on the historic status of Tower 12-00 in consultation with the Nevada State Historic Preservation Office. DOE consulted with the Nevada State Historic Preservation Office on the matter and is notifying both the Nevada State Historic Preservation Office and the Advisory Council on Historic Preservation of the event. This event was also listed as a DOE reportable occurrence (Section 2.6.2).

DOE also consulted with the Nevada State Historic Preservation Office regarding the proposed reroofing of Building 03-53. Nevada State Historic Preservation Office concurred with a finding of no adverse effect to the building; however, the proposed reroofing plan has since been found to be unworkable, and a new approach will require new consultation.

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

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## 2.5 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 2018.

**Table 2-4.** SNL/TTR permits, 2018

Permit Type and Location	Permit Number	Issue Date	Expiration Date	Comments
<b>Air Quality</b>				
Class II Air Quality Operation Permit	<ul style="list-style-type: none"> <li>AP 8733-0680.03</li> <li>FIN A0025</li> </ul>	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 renewal is still pending NDEP approval)	<ul style="list-style-type: none"> <li>Portable screen</li> <li>Welding operation</li> <li>Carpenter area</li> <li>Paint booth</li> <li>Generators (four logged systems)</li> <li>Surface area disturbance (less than 5 acres)</li> </ul>
Class II General Air Quality Operating Permit for Temporary Construction Sources	<ul style="list-style-type: none"> <li>API442-3996.04</li> <li>FIN A2118</li> <li>Air Case 9739</li> </ul>	July 30, 2018	May 7, 2022	
Notification of Issuance of the Class II Change of Location	<ul style="list-style-type: none"> <li>Approval #2620</li> <li>FIN A2118,</li> <li>API442-3996.04</li> <li>Air Case 9740</li> </ul>	July 30, 2018	July 30, 2019	
<b>Hazardous Waste (RCRA)</b>				
Hazardous Waste Generator	NV1890011991 <sup>a</sup>	January 7, 1993	Indefinite	State of Nevada
<b>Hazardous Waste (Nevada State Fire Marshal)</b>				
Hazardous Materials Permit	<ul style="list-style-type: none"> <li>FDID Number: 13007</li> <li>Permit Number: 63377</li> </ul>	February 29, 2018	February 28, 2019	State of Nevada
<b>Stormwater Construction General Permit</b>				
TTR Test Unit Recovery Operations	<ul style="list-style-type: none"> <li>DOE Number: CSW-41616</li> <li>SNL Number: CSW-41615</li> </ul>	March 24, 2016	Notice of Termination submitted January 17, 2018	State of Nevada
<b>Production Well (Drinking Water)</b>				
Production Well 6	NY-3014-12-NTNC <sup>b</sup>	August 28, 2018	September 30, 2019	State of Nevada
Permit to Operate a Treatment Plant	NY-3014-TP11-12NTNC	August 28, 2018	September 30, 2019	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

<sup>a</sup> Generator identification number (not a permit number).

<sup>b</sup> The State of Nevada Bureau of Health Protection Services renews the permit for Production Well 6 (NV-3014-12NTNC) annually.

DOE = U.S. Department of Energy

SNL = Sandia National Laboratories

FDID = Fire Department Identification

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

NDEP = Nevada Division of Environmental Protection

TTR = Tonopah Test Range

RCRA = Resource Conservation and Recovery Act

## 2.6 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 corporate performance evaluation were set forth in the *FY18 DOE/NNSA Strategic Performance Evaluation Measurement Plan (PEMP)* (DOE/NNSA 2017a). Subsequently, DOE/NNSA/SFO prepared the annual *National Technology & Engineering Solutions of Sandia Performance Evaluation Report (PER)* (DOE/NNSA/SFO 2018a), assessing the management and operating contractor performance for May 1, 2017, through September 30, 2018. NTESS earned an overall excellent rating during this performance period. Two items of note related to environmental programs were as follows:

- Accomplishment—The Environmental Management System continued to maintain a mature and compliant program as demonstrated by its completion of the ISO 14001:2015 recertification ahead of schedule.
- Issue—NTESS line implementation of NEPA is inconsistent. As a result, management took positive steps and increased leadership attention to ensure that NEPA reviews are performed early in the program and project planning process.

### 2.6.1 Audits, Appraisals, and Inspections in 2018

Environmental programs at SNL/TTR are routinely subjected to audits, appraisals, inspections, and/or verifications by external agencies. Table 2-5 summarizes the 2018 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 external audits, appraisals, inspections, and violations, 2018

Appraising Agency	Title	Date	Summary
NDEP Bureau of Waste Management	RCRA Hazardous Waste Compliance Inspection	April 11, 2018	DOE/SNL operations appear to be in compliance with all applicable federal and state hazardous waste regulations

DOE = U. S. Department of Energy  
NDEP = Nevada Division of Environmental Protection

RCRA = Resource Conservation and Recovery Act  
SNL = Sandia National Laboratories

### 2.6.2 Occurrence Reporting in 2018

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 the 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.

All 2018 occurrences at SNL/TTR that meet 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

## SNL/TTR Compliance Summary

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.

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.”

During 2018, one occurrence (Table 2-6) met the query criteria for reporting in the *Annual Site Environmental Report*. Table 2-6 also cross-references DOE O 232.2A reportable occurrences that were reportable to an outside agency, if applicable.

**Table 2-6.** Occurrence reports per DOE O 232.2A, 2018

Reporting Criteria	Month	Report Level	Report Number and Title	Also Reported to Outside Agency
<b>Group 5 – Environmental</b> 5B(1) - Any occurrence including releases causing significant impact to ecological or cultural resource for which DOE has responsibility under applicable laws, regulations, and executive orders. For example, extensive damage to, or destruction of: (a) Ecologically preserved areas, or pristine or protected wetlands; (b) Threatened or protected flora or fauna or critical habitats; (c) Potable drinking water intake or well usage; or (d) Historical/archeological sites.	February	High	<b>NA--SS-SNL-4000-2018-0002</b> Demolition of Historic and Yet-to-Be-Determined Radar Towers at TTR without Completing Required NEPA Process See Section 2.4.1	Advisory Council on Historic Preservation, and Nevada State Historic Preservation Office

DOE = U.S. Department of Energy  
 NEPA = National Environmental Policy Act  
 TTR = Tonopah Test Range

## Chapter 3. SNL/TTR Environmental Programs



Johnson's fishhook cactus (*Echinomastus johnsonii*)

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**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.

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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 and Chemical Exchange Program
- 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 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 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 2018, emissions from the permitted sources were in compliance with permitted limits. [Table 3-1](#) summarizes the permitted source emission data for 2018.

**Table 3-1.** Permitted source emission data, 2018

Emissions <sup>a</sup>					
Carbon Monoxide	Hazardous Air Pollutant	Nitrogen Oxide	Particulate Matter with a Diameter ≤ 10 µm	Sulfur Dioxide	Volatile Organic Compound
7.53E-02	3.25E-03	3.07E-01	2.59E-02	8.37E-03	1.55E-02

<sup>a</sup> All units are in tons per year.

### 3.1.2 Radionuclide Air Emissions

The Radionuclide NESHAP Program reports radionuclide emission releases at SNL/TTR and annual dose assessments in the *Radionuclide National Emission Standards for Hazardous Air Pollutants Annual Report for Calendar Year 2018, Sandia National Laboratories, Tonopah Test Range* (SNL/NM 2018b).

Currently, operations at SNL/TTR do not involve activities that release radioactive emissions from either point sources (stacks and vents) or new diffuse sources. However, diffuse radiological emissions are produced from the resuspension of americium and plutonium, which are present at the Clean Slate environmental restoration sites (see Section 3.4.1).

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 of the Clean Slate sites (SNL/NM 1995).

Soil removal activities were concluded at Clean Slate II in 2018. 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. Air monitoring was conducted during the soil removal activities at Clean Slate II and Clean Slate III. See Section 3.4.2 and [Appendix A](#), “SNL/TTR Air Monitoring Stations in 2018,” for further information on air-monitoring activities.

The Clean Air Act Assessment Package dose code was used to evaluate applicability with radiological NESHAP guidelines. The maximum release values obtained from the monitoring results were used in the Clean Air Act Assessment Package dose code ([Table 3-2](#)).

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 at the airport location was calculated to be 7.94E-11 mrem/year, which is significantly below the annual NESHAP limit of 10 mrem/year (SNL/NM 2018b).

**Table 3-2.** Summary of reported radionuclide releases, 2018

Source, Name, Location	Description	Source Type	Monitoring Method	Radionuclide	Releases (curies)
Soil disturbance at Clean Slate II site	Approximately 3 acres of soil was disturbed	Area	Periodic	Plutonium-238	1.23E-12
				Plutonium-239/240	1.06E-10
Soil disturbance at Clean Slate III	Approximately 10 acres of soil was disturbed	Area	Periodic	Plutonium-238	1.16E-12
				Plutonium-239/240	1.57E-11

### 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 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 2018, 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 3.4.4).

## 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 115,000 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, Environmental Life-Cycle Management 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 2018, environmental impacts of six 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 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 2018, 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 3-3 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 3-3. CAU 411, CAU 412, CAU 415, and CAU 541 were closed in previous years, and CAU 413 was closed in 2018. 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 3-3.** Status of remediation activities at SNL/TTR, 2018

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

<sup>a</sup> 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

### 3.4.2 Environmental Restoration Project Activities in 2018

Soil removal activities were concluded at Clean Slate II in 2018. Approximately 3,800 cubic yards of contaminated soil was packaged and shipped to the Nevada National Security Site for disposal (during 2017 and 2018). In September 2018, remediation activities began at Clean Slate III. These activities included soil excavation, soil removal, and packaging and shipping of contaminated soil and debris. Approximately 3,100 cubic yards of contaminated soil and debris was shipped to the Nevada National Security Site for disposal in 2018. DOE manages all waste generated from environmental restoration activities.

Other environmental restoration activities conducted on the SNL/TTR and the Nevada Test and Training Range sites in 2018 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 2018.

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 the following sections.

### 3.4.3 History of Double Tracks and Clean Slate Sites

Operation Roller Coaster, conducted in May and June 1963, included a series of four nuclear devices which were subjected to chemical explosions that 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 was clean closed in 2018. Clean Slate III is currently being remediated by removal of contaminated soil and debris. These sites are presently fenced and have signage posted. The areas are inspected each year to determine whether any fence repairs or sign replacement is required.

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.

### 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 1 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.

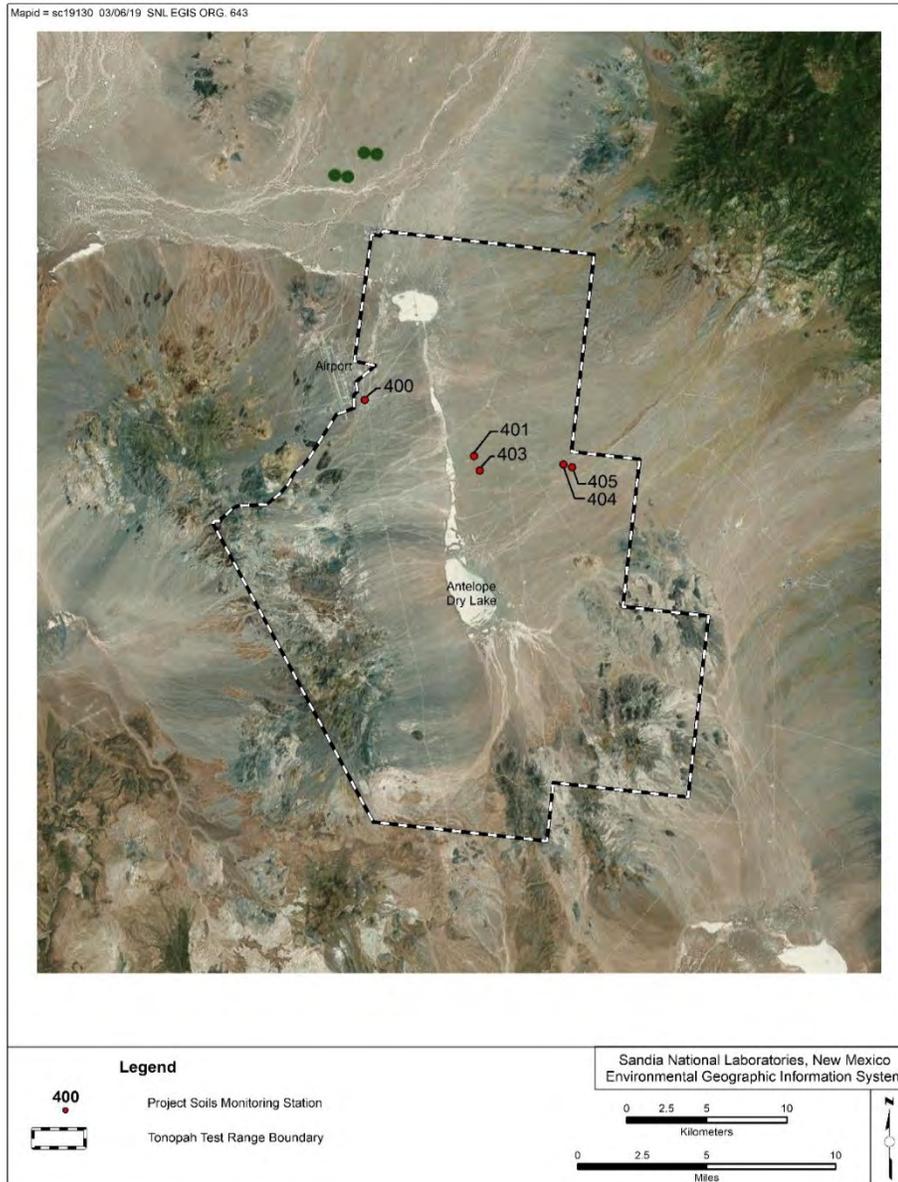
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*The environment is the sum of all external conditions affecting an organism's life, development, and survival.*

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During 2018, 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 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 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 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 upwind and downwind directions.

The orientations of the 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 low-volume air samplers having a flow rate of approximately two cubic feet per minute. 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 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 2018 Meteorological, Radiological, and Wind Transported Particulate Observations* (Chapman et al. 2019 in progress). A summary of air monitoring stations and 2018 results is provided in Appendix A, “SNL/TTR Air Monitoring Stations in 2018.”

## **3.5 National Environmental Policy Act Program**

NEPA Program personnel provide DOE with technical assistance to support Sandia compliance with NEPA and the National Historic Preservation Act. The NEPA team reviews projects for conformance with existing DOE NEPA documents and determinations. NEPA Docs software is used to facilitate NEPA reviews and quality assurance activities by providing a consistent framework for reporting and making NEPA documentation readily available for reference.

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 2018, the NEPA team completed 12 NEPA checklists for SNL/TTR, 9 of which were transmitted to the DOE National Nuclear Security Administration Sandia Field Office for review and completion.

## 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 maintains and implements 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 2018, the inventory of oil storage containers operating under the SNL/TTR Spill Prevention, Control, and Countermeasure Plan includes 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 following Spill Prevention, Control, and Countermeasure Plan-related activities occurred in 2018:

- Four new 45 kW portable generators were added to the mobile generator inventory.
- Two temporary portable generators at Station 39 were replaced with a permanent 125 kW generator.
- An oil water separator became clogged and overflowed water into the vault. The overflow water was removed, and maintenance was performed on the separator and vault.
- Drip plans were deployed and monitored to capture small-quantity leaks from hydraulic equipment on two high-speed telescope trailers. The units were repaired and are being monitored to ensure effectiveness of the repairs.

### 3.6.1 Oil Storage Program Results in 2018

There were no reportable oil spills or releases at SNL/TTR in 2018.

## 3.7 Terrestrial Surveillance Program

Terrestrial Surveillance Program personnel collect environmental media (soil) samples and send them for off-site laboratory analysis of the radiological constituents, as required. As a best management practice, samples are also collected for analysis of metals. In addition to the environmental media samples, ambient external gamma radiation levels are measured using 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 with lower detection capabilities than those previously available for many of the metals was contracted. The same database has been used for statistical analysis from 2000 to the present.

### 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 Environmental Management System, which is certified to the ISO 14001:2015 standard. 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 closely approximate the dose potentially received from natural and unnatural sources.

The on-site sample locations ([Table 3-4, Figure 3-2](#)) are in areas of known contamination: Corrective Action Sites and areas of potential release (sites with current outdoor testing activities).

**Table 3-4.** SNL/TTR on-site terrestrial surveillance locations, sample media, and parameters

Surveillance Location	Location Number	Sample Location	Soil <sup>a</sup>	Dosimeter <sup>b</sup>
Range Operations Center	S-40	Wastewater monitoring station	X <sup>c</sup>	
	S-41	“Danger Powerline Crossing” sign	X <sup>c</sup>	
	S-42	Main Road/Edward’s Freeway	X <sup>c</sup>	
	S-43	Range Operation Center (southwest corner)	X <sup>c</sup>	
	S-44	Range Operation Center (northeast corner)	X <sup>c</sup>	
	S-45	Storage shelters 03-38 and 03-39	X <sup>c</sup>	
	S-46	Sand Building	X <sup>c</sup>	
	S-47	Generator storage area	X <sup>c</sup>	
South Plume Area	S-49	North/south Mellan Airstrip—southwest of S-48	X <sup>d</sup>	
	S-50	North/south Mellan Airstrip—signpost	X <sup>d</sup>	
	S-51	North/south Mellan Airstrip—northeast of S-50	X <sup>d</sup>	
	S-52	Northeast of Mellan Airstrip	X <sup>d</sup>	
Various on-site	S-01	Antelope Lake area fence, cultural area sign	X <sup>d</sup>	X
	S-02	North/south Mellan Airstrip (south fencepost)	X <sup>d</sup>	X
	S-03	Dosimeter at Clean Slate I	X <sup>d</sup>	X
	S-04	Dosimeter at Clean Slate III	X <sup>d</sup>	X
	S-09	Roller Coaster Decontamination Area	X <sup>d</sup>	X
	S-10	Brownes Road/Denton Freeway	X <sup>d</sup>	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 <sup>d</sup>	
	S-39	Mellan Hill—north	X <sup>d</sup>	
S-53	Main Road/Lake Road southeast	X <sup>d</sup>		

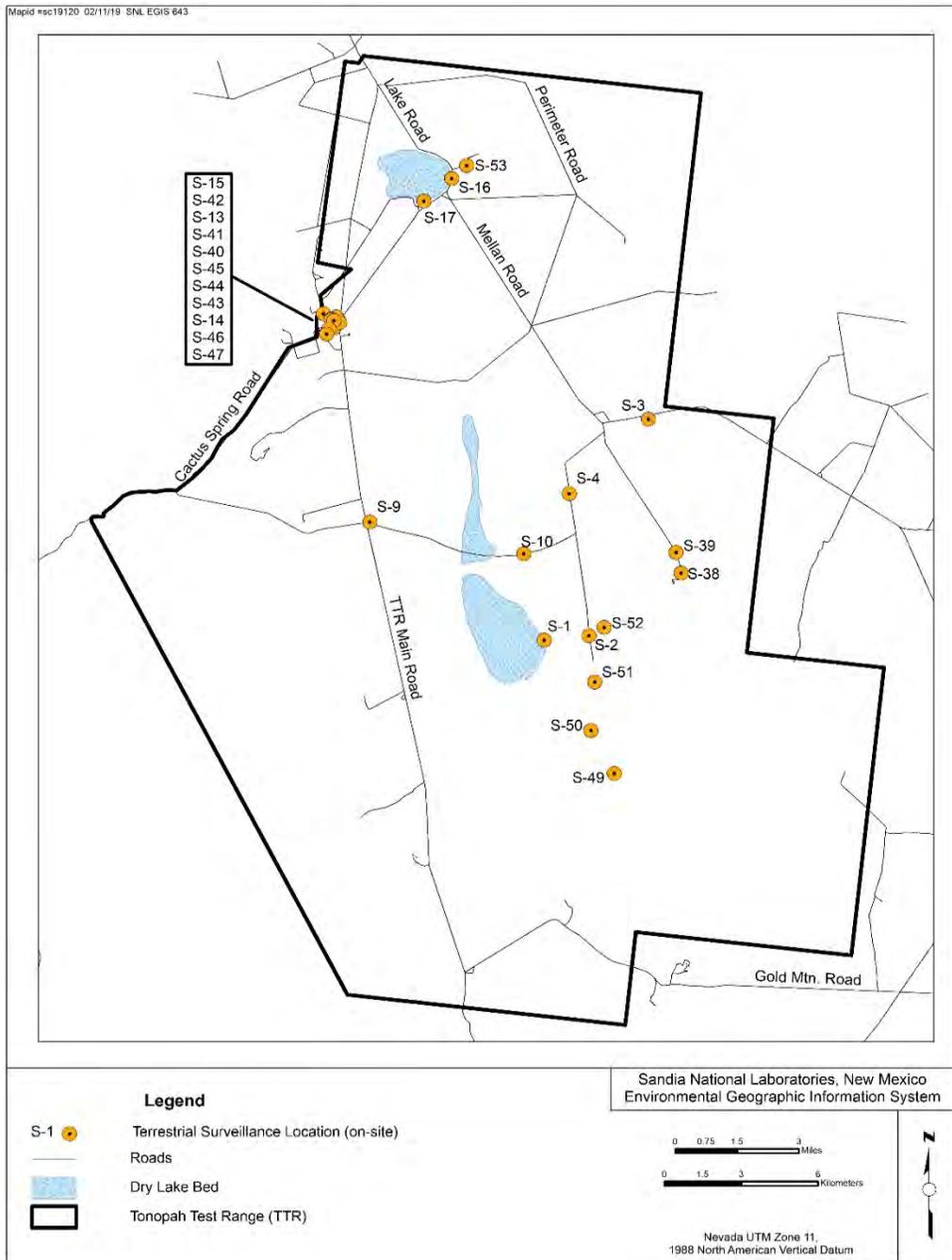
<sup>a</sup> Soil samples are analyzed for radionuclides by gamma spectroscopy annually.

<sup>b</sup> Dosimeters are analyzed for gamma radiation.

<sup>c</sup> Soil samples are analyzed for Target Analyte List metals every five years (sampled in 2018).

<sup>d</sup> 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 3-5, Figure 3-3) are located around the boundaries of SNL/TTR. Off-site sample locations (Table 3-6, Figure 3-4) are located in remote areas, areas near local population, and along major roadways. Off-site sample results are used for comparison to the on-site and the perimeter sample results. Off-site and perimeter locations are sampled every five years and were sampled in 2018.

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

Surveillance Location	Location Number	Sample Location	Soil <sup>a,b</sup>	Dosimeter <sup>c</sup>
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	

<sup>a</sup> Soil samples are analyzed for radionuclides by gamma spectroscopy annually.

<sup>b</sup> Soil samples are analyzed for Target Analyte List metals every five years (sampled in 2018).

<sup>c</sup> Dosimeters are analyzed for gamma radiation.

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

U.S. = United States

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

Surveillance Location	Location Number <sup>a</sup>	Sample Location	Soil <sup>b,c</sup>	Dosimeter <sup>d</sup>
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	

<sup>a</sup> Off-site samples were previously called “community” samples, thus the C label in the location number (maintained for the database).

<sup>b</sup> Soil samples are analyzed for radionuclides by gamma spectroscopy annually.

<sup>c</sup> Soil samples are analyzed for Target Analyte List metals every five years (sampled in 2018).

<sup>d</sup> Dosimeters are analyzed for gamma radiation.

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

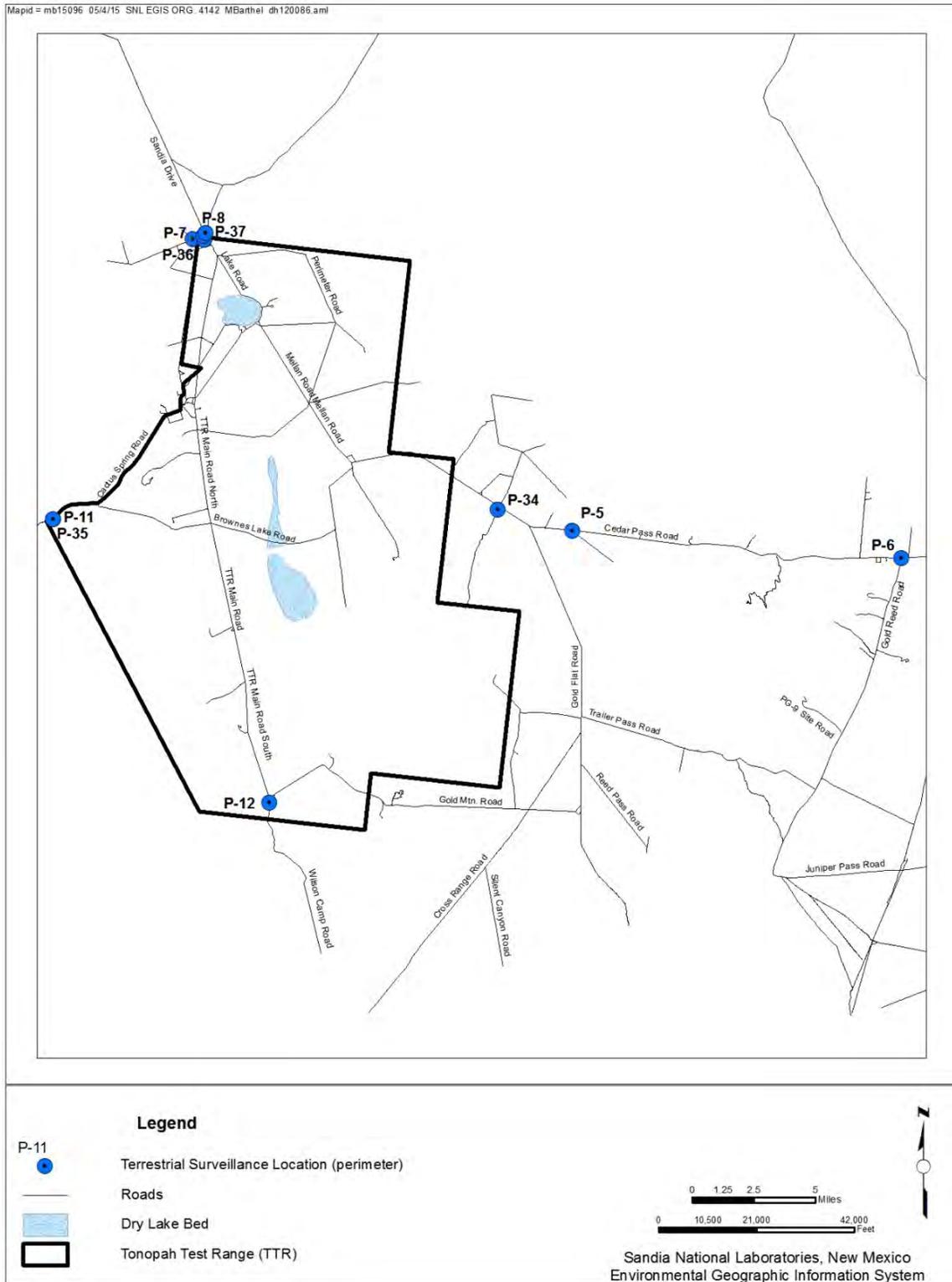


Figure 3-3. SNL/TTR perimeter terrestrial surveillance locations

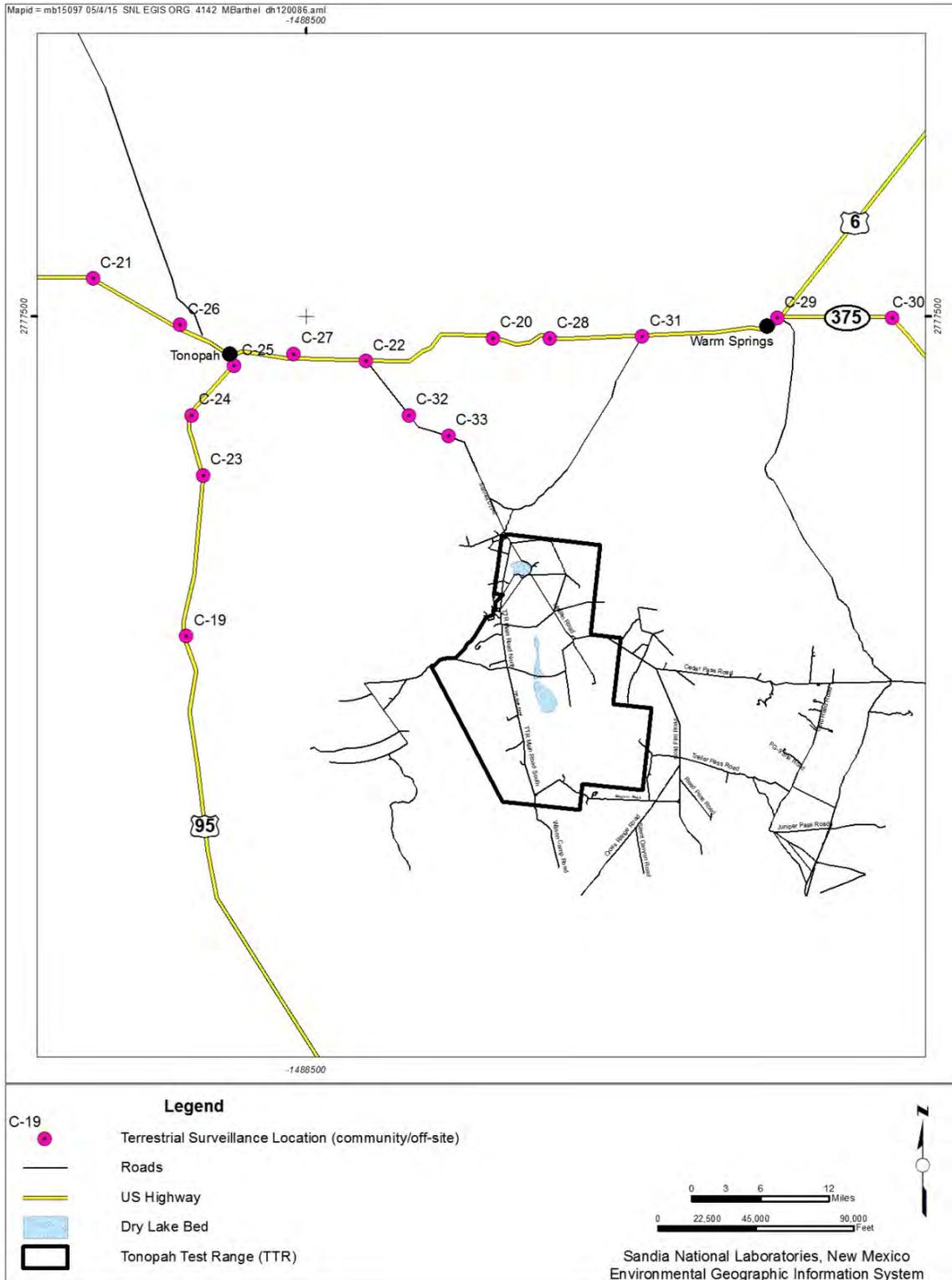


Figure 3-4. SNL/TTR off-site terrestrial surveillance locations

### 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 2016a).

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, plutonium, and uranium. 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.
- **Uranium:** Uranium occurs naturally in soils and may also be present as a contaminant in the environment at SNL/TTR due to past testing conducted there. Total uranium analysis is used to measure all uranium isotopes present in a sample. An isotope-specific analysis may be performed to determine the possible source of uranium (i.e., natural, man-made, enriched, or depleted).

In 2018, Terrestrial Surveillance Program personnel discontinued the use of thermoluminescent dosimeters to measure ionizing radiation. Optically stimulated luminescence dosimeters are now employed. The optically stimulated luminescence dosimeters are issued and analyzed by an accredited off-site laboratory.

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*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.

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Thermoluminescent dosimeter results from previous years are not directly comparable to the optically stimulated luminescent dosimeter results for 2018. Historical thermoluminescent dosimeter data and trend analysis can be found in previous Annual Site Environmental Reports. The 2018 optically stimulated luminescent dosimeter data is presented here, but trend analysis will not be performed until several more years of data is available.

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.

### 3.7.4 Sample Result Analysis and Methodology

Statistical analyses are conducted to compare on-site and perimeter sample results with off-site results, and to establish any trends that may indicate the potential for a release of contaminant(s).

#### **Statistical Analysis and Methodology**

Samples are collected from specified locations to enable effective statistical comparisons with results from previous years. Statistical analyses are performed to determine whether a specific on-site or perimeter sample result differs from off-site sample results and to identify trends at a particular sampling location. The statistical analysis results are used to prioritize sample results for possible follow-up actions, such as resampling, additional investigation, and/or notifications to applicable entities.

A decision-making tool is used to help determine the appropriate level of concern for each sample result. The statistical analysis prioritization methodology (Shyr, Herrera, and Haaker 1998) is based on a matrix of four priority levels (Table 3-7).

**Table 3-7.** Priority decision matrix and actions

Priority	Are Results Higher Than Off-Site?	Is There an Increasing Trend?	Action
1	Yes	Yes	Immediate attention is needed. Specific investigation is planned and/or notifications will be made to applicable entities.
2	Yes	No	Some concern is warranted. Further investigation and/or notifications may be necessary.
3	No	Yes	A minor concern. Further investigation and/or notifications may be necessary.
4	No	No	No concern. No investigation will be required.

#### **Other Standards for Comparison**

In addition to the statistical analysis, 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 screening levels for soil (EPA 2018)
- U.S. surface soil surface concentrations (Kabata-Pendias 2000)

In some instances, a qualitative inspection of the data may be augmented by the graphical evaluation methodology described and documented in *Chemical Analyses of Soil Samples Collected from the Sandia National Laboratories, Tonopah Test Range Environs, 1994–2005* (SNL/NM 2006).

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 U.S. 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).

No regulatory limits are available to directly compare concentrations of radiological or nonradiological constituents in surface soil.

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

Analyte	Nevada Soil Concentrations <sup>a</sup>		EPA Risk-Based Soil Screening Levels <sup>b</sup>		U.S. Soil Concentrations <sup>c</sup>	
	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

<sup>a</sup> Dragun and Chekiri 2005.<sup>b</sup> EPA (Target Hazard Quotient = 1.0) 2018.<sup>c</sup> 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 2018

The following Terrestrial Surveillance Program activities occurred in 2018:

- The annual sampling of soil at on-site locations occurred in June 2018 at designated locations.
- Environmental dosimeters were deployed, collected, and analyzed at designated locations quarterly. The results are reported as an estimated annual exposure rate (the mean of the quarterly annualized values).

The analytical results for radiological (including environmental dosimeters) and nonradiological parameters for the 2018 sampling events are summarized in the following subsections, and the data are provided in [Appendix B](#), “SNL/TTR Terrestrial Surveillance Results in 2018.”

**Radiological Results**

The summary statistics for radiological results for 2000 through 2018 are presented in [Table 3-9](#). The respective radiological analytes are discussed in the following subsections, which list the locations identified as Priority-1 and Priority-2.

**Table 3-9.** SNL/TTR radiological summary statistics, 2000–2018

Analyte	Location Classification	Number of Samples	Mean (pCi/g)	Median (pCi/g)	Standard Deviation (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)
Americium-241	Perimeter	160	0.02	0.02	0.05	-0.24 U	0.15 BD
	On-site	389	0.40	0.05	1.5	-0.23 U	17
	Off-site	274	0.02	0.02	0.04	-0.20 U	0.16
Cesium-137	Perimeter	160	0.19	0.16	0.14	0.012 U	0.89
	On-site	400	0.22	0.20	0.18	0.0 U	1.5
	Off-site	274	0.20	0.16	0.15	-0.0017 BD	0.93
Plutonium-238	Perimeter	18	0.0082	0.0034	0.19	-0.0056 U	0.080 BD
	On-site	122	0.18	0.020	0.83	-0.19 BD	8.4
	Off-site	34	0.0028	0.00094	0.0050	-0.0037 U	0.020
Plutonium-239/240	Perimeter	18	0.054	0.018	0.14	0.0014 U	0.62 BD
	On-site	122	16	0.61	110	-0.080 U	1200 J
	Off-site	34	0.014	0.011	0.013	-0.0011 U	0.050
Plutonium-242	On-site	5	3.5	3.5	0.032	3.5	3.6
Uranium-235	Perimeter	160	0.076	0.071	0.056	-0.059 U	0.25
	On-site	400	0.085	0.079	0.062	-0.077 BD	0.39
	Off-site	274	0.082	0.072	0.060	-0.010 BD	0.29
Uranium-238	Perimeter	160	1.3	1.3	0.52	0.0029 U	3.1 R
	On-site	399	1.3	1.3	0.53	-0.052 BD	3.1
	Off-site	270	1.3	1.2	0.51	-0.019 BD	3.1 J

BD = below detection limit as used in radiochemistry to identify results that are not statistically different from zero (data validation qualifier)  
 J = the associated numerical value is an estimated quantity (data validation qualifier)  
 R = the data are unusable, not used in statistical analysis  
 SNL/TTR = Sandia National Laboratories, Tonopah Test Range  
 U = the analyte was analyzed for but was not detected; the associated numerical value is the sample quantitation limit (laboratory qualifier)

**Americium-241**

The results of the statistical analysis for americium-241 identified one Priority-1 on-site location (S-51 soil) with a value of 17 pCi/g ([Table 3-10](#)).

Americium-241 at location S-51 continues to be identified as Priority-1. This location is at the edge of South Plume Area and is expected to have elevated readings. This is consistent with the hot particle theory, where the presence of americium-241 or plutonium-239/240 in a heterogeneous sample skews the apparent average concentration, making it appear greater. Sampling and trend analyses will continue for americium-241 (and plutonium-239/240) at this location. All other locations were identified as Priority-4 for americium-241.

**Table 3-10.** SNL/TTR radiological summary statistics for Priority-1 soil sample locations, 2018

Priority	Analyte	Location	Number of Samples 2000–2018	Mean (pCi/g)	Median (pCi/g)	Standard Deviation (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	2018 Result
1	Americium-241	S-51	19	4.6	4.3	4.5	-0.0095 U	17	17

SNL/TTR = Sandia National Laboratories, Tonopah Test Range  
 U = the analyte was analyzed for but was not detected; the associated numerical value is the sample quantitation limit (laboratory qualifier)

### Dosimeter Results

Analysis of the dosimeter data was performed to determine the average exposure rates for the three location classifications and whether any statistical differences between the groups were observed. [Table 3-11](#) shows the mean exposure rate summary statistics. In 2018, there was a significant statistical difference between the means of on-site and perimeter locations compared to the mean of off-site locations (which was lower). The mean annual exposure 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 3-11.** SNL/TTR dosimeter exposure rate summary statistics by location classification, 2018

Location Classification	Number of Observations	Mean (mR/year)	Median (mR/year)	Standard Deviation (mR/year)	Minimum (mR/year)	Maximum (mR/year)
On-site	11	110	100	11	86	120
Perimeter	6	100	110	11	85	110
Off-site	2	78	78	21	63	93

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

### Nonradiological Results

Nonradiological parameters include modified Target Analyte List metals. In addition to the statistical analysis, results may be compared to values from the references listed in [Section 3.7.4](#) and provided in [Table 3-8](#).

In 2018, soil samples were collected at the locations listed in [Table 3-4](#), [Table 3-5](#), and [Table 3-6](#) for specified parameters. Designated locations were sampled for metals analysis. The results of the statistical analyses for metals are provided in [Table 3-12](#).

**Table 3-12.** SNL/TTR metals summary statistics for Priority-2 and Priority-3 sample locations, 2018

Priority	Analyte	Location	Sample Matrix	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Standard Deviation (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)	2018 Result (mg/kg)
2	Beryllium	P-35	Soil	6	1.0	1.0	0.23	0.61	1.2	0.61
2	Cadmium	S-45	Soil	6	0.85	0.93	0.42	0.17	1.4	0.96
2	Chromium	S-45	Soil	6	22	14	19	4.7	46	17
2	Cobalt	S-09	Soil	13	5.9	6.0	0.51	4.9	6.8	5.5
2	Cobalt	P-35	Soil	6	7.0	6.7	2.2	3.6	10	3.6
2	Copper	P-35	Soil	6	22	24	12	5	36	5.0
2	Nickel	P-35	Soil	6	11	12	4.3	4.0	17	4.0
3	Potassium	C-26	Soil	6	3,500	3,400	550	2,800	4,300	4,300
3	Potassium	C-27	Soil	6	4,300	4,200	780	3,200	5,500	4,800
3	Potassium	C-33	Soil	6	2,800	3,000	470	2,100	3,300	3,300
3	Uranium, total	S-38	Soil	16	0.65	0.66	0.11	0.51	0.86	0.66

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

### Beryllium

The results of the statistical analysis for beryllium identified one Priority-2 perimeter location (P-35 soil) with a result of 0.61 mg/kg. The result was within the range of values for beryllium at P-35 and within the range for Nevada soils, as shown in [Table 3-12](#).

**Cadmium**

The results of the statistical analysis for cadmium identified one Priority-2 on-site location (S-45 soil) with a result of 0.96 mg/kg. The result was within the range of values for cadmium at S-45 and within the range for Nevada soils, as shown in [Table 3-12](#).

**Chromium**

The results of the statistical analysis for chromium identified one Priority-2 on-site location (S-45 soil) with a result of 17 mg/kg. The result was within the range of values for chromium at S-45 ([Table 3-12](#)) and within the range for Nevada soils, as shown in [Table 3-8](#).

**Cobalt**

The results of the statistical analysis for cobalt identified two Priority-2 locations (S-09 soil and P-35 soil) with results of 5.5 and 3.6 mg/kg, respectively. The results were within the range of values for cobalt at those sites ([Table 3-12](#)) and within the range for Nevada soils, as shown in [Table 3-8](#).

**Nickel**

The results of the statistical analysis for nickel identified one Priority-2 perimeter location (P-35 soil) with a result of 4.0 mg/kg. The result was within the range of values for nickel at P-35 ([Table 3-12](#)) and below the range for Nevada soils, as shown in [Table 3-8](#).

**Potassium**

The results of the statistical analysis for potassium identified three Priority-3 off-site locations (C-26 soil, C-27 soil, and C-33 soil) with results of 4,300, 4,800, and 3,300 mg/kg, respectively. The results at C-26 and C-33 represent a new maximum for potassium ([Table 3-12](#)), but were within the range for Nevada soils, as shown in [Table 3-8](#).

**Uranium, Total**

The results of the statistical analysis for uranium, total identified one Priority-3 on-site location (S-38 soil) with a result of 0.66 mg/kg. The result was within the range of values for uranium, total, at S-38 ([Table 3-12](#)) and below the range for Nevada soils, as shown in [Table 3-8](#).

All other locations were identified as Priority-4 for the Target Analyte List metals.

***Additional Activities and Variances***

There were no other Terrestrial Surveillance Program activities at SNL/TTR in 2018. There were no variances from the planned activities.



Old car in Nevada fields

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### 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 2018 is presented in [Table 3-13](#) and [Table 3-14](#), respectively. All regulated waste was shipped off-site to permitted treatment, storage, and disposal facilities.

**Table 3-13.** SNL/TTR waste generated, 2018

Waste Type	Weight (pounds)
Total RCRA hazardous waste	748
Total non-RCRA-regulated waste	17,067
Total recycled materials	6323
Toxic Substances Control Act waste (PCB)	40
Toxic Substances Control Act waste (asbestos)	0
Radioactive waste	0

PCB = polychlorinated biphenyl

RCRA = Resource Conservation and Recovery Act

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

**Table 3-14.** SNL/TTR waste shipped, 2018

Waste Type/Facility	Weight (pounds)
Sanitary landfill (USAF Sanitary Landfill)	23,960
Construction debris (USAF Construction Landfill)	183,744
Tires (Lunas Tire Recycling)	4,560 <sup>a</sup>
Battery recycling (National Automotive Parts Association and Veolia)	726 <sup>a</sup>

<sup>a</sup>This total is also included in the “Total recycled materials” total located in [Table 3-13](#).

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 2018 are presented in [Table 3-15](#).

**Table 3-15.** SNL/TTR material recycled or energy-recovered and shipped off-site, 2018

Recycled or Energy-Recovered Waste	Shipped (pounds)
Automotive type batteries	726
Universal waste batteries	207
Universal waste lamps	222
Mercury-containing articles	7
Non-PCB light ballasts	348
Antifreeze	0
Used oil	0
Used oil filters	253
Tires	4,560
<b>Total</b>	<b>6,323<sup>a</sup></b>

<sup>a</sup>Weights have been rounded to nearest integer.

PCB = polychlorinated biphenyl

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

### **Radioactive Waste Management**

There were no radioactive waste shipments in 2018.

## **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 3-16](#). 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?tinmsys\\_is\\_number=296666&tinmsys\\_st\\_code=NV&nsnumber=NV0003014](https://ndwis.ndep.nv.gov/DWW/JSP/WaterSystemDetail.jsp?tinmsys_is_number=296666&tinmsys_st_code=NV&nsnumber=NV0003014)

Sampling parameters include (but are not limited to) total coliform, arsenic, nitrates, total trihalomethanes and haloacetic acids, 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 3-16.** SNL/TTR routine production well parameters

Analyte	Reporting Frequency
Coliform, total	Quarterly
Arsenic	Quarterly
Disinfectant, residual	Quarterly (checked daily)
Total trihalomethanes and haloacetic acids (5)	Annually
Di(2-ethylhexyl) phthalate (DEHP) <i>also known as Bis(2-ethylhexyl) phthalate</i>	As required by NDEP, usually every three years
Nitrate	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
Dioxin	As required by NDEP, usually every three years
Secondary (13) drinking water standards	As required by NDEP, usually every three years

IOC = inorganic compound

SOC = synthetic organic compound

NDEP = Nevada Division of Environmental Protection

VOC = volatile organic compound

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

There is also a Nevada Division of Environmental Protection-permitted treatment system for arsenic removal (permit number NV-3014 TP-11-12NTNC) 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 required to be between 6.5 and 7.0 on the pH scale for efficient and effective operation of the arsenic removal system, as defined by the Nevada Division of Environmental Protection permit.

### **Summary of Production Well Monitoring Activities and Results in 2018**

In 2018, 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 2018. 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 during 2018 was 4.82 ppb. The arsenic removal media was changed out in June 2018, and it usually lasts approximately five years before needing to be replaced.

During 2018, Production Well 6 produced 932,700 gallons of water that was chlorinated and sent to the elevated water storage tower. This equals an average monthly production of approximately 77,700 gallons during 2018. Daily production during 2018 averaged approximately 2,500 gallons.

### 3.9.2 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, Area 3 wastewater is sampled 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](#)).

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

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During 2018, 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 2018.”

### 3.9.3 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 2018. All other remaining septic tank systems have been closed or are undergoing closure and are being addressed by Environmental Restoration Project personnel.

#### **3.9.4 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.

#### **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



Wild Horses (*Equus ferus*), mare and colt

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**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. The Ecology Program helps operations comply with wildlife regulations and laws by providing biological evaluations and surveys in support of site activities.

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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 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 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 0.5 m) and is typified by shadscale (*Atriplex confertifolia*), budsage (*Artemisia spinescens*), winter fat (*Krascheninnikovia 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 0.5 m) 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. Of note, there is a small (half acre or less) man-made pond known as the Roller Coaster Construction Pond. The water from this pond is primarily used for dust suppression and construction at SNL/TTR. The vegetation associated with this pond is typical of a wetland. There are at least two naturally occurring ephemeral springs—Cactus Spring and Antelope Spring—within the DOE-controlled portion of SNL/TTR. These springs have been altered extensively by man over time. Portions of these springs stay wet enough throughout the year to support emergent vegetation and a few deciduous trees.

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

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#### 4.1.2 Wildlife

The wildlife that is known to occur at SNL/TTR is fairly typical of the Great Basin biogeographic province. Except for the Roller Coaster Construction Pond, there are no sites with fish at SNL/TTR. The fish in this pond are Tui Chub (*Gila bicolor*) and Mosquitofish (*Gambusia* spp.), which have been introduced.

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 (*Zenaidura 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 (*Zenaidura 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*), 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 Ground Squirrel (*Ammospermophilus leucurus*), Merriam 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 of these bat species primarily use caves, abandoned mines, trees, and buildings for roosts; they include Long-legged Myotis (*Myotis volans*), Fringe-tailed Myotis (*Myotis thysanodes*), California Myotis (*Myotis californicus*), Canyon Bat (*Parastrellus hesperus*), Townsend's Big-eared Bat (*Plecotus 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.

Surveys were conducted annually from 2004 through 2016 (with the exception of four years) during late spring (mid-May to early June). Scheduling conflicts (e.g., restricted site access during testing activities) prevented surveys in 2006, 2015, 2017, and again in 2018. From these surveys, 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 13 years that these surveys have been run, two bird species have been encountered at every survey location at least once (Horned Lark and Common Raven). Both of these species are year-round residents. Horned Larks are the most abundant species at SNL/TTR. On average across the 11 years and all the survey locations, 65 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 11 years, 9 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 (33 of the 114 species [29 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

Approximant Location of the Bird Surveys	Habitat Description
Antelope Peak (AP)	Scattered Joshua tree/juniper and mixed desert shrub
Antelope Spring (AS)	Mixed desert scrub (greater than or equal to 0.5 m), some grassland
Area 3 (A3)	Buildings and other structures
Area 9 (A9)	Dwarf shrub (less than or equal to 0.5 m)
Area 49 (A49)	Dwarf shrub (less than or equal to 0.5 m)
Cactus Spring (CS)	Scattered Joshua tree/juniper and mixed desert shrub <b>Note:</b> An ephemeral spring with emergent vegetation and two deciduous trees is close to one point of this survey.
Mellon Airstrip (MA)	Dwarf shrub (less than or equal to 0.5 m)
Roller Coaster Construction Pond (CP)	Small open water pond with emergent vegetation and numerous deciduous trees

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

**Table 4-2.** SNL/TTR bird species encountered

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
American Avocet	<i>Recurvirostra americana</i>						✓			✓
American Coot	<i>Fulica americana</i>						✓			
American Kestrel	<i>Falco sparverius</i>				✓					✓
American Pipit	<i>Anthus rubescens</i>						✓	✓		
American Robin	<i>Turdus migratorius</i>						✓	✓		
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>		✓							
Barn Swallow	<i>Hirundo rustica</i>	✓								✓
Belted Kingfisher	<i>Ceryle alcyon</i>						✓			
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>						✓			
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>						✓	✓		
Black-necked Stilt	<i>Himantopus mexicanus</i>						✓			✓
Black Phoebe	<i>Sayornis nigricans</i>						✓			
Black-throated Gray Warbler	<i>Setophaga nigrescens</i>						✓			
Black-throated Sparrow	<i>Amphispiza bilineata</i>		✓	✓	✓	✓		✓		
Blue-gray Gnatcatcher	<i>Poliptila caerulea</i>						✓			
Blue Grosbeak	<i>Passerina caerulea</i>						✓			
Bonaparte's Gull	<i>Chroicocephalus philadelphia</i>									✓
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>						✓	✓		
Brewer's Sparrow	<i>Spizella breweri</i>				✓	✓	✓	✓		
Brown-headed Cowbird	<i>Molothrus ater</i>						✓			
Bufflehead	<i>Bucephala albeola</i>									✓
Bullock's Oriole	<i>Icterus bullockii</i>			✓			✓	✓		
Burrowing Owl	<i>Athene cunicularia</i>									✓
Calliope Hummingbird	<i>Selasphorus calliope</i>							✓		
Canvasback	<i>Aythya valisineria</i>									✓
Canyon Wren	<i>Catherpes mexicanus</i>				✓			✓		
Cassin's Kingbird	<i>Tyrannus vociferans</i>		✓							
Cassin's Sparrow	<i>Peucaea cassinii</i>				✓					
Cassin's Vireo	<i>Vireo cassinii</i>						✓			
Chipping Sparrow	<i>Spizella passerina</i>						✓	✓		
Chukar	<i>Alectoris chukar</i>				✓			✓		
Cinnamon Teal	<i>Anas cyanoptera</i>						✓			
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	✓					✓			✓
Common Raven	<i>Corvus corax</i>	✓	✓	✓	✓	✓		✓	✓	✓
Common Yellowthroat	<i>Geothlypis trichas</i>						✓			
Cooper's Hawk	<i>Accipiter cooperii</i>						✓			
Dusky Flycatcher	<i>Empidonax oberholseri</i>						✓	✓		
Eared Grebe	<i>Podiceps nigricollis</i>									✓
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>	✓					✓			
European Starling	<i>Sturnus vulgaris</i>	✓					✓			

Table continued on next page

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

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
Ferruginous Hawk	<i>Buteo regalis</i>									✓
Gadwall	<i>Anas strepera</i>						✓			✓
Golden Eagle	<i>Aquila chrysaetos</i>			✓				✓		✓
Gray Flycatcher	<i>Empidonax wrightii</i>						✓	✓		
Great Egret	<i>Ardea alba</i>						✓			✓
Great Horned Owl	<i>Bubo virginianus</i>	✓	✓							
Great-tailed Grackle	<i>Quiscalus mexicanus</i>	✓					✓			
Green-tailed Towhee	<i>Pipilo chlorurus</i>				✓					
Green-winged Teal	<i>Anas crecca</i>						✓			✓
Hermit Thrush	<i>Catharus guttatus</i>						✓			
Herring Gull	<i>Larus argentatus</i>									✓
Horned Grebe	<i>Podiceps auritus</i>									✓
Horned Lark	<i>Eremophila alpestris</i>	✓	✓	✓	✓	✓	✓	✓	✓	✓
House Finch	<i>Carpodacus mexicanus</i>	✓				✓		✓		
House Sparrow	<i>Passer domesticus</i>	✓								✓
House Wren	<i>Troglodytes aedon</i>						✓			
Killdeer	<i>Charadrius vociferus</i>						✓			
Ladder-backed Woodpecker	<i>Picoides scalaris</i>							✓		
Lark Sparrow	<i>Chondestes grammacus</i>	✓	✓				✓			
Lazuli Bunting	<i>Passerina amoena</i>					✓	✓			
Lincoln's Sparrow	<i>Melospiza lincolnii</i>						✓			
Loggerhead Shrike	<i>Lanius ludovicianus</i>		✓	✓	✓	✓		✓		
MacGillivray's Warbler	<i>Geothlypis tolmiei</i>						✓			
Mourning Dove	<i>Zenaida macroura</i>	✓					✓	✓		
Nashville Warbler	<i>Oreothlypis ruficapilla</i>						✓			
Northern Mockingbird	<i>Mimus polyglottos</i>		✓		✓	✓		✓		
Northern Pintail	<i>Anas acuta</i>						✓			✓
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	✓					✓			✓
Northern Shoveler	<i>Anas clypeata</i>						✓			
Northern Waterthrush	<i>Parkesia noveboracensis</i>						✓			
Olive-sided Flycatcher	<i>Contopus cooperi</i>				✓		✓			
Orange-crowned Warbler	<i>Oreothlypis celata</i>						✓			
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>						✓			
Palm Warbler	<i>Setophaga palmarum</i>						✓			
Pine Siskin	<i>Carduelis pinus</i>							✓		
Prairie Falcon	<i>Falco mexicanus</i>				✓	✓	✓		✓	
Redhead	<i>Aythya americana</i>									✓
Red-tailed Hawk	<i>Buteo jamaicensis</i>	✓	✓	✓	✓		✓			✓
Red-winged Blackbird	<i>Agelaius phoeniceus</i>						✓			
Ring-billed Gull	<i>Larus delawarensis</i>									✓
Rock Wren	<i>Salpinctes obsoletus</i>				✓	✓		✓		
Ruby-crowned Kinglet	<i>Regulus calendula</i>			✓			✓	✓		

Table continued on next page

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

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
Sagebrush Sparrow	<i>Artemisiospiza nevadensis</i>		✓			✓			✓	
Sage Thrasher	<i>Oreoscoptes montanus</i>				✓	✓		✓		
Savannah Sparrow	<i>Passerculus sandwichensis</i>						✓		✓	
Say's Phoebe	<i>Sayornis saya</i>	✓	✓						✓	
Scott's Oriole	<i>Icterus parisorum</i>				✓			✓		
Sharp-shinned Hawk	<i>Accipiter striatus</i>						✓			
Snowy Egret	<i>Egretta thula</i>						✓			✓
Sora	<i>Porzana carolina</i>						✓			
Spotted Sandpiper	<i>Actitis macularius</i>						✓			✓
Spotted Towhee	<i>Pipilo maculatus</i>						✓			
Summer Tanager	<i>Piranga rubra</i>						✓			
Swainson's Hawk	<i>Buteo swainsoni</i>	✓		✓	✓					✓
Townsend's Warbler	<i>Setophaga townsendi</i>						✓	✓		
Tree Swallow	<i>Tachycineta bicolor</i>	✓					✓			✓
Turkey Vulture	<i>Cathartes aura</i>	✓	✓				✓		✓	
Vermilion Flycatcher	<i>Pyrocephalus rubinus</i>						✓			
Vesper Sparrow	<i>Poocetes gramineus</i>			✓				✓		
Violet-green Swallow	<i>Tachycineta thalassina</i>	✓	✓				✓			✓
Virginia Rail	<i>Rallus limicola</i>						✓			
Virginia's Warbler	<i>Oreothlypis virginiae</i>						✓			
Warbling Vireo	<i>Vireo gilvus</i>						✓			
Western Kingbird	<i>Tyrannus verticalis</i>	✓	✓	✓						
Western Tanager	<i>Piranga ludoviciana</i>				✓		✓			
Western Wood Pewee	<i>Contopus sordidulus</i>				✓	✓	✓	✓		
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>				✓		✓	✓	✓	
White-faced Ibis	<i>Plegadis chihi</i>									✓
White-winged Dove	<i>Zenaida asiatica</i>	✓					✓			
Wilson's Phalarope	<i>Phalaropus tricolor</i>						✓			✓
Wilson's Warbler	<i>Cardellina pusilla</i>						✓	✓		
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>						✓		✓	
Yellow-rumped Warbler	<i>Setophaga coronata</i>			✓	✓		✓	✓	✓	
Yellow Warbler	<i>Setophaga petechia</i>						✓	✓		

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

### 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). [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*), spiny star/bee hive 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.

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

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
<b>Plants</b>				
Amargosa niterwort	<i>Nitrophila mohavensis</i>	Endangered	Endangered	
armored hedgehog cactus	<i>Echinocereus engelmannii</i> var. <i>armatus</i>	—	Protected	
Ash Meadows blazingstar	<i>Mentzelia leucophylla</i>	Threatened	Endangered	
Ash Meadows gumplant	<i>Grindelia fraxinipratensis</i>	Threatened	Endangered	
Ash Meadows milkvetch	<i>Astragalus phoenix</i>	Threatened	Endangered	
Ash Meadows mousetails	<i>Ivesia kingii</i> var. <i>eremica</i>	Threatened	Endangered	
Ash Meadows sunray	<i>Enceliopsis nudicaulis</i> var. <i>corrugata</i>	Threatened	Endangered	
Blaine's pincushion	<i>Sclerocactus blainei</i>	—	Protected	
branched pencil cholla	<i>Cylindropuntia ramosissima</i>	—	Protected	✓
Clokey pincushion	<i>Coryphantha vivipara</i> var. <i>rosea</i>	—	Protected	
cottontop cactus	<i>Echinocactus polycephalus</i>	—	Protected	✓
Eastwood milkweed	<i>Asclepias eastwoodiana</i>	—	Protected	✓
Joshua tree	<i>Yucca brevifolia</i>	—	Protected	✓
Mojave barrel cactus	<i>Ferocactus cylindraceus</i> var. <i>lecontei</i>	—	Protected	
mountain cactus	<i>Pediocactus simpsonii</i>	—	Protected	
Nye pincushion cactus	<i>Sclerocactus nyensis</i>	—	Protected	
old-man prickly-pear	<i>Opuntia erinacea</i>	—	Protected	✓
pineapple cactus	<i>Sclerocactus polyancistrus</i>	—	Protected	✓
sand/sagebrush cholla	<i>Grusonia pulchella</i>	—	Protected	✓
silver cholla	<i>Cylindropuntia echinocarpa</i>	—	Protected	✓
Sodaville milkvetch	<i>Astragalus lentiginosus</i> var. <i>sesquimetralis</i>	—	Endangered	
spiny star/bee hive cactus	<i>Escobaria vivipara</i>	—	Protected	✓
spring-loving centaury	<i>Centaurium namophilum</i>	Threatened	Endangered	

Table continued on next page

**Table 4-3.** Federally listed and state-listed threatened and endangered species and other 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
<b>Plants (continued)</b>				
sunnyside green gentian	<i>Frasera gypsicola</i>	—	Endangered	
Williams combleaf	<i>Polyctenium williamsiae</i>	—	Endangered	
<b>Animals</b>				
<b>Invertebrates</b>				
Ash Meadows Naucorid	<i>Ambrysus amargosus</i>	Threatened	—	
<b>Fishes</b>				
Ash Meadows Amargosa Pupfish	<i>Cyprinodon nevadensis mionectes</i>	Endangered	Threatened	
Ash Meadows Speckled Dace	<i>Rhinichthys osculus nevadensis</i>	Endangered	Endangered	
Big Smoky Valley Speckled Dace	<i>Rhinichthys osculus lariversi</i>	—	Sensitive	
<b>Fishes (continued)</b>				
Big Smoky Valley Tui Chub	<i>Gila bicolor</i> spp. 8	—	Sensitive	
Devils Hole Pupfish	<i>Cyprinodon diabolis</i>	Endangered	Endangered	
Lahontan Cutthroat Trout	<i>Oncorhynchus clarkii henshawi</i>	Threatened	Threatened	
Moapa dace	<i>Moapa coriacea</i>	Endangered	Endangered	
Monitor Valley Speckled Dace	<i>Rhinichthys osculus</i> spp. 5	—	Sensitive	
Moorman White River Springfish	<i>Crenichthys baileyi thermophilus</i>	—	Protected	
Oasis Valley Speckled Dace	<i>Rhinichthys osculus</i> spp. 6	—	Sensitive	
Railroad Valley Springfish	<i>Crenichthys nevadae</i>	Threatened	Threatened	
Railroad Valley Tui Chub	<i>Gila bicolor</i> spp. 7	—	Sensitive	
Warm Springs Amargosa Pupfish	<i>Cyprinodon nevadensis pectoralis</i>	Endangered	Endangered	
White River Desert Sucker	<i>Catostomus clarkii intermedius</i>	—	Protected	
White River Spinedace	<i>Lepidomeda albivallis</i>	Endangered	Endangered	
<b>Reptiles/Amphibians</b>				
Amargosa Toad	<i>Anaxyrus nelsoni</i>	—	Protected	
Columbia Spotted Frog	<i>Rana luteiventris</i>	—	Protected	
Gila Monster	<i>Heloderma suspectum</i>	—	Protected	
<b>Reptiles (continued)</b>				
Mojave Desert Tortoise	<i>Gopherus agassizii</i>	Threatened	Threatened	
Northern Leopard Frog	<i>Lithobates pipiens</i>	—	Protected	
Sonoran Mountain Kingsnake	<i>Lampropeltis pyromelana</i>	—	Protected	
<b>Mammals</b>				
Allen's Big-eared Bat	<i>Idionycteris phyllotis</i>	—	Protected	
American Pika	<i>Ochotona princeps</i>	—	Protected	
Ash Meadows Montane Vole	<i>Microtus montanus nevadensis</i>	—	Sensitive	
California Leaf-nosed Bat	<i>Macrotus californicus</i>	—	Sensitive	
Dark Kangaroo Mouse	<i>Microdipodops megacephalus</i>	—	Protected	
Fringed myotis	<i>Myotis thysanodes</i>	—	Protected	
Mexican Free-tailed Bat	<i>Tadarida brasiliensis</i>	—	Protected	
Pale Kangaroo Mouse	<i>Microdipodops pallidus</i>	—	Protected	
Pallid Bat	<i>Antrozous pallidus</i>	—	Protected	
Palmer's Chipmunk	<i>Neotamias palmeri</i>	—	Sensitive	

Table continued on next page

**Table 4-3.** Federally listed and state-listed threatened and endangered species and other 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
<b>Animals (continued)</b>				
Spotted Bat	<i>Euderma maculatum</i>	—	Threatened	
Townsend’s Big-eared Bat	<i>Corynorhinus townsendii</i>	—	Sensitive	
Western Red Bat	<i>Lasiurus blossevillii</i>	—	Sensitive	
<b>Birds</b>				
Bald Eagle	<i>Haliaeetus leucocephalus</i>	—	Endangered	
Brewer’s Sparrow	<i>Spizella breweri</i>	—	Sensitive	✓
Golden Eagle	<i>Aquila chrysaetos</i>	—	Sensitive	✓
Loggerhead Shrike	<i>Lanius ludovicianus</i>	—	Sensitive	✓
Northern Goshawk	<i>Accipiter gentilis</i>	—	Sensitive	
Peregrine Falcon	<i>Falco peregrinus</i>	—	Endangered	
Sage Thrasher	<i>Oreoscoptes montanus</i>	—	Sensitive	✓
Southwestern Willow Flycatcher	<i>Empidonax traillii extimus</i>	Endangered	Endangered	
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	Threatened	Sensitive	
Yuma Clapper Rail	<i>Rallus longirostris yumanensis</i>	Endangered	Endangered	

— = no designation

ESA = Endangered Species Act

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

## Chapter 5. SNL/TTR Quality Assurance



Mountains at SNL/TTR

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**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.

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Sandia personnel take responsibility and assume accountability for implementing quality assurance for operations as specified in ISO 9001 (ISO 2008), the Contractor Requirements Document of DOE O 414.1D (DOE O 414.1D Admin Change 1), *Quality Assurance*, and in Title 10 CFR Part 830 (10 CFR 830), *Nuclear Safety Management*, 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 sample collection, sample preservation and handling, sample control, laboratory quality control, required limits of detection, field quality control, health and safety, schedules and frequency of sampling, data review, 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, personnel provide guidance and sample management support for field activities. However, program leads are responsible for each distinct 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. The 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 (QAPP) for the Sample Management Office (SNL/NM 2016b)*. 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 2018c). 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. Additionally, 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 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, 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 the 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.

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

## **5.2 Sample Management Office Activities in 2018**

Sample Management Office activities in 2018 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 2018, Sample Management Office personnel processed 192 samples in support of the SNL/TTR Terrestrial Surveillance Program. Of the 192 samples, 26 samples were submitted as field and analytical quality control samples to assist with data validation and decision-making.

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In 2018, Sample Management Office personnel processed 192 samples in support of the SNL/TTR Terrestrial Surveillance Program.

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During 2018, 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 2018, 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 how 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 Department of Defense/DOE *Consolidated Quality Systems Manual (QSM) for Environmental Laboratories* (DoD/DOE 2017).

In 2018, DOECAP and/or the accrediting bodies conducted assessments at six 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 2018 in DOECAP assessment reports or other applicable DOE programs.

# PART TWO



## SANDIA NATIONAL LABORATORIES KAUA'I TEST FACILITY, HAWAI'I

## Chapter 6. SNL/KTF Introduction



Napali coast of Kaua'i

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**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.

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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:

<http://www.sandia.gov/news/publications/environmental/index.html>

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 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 2108. While all 2018 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).

### 6.1 Mission

Sandia National Laboratories—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—anticipates and resolves emerging national security challenges, innovates and discovers new technologies to strengthen the nation's

technological superiority, creates value through products and services that solve important national security challenges, and informs 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>

### 6.1.1 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 Environmental Management System 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](#)). An internal assessment is conducted every three years to verify implementation. A SNL/KTF assessment was conducted in 2018.

## 6.2 History

On November 1, 1949, Sandia Corporation, a wholly owned subsidiary of Western Electric, began managing 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, Sandia became a wholly owned subsidiary of Honeywell International Inc.

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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.

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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 2018, SNL/KTF personnel have supported 104 launches from SNL/KTF, the Pacific Missile Range Facility, and other mission assets.

The 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 6-1]) 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.

### 6.3 Location Description

KTF is on the western coast of Kaua'i, Hawai'i. SNL/KTF is a tenant of the DoD Pacific Missile Range Facility, and is located within the boundaries of the Pacific Missile Range Facility. The facility 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 6-1).

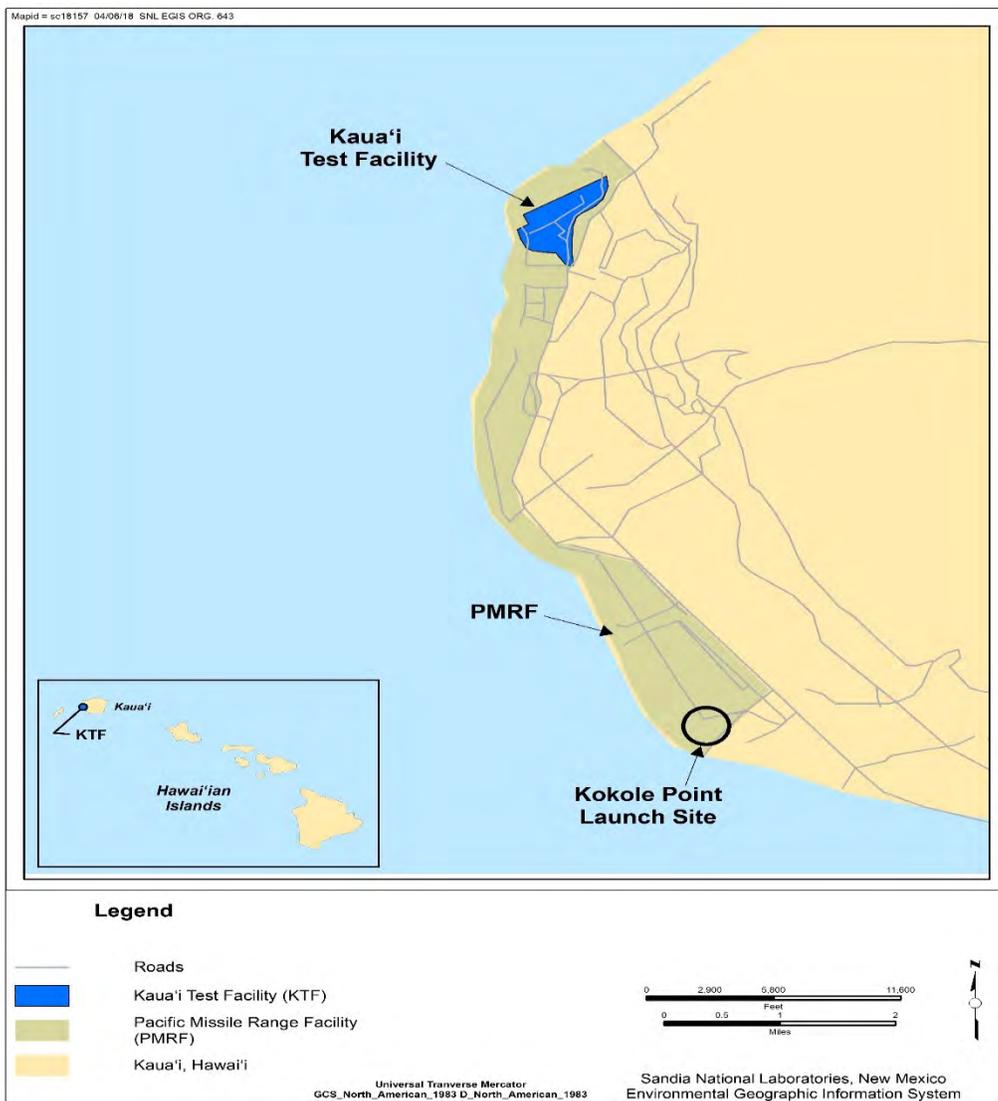


Figure 6-1. KTF location on Kaua'i, Hawai'i

### 6.4 Demographics

There were 15 permanent on-site personnel at SNL/KTF in 2018. 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](#)), approximately ten miles southeast of the site.

## 6.5 Activities and Facilities

SNL/KTF has been an active rocket-launching facility since 1962. The 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 customer(s), defense contractor personnel, and technical staff from SNL/NM; general maintenance activities are performed during noncampaign operations. Additionally, 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 2019. The Kokole Point launch complex and associated facilities were transferred to the U.S. Navy in 2013.

### 6.5.1 Rocket Launches in 2018

SNL/KTF personnel supported six rocket launches in 2018. The launches were 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](#)) and include the following:

- March 8, 2018, Aegis Ballistic Missile Defense, AMDR-CZ (launched from the Pacific Missile Range Facility)
- May 23, 2018, Sandia National Laboratories, High Operation Tempo Flight 1 (launched from SNL/KTF)
- August 8, 2018, Aegis Ballistic Missile Defense, Pac Dragon 18 (launched from the Pacific Missile Range Facility)
- September 11, 2018, Aegis Ballistic Missile Defense, Pac Dragon 18 (launched from SNL/KTF)
- September 12, 2018, Missile Defense Agency, JFTM-05 Event 1 (launched from SNL/KTF)
- October 26, 2018, Missile Defense Agency, FTM-45 (launched from the Pacific Missile Range Facility)

## 6.6 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 1992a).

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

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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.

### 6.6.1 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 in 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, but slightly dissected remnants are occupied by the Alakaʻi Swamp.

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).

### 6.6.2 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). There are no groundwater wells located on SNL/KTF.

### 6.6.3 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.

#### 6.6.4 Climate

The climate at SNL/KTF is typical of maritime subtropical islands. Average yearly temperatures range between 84°F and 69°F. August is the warmest month of the year, with daytime highs averaging 85°F and lows averaging 75°F. January is the coolest month, with daytime highs averaging 78°F and lows averaging 65°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 22 inches. The wet season generally starts in November and extends into March. June and July are the driest months of the year, when less than one-half an inch of rain is recorded for each month ([WRRC 2019](#)).

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 last direct impact and most destructive hurricane to hit Kauaʻi was Hurricane Iniki in September 1992.

## Chapter 7. SNL/KTF Compliance Summary



Green Sea Turtle (*Chelonia mydas*) off the coast of Kaua'i

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**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.

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Sandia operations at SNL/KTF are in compliance 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 under the ES&H policy, which includes the following statement:

Sandia performs work safely, in a safe and environmentally responsible manner to ensure adequate protection for the Members of the Workforce, the public, and the environment; is accountable for the safe and environmentally responsible performance of work; exercises a degree of care commensurate with the work and the associated hazards; and integrates environment, safety, and health into work planning and execution.

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, 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.

## 7.1 Environmental Management System

Sandia management takes the responsibility of protecting the environment seriously and requires employees, contractors, and visitors to prevent pollution and conserve natural resources by adhering to the ES&H policy. An Environmental Management System is used to establish objectives and targets that address environmental impacts and increase operating efficiencies through a continuing cycle of planning, implementing, evaluating, and improving programs and processes.

DOE O 436.1, *Departmental Sustainability*, was established to ensure that environmental management systems and site sustainability (Section 7.2) are at the forefront of environmental excellence. This directive is implemented through an ISO 14001-certified (ISO 2004) Environmental Management System. 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 Environmental Management System was recertified under the new ISO 14001:2015 standard (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 personnel follow the management approach of the ISO standard. An Environmental Management System ISO 14001:2004 assessment of SNL/KTF operations was completed in January 2018. Additional information can be found at the following external Environmental Management System website:

*[www.sandia.gov/about/environment/environmental\\_management\\_system/index.html](http://www.sandia.gov/about/environment/environmental_management_system/index.html)*

The Environmental Management System 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 2018, the Environmental Management System identified that natural resource use, hazardous materials use, and hazardous waste generation continue to be the top three significant aspects for Sandia operations. When significant aspects and negative impacts have been identified, objectives and measurable targets—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts).

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*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.*

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## 7.2 Site Sustainability Plan

A Site Sustainability Plan is prepared annually to assist DOE in meeting the current DOE *Strategic Sustainability Performance Plan* (DOE 2016) goals and the broader sustainability program set forth in EO 13834, *Efficient Federal Operations* (EO 13834). Sandia's most recent plan, *FY 2019 Site Sustainability Plan* (SNL/NM 2018a), describes the performance status for FY 2018. Additional information about pollution prevention activities is provided in Chapter 8.

Sustainability goals are being met or exceeded in several key areas. [Table 7-1](#) presents performance status for several selected key areas (SNL/NM 2018a).

**Table 7-1.** Site Sustainability Plan performance status for key areas

DOE Strategic Sustainability Performance Plan and Goal/Sandia Objective	Sandia Performance Status through FY 2018
<b>Greenhouse Gas Reduction</b>	
<p>Reduce Scope 1 and Scope 2 greenhouse gas emissions by 50% relative to a FY 2008 baseline by FY 2025.</p> <p>Reduce Scope 3 greenhouse gas emissions by 25% relative to a FY 2008 baseline by FY 2025.</p>	<p>Met this objective by reducing Scope 1 and Scope 2 greenhouse gas emissions by 59% relative to a FY 2008 baseline.</p> <p>The Scope 3 greenhouse gas goal is not on track; emissions have continued to increase in parallel with site population and air travel increases. There was a 39% increase in FY 2018 relative to the FY 2008 baseline.</p>
<b>Sustainable Buildings</b>	
<p>Reduce energy intensity in goal-subject buildings by 25% relative to a FY 2015 baseline by 2025.</p>	<p>Met this objective by reducing energy intensity 3.76% in FY 2018 relative to a FY 2015 revised baseline for goal-subject buildings.</p>
<p>Comply with the revised guiding principles for High Performance and Sustainable Buildings for at least 17% (by building count) of existing buildings greater than 5,000 gross square feet by FY 2025, with progress to 100% thereafter.</p>	<p>Met this objective with 17% of buildings, by gross square feet, achieving 2008 guiding principles and therefore being “grandfathered.”</p>
<b>Clean and Renewable Energy</b>	
<p>Use no less than 10% clean energy in FY 2017, working toward a 25% reduction by FY 2025.</p>	<p>Met this objective by purchasing renewable energy credits in FY 2018.</p>
<b>Water Use Efficiency and Management</b>	
<p>Reduce potable water intensity by 36% relative to a FY 2007 baseline by FY 2025.</p>	<p>Exceeded this objective with a 27% decrease in potable water intensity in FY 2018 relative to an FY 2007 baseline.</p>
<b>Fleet Management</b>	
<p>Acquire light-duty vehicles, 75% of which must be alternative fuel vehicles.</p>	<p>Met this objective in FY18.</p>
<b>Sustainable Acquisition</b>	
<p>Promote sustainable acquisition and procurement to the maximum extent practicable, ensuring that BioPreferred and biobased provisions and clauses are included in 95% of applicable contracts.</p>	<p>Efforts are underway to improve the promotion of sustainable acquisition and procurement, including establishing a process to ensure that the appropriate provisions are included in 95% of applicable contracts.</p>
<b>Pollution Prevention and Waste Reduction</b>	
<p>Divert at least 50% of nonhazardous solid waste and construction and demolition debris.</p>	<p>Met this objective by diverting 68% of nonhazardous solid waste and 84% of construction and demolition waste from landfills.</p>
<b>Electronic Stewardship</b>	
<p>Purchase eligible acquisitions so that 95% are EPEAT-registered products each year.</p>	<p>Met this objective with 99.93% of eligible electronics acquisitions being EPEAT-registered products in FY 2018.</p>
<b>Organizational Resilience</b>	
<p>Discuss overall integration of climate resilience in emergency response, workforce, and operations procedures and protocols.</p>	<p>Began to meet this objective by developing a Climate Change Vulnerability Assessment in FY 2018. This will aide in developing a future climate change resilience plan to meet this objective.</p>

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

FAST = Federal Automotive Statistical Tool  
 FY = fiscal year

On May 17, 2018, EO 13834, *Efficient Federal Operations*, was signed, affirming 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*.

## 7.3 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 regulation 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 2018, the management and operating contractor adhered to the requirements cited below for SNL/KTF operations.

### 7.3.1 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 consider human health and environmental issues associated with proposed actions, be aware of the potential environmental impacts associated with these issues 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* ([DOE 2011](#)).

##### **Compliance Status**

Section [8.6](#) 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, clean-up, and emergency response for inactive hazardous waste sites at all federal facilities. CERCLA also establishes a program to report spills of hazardous substances to the National Response Center (with relevant SNL/KTF information included under the heading of Chemical Management).

##### **Compliance Status**

EPA designated ongoing oversight of SNL/KTF to the 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 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 an EPA-permitted facility.

#### **Compliance Status**

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

Section [8.9](#) provides information on waste management.

#### **Resource Conservation and Recovery Act (RCRA), enacted in 1976, Subtitle I**

Subtitle I of RCRA, which was added in 1984, regulates the storage of petroleum products in underground storage tanks to prevent potential releases that could impact groundwater or otherwise damage environmental resources.

Under RCRA, the EPA has delegated authority to the Hawai'i Department of Health to administer the underground storage tank regulatory program in Hawai'i.

#### **Compliance Status**

The single SNL/KTF underground storage tank is regulated under the Hawai'i Administrative Rules, Title 11, Chapter 281, *Underground Storage Tanks* ([References](#), "State of Hawai'i Environmental Regulations").

Section [8.7](#) provides information regarding oil storage.

## **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**

Not applicable as operations do not (currently or in the past) involve radioactive materials (Section [6.5](#)).

## **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 regulate air pollutants from stationary and mobile sources and to establish ambient air quality standards.

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

#### **Compliance Status**

Compliance is achieved by adherence to permit requirements.

Section [8.1](#) 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 U.S. waters; protecting fish, wildlife, and recreation; and reducing pollutant discharges.

#### **Compliance Status**

Wastewater is managed under state-registered septic tanks. There are no stormwater compliance requirements for SNL/KTF (Section [8.10.1](#)).

Section [8.10](#) 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**

Section 8.10.1 provides information on the Stormwater Program.

#### **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**

Operations at SNL/KTF are conducted under the Pacific Missile Range Facility Spill Prevention, Control, and Countermeasure Plan.

Section 8.7 provides information regarding 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 U.S., focusing on all waters actually or potentially designed for drinking use, whether from aboveground or underground sources.

##### **Compliance Status**

All drinking water at the site is either supplied by the Pacific Missile Range Facility drinking water system or purchased from commercial suppliers.

## **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 chemical usage and releases for federal, state, and local governments and industry. These provisions help increase the public's knowledge and access to information on chemicals at a facility, their uses, and releases into the environment.

##### **Compliance Status**

In 2018, there were no reportable quantity releases of extremely hazardous substances requiring notification.

Table 7-2 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 U.S.

##### **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 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 8.9 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 2018, biological surveys were conducted as needed and no impact to endangered species were identified. [Chapter 9](#) provides information about threatened or endangered species potentially occurring on Kaua'i.

### **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 furtherance of the provisions of this chapter.”

A Memorandum of Understanding is in place between the U.S. Department of Energy and the U.S. Fish and Wildlife Service Regarding Implementation of Executive Order 13186, “Responsibilities of Federal Agencies to Protect Migratory Birds” was signed in 2013. This strengthens migratory bird conservation through enhanced collaboration between the two federal agencies in coordination with state, tribal, and local governments. This collaboration will contribute substantially to the conservation and management of migratory birds and their habitats.

#### **Compliance Status**

Compliance is achieved through avian surveys, as needed. In 2018, no surveys were conducted.

[Chapter 9](#) 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 U.S. and Great Britain (for Canada), and later amendments implemented treaties between the U.S. and Mexico, the U.S. and Japan, and the U.S. 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 for bird surveys. In 2018, there were no avian surveys conducted, as planned activities at the site did not require a survey.

[Chapter 9](#) provides information on compliance with the 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 U.S.

**Compliance Status**

In 2018, compliance was achieved by adherence with the Memorandum of Understanding between the U.S. Department of Energy and the U.S. Fish and Wildlife Service.

[Chapter 9](#) provides information on the Ecology Program.

**EO 11988 of 1977, Floodplain Management, as amended**

This act 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 the site are within designated floodplains ([Hawai'i 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.

## Cultural Resources

**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 archaeological sites, and appropriate documentation is undertaken to mitigate adverse effects when necessary. In 2018, there were no activities that required interaction with any Native Hawaiians.

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

This act governs excavation 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 undertaken to mitigate adverse effects when necessary. In 2018, local archaeological monitors (Native Hawaiians meeting specific criteria) were contracted for the monitoring of all ground disturbance activities.

**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.

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.

**Compliance Status**

Planning through the NEPA process identifies potential impacts to these sites, and appropriate documentation is undertaken to mitigate adverse effects when necessary. In 2018, no historic properties were threatened, and no buildings previously unassessed were modified or demolished.

Section [7.3.2](#) provides information on cultural resource activities.

**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 these sites, and appropriate documentation is undertaken to mitigate adverse effects when necessary. In 2018, there were no cultural items discovered or excavated.

**Quality Assurance**

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

This order is 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 products and services meet or exceed customer requirement/expectations.

**Compliance Status**

All environmental sampling and analysis that was conducted in 2018 conformed to applicable quality assurance plans.

Chapter 10 provides information on quality assurance.



Kaua'i, Hawai'i

**Table 7-2. SNL/KTF applicable EPCRA reporting requirements, 2018**

Section	EPCRA Section Title	Requires Reporting?		Description
		Yes	No	
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. In addition, safety data sheets must be recorded for each chemical entry.
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

### 7.3.2 Cultural Resources

Cultural resources are protected at SNL/KTF. NEPA Program personnel coordinate cultural resources compliance; this includes historic buildings and archeological sites. 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 impacts. In 2018, no historic properties were threatened, and no buildings previously unassessed were modified or demolished. However, planning and negotiation were undertaken to transfer the properties Sandia personnel use on Mt. Haleakala from DOE to another federal agency. DOE consultation with the Hawai'i State Historic Preservation Officer is completed regarding the historic status of the properties at the site, but discussion is ongoing regarding methods of removal and cleanup of minor structures that will be demolished.

## 7.4 Environmental Permit Status

Table 7-3 lists the applicable permits in effect at SNL/KTF in 2018.

**Table 7-3.** SNL/KTF permits, 2018

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

## 7.5 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 *FY18 DOE/NNSA Strategic Performance Evaluation Measurement Plan (PEMP)* (DOE/NNSA/SFO 2018a). Subsequently, the DOE National Nuclear Security Administration Sandia Field Office prepared the annual *National Technology & Engineering Solutions of Sandia Performance Evaluation Report (PER)* (DOE/NNSA/SFO 2018a), assessing the management and operating contractor performance for May 1, 2017, through September 30, 2018. NTESS earned an excellent rating during this performance period. Two items of note related to environmental programs were as follows:

- Accomplishment—The Environmental Management System continued to maintain a mature and compliant program as demonstrated by its completion of the ISO 14001:2015 recertification ahead of schedule.
- Issue—NTESS line implementation of NEPA is inconsistent. As a result, management took positive steps and increased leadership attention to ensure that NEPA reviews are performed early in the program and project planning process.

### 7.5.1 Occurrence Reporting in 2018

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. There were no DOE O 232.2A reportable occurrences at SNL/KTF in 2018.

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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.”

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## Chapter 8. SNL/KTF Environmental Programs



Sunset in Hawai'i

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

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Sandia personnel collect data at SNL/KTF to determine and report the impact of existing operations on the environment. These environmental programs 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 9](#).

## 8.1 Air Quality Compliance Program

As required, the 2018 Annual Emissions Report for air emissions was submitted to the State of Hawai'i (DOE/NNSA/SFO 2018b). The annual fee was submitted to the State of Hawai'i for 2018, 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 III, "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.

Additionally, two monitoring reports for the Noncovered Source Permit were submitted to the State of Hawai'i for 2018 operations within required timelines (DOE/NNSA/SFO 2018b; DOE/NNSA/SFO 2017b). The highest total combined operating hours for a rolling 12-month period was 3,233.7 hours, which occurred in the period from December 2017 to January 2018.

## 8.2 Chemical Information System

The Chemical Information System is a comprehensive tool used to track workplace chemical and biological containers by location. State and federal regulations are the primary drivers for the Chemical Information System, 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 115,000 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.

## 8.3 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 2018, environmental impacts of three projects were reviewed and documented.

## 8.4 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 restoration 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.

## 8.5 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 the 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.

## 8.6 National Environmental Policy Act Program

NEPA Program personnel provide DOE with technical assistance in support of Sandia compliance with NEPA and the National Historic Preservation Act. The NEPA team reviews projects for conformance with existing DOE NEPA documents and determinations. NEPA Docs software is used to facilitate NEPA reviews and quality assurance activities by providing a consistent framework for reporting and making NEPA documentation readily available for reference.

In 2018, 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 five NEPA checklists for SNL/KTF, four of which were transmitted to the DOE National Nuclear Security Administration Sandia Field Office for review and completion. The Kaua'i Test Facility Site-Wide Environmental Assessment draft was completed and submitted in December 2018 for a 30-day public comment period. Publication of the final environmental assessment is anticipated in 2019.



*Pritchardia* spp.

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## 8.7 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 include:

- Four 55-gallon drums used for oil collection and storage
- 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); the portable generator is new to SNL/KTF in 2018

In 2018, the aboveground diesel fuel storage tank was inspected in accordance with the Steel Tank Institute's *SP001 "Standard for the Inspection of Aboveground Storage Tanks"*. Although the integrity of the tank was determined to be in "fair" condition, the age and lack of manufacturing specifications for the tank resulted in a decision to pursue replacement in the future.

In addition, a single underground gasoline storage tank (2,500 gallons) 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 system is inspected annually in accordance with requirements.

### 8.7.1 Oil Storage Program Results in 2018

There were no reportable oil spills or releases at SNL/KTF in 2018.

## 8.8 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. In 2000, a single analytical laboratory with lower detection capabilities for many of the metals was contracted. Therefore, only data from 2002 to the present is used for the evaluation presented here.

### 8.8.1 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. Past or present operations at SNL/KTF do not involve radioactive materials. As a best management practice, samples are collected for metals analysis to determine whether these metals pose a risk to human health and the environment.

The Terrestrial Surveillance Program is also conducted to satisfy implementation of Sandia's Environmental Management System, which is certified to the ISO 14001:2015 standard. Reporting is done in accordance with [DOE O 231.1B, Admin Change 1, Environment, Safety and Health Reporting](#).

### 8.8.2 Sample Locations and Media

Terrestrial Surveillance Program personnel use two sample location classifications: on-site and off-site (the latter was previously referred to as community locations).

The on-site sampling locations (Figure 8-1) are in areas of known contamination and areas of potential release (sites with current outdoor testing activities).

The off-site sample locations were selected to provide a measurement of environmental conditions unaffected by SNL/KTF activities. The off-site locations were discontinued prior to the 2018 sampling event due to land access restrictions. Historical off-site sample results are used for comparison to the on-site sample results.

The sample media consists of surface soil (less than two inches deep), which is collected at designated locations.

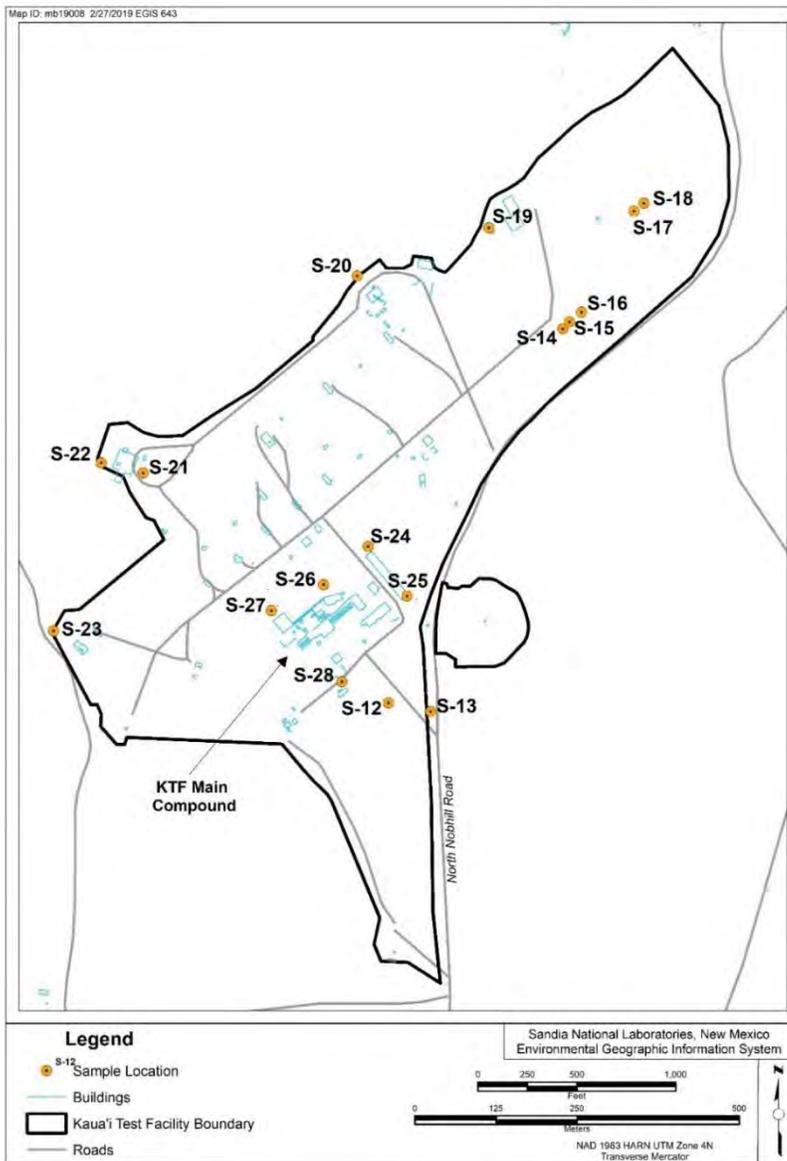


Figure 8-1. Terrestrial Surveillance Program on-site sampling locations

### 8.8.3 Field Methods, Analytical Parameters, and Quality Control Procedures

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

An off-site laboratory 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). Samples were analyzed for the following metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

Field quality control samples were collected and included triplicate environmental samples and equipment blank samples. These samples were prepared in accordance with applicable field operating procedures. Laboratory quality control samples are prepared and analyzed as specified in [Chapter 10](#).

### 8.8.4 Sample Results Analysis and Methodology

Statistical analyses are conducted to compare on-site and off-site sample results.

#### **Statistical Analysis and Methodology**

Samples are collected from specified locations to enable effective statistical comparisons with results from previous years. Statistical analyses are performed to determine whether there is a significant difference between on-site sample results and off-site sample results.

#### **Other Standards for Comparison**

In addition to the statistical analyses, analytical results for metals in soil samples may be compared to values in the following references (presented in [Table 8-1](#)):

- Hawai'i Department of Health soil screening levels ([Hawai'i DOH 2016](#))
- EPA risk-based soil screening levels ([EPA 2018](#))

**Table 8-1.** Comparison reference values for metals in soil at SNL/KTF

Analyte	HDOH Natural Background Concentration Range <sup>a</sup> (mg/kg)	HDOH Direct-Exposure Action Levels <sup>a</sup>	EPA Risk-Based Soil Screening Levels <sup>b</sup>	
		Unrestricted Land Use Scenario (mg/kg)	Residential Soil (mg/kg)	Industrial Soil (mg/kg)
Aluminum	—	—	77,000	1,100,000
Antimony	0.004–2.4	63	31	470
Arsenic	0.3–50	23	0.68	3.0
Barium	4.5–926	3,100	15,000	220,000
Beryllium	0.05–3.8	31	160	2,300
Cadmium	0.02–17	14	—	—
Calcium	—	—	—	—
Chromium (total)	8.52–3,180	—	120,000	1,800,000
Cobalt	0.69–113	4.7	23	350
Copper	2.4–450	630	3,100	47,000
Iron	—	—	55,000	820,000
Lead	0.76–73	200	400	800
Magnesium	—	—	—	—
Manganese	—	—	1,800	26,000

*Table continued on next page*

**Table 8-1.** Comparison reference values for metals in soil at SNL/KTF (continued)

Analyte	HDOH Natural Background Concentration Range <sup>a</sup> (mg/kg)	HDOH Direct-Exposure Action Levels <sup>a</sup>	EPA Risk-Based Soil Screening Levels <sup>b</sup>	
		Unrestricted Land Use Scenario (mg/kg)	Residential Soil (mg/kg)	Industrial Soil (mg/kg)
Nickel	21–767	310	1,500	22,000
Potassium	—	—	—	—
Selenium	0.24–12	78	390	5,800
Silver	0.02–1.5	78	390	5,800
Sodium	—	—	—	—
Thallium	< 0.25–15	78	0.78	12
Vanadium	0.25–1,090	78	390	5,800
Zinc	3.6–1,200	4,700	23,000	350,000

<sup>a</sup> Hawai'i Department of Health, 2016.

<sup>b</sup> EPA (Target Hazard Quotient = 1.0) 2018.

— = not available

EPA = U.S. Environmental Protection Agency

HDOH = Hawai'i Department of Health

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

### 8.8.5 Terrestrial Surveillance Program Results in 2018

The 2018 Terrestrial Surveillance Program activities at SNL/KTF included soil sampling in February at 17 on-site designated locations (Figure 8-1).

*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.

#### Statistics and Analytical Results

Table 8-2 presents summary statistics for all on-site data for the four surveyed years (2002, 2007, 2012, and 2018) combined. The analytical results for metals for the 2018 sampling event are also provided. The analytical data are provided in Appendix D, “SNL/KTF Terrestrial Surveillance Results in 2018.”

The maximum on-site values for antimony, arsenic, silver, and zinc exceed established background values for Hawai'i (Hawai'i DOH). Arsenic and zinc maximums also exceed the State of Hawai'i Department of Health direct-exposure action levels for an unrestricted land use scenario. Zinc is below the EPA risk-based soil screening values for residential land use, but arsenic exceeds the respective value. The means for antimony, arsenic, silver, and zinc are within the State of Hawai'i Department of Health natural background levels range.

The maximum arsenic concentration exceeded all comparison reference values in Table 8-1. Elevated arsenic values are found in Hawai'ian soils at or near former sugar cane fields and production plants, former pesticide storage mixing areas, and wood treatment plants (Hawai'i DOH 2010). Areas near SNL/KTF were used historically for sugar cane production (DOE/AL 1992), where arsenical pesticides likely were used and may be the source of arsenic found in the soil samples collected at SNL/KTF.

Statistical analyses performed on the 2018 sample results identified six metals with on-site means that were significantly different from the respective historical off-site means (Table 8-3). All metals listed in Table 8-3 had on-site means higher than historical off-site means except calcium, where the off-site mean is higher than the on-site mean.

Cadmium, cobalt, and vanadium have established Hawai'i Department of Health background values (Table 8-1). The means for these metals are within the range of background values and are, therefore, of no concern. Calcium and iron are common rock-forming elements and are abundant in soils; no background values or EPA risk-based soil screening levels exist. Manganese does not have a Hawai'i Department of Health background value, but the mean is well below the EPA risk-based soil screening levels.

Based on the results of the 2018 sampling event, the statistical analysis, and the comparison to reference values, there are no issues of concern that need to be addressed. The next planned sampling event will occur in 2023.

### **Variations**

There were no variations from planned activities in 2018.

**Table 8-2.** SNL/KTF summary statistics for on-site metal results from 2002, 2007, 2012, and 2018<sup>a</sup>

Analyte	Mean (mg/kg)	Median (mg/kg)	Standard Deviation (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Aluminum	7,200	6,700	3,800	2,000	13,000
Antimony	0.74	0.48	0.72	0.097	3.5
Arsenic	15	11	12	5.2	63
Barium	20	12	26	5.1	160
Beryllium	0.11	0.10	0.042	0.033	0.27
Cadmium	0.32	0.29	0.22	0.53	1.2
Calcium	250,000	250,000	51,000	170,000	360,000
Chromium	58	53	24	20	110
Cobalt	19	16	10	2.8	40 J-
Copper	25	13	56	2.8	410 J
Iron	19,000	18,000	7,800	4,300	39,000 J
Lead	5.5	1.6	8.3	0.28	31
Magnesium	37,000	32,000	15,000	17,000	78,000
Manganese	360	370	140	110	880 J
Nickel	220	170	150	30	560
Potassium	290	260	173	85	1,000
Selenium	0.85	0.44	0.84	0.12	2.5
Silver	0.56	0.20	0.69	0.10	2.8 J
Sodium	2,200	2,100	1000	1,000	9,500
Thallium	1.1	0.14	1.7	0.04	5.9
Vanadium	23	21	8.4	5.9	40
Zinc	281	43	800	7.2	4,800 J

<sup>a</sup>Sixty-eight observations for each analyte (17 locations sampled four separate years).

J = the associated numerical value is an estimated quantity

J- = the associated numerical value is an estimated quantity with a suspected negative bias

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

**Table 8-3.** SNL/KTF summary statistics for metals with a significant statistical difference between on-site means and historical off-site means, 2018

Metal	Location Type	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Standard Deviation (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Cadmium	On-site	68	0.32	0.29	0.22	0.53	1.2
	Off-Site	33	0.18	0.16	0.1	0.05	0.52
Calcium	On-site	68	250,000	250,000	51,000	170,000	360,000
	Off-Site	33	290,000	300,000	69,000	110,000	390,000
Cobalt	On-site	68	19	16	10	2.8	40 J-
	Off-Site	33	13	8.8	13	1.4	54 J
Iron	On-site	68	19,000	18,000	7,800	4,300	39,000 J
	Off-Site	33	14,000	9,800	12,000	2,500	55,000 J
Manganese	On-site	68	360	370	140	110	880 J
	Off-Site	33	280	180	230	82	800
Vanadium	On-site	68	23	21	8.4	5.9	40
	Off-Site	33	18	11	16	5.4	86

J = the associated numerical value is an estimated quantity

J- = the associated numerical value is an estimated quantity with a suspected negative bias

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

## 8.9 Waste Management Program

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

At SNL/KTF, compliance with 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. A total of 110 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 September 2018, asbestos abatement was conducted in the main building at the Mount Haleakala site on Maui. Approximately 6,790 cubic feet of asbestos-containing materials were removed and disposed of in accordance with regulatory requirements.

## 8.10 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 drinking water system or purchased from commercial suppliers.

### 8.10.1 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.

### 8.10.2 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 2018, 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.*  
.....

### 8.10.3 Water Quality Program Results

In 2018, there were no compliance issues with respect to any state or federal water pollution regulations at SNL/KTF.

## Chapter 9. SNL/KTF Ecology Program



Island of Kaua'i

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**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.

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At SNL/KTF, the Ecology Program's primary functions are to 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 9-1](#) presents the Endangered Species Act and MBTA 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 KTF as a tenant. These biological opinions contain measures to mitigate the impact of proposed activities.

### 9.1 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 Kaua'i 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 Hawai'ian 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 niuhauense*), an endangered species of rare grass, has been observed near Queens Pond, also north of the Pacific Missile Range Facility.

## 9.2 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.

### 9.2.1 Birds

Forty species of birds have been identified in the general Pacific Missile Range Facility area, although not specifically at SNL/KTF. Seven of these species are native to Kaua'i: Hawai'ian Coot (*Fulica alai*), Hawai'ian Stilt (*Himantopus mexicanus knudseni*), Hawai'ian Gallinule (*Gallinula galleta sandwichensis*), Hawai'ian Duck (*Anas wyvilliana*), Hawai'ian Petrel (*Pterodroma sandwichensis*), Newell's Shearwater (*Puffinus auricularis newelli*), and Hawai'ian Short-eared Owl (*Asio flammeus sandwichensis*). The only native terrestrial species that may occur in the area is the Hawai'ian Short-eared Owl. Past wildlife

surveys of birds and mammals conducted at SNL/KTF found 20 species of birds throughout the facility.

Bird species protected under the MBTA that have been observed at SNL/KTF include the Hawai'ian Short-eared Owl along with 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.



Hawai'ian Goose (*Branta sandvicensis*)

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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 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).

### 9.2.2 Mammals

Thirteen species of mammals are known to occur on the island of Kaua'i. 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 Hawai'ian 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 Hawai'ian Hoary Bat has not been recorded at the Pacific Missile Range Facility, although 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).

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

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The Hawai'ian Monk Seal (*Monachus schauinslandi*) is protected under the Endangered Species Act as endangered and is Hawai'i's only indigenous mammal. Monk seals use sandy beaches to give birth and use vegetation behind beaches for shelter. Monk seals are only occasionally reported around the main Hawai'ian Islands (USFWS 1984) although they have been observed at the Pacific Missile Range Facility (The Traverse Group 1988).

### 9.2.3 Reptiles

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 Hawai'ian 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).

Up to 32 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).

## 9.3 Threatened and Endangered Species

Federally listed and state-listed threatened or endangered species potentially occurring on Kaua'i can be found in Table 9-1.

**Table 9-1.** Federally listed and state-listed threatened or endangered species potentially occurring on Kaua'i

Common Name	Scientific Name	Federal Status	State Status
<b>Plants</b>			
<b>Ferns and Allies</b>			
Pendant kihi fern	<i>Adenophorus periens</i>	Endangered	Endangered
No common name	<i>Asplenium diellaciniatum</i>	Proposed endangered	Proposed endangered
No common name	<i>Asplenium dielmannii</i>	Endangered	Endangered
No common name	<i>Asplenium dielpallidum</i>	Endangered	Endangered
Pauoa	<i>Ctenitis squamigera</i>	Endangered	Endangered
Asplenium-leaved diellia	<i>Diellia erecta</i>	Endangered	Endangered
Molokai twinsorus fern	<i>Diplazium molokaiense</i>	Endangered	Endangered
Kauai digit fern	<i>Doryopteris angelica</i>	Endangered	Endangered
Palapalai aumakua	<i>Dryopteris crinalis</i> var. <i>podosorus</i>	Endangered	Endangered
Kilau	<i>Dryopteris glabra</i> var. <i>pusilla</i>	Proposed endangered	Proposed endangered
Wawae'iole	<i>Huperzia mannii</i>	Endangered	Endangered
Wawae'iole	<i>Huperzia nutans</i>	Endangered	Endangered
<b>Flowering Plants</b>			
Liliwai	<i>Acaena exigua</i>	Endangered	Endangered
Blunt chaff flower	<i>Achyranthes mutica</i>	Endangered	Endangered
Mahoe	<i>Alectryon macrococcus</i>	Endangered	Endangered
Pa'iniu	<i>Astelia waialealae</i>	Endangered	Endangered
Hawai'i lady's nightcap	<i>Bonamia menziesii</i>	Endangered	Endangered
Olulu	<i>Brighamia insignis</i>	Endangered	Endangered
'Awikiwiki	<i>Canavalia napaliensis</i>	Endangered	Endangered
'Awikiwiki	<i>Canavalia pubescens</i>	Endangered	Endangered
Awiwi	<i>Centaurium sebaeoides</i>	Endangered	Endangered
Papala	<i>Charpentiera densiflora</i>	Endangered	Endangered
Haha	<i>Cyanea asarifolia</i>	Endangered	Endangered
Haha	<i>Cyanea dolichopoda</i>	Endangered	Endangered
Haha	<i>Cyanea eleeleensis</i>	Endangered	Endangered
Haha	<i>Cyanea kolekoleensis</i>	Endangered	Endangered
Haha	<i>Cyanea kuhihewa</i>	Endangered	Endangered
Haha	<i>Cyanea recta</i>	Threatened	Threatened
Haha	<i>Cyanea remyi</i>	Endangered	Endangered
Haha	<i>Cyanea rivularis</i>	Endangered	Endangered
Haha	<i>Cyanea undulata</i>	Endangered	Endangered
Coastal flatsedge	<i>Cyperus pennatifloris</i>	Endangered	Endangered
Pu'uka'a	<i>Cyperus trachysanthos</i>	Endangered	Endangered
Mapele	<i>Cyrtandra cyaneoides</i>	Endangered	Endangered
Ha'iwale	<i>Cyrtandra limahuliensis</i>	Threatened	Threatened
Ha'iwale	<i>Cyrtandra oenobarba</i>	Endangered	Endangered
Ha'iwale	<i>Cyrtandra paliku</i>	Endangered	Endangered
No common name	<i>Delissea rhytidosperra</i>	Endangered	Endangered
No common name	<i>Delissea undulata</i>	Endangered	Endangered
Na'ena'e	<i>Dubautia imbricata</i>	Endangered	Endangered
Na'ena'e	<i>Dubautia kalalauensis</i>	Endangered	Endangered
Na'ena'e	<i>Dubautia kenwoodii</i>	Endangered	Endangered
Na'ena'e	<i>Dubautia latifolia</i>	Endangered	Endangered
Na'ena'e	<i>Dubautia pauciflorula</i>	Endangered	Endangered
Na'ena'e	<i>Dubautia plantaginea magnifolia</i>	Endangered	Endangered

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**Table 9-1.** Federally listed and state- listed threatened or endangered species potentially occurring on Kaua'i (continued)

Common Name	Scientific Name	Federal Status	State Status
<b>Plants (continued)</b>			
<b>Flowering Plants (continued)</b>			
Na'ena'e	<i>Dubautia waialealae</i>	Endangered	Endangered
'Akoko	<i>Euphorbia eleanoriae</i>	Endangered	Endangered
'Akoko	<i>Euphorbia haeleleana</i>	Endangered	Endangered
'Akoko	<i>Euphorbia halemanui</i>	Endangered	Endangered
'Akoko	<i>Euphorbia remyi</i> var. <i>Kaua'iensis</i>	Endangered	Endangered
'Akoko	<i>Euphorbia remyi</i> var. <i>remyi</i>	Endangered	Endangered
Heau	<i>Exocarpos luteolus</i>	Endangered	Endangered
Mehamehame	<i>Flueggea neowawraea</i>	Endangered	Endangered
Nanu	<i>Gardenia remyi</i>	Proposed endangered	Proposed endangered
Nohoanu	<i>Geranium Kaua'iense</i>	Endangered	Endangered
Smoothfruit chewstick	<i>Gouania meyenii</i>	Endangered	Endangered
Honohono	<i>Haplostachys haplostachya</i>	Endangered	Endangered
No common name	<i>Hesperomannia lydgatei</i>	Endangered	Endangered
Kaua'i hau kuahiwi	<i>Hibiscadelphus distans</i>	Endangered	Endangered
Wood's hau kuahiwi	<i>Hibiscadelphus woodii</i>	Endangered	Endangered
Clay's hibiscus	<i>Hibiscus clayi</i>	Endangered	Endangered
Koki'o ke'oke'o	<i>Hibiscus waimeae</i> ssp. <i>hannerae</i>	Endangered	Endangered
Hilo ischaemum	<i>Ischaemum byrone</i>	Endangered	Endangered
Aupaka	<i>Isodendron laurifolium</i>	Endangered	Endangered
Aupaka	<i>Isodendron longifolium</i>	Threatened	Threatened
'Ohe	<i>Joinvillea ascendens</i>	Proposed endangered	Proposed endangered
Kampua'a	<i>Kadua (=Hedyotis) fluviatilis</i>	Proposed endangered	Proposed endangered
'Awiwi	<i>Kadua cookiana</i>	Endangered	Endangered
No common name	<i>Kadua haupuensis</i>	Proposed endangered	Proposed endangered
Na' Pali beach starviolet	<i>Kadua st.-johnii</i>	Endangered	Endangered
No common name	<i>Keysseria (=Lagenifera) erici</i>	Endangered	Endangered
No common name	<i>Keysseria (=Lagenifera) helenae</i>	Endangered	Endangered
Koki'o	<i>Kokia Kaua'iensis</i>	Endangered	Endangered
Kamakahala	<i>Labordia helleri</i>	Endangered	Endangered
Kamakahala	<i>Labordia lydgatei</i>	Endangered	Endangered
Kamakahala	<i>Labordia pumila</i>	Endangered	Endangered
Kamakahala	<i>Labordia tinifolia</i> var. <i>wahiawaensis</i>	Endangered	Endangered
Round pepperweed	<i>Lepidium orbiculare</i>	Proposed endangered	Proposed endangered
Nehe	<i>Lipochaeta fauriei</i>	Endangered	Endangered
Nehe	<i>Lipochaeta micrantha</i>	Endangered	Endangered
Niihau lobelia	<i>Lobelia niihauensis</i>	Endangered	Endangered
Lehua makanoe	<i>Lysimachia daphnoides</i>	Endangered	Endangered
Wailua River yellow loosestrife	<i>Lysimachia filifolia</i>	Endangered	Endangered
Wailua River yellow loosestrife	<i>Lysimachia iniki</i>	Endangered	Endangered
Broad-leaf yellow loosestrife	<i>Lysimachia pendens</i>	Endangered	Endangered
Shiny-leaf yellow loosestrife	<i>Lysimachia scopulensis</i>	Endangered	Endangered
Veined yellow loosestrife	<i>Lysimachia venosa</i>	Endangered	Endangered
Alani	<i>Melicope degeneri</i>	Endangered	Endangered
Alani	<i>Melicope haupuensis</i>	Endangered	Endangered
Alani	<i>Melicope knudsenii</i>	Endangered	Endangered
Alani	<i>Melicope pallida</i>	Endangered	Endangered

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**Table 9-1.** Federally listed and state-listed threatened or endangered species potentially occurring on Kaua'i (continued)

Common Name	Scientific Name	Federal Status	State Status
<b>Plants (continued)</b>			
<b>Flowering Plants (continued)</b>			
Alani	<i>Melicope paniculata</i>	Endangered	Endangered
Alani	<i>Melicope puberula</i>	Endangered	Endangered
Alani	<i>Melicope quadrangularis</i>	Endangered	Endangered
Uhiuhi	<i>Mezoneuron kauaiense</i>	Endangered	Endangered
Kolea	<i>Myrsine fosbergii</i>	Proposed endangered	Proposed endangered
Kolea	<i>Myrsine knudsenii</i>	Endangered	Endangered
Kolea	<i>Myrsine linearifolia</i>	Threatened	Threatened
Kolea	<i>Myrsine mezii</i>	Endangered	Endangered
'Aiea	<i>Nothoecstrum latifolium</i>	Proposed endangered	Proposed endangered
'Aiea	<i>Nothoecstrum peltatum</i>	Endangered	Endangered
Lau 'ehu	<i>Panicum niihauense</i>	Endangered	Endangered
Makou	<i>Peucedanum sandwicense</i>	Threatened	Threatened
Mt. Kahili phyllostegia	<i>Phyllostegia helleri</i>	Proposed endangered	Proposed endangered
Waimea phyllostegia	<i>Phyllostegia knudsenii</i>	Endangered	Endangered
Red-leaf phyllostegia	<i>Phyllostegia renovans</i>	Endangered	Endangered
Kauai phyllostegia	<i>Phyllostegia waimeae</i>	Endangered	Endangered
Fuzzystem phyllostegia	<i>Phyllostegia wawrana</i>	Endangered	Endangered
Ho'awa	<i>Pittosporum napaliense</i>	Endangered	Endangered
Pilo kea lau li'i	<i>Platydesma rostrata</i>	Endangered	Endangered
Mann's bluegrass	<i>Poa mannii</i>	Endangered	Endangered
Hawai'ian bluegrass	<i>Poa sandwicensis</i>	Endangered	Endangered
Kauai bluegrass	<i>Poa siphonoglossa</i>	Endangered	Endangered
No common name	<i>Polyscias bisattenuata</i>	Endangered	Endangered
Hawaii bog orchid	<i>Platanthera holochila</i>	Endangered	Endangered
No common name	<i>Polyscias flynnii</i>	Endangered	Endangered
False 'ohe	<i>Polyscias racemosa</i>	Endangered	Endangered
Lo'ulu (=Na'ena'e)	<i>Pritchardia hardyi</i>	Endangered	Endangered
Lo'ulu	<i>Pritchardia napaliensis</i>	Endangered	Endangered
Lo'ulu	<i>Pritchardia viscosa</i>	Endangered	Endangered
Kopiko	<i>Psychotria grandiflora</i>	Endangered	Endangered
Kopiko	<i>Psychotria hobbyi</i>	Endangered	Endangered
Kaulu	<i>Pteralyxia Kaua'iensis</i>	Endangered	Endangered
Makou	<i>Ranunculus mauiensis</i>	Proposed endangered	Proposed endangered
No common name	<i>Remya Kaua'iensis</i>	Endangered	Endangered
Kalalau Valley remya	<i>Remya montgomeryi</i>	Endangered	Endangered
No common name	<i>Santalum involutum</i>	Proposed endangered	Proposed endangered
Dwarf naupaka	<i>Scaevola coriacea</i>	Endangered	Endangered
Ma'oli'oli	<i>Schiedea apokremnos</i>	Endangered	Endangered
Kalalau schiedea	<i>Schiedea attenuata</i>	Endangered	Endangered
Heller's schiedea	<i>Schiedea helleri</i>	Endangered	Endangered
Kauai schiedea	<i>Schiedea Kaua'iensis</i>	Endangered	Endangered
Kuawawaenuhu	<i>Schiedea lychnoides</i>	Endangered	Endangered
Papery schiedea	<i>Schiedea membranacea</i>	Endangered	Endangered
Valley schiedea	<i>Schiedea nuttallii</i>	Endangered	Endangered

Table continued on next page.

**Table 9-1.** Federally listed and state- listed threatened or endangered species potentially occurring on Kaua'i (continued)

Common Name	Scientific Name	Federal Status	State Status
<b>Plants (continued)</b>			
<b>Flowering Plants (continued)</b>			
Canyon schiedea	<i>Schiedea spergulina</i> var. <i>leiopoda</i>	Endangered	Endangered
No common name	<i>Schiedea spergulina</i> var. <i>spergulina</i>	Threatened	Threatened
Lau lihilihi	<i>Schiedea stellarioides</i>	Endangered	Endangered
No common name	<i>Schiedea viscosa</i>	Endangered	Endangered
Ohai	<i>Sesbania tomentosa</i>	Endangered	Endangered
No common name	<i>Sicyos lanceoloideus</i>	Proposed endangered	Proposed endangered
Kauai catchfly	<i>Silene lanceolata</i>	Endangered	Endangered
Popolo ku mai	<i>Solanum incompletum</i>	Endangered	Endangered
Popolo	<i>Solanum nelsonii</i>	Proposed endangered	Proposed endangered
'Aiakeakua, popolo	<i>Solanum sandwicense</i>	Endangered	Endangered
Hawai'i scaleseed	<i>Spermolepis Hawai'iensis</i>	Endangered	Endangered
Kalalau Valley stenogyne	<i>Stenogyne campanulata</i>	Endangered	Endangered
Keal's stenogyne	<i>Stenogyne kealiae</i>	Endangered	Endangered
Wahiawa stream violet	<i>Viola helenae</i>	Endangered	Endangered
Nani wai'ale'ale	<i>Viola Kaua'iensis</i> var. <i>wahiawaensis</i>	Endangered	Endangered
Skottsberg's false ohelo	<i>Wikstroemia skottsbergiana</i>	Proposed endangered	Proposed endangered
Dwarf iliau	<i>Wilkesia hobdyi</i>	Endangered	Endangered
No common name	<i>Xylosma crenatum</i>	Endangered	Endangered
A'e	<i>Zanthoxylum Hawai'iense</i>	Endangered	Endangered
<b>Animals</b>			
<b>Mammals</b>			
Hawai'ian Hoary Bat	<i>Lasiurus cinereus semotus</i>	Endangered	Endangered
<b>Birds</b>			
Koloa (Hawai'ian Duck)	<i>Anas wyvilliana</i>	Endangered	Endangered
Nēnē (Hawai'ian Goose)	<i>Branta sandvicensis</i>	Endangered	Endangered
'Alae ke'oke'o (Hawai'ian Coot)	<i>Fulica alai</i>	Endangered	Endangered
'Alae 'ula (Hawai'ian Gallinule)	<i>Gallinula galeata sandvicensis</i>	Endangered	Endangered
Nuku pu'u (Honeycreeper)	<i>Hemignathus lucidus</i>	Endangered	Endangered
Kaua'i 'Akialoa (Honeycreeper)	<i>Hemignathus procerus</i>	Endangered	Endangered
Kaua'i 'amakihi	<i>Hemignathus kauaiensis</i>	—	Vulnerable
'Anianiau	<i>Hemignathus parvus</i>	—	Vulnerable
Ae'o (Hawai'ian Stilt)	<i>Himantopus mexicanus knudseni</i>	Endangered	Endangered
'Akeke'e (Kaua'i Akepa)	<i>Loxops caeruleirostris</i>	Endangered	Endangered
Kaua'i 'o'o (Honeyeater)	<i>Moho braccatus</i>	Endangered	Endangered
Kāma'o (Large Kaua'i Thrush)	<i>Myadestes myadestinus</i>	Endangered	Endangered
Puaiohi (Small Kaua'i Thrush)	<i>Myadestes palmeri</i>	Endangered	Endangered
Band-rumped Storm Petrel	<i>Oceanodroma castro</i>	Endangered	Endangered
Short-tailed Albatross	<i>Phoebastria albatrus</i>	—	Threatened
Laysan Albatross	<i>Phoebastria immutabilis</i>	—	Near threatened
'Akikiki (Kaua'i Creeper)	<i>Oreomystis bairdi</i>	Endangered	Endangered
'I'iwi	<i>Vestiaria coccinea</i>	Proposed threatened	Vulnerable
'O'u	<i>Psittirostra psittacea</i>	Endangered	Endangered
Hawai'ian Petrel	<i>Pterodroma sandwichensis</i>	Endangered	Endangered
Newell's Shearwater	<i>Puffinus newelli</i>	Threatened	Endangered
Kioea (Bristle-thighed Curlew)	<i>Numenius tahitiensis</i>	—	Vulnerable

Table continued on next page.

**Table 9-1.** Federally listed and state- listed threatened or endangered species potentially occurring on Kaua'i (continued)

Common Name	Scientific Name	Federal Status	State Status
<b>Animals (continued)</b>			
<b>Reptiles</b>			
Green Sea Turtle	<i>Chelonia mydas</i>	Threatened	Threatened
Leatherback Sea Turtle	<i>Dermochelys coriacea</i>	Endangered	Endangered
Hawksbill Sea Turtle	<i>Eretmochelys imbricata</i>	Endangered	Endangered
Olive Ridley Sea Turtle	<i>Lepidochelys olivacea</i>	Threatened	Threatened
<b>Snails</b>			
Newcomb's Snail	<i>Erinna newcombi</i>	Threatened	Threatened
<b>Arachnids</b>			
Kaua'i Cave Wolf or Pe'e maka 'ole Spider	<i>Adelocosa anops</i>	Endangered	Endangered
<b>Insects</b>			
Pomace Fly (no common name)	<i>Drosophila musaphilia</i>	Endangered	Endangered
Hawai'ian Picture-wing Fly	<i>Drosophila sharpi</i>	Endangered	Endangered
Pacific Hawai'ian Damselfly	<i>Megalagrion pacificum</i>	Endangered	Endangered
Orangeblack Hawai'ian Damselfly	<i>Megalagrion xanthomelas</i>	Proposed endangered	Proposed endangered
<b>Crustaceans</b>			
Kaua'i cave amphipod	<i>Spelaeorchestia koloana</i>	Endangered	Endangered

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

## Chapter 10. SNL/KTF Quality Assurance



Canyons and waterfall at SNL/KTF

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**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.

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Sandia personnel take responsibility and assume accountability for implementing quality assurance for operations as specified in ISO 9001 (ISO 2008), the Contractor Requirements Document of DOE O 414.1D (DOE O 414.1D Admin Change 1), *Quality Assurance*, and in 10 CFR 830 (10 CFR 830), *Nuclear Safety Management*, 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.

### 10.1 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 sample collection, sample preservation and handling, sample control, laboratory quality control, required limits of detection, field quality control, health and safety, schedules and frequency of sampling, data review, data acceptability, and reporting.

### 10.1.1 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, personnel provide guidance and sample management support for field activities. However, program leads are responsible for each distinct 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 samples are shipped directly to off-site laboratories, rather than to the Sample Management Office at SNL/NM. The Terrestrial Surveillance Program soil samples are shipped directly to an off-site laboratory.

### 10.1.2 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 (QAPP) for the Sample Management Office* (SNL/NM 2016b). 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 Sample Management Office Statement of Work for Analytical Laboratories (SNL/NM 2018c). 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).

### 10.1.3 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. Additionally, 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 laboratory procedures. Quality control sample summaries are included in analytical reports prepared by contract laboratory personnel.

#### **10.1.4 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 the 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.

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

## **10.2 Sample Management Office Activities in 2018**

Sample Management Office activities in 2018 included sample packaging, shipping, and tracking to off-site contracted laboratories, and reviewing all data deliverables for compliance with contract and data quality requirements.

### **10.2.1 Sample Handling and Analyses**

In 2018, Sample Management Office personnel processed 28 samples in support of the SNL/KTF Terrestrial Surveillance Program. Of the 28 samples, 10 samples were submitted as field and analytical quality control samples to assist with data validation and decision-making.

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In 2018, Sample Management Office personnel processed 28 samples in support of the SNL/KTF Terrestrial Surveillance Program.

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General Engineering Laboratories in Charleston, South Carolina, was employed to analyze SNL/KTF soil samples.

### **10.2.2 Laboratory Quality Assurance Assessments and Validation**

In 2018, 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.

### 10.2.3 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 how 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 Department of Defense/DOE *Consolidated Quality Systems Manual (QSM) for Environmental Laboratories (DoD/DOE 2017)*, which guides DOECAP audits.

In 2018, DOECAP and/or the accrediting bodies conducted assessments at six 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 2018 in DOECAP assessment reports or other applicable DOE programs.

## Appendix A. SNL/TTR Air Monitoring Stations in 2018



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

### A.1 Introduction

During 2018, DRI maintained five portable air monitoring stations at SNL/TTR as part of Project Soils, an environmental restoration activity. 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	✓	✓	✓	✓	✓
Airborne particle collector	✓	✓	✓	✓	✓
Saltation sensor	N/A	✓	✓	✓	✓
Gamma radiation pressurized ionization chamber	✓	✓	✓	N/A	N/A
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. Working with Hi-Q Products Inc., 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.

A description 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 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 analysis. 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 4-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 20, 2017, and December 19, 2018, 26 air particulate filter samples were collected and analyzed by gamma spectroscopy for gross alpha and gross beta activity. [Table A-2](#) and [Table A-3](#) provide gross alpha and gross beta results for Station 400 for 2018.

The following naturally occurring radionuclides were identified and measured on Station 400 filters: beryllium-7 (26 samples), lead-210 (3 samples), bismuth-214 (5 samples), and actinium-228 (9 samples).

**Table A-2.** Gross alpha results for monitoring stations during 2018

Station Location	Number of Samples	Concentration ( $\times 10^{-15}$ $\mu\text{Ci}/\text{mL}$ [ $3.7 \times 10^{-5}$ $\text{Bq}/\text{m}^3$ ])			
		Mean	Standard Deviation	Minimum	Maximum
400	26	2.51	1.35	0.84	5.31
401	25	2.59	1.57	0.89	8.91
403	24	3.56	1.93	1.06	8.35
404	26	6.99	6.71	1.09	30.50
405	22	3.21	1.87	1.17	9.59

**Table A-3.** Gross beta results for monitoring stations during 2018

Station Location	Number of Samples	Concentration ( $\times 10^{-14}$ $\mu\text{Ci}/\text{mL}$ [ $3.7 \times 10^{-4}$ $\text{Bq}/\text{m}^3$ ])			
		Mean	Standard Deviation	Minimum	Maximum
400	26	1.80	0.56	0.56	2.97
401	25	1.4	0.49	0.37	2.34
403	24	2.04	0.54	0.98	2.96
404	26	2.1	0.56	0.51	3.19
405	22	1.93	0.60	0.53	3.01

**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 4-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 20, 2017, and December 19, 2018, 25 air particulate filter samples were collected and analyzed by gamma spectroscopy for gross alpha and gross beta activity. Due to air sampler malfunction, no samples were available for analysis for the period of October 11–24, 2018. [Table A-2](#) and [Table A-3](#) contain gross alpha and gross beta results for Station 401 for 2018.

The following naturally occurring radionuclides were identified and measured on Station 401 filters: beryllium-7 (23 samples), lead-210 (3 samples), lead-214 (2 samples), bismuth-214 (9 samples), and actinium-228 (9 samples).

#### **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 4-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 20, 2017, and December 19, 2018, 24 air particulate filter samples were collected and analyzed by gamma spectroscopy for gross alpha and gross beta activity. Due to air sampler malfunction, no samples were available for analysis for the periods of March 14–27, 2018, and November 8–27, 2018. [Table A-2](#) and [Table A-3](#) contain gross alpha and gross beta results for Station 403 for 2018.

The following naturally occurring radionuclides were identified and measured on Station 403 filters: beryllium-7 (24 samples), lead-210 (2 samples), lead-214 (1 sample), bismuth-214 (4 samples), and actinium-228 (7 samples).

### 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 4-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 20, 2017, and December 19, 2018, 26 air particulate filter samples were collected and analyzed by gamma spectroscopy for gross alpha and gross beta activity. [Table A-2](#) and [Table A-3](#) contain gross alpha and gross beta results for Station 404 for 2018.

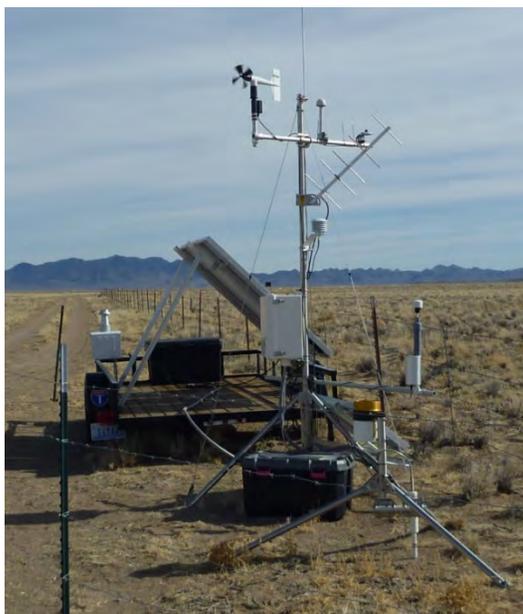
Americium-241 was measured at a concentration of  $4.21 \times 10^{-15}$   $\mu\text{Ci}/\text{mL}$  for the filter deployed from May 10–23, 2018. The following naturally occurring radionuclides were also identified and measured: beryllium-7 (25 samples), bismuth-214 (4 samples), and actinium-228 (7 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 4-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 20, 2017, and December 19, 2018, 22 air particulate filter samples were collected and analyzed by gamma spectroscopy for gross alpha and gross beta activity. Due to air sampler malfunction, no samples were available for analysis for the period of June 20–August 15, 2018. [Table A-2](#) and [Table A-3](#) contain 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) and actinium-228 (7 samples).

## A.3 Alpha Spectroscopy Results

Air filters collected in 2018 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 TestAmerica Laboratories, Inc. for 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 one sample for 2018 at Station 404 for the filter deployed during the

May 10–May 23, 2018, period, which automatically flagged the sample 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 2018. Neither Pu-238 nor Pu-239/240 were detected on any filters from Station 400. Pu-238 was detected on three samples from the Clean Slate II monitoring stations (404 and 405) during the first and second quarters of the year. Pu-239/240 was detected on multiple samples from each station at Clean Slate II (404 and 405) and Clean Slate III (401 and 403) throughout 2018.

**Table A-4.** Plutonium-238 alpha spectrometry results for 2018

Station Number	Number of Samples Analyzed	Number of Samples > MDC Pu-238	Quarters with Pu-238 Detected	Pu-238 Concentration ( $\times 10^{-16}$ $\mu\text{Ci/mL}$ [ $3.7 \times 10^{-6}$ $\text{Bq/m}^3$ ])			
				Mean	Standard Deviation	Min.	Max.
400	8	0	N/A	N/A	N/A	N/A	N/A
401	8	0	N/A	N/A	N/A	N/A	N/A
403	8	0	N/A	N/A	N/A	N/A	N/A
404	8	2	1, 2	2.27	0.53	1.89	2.64
405	8	1	2	1.24	N/A	1.24	1.24

Max = maximum

MDC = minimum detectable concentration

Min = minimum

N/A = not applicable

Pu = plutonium

**Table A-5.** Plutonium-239/240 alpha spectrometry results for 2018

Station Number	Number of Samples Analyzed	Number of Samples > MDC Pu-239/240	Quarters with Pu-239/240 Detected	Pu-239/240 Concentration ( $\times 10^{-16}$ $\mu\text{Ci/mL}$ [ $3.7 \times 10^{-6}$ $\text{Bq/m}^3$ ])			
				Mean	Standard Deviation	Min.	Max.
400	8	0	N/A	N/A	N/A	N/A	N/A
401	8	6	1, 2,3,4	16.39	33.43	1.42	84.56
403	8	5	2,3,4	24.91	35.84	1.16	83.58
404	8	7	1, 2,3,4	127.72	138.36	8.92	378.67
405	8	6	1, 2,3,4	31.19	47.30	1.14	124.72

Max = maximum

MDC = minimum detectable concentration

Min = minimum

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 93.4 percent of the time during 2018; wind speeds exceeded 30 mph for 2 hours and 40 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 89.5 percent of the time, and wind speed exceeded 30 mph for approximately 11 hours and 20 minutes during 2018. 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 recorded for about 2 hours. Stations 404 and 405, at the north and south ends of Clean Slate II, respectively, recorded winds

below 15 mph for 92.8 and 93.5 percent of the time, respectively. Winds over 30 mph at stations 404 and 405 occurred for a total of 2 hours and 10 minutes and 2 hours and 20 minutes, respectively, during the recorded time.

Figure A-6 shows the average respirable particulate matter (having a diameter equal to or less than  $10 \mu$  [ $PM_{10}$ ]) 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, but the average  $PM_{10}$  concentration at most stations decreased slightly for winds over 30 mph, suggesting dust supply limitations. 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 six stations were less than approximately  $15 \mu\text{g}/\text{m}^3$  for wind speeds below 15 mph. At Station 400,  $PM_{10}$  concentrations peaked at  $45 \mu\text{g}/\text{m}^3$  for wind speeds over 30 mph. At Station 401,  $PM_{10}$  concentrations rose to  $497 \mu\text{g}/\text{m}^3$  for wind speeds over 35 mph.  $PM_{10}$  concentrations at Station 403 peaked at  $285 \mu\text{g}/\text{m}^3$  for wind speeds over 30 mph. At Station 404, the highest average  $PM_{10}$  concentration of  $235 \mu\text{g}/\text{m}^3$  was observed for winds over 30 mph.  $PM_{10}$  concentrations at Station 405 peaked at  $108 \mu\text{g}/\text{m}^3$  for winds over 30 mph.

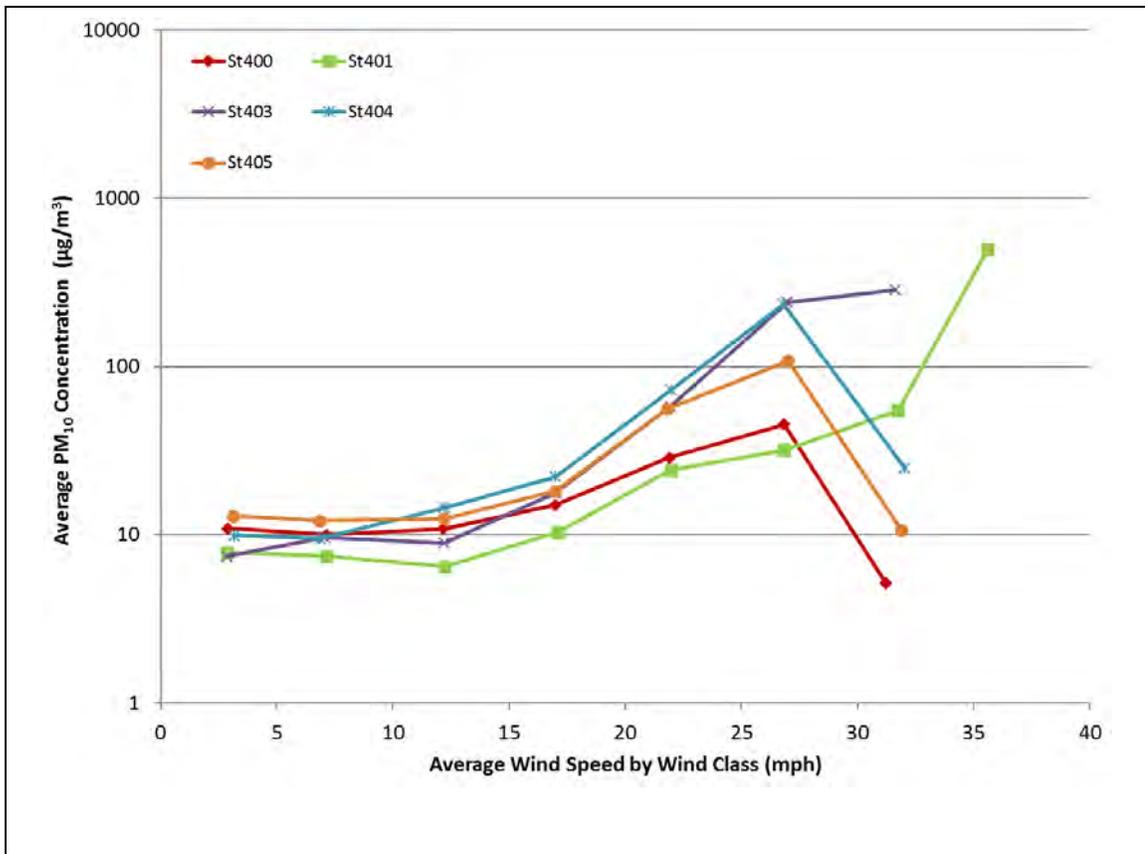


Figure A-6. Wind speed and log-normal  $PM_{10}$  trends for stations 400, 401, 403, 404, and 405 for January 1–December 31, 2018

## Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018



Indian paintbrush (*Castilleja ssp.*)

**Table B-1.** Radiological results for off-site soil sampling locations at SNL/TTR, 2018

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
C-20	Americium-241	0.0198 ± 0.0449	0.077	U	BD	HASL-300
	Uranium-235	0.0206 ± 0.113	0.107	U	BD	HASL-300
	Uranium-238	1.4 ± 0.898	0.655		J	HASL-300
C-21	Americium-241	-0.00222 ± 0.02	0.0382	U	BD	HASL-300
	Cesium-137	0.0959 ± 0.0378	0.0292		None	HASL-300
	Uranium-235	0.0804 ± 0.159	0.124	U	BD	HASL-300
	Uranium-238	1.43 ± 0.54	0.378		None	HASL-300
C-22	Americium-241	-0.00447 ± 0.0513	0.0889	U	BD	HASL-300
	Cesium-137	0.0828 ± 0.0213	0.0193		None	HASL-300
	Uranium-235	0.274 ± 0.146	0.124		J	HASL-300
	Uranium-238	01.83 ± 1.23	0.738		J	HASL-300
C-23	Americium-241	0.00451 ± 0.0765	0.122	U	BD	HASL-300
	Cesium-137	0.13 ± 0.0325	0.0261		None	HASL-300
	Uranium-235	0.0741 ± 0.155	0.16	U	BD	HASL-300
C-24	Americium-241	0.00845 ± 0.0628	0.114	U	BD	HASL-300
	Cesium-137	0.132 ± 0.0347	0.031		None	HASL-300
	Uranium-235	0.0684 ± 0.0935	0.171	U	BD	HASL-300
	Uranium-238	1.9 ± 1.28	0.965		J	HASL-300
C-25	Americium-241	0.00351 ± 0.0956	0.173	U	BD	HASL-300
	Cesium-137	0.468 ± 0.0578	0.0279		None	HASL-300
	Uranium-235	0.0113 ± 0.0934	0.149	U	BD	HASL-300
	Uranium-238	0.881 ± 1.25	1.32	U	BD	HASL-300

Table continued on next page

Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-1.** Radiological results for off-site soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
C-26	Americium-241	0.085 ± 0.0915	0.147	U	BD	HASL-300
	Cesium-137	0.282 ± 0.0564	0.0369		None	HASL-300
	Uranium-235	0.0256 ± 0.104	0.203	U	BD	HASL-300
C-27	Americium-241	0.00477 ± 0.0608	0.123	U	BD	HASL-300
	Cesium-137	0.179 ± 0.0456	0.025		None	HASL-300
	Uranium-235	0.0148 ± 0.0726	0.128	U	BD	HASL-300
C-28	Americium-241	0.00868 ± 0.0788	0.134	U	BD	HASL-300
	Cesium-137	0.0525 ± 0.0271	0.0228		J	HASL-300
	Uranium-235	0.0157 ± 0.132	0.128	U	BD	HASL-300
	Uranium-238	1.84 ± 1.41	1.05		J	HASL-300
C-29	Americium-241	0.0199 ± 0.0903	0.158	U	BD	HASL-300
	Cesium-137	0.23 ± 0.0367	0.0273		None	HASL-300
	Uranium-235	0.234 ± 0.18	0.158		J	HASL-300
	Uranium-238	-0.0187 ± 0.924	1.42	U	BD	HASL-300
C-30	Americium-241	0.054 ± 0.0492	0.0805	U	BD	HASL-300
	Cesium-137	0.209 ± 0.0384	0.0293		None	HASL-300
	Uranium-235	0.00602 ± 0.167	0.157	U	BD	HASL-300
C-31	Americium-241	0.0064 ± 0.0235	0.0398	U	BD	HASL-300
	Cesium-137	0.0374 ± 0.0267	0.0305		J	HASL-300
	Uranium-235	0.0535 ± 0.137	0.125	U	BD	HASL-300
	Uranium-238	1.18 ± 0.62	0.392		None	HASL-300
C-32	Americium-241	-0.0401 ± 0.0592	0.0969	U	BD	HASL-300
	Cesium-137	0.0807 ± 0.0218	0.0216		None	HASL-300
	Uranium-235	0.0388 ± 0.101	0.117	U	BD	HASL-300
C-33	Americium-241	-0.00837 ± 0.0183	0.0304	U	BD	HASL-300
	Cesium-137	0.102 ± 0.0268	0.0258		None	HASL-300
	Uranium-235	0.0636 ± 0.122	0.105	U	BD	HASL-300
	Uranium-238	0.731 ± 0.442	0.308		J	HASL-300

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95% 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 result was below the MDA

**Data Validation Qualifier**

BD = below detection limit as used in radiochemistry to identify results that are not statistically different from zero

J = associated value is an estimated quantity

None = no data validation for corrected gross alpha activity

**Table B-2.** Radiological results for perimeter soil sampling locations at SNL/TTR, 2018

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
P-06	Americium-241	0.00503 ± 0.0523	0.0872	U	BD	HASL-300
	Cesium-137	0.0819 ± 0.0385	0.0275		J	HASL-300
	Uranium-235	0.0449 ± 0.142	0.146	U	BD	HASL-300
	Uranium-238	0.756 ± 0.872	0.796	U	BD	HASL-300
P-08	Americium-241	-0.0516 ± 0.0995	0.167	U	BD	HASL-300
	Cesium-137	0.032 ± 0.02	0.032	U	BD	HASL-300
	Uranium-235	0.0456 ± 0.158	0.135	U	BD	HASL-300
	Uranium-238	1.81 ± 1.79	1.36		J	HASL-300
P-11	Americium-241	-0.0309 ± 0.0529	0.0983	U	BD	HASL-300
	Cesium-137	0.322 ± 0.037	0.0211		None	HASL-300
	Uranium-235	0.176 ± 0.133	0.104		J	HASL-300
	Uranium-238	1.3 ± 1.06	0.793		J	HASL-300
P-12	Americium-241	0.0244 ± 0.0663	0.117	U	BD	HASL-300
	Cesium-137	0.15 ± 0.0423	0.0312		None	HASL-300
	Uranium-235	0.107 ± 0.144	0.165	U	BD	HASL-300
	Uranium-238	1.7 ± 1.3	0.975		J	HASL-300
P-34	Americium-241	0.114 ± 0.132	0.223	U	BD	HASL-300
	Cesium-137	0.194 ± 0.0397	0.0303		None	HASL-300
	Uranium-238	1.03 ± 2.04	1.73	U	BD	HASL-300
P-35	Americium-241	-0.00859 ± 0.0858	0.142	U	BD	HASL-300
	Cesium-137	0.462 ± 0.0489	0.0249		None	HASL-300
	Uranium-235	0.0228 ± 0.132	0.133	U	BD	HASL-300
	Uranium-238	1.44 ± 1.34	1.12		J	HASL-300
P-36	Americium-241	-0.0122 ± 0.0689	0.137	U	BD	HASL-300
	Cesium-137	0.101 ± 0.0246	0.0232		None	HASL-300
	Uranium-235	0.0781 ± 0.112	0.111	U	BD	HASL-300
	Uranium-238	0.598 ± 1.21	1.05	U	BD	HASL-300
P-37	Americium-241	0.038 ± 0.0515	0.0464	U	BD	HASL-300
	Cesium-137	0.0362 ± 0.0231	0.0313		J	HASL-300
	Uranium-235	0.119 ± 0.17	0.136	U	BD	HASL-300
	Uranium-238	1.35 ± 0.822	0.442		None	HASL-300

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95% 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 analyzed for, but not detected; or organic and inorganic analytes the result is less than the effective MDL concentration

#### Data Validation Qualifier

BD = below detection limit as used in radiochemistry to identify results that are not statistically different from zero

J = associated value is an estimated quantity

None = no data validation for corrected gross alpha activity

**Table B-3.** Radiological results for South Plume Area soil sampling locations at SNL/TTR, 2018

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-49	Americium-241	0.331 ± 0.203	0.178		J	HASL-300
	Cesium-137	0.254 ± 0.0484	0.0361		None	HASL-300
	Plutonium-238	0.203 ± 0.222	0.434	U	BD	HASL-300u
	Plutonium-239/240	0.231 ± 0.313	0.543	*U	BD	HASL-300
	Uranium-235	0.0244 ± 0.169	0.175	U	BD	HASL-300
	Uranium-238	2.36 ± 1.79	1.4		J	HASL-300
S-50	Americium-241	0.0774 ± 0.0907	0.156	U	BD	HASL-300
	Cesium-137	0.412 ± 0.0468	0.0263		None	HASL-300
	Uranium-238	0.788 ± 1.4	1.2	U	None	HASL-300
S-51	Americium-241	16.7 ± 1.31	0.171		None	HASL-300
	Cesium-137	0.486 ± 0.0519	0.0247		None	HASL-300
	Plutonium-238	1.22 ± .578	0.73		J+	HASL-300
	Plutonium-239/240	127 ± 19.4	0.914	*	J+	HASL-300
	Uranium-235	0.0644 ± .134	0.147	U	BD	HASL-300
	Uranium-238	1.24 ± 1.16	0.984		J	HASL-300
S-52	Americium-241	0.0868 ± 0.0989	0.0876	U	BD	HASL-300
	Cesium-137	0.118 ± 0.0364	0.034		None	HASL-300
	Uranium-235	-0.0768 ± 0.101	0.173	U	BD	HASL-300
	Uranium-238	1.46 ± 1.17	0.794		J	HASL-300

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

#### Laboratory Data Qualifier

\* = a replicate was outside limits

U = the analyte result was below the MDA

#### Data Validation Qualifier

BD = below detection limit as used in radiochemistry to identify results that are not statistically different from zero

J = associated value is an estimated quantity

J+ = The associated numerical value is an estimated quantity with a suspected positive base

None = no data validation for corrected gross alpha activity

**Table B-4.** Radiological results for Range Operations Center on-site soil sampling locations at SNL/TTR, 2018

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-40	Americium-241	-0.00343 ± 0.0994	0.162	U	BD	HASL-300
	Cesium-137	0.0521 ± 0.0194	0.0294		J	HASL-300
	Uranium-235	0.118 ± 0.171	0.166	U	BD	HASL-300
	Uranium-238	0.494 ± 1.57	1.32	U	BD	HASL-300
S-41	Americium-241	0.0304 ± 0.0475	0.0803	U	BD	HASL-300
	Cesium-137	0.0528 ± 0.0334	0.0279		J	HASL-300
	Uranium-235	.0916 ± 0.163	0.147	U	BD	HASL-300
	Uranium-238	1.43 ± 0.883	0.714		J	HASL-300
S-42	Americium-241	-0.0204 ± 0.0525	0.088	U	BD	HASL-300
	Cesium-137	0.263 ± 0.045	0.0292		None	HASL-300
	Uranium-235	0.0503 ± 0.103	0.176	U	BD	HASL-300
S-43	Americium-241	0.142 ± 0.188	0.151	U	BD	HASL-300
	Cesium-137	0.0229 ± 0.0234	0.0255	U	BD	HASL-300
	Uranium-235	-0.0281 ± 0.0972	0.157	U	BD	HASL-300
	Uranium-238	0.881 ± 1.46	1.23	U	BD	HASL-300
S-44	Americium-241	-0.0203 ± 0.0908	0.152	U	BD	HASL-300
	Cesium-137	0.019 ± 0.0269	0.0264	U	BD	HASL-300
	Uranium-235	0.0976 ± 0.16	0.141	U	BD	HASL-300
	Uranium-238	2.2 ± 1.63	1.21		J	HASL-300
S-45	Americium-241	-0.0445 ± 0.0895	0.15	U	BD	HASL-300
	Cesium-137	0.0236 ± 0.0215	0.0272	U	BD	HASL-300
	Uranium-235	0.111 ± 0.141	0.127	U	BD	HASL-300
	Uranium-238	2.1 ± 1.68	1.19		J	HASL-300
S-46	Americium-241	-0.0479 ± 0.0888	0.154	U	BD	HASL-300
	Cesium-137	0.0201 ± 0.0218	0.0241	U	BD	HASL-300
	Uranium-235	0.0395 ± 0.13	0.127	U	BD	HASL-300
	Uranium-238	1.73 ± 1.24	1.19		J	HASL-300
S-47	Americium-241	-0.00177 ± 0.0866	0.148	U	BD	HASL-300
	Cesium-137	0.0808 ± 0.0258	0.0249		None	HASL-300
	Uranium-235	0.0445 ± 0.131	0.13	U	BD	HASL-300
	Uranium-238	0.913 ± 1.64	1.14	U	BD	HASL-300

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95% 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 result was below the MDA

**Data Validation Qualifier**

BD = below detection limit as used in radiochemistry to identify results that are not statistically different from zero

J = associated value is an estimated quantity

None = no data validation for corrected gross alpha activity

**Table B-5.** Radiological results for various on-site soil sampling locations at SNL/TTR, 2018

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-02	Americium-241	-0.0612 ± 0.0981	0.183	U	BD	HASL-300
	Cesium-137	0.223 ± 0.0418	0.0318		None	HASL-300
	Uranium-235	0.0382 ± 0.104	0.163	U	BD	HASL-300
	Uranium-238	0.928 ± 1.84	1.44	U	BD	HASL-300
S-03	Cesium-137	0.244 ± 0.0368	0.0254		None	HASL-300
	Plutonium-238	-0.132 ± 0.224	0.494	U	BD	HASL-300
	Plutonium-239/240	1.28 ± 0.527	0.618	*	J+	HASL-300
	Uranium-238	1.91 ± 1.47	1.02		None	HASL-300
S-04	Americium-241	0.0156 ± 0.0607	0.115	U	BD	HASL-300
	Cesium-137	0.313 ± 0.039	0.0198		None	HASL-300
	Uranium-235	0.0816 ± 0.107	0.0963	U	BD	HASL-300
	Uranium-238	0.296 ± 1.25	0.882	U	BD	HASL-300
S-09	Americium-241	2.78 ± .0318	0.131		None	HASL-300
	Cesium-137	0.106 ± 0.0345	0.0289		None	HASL-300
	Plutonium-238	0.369 ± 0.43	0.79	U	BD	HASL-300, Pu
	Plutonium-239/240	11.2 ± 2.32	0.988	*	J+	HASL-300
	Uranium-235	0.0402 ± 0.138	0.149	U	BD	HASL-300
	Uranium-238	2.65 ± 1.53	1.07		J	HASL-300
S-10	Cesium-137	0.127 ± 0.0259	0.019		None	HASL-300
	Plutonium-238	-0.0399 ± 0.282	0.597	U	BD	HASL-300
	Plutonium-239/240	-0.0796 ± 0.398	0.747	*U	BD	HASL-300
	Uranium-238	1.47 ± 0.547	0.273		None	HASL-300
S-38	Americium-241	0.146 ± 0.124	0.197	U	BD	HASL-300
	Cesium-137	0.233 ± 0.0396	0.0269		None	HASL-300
	Uranium-235	-0.0415 ± 0.0919	0.153	U	BD	HASL-300
	Uranium-238	2.55 ± 2.17	1.45		J	HASL-300
S-39	Americium-241	0.0529 ± 0.0899	0.16	U	BD	HASL-300
	Cesium-137	0.328 ± 0.0471	0.0292		None	HASL-300
	Uranium-235	0.00717 ± 0.172	0.159	U	BD	HASL-300
	Uranium-238	3.04 ± 2.21	1.28		J	HASL-300
S-53	Americium-241	0.0543 ± 0.0493	0.072	U	BD	HASL-300
	Cesium-137	0.171 ± 0.0265	0.0202		None	HASL-300
	Uranium-235	0.0602 ± 0.0756	0.126	U	BD	HASL-300
	Uranium-238	1.29 ± 0.742	0.631		J	HASL-300

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

**Laboratory Data Qualifier**

\* = a replicate was outside limits

U = the analyte result was below the MDA

**Data Validation Qualifier**

BD = below detection limit as used in radiochemistry to identify results that are not statistically different from zero

J = associated value is an estimated quantity

J+ = The associated numerical value is an estimated quantity with a suspected positive base

None = no data validation for corrected gross alpha activity

**Table B-6.** Environmental dosimeter measurements, 2018

Location Class	Location Number	First Quarter (86 Days)		Second Quarter (113 Days)		Third Quarter (8 Days)		Fourth Quarter (103 Days)	
		Gross Exposure (mR)	Net Exposure (mR)	Gross Exposure (mR)	Net Exposure (mR)	Gross Exposure (mR)	Net Exposure (mR)	Gross Exposure (mR)	Net Exposure (mR)
On-Site	S-01	59.3	23.8	67.9	30.5	54.8	21.1	66.6	30.3
	S-02	60.3	24.7	68.3	30.9	58.5	24.8	66.1	29.8
	S-03	58.2	22.7	69.5	32.1	58.8	25.2	71.7	35.4
	S-04	62.5	27.0	75.5	38.0	58.4	24.8	66.5	30.2
	S-09	51.5	16.0	61.0	23.6	53.8	20.2	62.9	26.6
	S-10	60.8	25.3	68.5	31.1	56.3	22.7	62.1	25.9
	S-13	55.6	20.1	65.2	27.8	57.2	23.6	68.8	32.5
	S-14	55.4	19.9	64.1	26.7	51.8	18.2	58.7	22.4
	S-15	67.3	31.8	72.5	35.1	54.7	21.1	66.0	29.7
	S-16	59.8	24.3	66.0	28.6	55.8	22.2	62.7	26.4
Perimeter	S-17	57.9	22.4	67.6	30.2	56.0	22.3	65.6	29.3
	P-05	57.1	21.6	71.7	34.3	57.1	23.5	67.1	30.9
	P-06	56.7	21.2	68.9	31.5	58.8	25.1	62.6	26.3
	P-07	55.4	19.9	66.2	28.8	52.4	18.7	57.3	21.0
	P-08	54.2	18.7	61.8	24.4	50.7	17.1	61.1	24.8
	P-11	63.0	27.5	74.2	36.8	53.5	19.9	62.8	26.5
Community	P-12	58.8	23.3	67.8	30.4	56.8	23.1	67.2	31.0
	C-19	46.3	10.8	57.4	20.0	49.5	15.9	52.2	16.0
	C-21	58.3	22.8	66.3	28.9	55.8	22.1	Not collected	Not collected
	C-22	56.4	20.9	62.7	25.3	54.3	20.7	62.4	26.1

**Table B-7.** Nonradiological results for South Plume Area soil sampling locations at SNL/TTR, 2018

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-49	Aluminum	15,000	21	46.2	B	J	SW-8W-846 3050B/6020
	Antimony	1.63	0.305	0.924		J	SW-846 3050B/6010B
	Arsenic	3.23	0.312	0.924		None	SW-846 3050B/6020
	Barium	228	0.462	1.85	B	J	SW-846 3050B/6020
	Beryllium	0.604	0.0185	0.0924		None	SW-846 3050B/6020
	Cadmium	0.204	0.0185	0.185		None	SW-846 3050B/6020
	Calcium	10,700	61.9	185		None	SW-846 3050B/6020
	Chromium	6.26	0.185	0.555		None	SW-846 3050B/6020
	Cobalt	3.58	0.0555	0.185		None	SW-846 3050B/6020
	Copper	7.48	0.061	0.185		None	SW-846 3050B/6020
	Iron	10,400	30.5	92.4	B	J	SW-846 3050B/6020
	Lead	10.3	0.0924	0.37		None	SW-846 3050B/6020
	Magnesium	4,960	1.85	5.55		None	SW-846 3050B/6020
	Manganese	540	0.924	4.62		J	SW-846 3050B/6020
	Nickel	6.2	0.0924	0.37	B	None	SW-846 3050B/6020
	Potassium	6,840	14.8	55.5		None	SW-846 3050B/6020
	Selenium	0.638	0.333	0.924	J	None	SW-846 3050B/6020
	Silver	0.495	0.0924	0.462	B	None	SW-846 3050B/6010B
	Sodium	1,460	14.8	46.2		None	SW-846 3050B/6020
	Thallium	0.16	0.129	0.37	J	None	SW-846 3050B/6020
Uranium	0.688	0.0122	0.037		None	SW-846 3050B/6020	
Vanadium	24	0.0924	0.462		None	SW-846 3050B/6010B	
Zinc	36.4	0.739	1.85	B	J	SW-846 3050B/6020	
S-50	Aluminum	12,100	22.3	48.9	B	J	SW-846 3050B/6020
	Antimony	1.3	0.314	0.952		J	SW-846 3050B/6010B
	Arsenic	2.84	0.331	0.978		None	SW-846 3050B/6020
	Barium	169	0.0978	0.391	B	J	SW-846 3050B/6020
	Beryllium	0.494	0.0196	0.0978		None	SW-846 3050B/6020
	Cadmium	0.219	0.0196	0.196		None	SW-846 3050B/6020
	Calcium	4,570	13.1	39.1		None	SW-846 3050B/6020

Table continued on next page

Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-7.** Nonradiological results for South Plume Area soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-50	Chromium	5.51	0.196	0.587		None	SW-846 3050B/6020
	Cobalt	3.26	0.0587	0.196		None	SW-846 3050B/6020
	Copper	6.63	0.0646	0.196		None	SW-846 3050B/6020
	Iron	8,980	6.46	19.6	B	J	SW-846 3050B/6020
	Lead	12.5	0.0978	0.391		None	SW-846 3050B/6020
	Magnesium	3,920	1.96	5.87		None	SW-846 3050B/6020
	Manganese	492	0.978	4.89		J	SW-846 3050B/6020
	Nickel	5.36	0.0978	0.391	B	None	SW-846 3050B/6020
	Potassium	5,000	15.7	58.7		None	SW-846 3050B/6020
	Selenium	0.626	0.352	0.978	J	None	SW-846 3050B/6020
	Silver	0.397	0.0952	0.476	JB	0.476U	SW-846 3050B/6010B
	Sodium	588	15.7	48.9		None	SW-846 3050B/6020
	Thallium	0.137	0.137	0.391	U	None	SW-846 3050B/6020
	Uranium	0.529	0.0129	0.0391		None	SW-846 3050B/6020
	Vanadium	20.3	0.0952	0.476		None	SW-846 3050B/6010B
Zinc	38.3	0.783	1.96	B	J	SW-846 3050B/6020	
S-51	Aluminum	11,600	21.3	46.9	B	J	SW-846 3050B/6020
	Antimony	1.29	0.308	0.935		J+	SW-846 3050B/6010B
	Arsenic	3.03	0.317	0.938		None	SW-846 3050B/6020
	Barium	203	0.469	1.88	B	J	SW-846 3050B/6020
	Beryllium	0.477	0.0188	0.0938		None	SW-846 3050B/6020
	Cadmium	0.218	0.0188	0.188		None	SW-846 3050B/6020
	Calcium	4,480	12.6	37.5		None	SW-846 3050B/6020
	Chromium	5.47	0.188	0.563		None	SW-846 3050B/6020
	Cobalt	3.96	0.0563	0.188		None	SW-846 3050B/6020
	Copper	6.41	0.0619	0.188		None	SW-846 3050B/6020
	Iron	8,600	6.19	18.8	B	J	SW-846 3050B/6020
	Lead	12.2	0.0938	0.375		None	SW-846 3050B/6020
	Magnesium	3,870	1.88	5.63		None	SW-846 3050B/6020

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-7.** Nonradiological results for South Plume Area soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-51	Manganese	648	0.938	4.69		J	SW-846 3050B/6020
	Nickel	5.5	0.0938	0.375	B	None	SW-846 3050B/6020
	Potassium	4,790	15	56.3		None	SW-846 3050B/6020
	Selenium	0.644	0.338	0.938	J	None	SW-846 3050B/6020
	Silver	0.371	0.0935	0.467	JB	0.467U	SW-846 3050B/6010B
	Sodium	708	15	46.9		None	SW-846 3050B/6020
	Thallium	0.131	0.131	0.375	U	None	SW-846 3050B/6020
	Uranium	0.673	0.0124	0.0375		None	SW-846 3050B/6020
	Vanadium	13.4	0.0935	0.467		None	SW-846 3050B/6010B
	Zinc	30.3	0.75	1.88	B	J	SW-846 3050B/6020
S-52	Aluminum	8,630	4.33	9.51	B	J	SW-846 3050B/6020
	Antimony	1.03	0.315	0.954		J	SW-846 3050B/6010B
	Arsenic	3.4	0.321	0.951		None	SW-846 3050B/6020
	Barium	95.5	0.0951	0.38	B	J	SW-846 3050B/6020
	Beryllium	0.438	0.019	0.0951		None	SW-846 3050B/6020
	Cadmium	0.149	0.019	0.19	J	None	SW-846 3050B/6020
	Calcium	2,170	12.7	38		None	SW-846 3050B/6020
	Chromium	4.17	0.19	0.57		None	SW-846 3050B/6020
	Cobalt	2.42	0.057	0.19		None	SW-846 3050B/6020
	Copper	4.7	0.0627	0.19		None	SW-846 3050B/6020
	Iron	6,410	6.27	19	B	J	SW-846 3050B/6020
	Lead	7.5	0.0951	0.38		None	SW-846 3050B/6020
	Magnesium	2,670	1.9	5.7		None	SW-846 3050B/6020
	Manganese	343	0.951	4.75		J	SW-846 3050B/6020
	Nickel	3.69	0.0951	0.38	B	None	SW-846 3050B/6020
	Potassium	2,710	15.2	57		None	SW-846 3050B/6020
	Selenium	0.583	0.342	0.951	J	None	SW-846 3050B/6020
Silver	0.168	0.0954	0.477	JB	0.477U	SW-846 3050B/6010B	
Sodium	195	15.2	47.5		None	SW-846 3050B/6020	

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-7.** Nonradiological results for South Plume Area soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-52	Thallium	0.133	0.133	0.38	U	None	SW-846 3050B/6020
	Uranium	0.7	0.0125	0.038		None	SW-846 3050B/6020
	Vanadium	11.4	0.0954	0.477		None	SW-846 3050B/6010B
	Zinc	32	0.76	1.9	B	J	SW-846 3050B/6020

MDL = method detection limit

PQL = practical quantitation limit; the lowest concentration of analytes in a sample that can be determined reliably within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

**Laboratory Data Qualifier**

B = analyte detected in the blank

J = estimated value, the analyte concentration fell above the effective MDL and below the effective PQL

U = the analyte was analyzed for, but not detected; or organic and inorganic analytes the result is less than the effective MDL concentration

**Data Validation Qualifier**

J = associated value is an estimated quantity

J+ = The associated numerical value is an estimated quantity with a suspected positive base

None = no data validation for corrected gross alpha activity

U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit

**Table B-8.** Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2018

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-02	Aluminum	12,000	21.8	47.9	B	J	SW-846 3050B/6020
	Antimony	1.61	0.316	0.958		J	SW-846 3050B/6010B
	Arsenic	3.03	0.324	0.958		None	SW-846 3050B/6020
	Barium	89.9	0.0958	0.383	B	J	SW-846 3050B/6020
	Beryllium	0.569	0.0192	0.0958		None	SW-846 3050B/6020
	Cadmium	0.102	0.0192	0.192	J	None	SW-846 3050B/6020
	Calcium	2,790	12.8	38.3		None	SW-846 3050B/6020
	Chromium	4.92	0.192	0.575		None	SW-846 3050B/6020
	Cobalt	2.66	0.0575	0.192		None	SW-846 3050B/6020
	Copper	4.67	0.0632	0.192		None	SW-846 3050B/6020
	Iron	8,210	6.32	19.2	B	J	SW-846 3050B/6020
	Lead	8.09	0.0958	0.383		None	SW-846 3050B/6020
	Magnesium	3,070	1.92	5.75		None	SW-846 3050B/6020
	Manganese	282	0.958	4.79		J	SW-846 3050B/6020
	Nickel	4.6	0.0958	0.383	B	None	SW-846 3050B/6020
	Potassium	3,350	15.3	57.5		None	SW-846 3050B/6020
	Selenium	0.521	0.345	0.958	J	None	SW-846 3050B/6020
	Silver	0.466	0.0958	0.479	JB	0.479U	SW-846 3050B/6010B
	Sodium	172	15.3	47.9		None	SW-846 3050B/6020
	Thallium	0.142	0.134	0.383	J	None	SW-846 3050B/6020
Uranium	0.762	0.0126	0.0383		None	SW-846 3050B/6020	
Vanadium	16.6	0.0958	0.479		None	SW-846 3050B/6010B	
Zinc	35	0.766	1.92	B	J	SW-846 3050B/6020	
S-03	Aluminum	10,400	53.7	118		J	SW-846 3050B/6020
	Antimony	1.2	0.3	0.909	*	J+	SW-846 3050B/6010B
	Arsenic	3.35	0.319	0.943		None	SW-846 3050B/6020
	Barium	102	0.0943	0.377		J	SW-846 3050B/6020
	Beryllium	0.48	0.0189	0.0943		None	SW-846 3050B/6020
	Cadmium	0.124	0.0189	0.189	J	None	SW-846 3050B/6020
	Calcium	2,890	12.6	37.7		J	SW-846 3050B/6020

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-8.** Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-03	Chromium	5.6	0.189	0.566		None	SW-846 3050B/6020
	Cobalt	3.02	0.0566	0.189	*	None	SW-846 3050B/6020
	Copper	5.5	0.0623	0.189		J	SW-846 3050B/6020
	Iron	8,620	6.23	18.9		J	SW-846 3050B/6020
	Lead	8.57	0.0943	0.377	*	J	SW-846 3050B/6020
	Magnesium	3,280	1.89	5.66		J	SW-846 3050B/6020
	Manganese	305	2.36	11.8	*	J	SW-846 3050B/6020
	Nickel	4.75	0.0943	0.377		None	SW-846 3050B/6020
	Potassium	3,230	15.1	56.6		None	SW-846 3050B/6020
	Selenium	0.994	0.34	0.943	N	J	SW-846 3050B/6020
	Silver	0.35	0.0909	0.455	J	None	SW-846 3050B/6010B
	Sodium	288	15.1	47.2		None	SW-846 3050B/6020
	Thallium	0.135	0.132	0.377	J	None	SW-846 3050B/6020
	Uranium	0.744	0.0125	0.0377	*	None	SW-846 3050B/6020
	Vanadium	14.2	0.0909	0.455	*N	J-	SW-846 3050B/6010B
Zinc	25.1	0.755	1.89	B	J	SW-846 3050B/6020	
S-04	Aluminum	7,950	4.21	9.24		J	SW-846 3050B/6020
	Antimony	1.03	0.32	0.971	*	J+	SW-846 3050B/6010B
	Arsenic	3.04	0.312	0.924		None	SW-846 3050B/6020
	Barium	104	0.0924	0.37		J	SW-846 3050B/6020
	Beryllium	0.451	0.0185	0.0924		None	SW-846 3050B/6020
	Cadmium	0.172	0.0185	0.185	J	None	SW-846 3050B/6020
	Calcium	2,840	12.4	37		J	SW-846 3050B/6020
	Chromium	4.16	0.185	0.555		None	SW-846 3050B/6020
	Cobalt	2.37	0.0555	0.185	*	None	SW-846 3050B/6020
	Copper	4.82	0.061	0.185		J	SW-846 3050B/6020
	Iron	7,570	6.1	18.5		J	SW-846 3050B/6020
	Lead	7.23	0.0924	0.37	*	J	SW-846 3050B/6020
	Magnesium	2,870	1.85	5.55		J	SW-846 3050B/6020

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-8.** Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-04	Manganese	347	2.31	11.6	*	J	SW-846 3050B/6020
	Nickel	3.69	0.0924	0.37		None	SW-846 3050B/6020
	Potassium	3,010	14.8	55.5		None	SW-846 3050B/6020
	Selenium	0.814	0.333	0.924	JN	J	SW-846 3050B/6020
	Silver	0.328	0.0971	0.485	J	None	SW-846 3050B/6010B
	Sodium	252	14.8	46.2		None	SW-846 3050B/6020
	Thallium	0.129	0.129	0.37	U	None	SW-846 3050B/6020
	Uranium	0.717	0.0122	0.037	*	None	SW-846 3050B/6020
	Vanadium	13.1	0.0971	0.485	*N	J-	SW-846 3050B/6010B
	Zinc	24.8	0.739	1.85	B	J	SW-846 3050B/6020
S-09	Aluminum	11,800	52.6	116		J	SW-846 3050B/6020
	Antimony	0.983	0.315	0.954	*	J+	SW-846 3050B/6010B
	Arsenic	3.2	0.312	0.924		None	SW-846 3050B/6020
	Barium	131	0.0924	0.37		J	SW-846 3050B/6020
	Beryllium	0.543	0.0185	0.0924		None	SW-846 3050B/6020
	Cadmium	0.112	0.0185	0.185	J	None	SW-846 3050B/6020
	Calcium	6,740	12.4	37		J	SW-846 3050B/6020
	Chromium	5.82	0.185	0.555		None	SW-846 3050B/6020
	Cobalt	5.54	0.0555	0.185	*	None	SW-846 3050B/6020
	Copper	6.36	0.061	0.185		J	SW-846 3050B/6020
	Iron	11,500	76.2	231		J	SW-846 3050B/6020
	Lead	10.1	0.0924	0.37	*	J	SW-846 3050B/6020
	Magnesium	4450	1.85	5.55		J	SW-846 3050B/6020
	Manganese	369	2.31	11.6	*	J	SW-846 3050B/6020
	Nickel	5.52	0.0924	0.37		None	SW-846 3050B/6020
	Potassium	3,470	14.8	55.5		None	SW-846 3050B/6020
	Selenium	0.975	0.333	0.924	N	J	SW-846 3050B/6020
	Silver	0.647	0.0954	0.477		None	SW-846 3050B/6010B
Sodium	226	14.8	46.2		None	SW-846 3050B/6020	

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-8.** Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-09	Thallium	0.149	0.129	0.37	J	None	SW-846 3050B/6020
	Uranium	0.533	0.0122	0.037	*	None	SW-846 3050B/6020
	Vanadium	22.7	0.0954	0.477	*N	J-	SW-846 3050B/6010B
	Zinc	31.7	0.739	1.85	B	J	SW-846 3050B/6020
S-10	Aluminum	10,600	52.2	115		J	SW-846 3050B/6020
	Antimony	1.06	0.317	0.96	*	J+	SW-846 3050B/6010B
	Arsenic	3.16	0.31	0.917		None	SW-846 3050B/6020
	Barium	121	0.0917	0.367		J	SW-846 3050B/6020
	Beryllium	0.523	0.0183	0.0917		None	SW-846 3050B/6020
	Cadmium	0.163	0.0183	0.183	J	None	SW-846 3050B/6020
	Calcium	4,460	12.3	36.7		J	SW-846 3050B/6020
	Chromium	5.19	0.183	0.55		None	SW-846 3050B/6020
	Cobalt	2.95	0.055	0.183	*	None	SW-846 3050B/6020
	Copper	5.72	0.0606	0.183		J	SW-846 3050B/6020
	Iron	8,550	6.06	18.3		J	SW-846 3050B/6020
	Lead	8.08	0.0917	0.367	*	J	SW-846 3050B/6020
	Magnesium	3,480	1.83	5.5		J	SW-846 3050B/6020
	Manganese	388	2.29	11.5	*	J	SW-846 3050B/6020
	Nickel	4.65	0.0917	0.367		None	SW-846 3050B/6020
	Potassium	3,870	14.7	55		None	SW-846 3050B/6020
	Selenium	0.752	0.33	0.917	JN	J	SW-846 3050B/6020
	Silver	0.394	0.096	0.48	J	None	SW-846 3050B/6010B
	Sodium	612	14.7	45.9		None	SW-846 3050B/6020
	Thallium	0.141	0.128	0.367	J	None	SW-846 3050B/6020
Uranium	0.711	0.0121	0.0367	*	None	SW-846 3050B/6020	
Vanadium	13.4	0.096	0.48	*N	J-	SW-846 3050B/6010B	
Zinc	27.5	0.734	1.83	B	J	SW-846 3050B/6020	

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-8.** Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-38	Aluminum	13,800	53.1	117		J	SW-846 3050B/6020
	Antimony	0.796	0.327	0.99	*J	J+	SW-846 3050B/6010B
	Arsenic	3.79	0.315	0.933		None	SW-846 3050B/6020
	Barium	123	0.0933	0.373		J	SW-846 3050B/6020
	Beryllium	0.588	0.0187	0.0933		None	SW-846 3050B/6020
	Cadmium	0.255	0.0187	0.187		None	SW-846 3050B/6020
	Calcium	3,210	12.5	37.3		J	SW-846 3050B/6020
	Chromium	9.18	0.187	0.56		None	SW-846 3050B/6020
	Cobalt	4.07	0.056	0.187	*	None	SW-846 3050B/6020
	Copper	10.8	0.0616	0.187		J	SW-846 3050B/6020
	Iron	14,000	77	233		J	SW-846 3050B/6020
	Lead	11	0.0933	0.373	*	J	SW-846 3050B/6020
	Magnesium	4,480	1.87	5.6		J	SW-846 3050B/6020
	Manganese	356	2.33	11.7	*	J	SW-846 3050B/6020
	Nickel	8.42	0.0933	0.373		None	SW-846 3050B/6020
	Potassium	4,690	14.9	56		None	SW-846 3050B/6020
	Selenium	0.927	0.336	0.933	JN	J	SW-846 3050B/6020
	Silver	0.306	0.099	0.495	J	None	SW-846 3050B/6010B
	Sodium	702	14.9	46.6		None	SW-846 3050B/6020
	Thallium	0.188	0.131	0.373	J	None	SW-846 3050B/6020
Uranium	0.661	0.0123	0.0373	*	None	SW-846 3050B/6020	
Vanadium	11.7	0.099	0.495	*N	J-	SW-846 3050B/6010B	
Zinc	34	0.746	1.87	B	J	SW-846 3050B/6020	
S-39	Aluminum	10,900	55.4	122		J	SW-846 3050B/6020
	Antimony	1.28	0.299	0.907	*	J+	SW-846 3050B/6010B
	Arsenic	4.09	0.329	0.975		None	SW-846 3050B/6020
	Barium	140	0.0975	0.39		J	SW-846 3050B/6020
	Beryllium	0.511	0.0195	0.0975		None	SW-846 3050B/6020
	Cadmium	0.194	0.0195	0.195	J	None	SW-846 3050B/6020

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-8.** Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-39	Calcium	3,710	13.1	39		J	SW-846 3050B/6020
	Chromium	5.74	0.195	0.585		None	SW-846 3050B/6020
	Cobalt	3.45	0.0585	0.195	*	None	SW-846 3050B/6020
	Copper	6.16	0.0643	0.195		J	SW-846 3050B/6020
	Iron	9,080	6.43	19.5		J	SW-846 3050B/6020
	Lead	10.6	0.0975	0.39	*	J	SW-846 3050B/6020
	Magnesium	3,640	1.95	5.85		J	SW-846 3050B/6020
	Manganese	530	2.44	12.2	*	J	SW-846 3050B/6020
	Nickel	5.38	0.0975	0.39		None	SW-846 3050B/6020
	Potassium	3,470	15.6	58.5		None	SW-846 3050B/6020
	Selenium	1.01	0.351	0.975	N	J	SW-846 3050B/6020
	Silver	0.359	0.0907	0.454	J	None	SW-846 3050B/6010B
	Sodium	551	15.6	48.7		None	SW-846 3050B/6020
	Thallium	0.151	0.136	0.39	J	None	SW-846 3050B/6020
	Uranium	0.856	0.0129	0.039	*	None	SW-846 3050B/6020
Vanadium	14.8	0.0907	0.454	*N	J-	SW-846 3050B/6010B	
Zinc	29.6	0.78	1.95	B	J	SW-846 3050B/6020	
S-53	Aluminum	5,590	4.52	9.94		J	SW-846 3050B/6020
	Antimony	0.322	0.322	0.977	U	None	SW-846 3050B/6010B
	Arsenic	2.73	0.336	0.994		None	SW-846 3050B/6020
	Barium	150	0.0994	0.398		J	SW-846 3050B/6020
	Beryllium	0.311	0.0199	0.0994		None	SW-846 3050B/6020
	Cadmium	0.0952	0.0199	0.199	J	None	SW-846 3050B/6020
	Calcium	6,980	13.3	39.8		None	SW-846 3050B/6020
	Chromium	3.05	0.199	0.596		None	SW-846 3050B/6020
	Cobalt	1.51	0.0596	0.199		None	SW-846 3050B/6020
	Copper	4.35	0.0656	0.199		None	SW-846 3050B/6020
	Iron	4,530	6.56	19.9		J	SW-846 3050B/6020
	Lead	4.42	0.0994	0.398		None	SW-846 3050B/6020

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-8.** Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-53	Magnesium	2,210	1.99	5.96		None	SW-846 3050B/6020
	Manganese	165	0.994	4.97		J	SW-846 3050B/6020
	Nickel	2.61	0.0994	0.398		None	SW-846 3050B/6020
	Potassium	2,620	15.9	59.6		None	SW-846 3050B/6020
	Selenium	0.562	0.358	0.994	J	None	SW-846 3050B/6020
	Silver	0.0977	0.0977	0.488	U	None	SW-846 3050B/6010B
	Sodium	462	15.9	49.7		None	SW-846 3050B/6020
	Thallium	0.139	0.139	0.398	U	None	SW-846 3050B/6020
	Uranium	0.562	0.0131	0.0398		None	SW-846 3050B/6020
	Vanadium	10.7	0.0977	0.488		None	SW-846 3050B/6010B
	Zinc	16.5	0.795	1.99	B	J	SW-846 3050B/6020

MDL = method detection limit

PQL = practical quantitation limit; the lowest concentration of analytes in a sample that can be determined reliably within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

**Laboratory Data Qualifier**

\* = a replicate was outside limits

B = analyte detected in the blank

J = estimated value, the analyte concentration fell above the effective MDL and below the effective PQL

N = Results associated with a spike analysis that was outside control limits

U = analyte is absent or below the method detection limit

**Data Validation Qualifier**

J = associated value is an estimated quantity

J+ = The associated numerical value is an estimated quantity with a suspected positive base

J- = The associated numerical value is an estimated quantity with a suspected negative base

None = no data validation for corrected gross alpha activity

U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit

**Table B-9.** Nonradiological results for Range Operations Center soil sampling locations at SNL/TTR, 2018

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-40	Aluminum	9,560	4.39	9.65		J	SW-846 3050B/6020
	Antimony	0.329	0.329	0.996	U	None	SW-846 3050B/6010B
	Arsenic	3.88	0.326	0.965		None	SW-846 3050B/6020
	Barium	107	0.0965	0.386		J	SW-846 3050B/6020
	Beryllium	0.539	0.0193	0.0965		None	SW-846 3050B/6020
	Cadmium	0.216	0.0193	0.193		None	SW-846 3050B/6020
	Calcium	8,090	12.9	38.6		None	SW-846 3050B/6020
	Chromium	4.9	0.193	0.579		None	SW-846 3050B/6020
	Cobalt	3.65	0.0579	0.193		None	SW-846 3050B/6020
	Copper	6.32	0.0637	0.193		None	SW-846 3050B/6020
	Iron	9,350	6.37	19.3		J	SW-846 3050B/6020
	Lead	10.5	0.0965	0.386		None	SW-846 3050B/6020
	Magnesium	3,470	1.93	5.79		None	SW-846 3050B/6020
	Manganese	313	0.965	4.83		J	SW-846 3050B/6020
	Nickel	5.08	0.0965	0.386		None	SW-846 3050B/6020
	Potassium	3,460	15.4	57.9		None	SW-846 3050B/6020
	Selenium	0.507	0.347	0.965	J	None	SW-846 3050B/6020
	Silver	0.0996	0.0996	0.498	U	None	SW-846 3050B/6010B
	Sodium	483	15.4	48.3		None	SW-846 3050B/6020
	Thallium	0.135	0.135	0.386	U	None	SW-846 3050B/6020
Uranium	0.705	0.0127	0.0386		None	SW-846 3050B/6020	
Vanadium	19.5	0.0996	0.498		None	SW-846 3050B/6010B	
Zinc	28.6	0.772	1.93	B	J	SW-846 3050B/6020	
S-41	Aluminum	7,350	4.29	9.43		J	SW-846 3050B/6020
	Antimony	0.302	0.302	0.916	U	None	SW-846 3050B/6010B
	Arsenic	2.96	0.319	0.943		None	SW-846 3050B/6020
	Barium	93	0.0943	0.377		J	SW-846 3050B/6020
	Beryllium	0.445	0.0189	0.0943		None	SW-846 3050B/6020
	Cadmium	0.131	0.0189	0.189	J	None	SW-846 3050B/6020
	Calcium	7,080	12.6	37.7		None	SW-846 3050B/6020

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-9.** Nonradiological results for Range Operations Center soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-41	Chromium	4.16	0.189	0.566		None	SW-846 3050B/6020
	Cobalt	2.75	0.0566	0.189		None	SW-846 3050B/6020
	Copper	5	0.0623	0.189		None	SW-846 3050B/6020
	Iron	7,050	6.23	18.9		J	SW-846 3050B/6020
	Lead	8.3	0.0943	0.377		None	SW-846 3050B/6020
	Magnesium	2,720	1.89	5.66		None	SW-846 3050B/6020
	Manganese	250	0.943	4.72		J	SW-846 3050B/6020
	Nickel	3.92	0.0943	0.377		None	SW-846 3050B/6020
	Potassium	3,150	15.1	56.6		None	SW-846 3050B/6020
	Selenium	0.46	0.34	0.943	J	None	SW-846 3050B/6020
	Silver	0.122	0.0916	0.458	J	None	SW-846 3050B/6010B
	Sodium	603	15.1	47.2		None	SW-846 3050B/6020
	Thallium	0.132	0.132	0.377	U	None	SW-846 3050B/6020
	Uranium	0.625	0.0125	0.0377		None	SW-846 3050B/6020
	Vanadium	17.8	0.0916	0.458		None	SW-846 3050B/6010B
Zinc	26.2	0.755	1.89	B	J	SW-846 3050B/6020	
S-42	Aluminum	11,400	20.8	45.7		J	SW-846 3050B/6020
	Antimony	0.305	0.305	0.924	U	None	SW-846 3050B/6010B
	Arsenic	4.13	0.309	0.914		None	SW-846 3050B/6020
	Barium	145	0.0914	0.366		J	SW-846 3050B/6020
	Beryllium	0.548	0.0183	0.0914		None	SW-846 3050B/6020
	Cadmium	0.147	0.0183	0.183	J	None	SW-846 3050B/6020
	Calcium	8,080	12.2	36.6		None	SW-846 3050B/6020
	Chromium	5.35	0.183	0.548		None	SW-846 3050B/6020
	Cobalt	4.05	0.0548	0.183		None	SW-846 3050B/6020
	Copper	6.44	0.0603	0.183		None	SW-846 3050B/6020
	Iron	10,100	30.2	91.4		J	SW-846 3050B/6020
	Lead	8.52	0.0914	0.366		None	SW-846 3050B/6020
	Magnesium	4,190	1.83	5.48		None	SW-846 3050B/6020

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-9.** Nonradiological results for Range Operations Center soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-42	Manganese	333	0.914	4.57		J	SW-846 3050B/6020
	Nickel	5.54	0.0914	0.366		None	SW-846 3050B/6020
	Potassium	3,560	14.6	54.8		None	SW-846 3050B/6020
	Selenium	0.608	0.329	0.914	J	None	SW-846 3050B/6020
	Silver	0.114	0.0924	0.462	J	None	SW-846 3050B/6010B
	Sodium	591	14.6	45.7		None	SW-846 3050B/6020
	Thallium	0.135	0.128	0.366	J	None	SW-846 3050B/6020
	Uranium	0.598	0.0121	0.0366		None	SW-846 3050B/6020
	Vanadium	25.1	0.0924	0.462		None	SW-846 3050B/6010B
	Zinc	29.3	0.731	1.83	B	J	SW-846 3050B/6020
S-43	Aluminum	8,880	4.3	9.45		J	SW-846 3050B/6020
	Antimony	0.327	0.327	0.992	U	None	SW-846 3050B/6010B
	Arsenic	6.58	0.319	0.945		None	SW-846 3050B/6020
	Barium	115	0.0945	0.378		J	SW-846 3050B/6020
	Beryllium	0.498	0.0189	0.0945		None	SW-846 3050B/6020
	Cadmium	0.215	0.0189	0.189		None	SW-846 3050B/6020
	Calcium	14,600	63.3	189		None	SW-846 3050B/6020
	Chromium	3.82	0.189	0.567		None	SW-846 3050B/6020
	Cobalt	2.73	0.0567	0.189		None	SW-846 3050B/6020
	Copper	5.3	0.0624	0.189		None	SW-846 3050B/6020
	Iron	7,610	6.24	18.9		J	SW-846 3050B/6020
	Lead	9.43	0.0945	0.378		None	SW-846 3050B/6020
	Magnesium	2,740	1.89	5.67		None	SW-846 3050B/6020
	Manganese	236	0.945	4.73		J	SW-846 3050B/6020
	Nickel	3.58	0.0945	0.378		None	SW-846 3050B/6020
	Potassium	2,550	15.1	56.7		None	SW-846 3050B/6020
	Selenium	0.523	0.34	0.945	J	None	SW-846 3050B/6020
	Silver	0.134	0.0992	0.496	J	None	SW-846 3050B/6010B
Sodium	516	15.1	47.3		None	SW-846 3050B/6020	

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Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-9.** Nonradiological results for Range Operations Center soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-43	Thallium	0.132	0.132	0.378	U	None	SW-846 3050B/6020
	Uranium	0.797	0.0125	0.0378		None	SW-846 3050B/6020
	Vanadium	20	0.0992	0.496		None	SW-846 3050B/6010B
	Zinc	142	0.756	1.89	B	J	SW-846 3050B/6020
S-44	Aluminum	7,790	4.52	9.94		J	SW-846 3050B/6020
	Antimony	0.308	0.308	0.935	U	None	SW-846 3050B/6010B
	Arsenic	4.86	0.336	0.994		None	SW-846 3050B/6020
	Barium	104	0.0994	0.398		J	SW-846 3050B/6020
	Beryllium	0.46	0.0199	0.0994		None	SW-846 3050B/6020
	Cadmium	0.152	0.0199	0.199	J	None	SW-846 3050B/6020
	Calcium	6,960	13.3	39.8		None	SW-846 3050B/6020
	Chromium	4.43	0.199	0.596		None	SW-846 3050B/6020
	Cobalt	2.66	0.0596	0.199		None	SW-846 3050B/6020
	Copper	4.98	0.0656	0.199		None	SW-846 3050B/6020
	Iron	6,350	6.56	19.9		J	SW-846 3050B/6020
	Lead	18.1	0.0994	0.398		None	SW-846 3050B/6020
	Magnesium	2360	1.99	5.96		None	SW-846 3050B/6020
	Manganese	226	0.994	4.97		J	SW-846 3050B/6020
	Nickel	2.96	0.0994	0.398		None	SW-846 3050B/6020
	Potassium	2,260	15.9	59.6		None	SW-846 3050B/6020
	Selenium	0.549	0.358	0.994	J	None	SW-846 3050B/6020
	Silver	0.119	0.0935	0.467	J	None	SW-846 3050B/6010B
	Sodium	277	15.9	49.7		None	SW-846 3050B/6020
	Thallium	0.139	0.139	0.398	U	None	SW-846 3050B/6020
Uranium	0.625	0.0131	0.0398		None	SW-846 3050B/6020	
Vanadium	16.5	0.0935	0.467		None	SW-846 3050B/6010B	
Zinc	117	0.795	1.99	B	J	SW-846 3050B/6020	

Table continued on next page

Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-9.** Nonradiological results for Range Operations Center soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-45	Aluminum	10,300	22.1	48.5		J	SW-846 3050B/6020
	Antimony	0.638	0.319	0.967	J	J+	SW-846 3050B/6010B
	Arsenic	4	0.328	0.971		None	SW-846 3050B/6020
	Barium	116	0.0971	0.388		J	SW-846 3050B/6020
	Beryllium	0.587	0.0194	0.0971		None	SW-846 3050B/6020
	Cadmium	0.959	0.0194	0.194		None	SW-846 3050B/6020
	Calcium	10,000	65	194		None	SW-846 3050B/6020
	Chromium	17.1	0.194	0.583		None	SW-846 3050B/6020
	Cobalt	4.14	0.0583	0.194		None	SW-846 3050B/6020
	Copper	7.75	0.0641	0.194		None	SW-846 3050B/6020
	Iron	9,900	32	97.1		J	SW-846 3050B/6020
	Lead	20.3	0.0971	0.388		None	SW-846 3050B/6020
	Magnesium	4,890	1.94	5.83		None	SW-846 3050B/6020
	Manganese	300	0.971	4.85		J	SW-846 3050B/6020
	Nickel	8.25	0.0971	0.388		None	SW-846 3050B/6020
	Potassium	4,160	15.5	58.3		None	SW-846 3050B/6020
	Selenium	0.592	0.35	0.971	J	None	SW-846 3050B/6020
	Silver	0.181	0.0967	0.484	J	None	SW-846 3050B/6010B
	Sodium	1,660	15.5	48.5		None	SW-846 3050B/6020
	Thallium	0.153	0.136	0.388	J	None	SW-846 3050B/6020
Uranium	0.711	0.0128	0.0388		None	SW-846 3050B/6020	
Vanadium	22.9	0.0967	0.484		None	SW-846 3050B/6010B	
Zinc	93.3	0.777	1.94	B	J	SW-846 3050B/6020	
S-46	Aluminum	8,320	4.38	9.63		J	SW-846 3050B/6020
	Antimony	0.301	0.301	0.911	U	None	SW-846 3050B/6010B
	Arsenic	6.62	0.326	0.963		None	SW-846 3050B/6020
	Barium	103	0.0963	0.385		J	SW-846 3050B/6020
	Beryllium	0.501	0.0193	0.0963		None	SW-846 3050B/6020
	Cadmium	0.177	0.0193	0.193	J	None	SW-846 3050B/6020

Table continued on next page

Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-9.** Nonradiological results for Range Operations Center soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-46	Calcium	6,780	12.9	38.5		None	SW-846 3050B/6020
	Chromium	7.86	0.193	0.578		None	SW-846 3050B/6020
	Cobalt	3.05	0.0578	0.193		None	SW-846 3050B/6020
	Copper	10.9	0.0636	0.193		None	SW-846 3050B/6020
	Iron	9,380	6.36	19.3		J	SW-846 3050B/6020
	Lead	11.9	0.0963	0.385		None	SW-846 3050B/6020
	Magnesium	2,940	1.93	5.78		None	SW-846 3050B/6020
	Manganese	265	0.963	4.82		J	SW-846 3050B/6020
	Nickel	4.7	0.0963	0.385		None	SW-846 3050B/6020
	Potassium	3,240	15.4	57.8		None	SW-846 3050B/6020
	Selenium	0.509	0.347	0.963	J	None	SW-846 3050B/6020
	Silver	0.0911	0.0911	0.455	U	None	SW-846 3050B/6010B
	Sodium	425	15.4	48.2		None	SW-846 3050B/6020
	Thallium	0.135	0.135	0.385	U	None	SW-846 3050B/6020
	Uranium	0.647	0.0127	0.0385		None	SW-846 3050B/6020
S-47	Vanadium	19.8	0.0911	0.455		None	SW-846 3050B/6010B
	Zinc	114	0.771	1.93	B	J	SW-846 3050B/6020
	Aluminum	8,110	4.42	9.71		J	SW-846 3050B/6020
	Antimony	0.325	0.325	0.986	U	None	SW-846 3050B/6010B
	Arsenic	2.74	0.328	0.971		None	SW-846 3050B/6020
	Barium	119	0.0971	0.388		J	SW-846 3050B/6020
	Beryllium	0.409	0.0194	0.0971		None	SW-846 3050B/6020
	Cadmium	0.225	0.0194	0.194		None	SW-846 3050B/6020
	Calcium	5,720	13	38.8		None	SW-846 3050B/6020
	Chromium	4.28	0.194	0.583		None	SW-846 3050B/6020
	Cobalt	2.83	0.0583	0.194		None	SW-846 3050B/6020
	Copper	5.61	0.0641	0.194		None	SW-846 3050B/6020
	Iron	6,960	6.41	19.4		J	SW-846 3050B/6020
Lead	9.81	0.0971	0.388		None	SW-846 3050B/6020	

Table continued on next page

Appendix B. SNL/TTR Terrestrial Surveillance Analytical Results in 2018

**Table B-9.** Nonradiological results for Range Operations Center soil sampling locations at SNL/TTR, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-47	Magnesium	3,040	1.94	5.83		None	SW-846 3050B/6020
	Manganese	327	0.971	4.85		J	SW-846 3050B/6020
	Nickel	3.99	0.0971	0.388		None	SW-846 3050B/6020
	Potassium	3,940	15.5	58.3		None	SW-846 3050B/6020
	Selenium	0.562	0.35	0.971	J	None	SW-846 3050B/6020
	Silver	0.158	0.0986	0.493	J	None	SW-846 3050B/6010B
	Sodium	1,070	15.5	48.5		None	SW-846 3050B/6020
	Thallium	0.136	0.136	0.388	U	None	SW-846 3050B/6020
	Uranium	0.619	0.0128	0.0388		None	SW-846 3050B/6020
	Vanadium	18.2	0.0986	0.493		None	SW-846 3050B/6010B
	Zinc	42.3	0.777	1.94	B	J	SW-846 3050B/6020

MDL = method detection limit

PQL = practical quantitation limit; the lowest concentration of analytes in a sample that can be determined reliably within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions

SNL/TTR = Sandia National Laboratories, Tonopah Test Range

**Laboratory Data Qualifier**

B = analyte detected in the blank

J = estimated value, the analyte concentration fell above the effective MDL and below the effective PQL

U = the analyte was analyzed for, but not detected; or organic and inorganic analytes the result is less than the effective MDL concentration

**Data Validation Qualifier**

J = associated value is an estimated quantity

J+ = The associated numerical value is an estimated quantity with a suspected positive base

None = no data validation for corrected gross alpha activity

## Appendix C. SNL/TTR Wastewater Sampling Results in 2018



Old settlement at Tonopah Test Range

Appendix C. SNL/TTR Wastewater Sampling Results in 2018

**Table C-1.** Sanitary outfalls of inorganic analyses, June 2018

Station	Date Collected	Sample Identifier	Analyte	Result (mg/L)	MDL (mg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	13-Jun-2018	105373-001	Aluminum	0.105	0.0193		EPA 200.8
		105373-001	Arsenic	0.0154	0.002		EPA 200.8
		105373-001	Boron	0.562	0.052		EPA 200.8
		105373-001	Cadmium		0.0003	U	EPA 200.8
		105373-001	Chromium		0.003	U	EPA 200.8
		105373-001	Copper	0.041	0.0003		EPA 200.8
		105373-001	Lead	0.00121	0.0005	J	EPA 200.8
		105373-001	Mercury		0.000067	U	EPA 245.1/245.2
		105373-001	Molybdenum	0.00774	0.0002		EPA 200.8
		105373-001	Nickel	0.000804	0.0006	J	EPA 200.8
		105373-001	Selenium		0.002	U	EPA 200.8
		105373-001	Silver		0.0003	U	EPA 200.8
		105373-001	Zinc	0.108	0.0033		EPA 200.8
		105373-002	Cyanide, total	0.00605	0.00167		EPA 335.4
		105373-003	Solids, total suspended	19.2	2.28		SM 2540D
		105373-004	pH	8.2	0.01	H	SM 4500-H B
		105373-007	Phenols, Total	0.00718	0.00167		SW-846 9066
		105373-008	Grease and oil	2.3	1.24	J	EPA 1664A/1664B
		105373-009	Grease and oil		1.2	U	EPA 1664A/1664B
		105373-013	Chemical Oxygen Demand	69.2	8.95		EPA 410.4

TTR = Tonopah Test Range  
 MDL = method detection limit  
 pH = potential of hydrogen

**Laboratory Data Qualifier**

H = analytical holding time was exceeded  
 J = estimated value, the analyte concentration fell above the effective MDL and below the effective PQL  
 U = the analyte was analyzed for, but not detected; or organic and inorganic analytes the result is less than the effective MDL concentration

**Table C-2.** Sanitary outfalls of radiological analyses, June 2018

Station	Date Collected	Sample Identifier	Analyte	Activity (pCi/L)	MDA (pCi/L)	Laboratory Data Qualifiers	Analytical Method
TTR	13-Jun-2018	105373-010	Actinium-228	16.1 ± 19.8	16.2	U	EPA 901.1
		105373-010	Americium-241	5.9 ± 13.6	22.2	U	EPA 901.1
		105373-010	Beryllium-7	6.35 ± 12.6	22.6	U	EPA 901.1
		105373-010	Bismuth-212	51 ± 47.5	51	U	EPA 901.1
		105373-010	Bismuth-214	-3.44 ± 7.81	7.01	U	EPA 901.1
		105373-010	Cesium-137	0.16 ± 1.56	2.79	U	EPA 901.1
		105373-010	Cobalt-60	-0.649 ± 1.92	3.38	U	EPA 901.1
		105373-010	Lead-212	0.552 ± 6.69	5.66	U	EPA 901.1
		105373-010	Lead-214	-2.4 ± 5.52	6.71	U	EPA 901.1
		105373-010	Neptunium-237	0.294 ± 3.03	5.52	U	EPA 901.1
		105373-010	Potassium-40	25.8 ± 49.4	27.9	U	EPA 901.1
		105373-010	Radium-223	-12.6 ± 29.7	51.8	U	EPA 901.1
		105373-010	Radium-224	17.7 ± 33.1	50.5	U	EPA 901.1
		105373-010	Radium-226	-34.4 ± 67.9	70.9	U	EPA 901.1
		105373-010	Radium-228	16.1 ± 19.8	16.2	U	EPA 901.1
		105373-010	Sodium-22	0.133 ± 1.52	2.87	U	EPA 901.1
		105373-010	Thorium-227	-11 ± 13.9	20.3	U	EPA 901.1
		105373-010	Thorium-231	-35 ± 45.4	39.3	U	EPA 901.1
		105373-010	Thorium-234	-255 ± 266	201	U	EPA 901.1
		105373-010	Uranium-235	5.89 ± 21	18.1	U	EPA 901.1
		105373-010	Uranium-238	-255 ± 266	201	U	EPA 901.1
		105373-011	Alpha, gross	1.36 ± 1.17	1.92	U	EPA 900.0/SW-846 9310
105373-011	Beta, gross	9.56 ± .899	1.11		EPA 900.0/SW-846 9310		
105373-012	Tritium	-39.4 ± 86.2	162	U	EPA 906.0 Modified		

TTR = Tonopah Test Range

MDA = minimal detectable activity or minimum measured activity in a sample required to ensure a 95% probability that the measured activity is accurately quantified above the critical level

**Laboratory Data Qualifier**

U = the analyte result was below the MDA

**Table C-3.** Sanitary outfalls of semivolatile organic compounds, June 2018

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	13-Jun-2018	105373-006	Acenaphthene		0.288	U	EPA 625.1
		105373-006	Acenaphthylene		0.288	U	EPA 625.1
		105373-006	Anthracene		0.288	U	EPA 625.1
		105373-006	Benzidine		3.75	NU	EPA 625.1
		105373-006	Benzo(a)anthracene		0.288	U	EPA 625.1
		105373-006	Benzo(a)pyrene		0.288	U	EPA 625.1
		105373-006	Benzo(b)fluoranthene		0.288	U	EPA 625.1
		105373-006	Benzo(ghi)perylene		0.288	U	EPA 625.1
		105373-006	Benzo(k)fluoranthene		0.288	U	EPA 625.1
		105373-006	Bromophenyl phenyl ether, 4-		2.88	U	EPA 625.1
		105373-006	Butylbenzyl phthalate	2.29	0.288	J	EPA 625.1
		105373-006	Chloro-3-methylphenol, 4-		2.88	*U	EPA 625.1
		105373-006	Chloroethoxy)methane, bis(2-		2.88	U	EPA 625.1
		105373-006	Chloroethyl)ether, bis(2-		2.88	U	EPA 625.1
		105373-006	Chloroisopropyl ether, bis-		2.88	U	EPA 625.1
		105373-006	Chloronaphthalene, 2-		0.394	U	EPA 625.1
		105373-006	Chlorophenol, 2-		2.88	*NU	EPA 625.1
		105373-006	Chlorophenyl phenyl ether, 4-		2.88	U	EPA 625.1
		105373-006	Chrysene		0.288	U	EPA 625.1
		105373-006	Di-n-butyl phthalate		0.288	U	EPA 625.1
		105373-006	Di-n-octyl phthalate		0.288	U	EPA 625.1
		105373-006	Dibenz[a,h]anthracene		0.288	U	EPA 625.1
		105373-006	Dichlorobenzidine, 3,3'-		2.88	NU	EPA 625.1
		105373-006	Dichlorophenol, 2,4-		2.88	*NU	EPA 625.1
		105373-006	Diethylphthalate		0.288	U	EPA 625.1
		105373-006	Dimethylphenol, 2,4-		2.88	U	EPA 625.1
		105373-006	Dimethylphthalate		0.288	U	EPA 625.1
		105373-006	Dinitro-o-cresol		2.88	*NU	EPA 625.1
		105373-006	Dinitrophenol, 2,4-		4.81	*NU	EPA 625.1
		105373-006	Dinitrotoluene, 2,4-		2.88	U	EPA 625.1

Table continued on next page

Appendix C. SNL/TTR Wastewater Sampling Results in 2018

**Table C-3.** Summary of sanitary outfalls of semivolatile organic compounds, June 2018 (continued)

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	13-Jun-2018	105373-006	Dinitrotoluene, 2,6-		2.88	U	EPA 625.1
		105373-006	Diphenyl amine		2.88	U	EPA 625.1
		105373-006	Diphenylhydrazine, 1,2-		2.88	U	EPA 625.1
		105373-006	Ethylhexyl)phthalate, bis(2-	2.13	0.288		EPA 625.1
		105373-006	Fluoranthene		0.288	U	EPA 625.1
		105373-006	Fluorene		0.288	U	EPA 625.1
		105373-006	Hexachlorobenzene		2.88	U	EPA 625.1
		105373-006	Hexachlorobutadiene		2.88	U	EPA 625.1
		105373-006	Hexachlorocyclopentadiene		2.88	U	EPA 625.1
		105373-006	Hexachloroethane		2.88	U	EPA 625.1
		105373-006	Indeno(1,2,3-c,d)pyrene		0.288	U	EPA 625.1
		105373-006	Isophorone		3.37	U	EPA 625.1
		105373-006	Naphthalene		0.288	U	EPA 625.1
		105373-006	Nitro-benzene		2.88	U	EPA 625.1
		105373-006	Nitrophenol, 2-		2.88	*NU	EPA 625.1
		105373-006	Nitrophenol, 4-		2.88	*U	EPA 625.1
		105373-006	Nitrosodimethylamine, n-		2.88	U	EPA 625.1
		105373-006	Nitrosodipropylamine, n-		2.88	U	EPA 625.1
		105373-006	Pentachlorophenol		2.88	*NU	EPA 625.1
		105373-006	Phenanthrene		0.288	U	EPA 625.1
		105373-006	Phenol		2.88	*U	EPA 625.1
		105373-006	Pyrene		0.288	U	EPA 625.1
105373-006	Trichlorobenzene, 1,2,4-		2.88	U	EPA 625.1		
105373-006	Trichlorophenol, 2,4,6-		2.88	*NU	EPA 625.1		

TTR = Tonopah Test Range

MDL = method detection limit

**Laboratory Data Qualifier**

J = estimated value, the analyte concentration fell above the effective MDL and below the effective PQL

N = Results associated with a spike analysis that was outside control limits

U = the analyte was analyzed for, but not detected; or organic and inorganic analytes the result is less than the effective MDL concentration

\* = recovery or percent RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPS's are not applicable where the concentrations is below the effective PQL

**Table C-4.** Sanitary outfalls of volatile organic compounds, June 2018

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	13-Jun-2018	105373-005	Acrolein		1.67	U	EPA 624.1
		105373-005	Acrylonitrile		1.67	U	EPA 624.1
		105373-005	Benzene		0.333	U	EPA 624.1
		105373-005	Bromodichloromethane		0.333	U	EPA 624.1
		105373-005	Bromoform		0.333	U	EPA 624.1
		105373-005	Bromomethane		0.337	U	EPA 624.1
		105373-005	Carbon tetrachloride		0.333	U	EPA 624.1
		105373-005	Chlorobenzene		0.333	U	EPA 624.1
		105373-005	Chloroethane		0.333	U	EPA 624.1
		105373-005	Chloroethyl vinyl ether, 2-		1.67	NU	EPA 624.1
		105373-005	Chloroform		0.333	U	EPA 624.1
		105373-005	Chloromethane		0.333	U	EPA 624.1
		105373-005	Dibromochloromethane		0.333	U	EPA 624.1
		105373-005	Dichlorobenzene, 1,2-		0.333	U	EPA 624.1
		105373-005	Dichlorobenzene, 1,3-		0.333	U	EPA 624.1
		105373-005	Dichlorobenzene, 1,4-		0.333	U	EPA 624.1
		105373-005	Dichlorodifluoromethane		0.355	U	EPA 624.1
		105373-005	Dichloroethane, 1,1-		0.333	U	EPA 624.1
		105373-005	Dichloroethane, 1,2-		0.333	U	EPA 624.1
		105373-005	Dichloroethene, 1,1-		0.333	U	EPA 624.1
		105373-005	Dichloroethene, trans-1,2-		0.333	U	EPA 624.1
		105373-005	Dichloropropane, 1,2-		0.333	U	EPA 624.1
		105373-005	Dichloropropene, cis-1,3-		0.333	U	EPA 624.1
		105373-005	Dichloropropene, trans-1,3-		0.333	U	EPA 624.1
		105373-005	Ethyl benzene		0.333	U	EPA 624.1
		105373-005	Methylene chloride		1.67	U	EPA 624.1
		105373-005	Tetrachloroethane, 1,1,2,2-		0.333	U	EPA 624.1
		105373-005	Tetrachloroethene		0.333	U	EPA 624.1
		105373-005	Toluene		0.333	U	EPA 624.1
		105373-005	Trichloroethane, 1,1,1-		0.333	U	EPA 624.1

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Appendix C. SNL/TTR Wastewater Sampling Results in 2018

**Table C-4.** Summary of sanitary outfalls of volatile organic compounds, June 2018 (continued)

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	13-Jun-2018	105373-005	Trichloroethane, 1,1,2-		0.333	U	EPA 624.1
		105373-005	Trichloroethene		0.333	U	EPA 624.1
		105373-005	Trichlorofluoromethane		0.333	U	EPA 624.1
		105373-005	Vinyl chloride		0.333	U	EPA 624.1

TTR = Tonopah Test Range  
 MDL = method detection limit

**Laboratory Data Qualifier**

N = Results associated with a spike analysis that was outside control limits

U = the analyte was analyzed for, but not detected; or organic and inorganic analytes the result is less than the effective MDL concentration

## Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018



Hills in Kaua'i

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-12	Aluminum	5,770	4.37	9.6		J	SW-846 3050B/6020B
S-12	Antimony	1.95	1.62	4.91	J	4.9UJ	SW-846 3050B/6010D
S-12	Arsenic	16.3	0.324	0.96	N	None	SW-846 3050B/6020B
S-12	Barium	9.18	0.096	0.384	N	J+	SW-846 3050B/6020B
S-12	Beryllium	0.0747	0.0192	0.096	JN	J	SW-846 3050B/6020B
S-12	Cadmium	0.0681	0.0192	0.192	JN	None	SW-846 3050B/6020B
S-12	Calcium	240,000	1,290	3,840		None	SW-846 3050B/6020B
S-12	Chromium	45.6	0.192	0.576		J	SW-846 3050B/6020B
S-12	Cobalt	15.2	0.0576	0.192	N	None	SW-846 3050B/6020B
S-12	Copper	7.68	0.0633	0.192	BN	None	SW-846 3050B/6020B
S-12	Iron	14,000	63.3	192	B	J	SW-846 3050B/6020B
S-12	Lead	2.56	0.096	0.384		None	SW-846 3050B/6020B
S-12	Magnesium	23,800	19.2	57.6		None	SW-846 3050B/6020B
S-12	Manganese	318	1.92	9.6		J	SW-846 3050B/6020B
S-12	Nickel	142	0.096	0.384		J	SW-846 3050B/6020B
S-12	Potassium	288	15.4	57.6		None	SW-846 3050B/6020B
S-12	Selenium	0.522	0.345	0.96	JN	J	SW-846 3050B/6020B
S-12	Silver	0.0982	0.0982	0.491	U	None	SW-846 3050B/6010D
S-12	Sodium	2,230	15.4	48		J	SW-846 3050B/6020B
S-12	Thallium	0.134	0.134	0.384	U	None	SW-846 3050B/6020B
S-12	Vanadium	18.1	0.288	0.96	N	J	SW-846 3050B/6020B
S-12	Zinc	21.7	0.768	1.92	B	None	SW-846 3050B/6020B
S-13	Aluminum	5,230	4.53	9.96		J	SW-846 3050B/6020B
S-13	Antimony	3.47	1.52	4.6	J	4.6UJ	SW-846 3050B/6010D
S-13	Arsenic	11.4	0.337	0.996	N	None	SW-846 3050B/6020B
S-13	Barium	10.2	0.0996	0.398	N	J+	SW-846 3050B/6020B
S-13	Beryllium	0.0761	0.0199	0.0996	JN	J	SW-846 3050B/6020B
S-13	Cadmium	0.119	0.0199	0.199	JN	None	SW-846 3050B/6020B
S-13	Calcium	171,000	1,330	3,980		None	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-13	Chromium	82.9	0.199	0.598		J	SW-846 3050B/6020B
S-13	Cobalt	31	0.0598	0.199	N	None	SW-846 3050B/6020B
S-13	Copper	8.33	0.0657	0.199	BN	None	SW-846 3050B/6020B
S-13	Iron	27,000	65.7	199	B	J	SW-846 3050B/6020B
S-13	Lead	2.63	0.0996	0.398		None	SW-846 3050B/6020B
S-13	Magnesium	55,700	19.9	59.8		None	SW-846 3050B/6020B
S-13	Manganese	522	1.99	9.96		J	SW-846 3050B/6020B
S-13	Nickel	478	0.996	3.98		J	SW-846 3050B/6020B
S-13	Potassium	231	15.9	59.8		None	SW-846 3050B/6020B
S-13	Selenium	0.725	0.359	0.996	JN	J	SW-846 3050B/6020B
S-13	Silver	0.46	0.46	2.3	U	None	SW-846 3050B/6010D
S-13	Sodium	1,450	15.9	49.8		J	SW-846 3050B/6020B
S-13	Thallium	0.139	0.139	0.398	U	None	SW-846 3050B/6020B
S-13	Vanadium	15.7	0.299	0.996	N	J	SW-846 3050B/6020B
S-13	Zinc	26.5	0.797	1.99	B	None	SW-846 3050B/6020B
S-14	Aluminum	6,690	4.24	9.31		J	SW-846 3050B/6020B
S-14	Antimony	2.13	1.59	4.82	J	4.8UJ	SW-846 3050B/6010D
S-14	Arsenic	9.6	0.315	0.931	N	None	SW-846 3050B/6020B
S-14	Barium	13	0.0931	0.372	N	J+	SW-846 3050B/6020B
S-14	Beryllium	0.104	0.0186	0.0931	N	J	SW-846 3050B/6020B
S-14	Cadmium	0.359	0.0186	0.186	N	None	SW-846 3050B/6020B
S-14	Calcium	169,000	1,250	3,720		None	SW-846 3050B/6020B
S-14	Chromium	103	0.186	0.559		J	SW-846 3050B/6020B
S-14	Cobalt	34.8	0.0559	0.186	N	None	SW-846 3050B/6020B
S-14	Copper	12.4	0.0615	0.186	BN	None	SW-846 3050B/6020B
S-14	Iron	27,700	61.5	186	B	J	SW-846 3050B/6020B
S-14	Lead	0.834	0.0931	0.372		None	SW-846 3050B/6020B
S-14	Magnesium	54,500	18.6	55.9		None	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-14	Manganese	537	1.86	9.31		J	SW-846 3050B/6020B
S-14	Nickel	492	0.931	3.72		J	SW-846 3050B/6020B
S-14	Potassium	282	14.9	55.9		None	SW-846 3050B/6020B
S-14	Selenium	1.68	1.68	4.66	NU	UJ	SW-846 3050B/6020B
S-14	Silver	0.482	0.482	2.41	U	None	SW-846 3050B/6010D
S-14	Sodium	1,660	14.9	46.6		J	SW-846 3050B/6020B
S-14	Thallium	0.13	0.13	0.372	U	None	SW-846 3050B/6020B
S-14	Vanadium	19.5	0.279	0.931	N	J	SW-846 3050B/6020B
S-14	Zinc	40.6	0.745	1.86	B	None	SW-846 3050B/6020B
S-15	Aluminum	6,640	4.16	9.14		J	SW-846 3050B/6020B
S-15	Antimony	1.6	1.6	4.84	U	None	SW-846 3050B/6010D
S-15	Arsenic	9.44	0.309	0.914	N	None	SW-846 3050B/6020B
S-15	Barium	11.6	0.0914	0.366	N	J+	SW-846 3050B/6020B
S-15	Beryllium	0.0854	0.0183	0.0914	JN	J	SW-846 3050B/6020B
S-15	Cadmium	0.123	0.0183	0.183	JN	None	SW-846 3050B/6020B
S-15	Calcium	187,000	1,220	3,660		None	SW-846 3050B/6020B
S-15	Chromium	91.4	0.183	0.548		J	SW-846 3050B/6020B
S-15	Cobalt	31.3	0.0548	0.183	N	None	SW-846 3050B/6020B
S-15	Copper	13	0.0603	0.183	BN	None	SW-846 3050B/6020B
S-15	Iron	25,900	60.3	183	B	J	SW-846 3050B/6020B
S-15	Lead	0.558	0.0914	0.366		None	SW-846 3050B/6020B
S-15	Magnesium	49,900	18.3	54.8		None	SW-846 3050B/6020B
S-15	Manganese	521	1.83	9.14		J	SW-846 3050B/6020B
S-15	Nickel	440	0.914	3.66		J	SW-846 3050B/6020B
S-15	Potassium	301	14.6	54.8		None	SW-846 3050B/6020B
S-15	Selenium	0.454	0.329	0.914	JN	J	SW-846 3050B/6020B
S-15	Silver	0.484	0.484	2.42	U	None	SW-846 3050B/6010D
S-15	Sodium	1,710	14.6	45.7		J	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-15	Thallium	0.128	0.128	0.366	U	None	SW-846 3050B/6020B
S-15	Vanadium	18.1	0.274	0.914	N	J	SW-846 3050B/6020B
S-15	Zinc	30.9	0.731	1.83	B	None	SW-846 3050B/6020B
S-16	Aluminum	6,450	4.54	9.98		J	SW-846 3050B/6020B
S-16	Antimony	1.55	1.55	4.69	U	None	SW-846 3050B/6010D
S-16	Arsenic	10	0.337	0.998	N	None	SW-846 3050B/6020B
S-16	Barium	20.2	0.0998	0.399	N	J+	SW-846 3050B/6020B
S-16	Beryllium	0.103	0.02	0.0998	N	J	SW-846 3050B/6020B
S-16	Cadmium	0.114	0.02	0.2	JN	None	SW-846 3050B/6020B
S-16	Calcium	182,000	1,340	3,990		None	SW-846 3050B/6020B
S-16	Chromium	91.4	0.2	0.599		J	SW-846 3050B/6020B
S-16	Cobalt	32.1	0.0599	0.2	N	None	SW-846 3050B/6020B
S-16	Copper	34.6	0.0659	0.2	BN	None	SW-846 3050B/6020B
S-16	Iron	28,100	65.9	200	B	J	SW-846 3050B/6020B
S-16	Lead	0.867	0.0998	0.399		None	SW-846 3050B/6020B
S-16	Magnesium	52,500	20	59.9		None	SW-846 3050B/6020B
S-16	Manganese	525	2	9.98		J	SW-846 3050B/6020B
S-16	Nickel	440	0.998	3.99		J	SW-846 3050B/6020B
S-16	Potassium	289	16	59.9		None	SW-846 3050B/6020B
S-16	Selenium	0.507	0.359	0.998	JN	J	SW-846 3050B/6020B
S-16	Silver	0.469	0.469	2.35	U	None	SW-846 3050B/6010D
S-16	Sodium	1,790	16	49.9		J	SW-846 3050B/6020B
S-16	Thallium	0.14	0.14	0.399	U	None	SW-846 3050B/6020B
S-16	Vanadium	21.3	0.299	0.998	N	J	SW-846 3050B/6020B
S-16	Zinc	34.3	0.798	2	B	None	SW-846 3050B/6020B
S-17	Aluminum	5,630	4.49	9.86		J	SW-846 3050B/6020B
S-17	Antimony	1.94	1.59	4.82	J	4.8UJ	SW-846 3050B/6010D
S-17	Arsenic	6.55	0.333	0.986	N	None	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-17	Barium	16.4	0.0986	0.394	N	J+	SW-846 3050B/6020B
S-17	Beryllium	0.0761	0.0197	0.0986	JN	J	SW-846 3050B/6020B
S-17	Cadmium	0.0606	0.0197	0.197	JN	None	SW-846 3050B/6020B
S-17	Calcium	211,000	1,320	3,940		None	SW-846 3050B/6020B
S-17	Chromium	55.2	0.197	0.592		J	SW-846 3050B/6020B
S-17	Cobalt	16.3	0.0592	0.197	N	None	SW-846 3050B/6020B
S-17	Copper	24.3	0.0651	0.197	BN	None	SW-846 3050B/6020B
S-17	Iron	13,700	65.1	197	B	J	SW-846 3050B/6020B
S-17	Lead	0.685	0.0986	0.394		None	SW-846 3050B/6020B
S-17	Magnesium	31,800	19.7	59.2		None	SW-846 3050B/6020B
S-17	Manganese	288	1.97	9.86		J	SW-846 3050B/6020B
S-17	Nickel	211	0.986	3.94		J	SW-846 3050B/6020B
S-17	Potassium	352	15.8	59.2		None	SW-846 3050B/6020B
S-17	Selenium	0.434	0.355	0.986	JN	J	SW-846 3050B/6020B
S-17	Silver	0.0963	0.0963	0.482	U	None	SW-846 3050B/6010D
S-17	Sodium	2,050	15.8	49.3		J	SW-846 3050B/6020B
S-17	Thallium	0.138	0.138	0.394	U	None	SW-846 3050B/6020B
S-17	Vanadium	15.4	0.296	0.986	N	J	SW-846 3050B/6020B
S-17	Zinc	19.4	0.789	1.97	B	None	SW-846 3050B/6020B
S-18	Aluminum	6,570	4.45	9.78		J	SW-846 3050B/6020B
S-18	Antimony	1.5	1.5	4.55	U	None	SW-846 3050B/6010D
S-18	Arsenic	7.18	0.331	0.978	N	None	SW-846 3050B/6020B
S-18	Barium	16.6	0.0978	0.391	N	J+	SW-846 3050B/6020B
S-18	Beryllium	0.0871	0.0196	0.0978	JN	J	SW-846 3050B/6020B
S-18	Cadmium	0.137	0.0196	0.196	JN	None	SW-846 3050B/6020B
S-18	Calcium	235,000	1,310	3,910		None	SW-846 3050B/6020B
S-18	Chromium	50.4	0.196	0.587		J	SW-846 3050B/6020B
S-18	Cobalt	14.8	0.0587	0.196	N	None	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-18	Copper	17.1	0.0646	0.196	BN	None	SW-846 3050B/6020B
S-18	Iron	12,900	64.6	196	B	J	SW-846 3050B/6020B
S-18	Lead	0.562	0.0978	0.391		None	SW-846 3050B/6020B
S-18	Magnesium	27,100	19.6	58.7		None	SW-846 3050B/6020B
S-18	Manganese	264	1.96	9.78		J	SW-846 3050B/6020B
S-18	Nickel	167	0.0978	0.391		J	SW-846 3050B/6020B
S-18	Potassium	362	15.7	58.7		None	SW-846 3050B/6020B
S-18	Selenium	1.76	1.76	4.89	NU	UJ	SW-846 3050B/6020B
S-18	Silver	0.455	0.455	2.28	U	None	SW-846 3050B/6010D
S-18	Sodium	2,300	15.7	48.9		J	SW-846 3050B/6020B
S-18	Thallium	0.137	0.137	0.391	U	None	SW-846 3050B/6020B
S-18	Vanadium	17.9	0.294	0.978	N	J	SW-846 3050B/6020B
S-18	Zinc	25.3	0.783	1.96	B	None	SW-846 3050B/6020B
S-19	Aluminum	5770	4.16	9.14		J	SW-846 3050B/6020B
S-19	Antimony	2.75	1.57	4.74	J	4.7UJ	SW-846 3050B/6010D
S-19	Arsenic	9.79	0.309	0.914	N	None	SW-846 3050B/6020B
S-19	Barium	21	0.0914	0.366	N	J+	SW-846 3050B/6020B
S-19	Beryllium	0.0746	0.0183	0.0914	JN	J	SW-846 3050B/6020B
S-19	Cadmium	0.185	0.0183	0.183	N	None	SW-846 3050B/6020B
S-19	Calcium	221,000	1,220	3,660		None	SW-846 3050B/6020B
S-19	Chromium	67.9	0.183	0.548		J	SW-846 3050B/6020B
S-19	Cobalt	21.6	0.0548	0.183	N	None	SW-846 3050B/6020B
S-19	Copper	11.1	0.0603	0.183	BN	None	SW-846 3050B/6020B
S-19	Iron	16,400	60.3	183	B	J	SW-846 3050B/6020B
S-19	Lead	1.6	0.0914	0.366		None	SW-846 3050B/6020B
S-19	Magnesium	36,200	18.3	54.8		None	SW-846 3050B/6020B
S-19	Manganese	331	1.83	9.14		J	SW-846 3050B/6020B
S-19	Nickel	268	0.914	3.66		J	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-19	Potassium	226	14.6	54.8		None	SW-846 3050B/6020B
S-19	Selenium	1.65	1.65	4.57	NU	UJ	SW-846 3050B/6020B
S-19	Silver	0.474	0.474	2.37	U	None	SW-846 3050B/6010D
S-19	Sodium	2,130	14.6	45.7		J	SW-846 3050B/6020B
S-19	Thallium	0.128	0.128	0.366	U	None	SW-846 3050B/6020B
S-19	Vanadium	17.9	0.274	0.914	N	J	SW-846 3050B/6020B
S-19	Zinc	24.8	0.731	1.83	B	None	SW-846 3050B/6020B
S-20	Aluminum	6,550	4.52	9.94		J	SW-846 3050B/6020B
S-20	Antimony	1.54	1.54	4.66	U	None	SW-846 3050B/6010D
S-20	Arsenic	10.5	0.336	0.994	N	None	SW-846 3050B/6020B
S-20	Barium	10.5	0.0994	0.398	N	J+	SW-846 3050B/6020B
S-20	Beryllium	0.0831	0.0199	0.0994	JN	J	SW-846 3050B/6020B
S-20	Cadmium	0.0982	0.0199	0.199	JN	None	SW-846 3050B/6020B
S-20	Calcium	201,000	1,330	3,980		None	SW-846 3050B/6020B
S-20	Chromium	63.4	0.199	0.596		J	SW-846 3050B/6020B
S-20	Cobalt	20.1	0.0596	0.199	N	None	SW-846 3050B/6020B
S-20	Copper	7.7	0.0656	0.199	BN	None	SW-846 3050B/6020B
S-20	Iron	18,600	65.6	199	B	J	SW-846 3050B/6020B
S-20	Lead	0.529	0.0994	0.398		None	SW-846 3050B/6020B
S-20	Magnesium	31,200	19.9	59.6		None	SW-846 3050B/6020B
S-20	Manganese	417	1.99	9.94		J	SW-846 3050B/6020B
S-20	Nickel	253	0.994	3.98		J	SW-846 3050B/6020B
S-20	Potassium	413	15.9	59.6		None	SW-846 3050B/6020B
S-20	Selenium	1.79	1.79	4.97	NU	UJ	SW-846 3050B/6020B
S-20	Silver	0.466	0.466	2.33	U	None	SW-846 3050B/6010D
S-20	Sodium	1,920	15.9	49.7		J	SW-846 3050B/6020B
S-20	Thallium	0.139	0.139	0.398	U	None	SW-846 3050B/6020B
S-20	Vanadium	17.8	0.298	0.994	N	J	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-20	Zinc	26	0.795	1.99	B	None	SW-846 3050B/6020B
S-21	Aluminum	6,730	4.17	9.17		J	SW-846 3050B/6020B
S-21	Antimony	0.315	0.315	0.954	U	0.95UJ	SW-846 3050B/6010D
S-21	Arsenic	14.7	0.31	0.917	N	None	SW-846 3050B/6020B
S-21	Barium	11.3	0.0917	0.367	N	J+	SW-846 3050B/6020B
S-21	Beryllium	0.0772	0.0183	0.0917	JN	J	SW-846 3050B/6020B
S-21	Cadmium	0.198	0.0183	0.183	N	None	SW-846 3050B/6020B
S-21	Calcium	274,000	1,230	3,670		None	SW-846 3050B/6020B
S-21	Chromium	46.4	0.183	0.55		J	SW-846 3050B/6020B
S-21	Cobalt	13.6	0.055	0.183	N	None	SW-846 3050B/6020B
S-21	Copper	6.73	0.0606	0.183	BN	None	SW-846 3050B/6020B
S-21	Iron	12,500	60.6	183	B	J	SW-846 3050B/6020B
S-21	Lead	2.07	0.0917	0.367		None	SW-846 3050B/6020B
S-21	Magnesium	24,000	18.3	55		None	SW-846 3050B/6020B
S-21	Manganese	288	1.83	9.17		J	SW-846 3050B/6020B
S-21	Nickel	128	0.0917	0.367		J	SW-846 3050B/6020B
S-21	Potassium	317	14.7	55		None	SW-846 3050B/6020B
S-21	Selenium	0.512	0.33	0.917	JN	J	SW-846 3050B/6020B
S-21	Silver	0.0954	0.0954	0.477	U	None	SW-846 3050B/6010D
S-21	Sodium	2,690	14.7	45.9		J	SW-846 3050B/6020B
S-21	Thallium	0.128	0.128	0.367	U	None	SW-846 3050B/6020B
S-21	Vanadium	20.1	0.275	0.917	N	J	SW-846 3050B/6020B
S-21	Zinc	23.7	0.734	1.83	B	None	SW-846 3050B/6020B
S-22	Aluminum	2,640	4.38	9.63		None	SW-846 3050B/6020B
S-22	Antimony	0.485	0.324	0.98	J	J	SW-846 3050B/6010D
S-22	Arsenic	9.64	1.63	4.82	N	J	SW-846 3050B/6020B
S-22	Barium	9.87	0.0963	0.385		None	SW-846 3050B/6020B
S-22	Beryllium	0.0407	0.0193	0.0963	JN	None	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-22	Cadmium	0.0528	0.0193	0.193	JN	J+	SW-846 3050B/6020B
S-22	Calcium	307,000	1,290	3,850		None	SW-846 3050B/6020B
S-22	Chromium	23.5	0.193	0.578		None	SW-846 3050B/6020B
S-22	Cobalt	3.38	0.0578	0.193		None	SW-846 3050B/6020B
S-22	Copper	6.85	0.0636	0.193		None	SW-846 3050B/6020B
S-22	Iron	4,560	6.36	19.3		J	SW-846 3050B/6020B
S-22	Lead	2.02	0.0963	0.385	*	None	SW-846 3050B/6020B
S-22	Magnesium	24,000	9.63	28.9		None	SW-846 3050B/6020B
S-22	Manganese	125	0.193	0.963		J	SW-846 3050B/6020B
S-22	Nickel	36.2	0.0963	0.385		None	SW-846 3050B/6020B
S-22	Potassium	170	15.4	57.8		None	SW-846 3050B/6020B
S-22	Selenium	1.73	1.73	4.82	NU	None	SW-846 3050B/6020B
S-22	Silver	0.098	0.098	0.49	U	None	SW-846 3050B/6010D
S-22	Sodium	2,340	15.4	48.2		None	SW-846 3050B/6020B
S-22	Thallium	0.135	0.135	0.385	U	None	SW-846 3050B/6020B
S-22	Vanadium	8.92	0.289	0.963		None	SW-846 3050B/6020B
S-22	Zinc	67.3	3.85	9.63	*	J	SW-846 3050B/6020B
S-23	Aluminum	1,980	4.23	9.29		None	SW-846 3050B/6020B
S-23	Antimony	0.315	0.315	0.954	U	0.95UJ	SW-846 3050B/6010D
S-23	Arsenic	5.25	0.314	0.929	N	J	SW-846 3050B/6020B
S-23	Barium	5.94	0.0929	0.372		None	SW-846 3050B/6020B
S-23	Beryllium	0.0329	0.0186	0.0929	JN	None	SW-846 3050B/6020B
S-23	Cadmium	0.0677	0.0186	0.186	JN	J+	SW-846 3050B/6020B
S-23	Calcium	293,000	1,250	3,720		None	SW-846 3050B/6020B
S-23	Chromium	19.8	0.186	0.558		None	SW-846 3050B/6020B
S-23	Cobalt	3.25	0.0558	0.186		None	SW-846 3050B/6020B
S-23	Copper	3.21	0.0613	0.186		None	SW-846 3050B/6020B
S-23	Iron	11,900	61.3	186		J	SW-846 3050B/6020B

Table continued on next page

Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-23	Lead	1.85	0.0929	0.372	*	None	SW-846 3050B/6020B
S-23	Magnesium	24,300	18.6	55.8		None	SW-846 3050B/6020B
S-23	Manganese	121	0.186	0.929		J	SW-846 3050B/6020B
S-23	Nickel	35.3	0.0929	0.372		None	SW-846 3050B/6020B
S-23	Potassium	143	14.9	55.8		None	SW-846 3050B/6020B
S-23	Selenium	0.335	0.335	0.929	NU	None	SW-846 3050B/6020B
S-23	Silver	0.477	0.477	2.39	U	2.4UJ	SW-846 3050B/6010D
S-23	Sodium	1,990	14.9	46.5		None	SW-846 3050B/6020B
S-23	Thallium	0.13	0.13	0.372	U	None	SW-846 3050B/6020B
S-23	Vanadium	5.91	0.279	0.929		None	SW-846 3050B/6020B
S-23	Zinc	2,360	7.43	18.6	*	J	SW-846 3050B/6020B
S-24	Aluminum	6,190	4.49	9.86		None	SW-846 3050B/6020B
S-24	Antimony	0.327	0.327	0.99	U	0.99UJ	SW-846 3050B/6010D
S-24	Arsenic	24.6	0.333	0.986	N	J	SW-846 3050B/6020B
S-24	Barium	15.2	0.0986	0.394		None	SW-846 3050B/6020B
S-24	Beryllium	0.0953	0.0197	0.0986	JN	None	SW-846 3050B/6020B
S-24	Cadmium	0.697	0.0197	0.197	N	J+	SW-846 3050B/6020B
S-24	Calcium	231,000	1,320	3,940		None	SW-846 3050B/6020B
S-24	Chromium	53.1	0.197	0.592		None	SW-846 3050B/6020B
S-24	Cobalt	16.3	0.0592	0.197		None	SW-846 3050B/6020B
S-24	Copper	10	0.0651	0.197		None	SW-846 3050B/6020B
S-24	Iron	17,900	65.1	197		J	SW-846 3050B/6020B
S-24	Lead	17.1	0.0986	0.394	*	None	SW-846 3050B/6020B
S-24	Magnesium	27,600	19.7	59.2		None	SW-846 3050B/6020B
S-24	Manganese	352	1.97	9.86		J+	SW-846 3050B/6020B
S-24	Nickel	149	0.0986	0.394		None	SW-846 3050B/6020B
S-24	Potassium	213	15.8	59.2		None	SW-846 3050B/6020B
S-24	Selenium	0.767	0.355	0.986	JN	None	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-24	Silver	0.495	0.495	2.48	U	2.5UJ	SW-846 3050B/6010D
S-24	Sodium	2,520	15.8	49.3		None	SW-846 3050B/6020B
S-24	Thallium	0.138	0.138	0.394	U	None	SW-846 3050B/6020B
S-24	Vanadium	23.2	0.296	0.986		None	SW-846 3050B/6020B
S-24	Zinc	4,800	7.89	19.7	*	J	SW-846 3050B/6020B
S-25	Aluminum	8,120	4.41	9.69		None	SW-846 3050B/6020B
S-25	Antimony	0.319	0.319	0.965	U	0.97UJ	SW-846 3050B/6010D
S-25	Arsenic	24.5	0.328	0.969	N	J	SW-846 3050B/6020B
S-25	Barium	39.5	0.0969	0.388		None	SW-846 3050B/6020B
S-25	Beryllium	0.132	0.0194	0.0969	N	None	SW-846 3050B/6020B
S-25	Cadmium	0.385	0.0194	0.194	N	J+	SW-846 3050B/6020B
S-25	Calcium	225,000	1,300	3,880		None	SW-846 3050B/6020B
S-25	Chromium	58.8	0.194	0.581		None	SW-846 3050B/6020B
S-25	Cobalt	16.8	0.0581	0.194		None	SW-846 3050B/6020B
S-25	Copper	15.5	0.064	0.194		None	SW-846 3050B/6020B
S-25	Iron	17,500	64	194		J	SW-846 3050B/6020B
S-25	Lead	25.5	0.0969	0.388	*	None	SW-846 3050B/6020B
S-25	Magnesium	2,7300	19.4	58.1		None	SW-846 3050B/6020B
S-25	Manganese	339	1.94	9.69		J+	SW-846 3050B/6020B
S-25	Nickel	154	0.0969	0.388		None	SW-846 3050B/6020B
S-25	Potassium	470	15.5	58.1		None	SW-846 3050B/6020B
S-25	Selenium	0.721	0.349	0.969	JN	None	SW-846 3050B/6020B
S-25	Silver	0.483	0.483	2.41	U	2.4UJ	SW-846 3050B/6010D
S-25	Sodium	2,820	15.5	48.4		None	SW-846 3050B/6020B
S-25	Thallium	0.136	0.136	0.388	U	None	SW-846 3050B/6020B
S-25	Vanadium	26	0.291	0.969		None	SW-846 3050B/6020B
S-25	Zinc	191	0.775	1.94	*	J	SW-846 3050B/6020B
S-26	Aluminum	7,480	4.38	9.62		None	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-26	Antimony	0.304	0.304	0.921	U	0.92UJ	SW-846 3050B/6010D
S-26	Arsenic	20.5	0.325	0.962	N	J	SW-846 3050B/6020B
S-26	Barium	24.5	0.0962	0.385		None	SW-846 3050B/6020B
S-26	Beryllium	0.113	0.0192	0.0962	N	None	SW-846 3050B/6020B
S-26	Cadmium	0.321	0.0192	0.192	N	J+	SW-846 3050B/6020B
S-26	Calcium	245,000	1,290	3,850		None	SW-846 3050B/6020B
S-26	Chromium	57.2	0.192	0.577		None	SW-846 3050B/6020B
S-26	Cobalt	16.1	0.0577	0.192		None	SW-846 3050B/6020B
S-26	Copper	10.8	0.0635	0.192		None	SW-846 3050B/6020B
S-26	Iron	17,400	63.5	192		J	SW-846 3050B/6020B
S-26	Lead	5.23	0.0962	0.385	*	None	SW-846 3050B/6020B
S-26	Magnesium	26,700	19.2	57.7		None	SW-846 3050B/6020B
S-26	Manganese	369	1.92	9.62		J+	SW-846 3050B/6020B
S-26	Nickel	145	0.0962	0.385		None	SW-846 3050B/6020B
S-26	Potassium	289	15.4	57.7		None	SW-846 3050B/6020B
S-26	Selenium	0.687	0.346	0.962	JN	None	SW-846 3050B/6020B
S-26	Silver	0.46	0.46	2.3	U	2.3UJ	SW-846 3050B/6010D
S-26	Sodium	2,430	15.4	48.1		None	SW-846 3050B/6020B
S-26	Thallium	0.135	0.135	0.385	U	None	SW-846 3050B/6020B
S-26	Vanadium	20.9	0.288	0.962		None	SW-846 3050B/6020B
S-26	Zinc	108	0.769	1.92	*	J	SW-846 3050B/6020B
S-27	Aluminum	5,990	4.22	9.28		None	SW-846 3050B/6020B
S-27	Antimony	1.61	1.61	4.89	U	None	SW-846 3050B/6010D
S-27	Arsenic	14	0.314	0.928	N	J	SW-846 3050B/6020B
S-27	Barium	11.2	0.0928	0.371		None	SW-846 3050B/6020B
S-27	Beryllium	0.102	0.0186	0.0928	N	None	SW-846 3050B/6020B
S-27	Cadmium	0.283	0.0186	0.186	N	J+	SW-846 3050B/6020B
S-27	Calcium	255,000	1,240	3,710		None	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-27	Chromium	50.7	0.186	0.557		None	SW-846 3050B/6020B
S-27	Cobalt	16.2	0.0557	0.186		None	SW-846 3050B/6020B
S-27	Copper	16.4	0.0612	0.186		None	SW-846 3050B/6020B
S-27	Iron	15,700	61.2	186		J	SW-846 3050B/6020B
S-27	Lead	1.34	0.0928	0.371	*	None	SW-846 3050B/6020B
S-27	Magnesium	26,800	18.6	55.7		None	SW-846 3050B/6020B
S-27	Manganese	343	1.86	9.28		J+	SW-846 3050B/6020B
S-27	Nickel	151	0.0928	0.371		None	SW-846 3050B/6020B
S-27	Potassium	337	14.8	55.7		None	SW-846 3050B/6020B
S-27	Selenium	0.553	0.334	0.928	JN	None	SW-846 3050B/6020B
S-27	Silver	0.489	0.489	2.45	U	2.5UJ	SW-846 3050B/6010D
S-27	Sodium	2,410	14.8	46.4		None	SW-846 3050B/6020B
S-27	Thallium	0.13	0.13	0.371	U	None	SW-846 3050B/6020B
S-27	Vanadium	17.9	0.278	0.928		None	SW-846 3050B/6020B
S-27	Zinc	64.9	0.742	1.86	*	J	SW-846 3050B/6020B
S-28	Aluminum	7,390	4.44	9.77		None	SW-846 3050B/6020B
S-28	Antimony	0.317	0.317	0.962	U	0.96UJ	SW-846 3050B/6010D
S-28	Arsenic	11.1	0.33	0.977	N	J	SW-846 3050B/6020B
S-28	Barium	54.3	0.0977	0.391		None	SW-846 3050B/6020B
S-28	Beryllium	0.126	0.0195	0.0977	N	None	SW-846 3050B/6020B
S-28	Cadmium	0.182	0.0195	0.195	JN	J+	SW-846 3050B/6020B
S-28	Calcium	255,000	1,310	3,910		None	SW-846 3050B/6020B
S-28	Chromium	39.4	0.195	0.586		None	SW-846 3050B/6020B
S-28	Cobalt	11.2	0.0586	0.195		None	SW-846 3050B/6020B
S-28	Copper	85.7	0.0645	0.195		None	SW-846 3050B/6020B
S-28	Iron	17,100	64.5	195		J	SW-846 3050B/6020B
S-28	Lead	5.49	0.0977	0.391	*	None	SW-846 3050B/6020B
S-28	Magnesium	22,700	19.5	58.6		None	SW-846 3050B/6020B

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Appendix D. SNL/KTF Terrestrial Surveillance Analytical Results in 2018

**Table D-1.** Nonradiological results for on-site soil sampling locations at SNL/KTF, 2018 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-28	Manganese	420	1.95	9.77		J+	SW-846 3050B/6020B
S-28	Nickel	85.1	0.0977	0.391		None	SW-846 3050B/6020B
S-28	Potassium	517	15.6	58.6		None	SW-846 3050B/6020B
S-28	Selenium	0.461	0.352	0.977	JN	None	SW-846 3050B/6020B
S-28	Silver	0.0962	0.0962	0.481	U	None	SW-846 3050B/6010D
S-28	Sodium	2,450	15.6	48.8		None	SW-846 3050B/6020B
S-28	Thallium	0.137	0.137	0.391	U	None	SW-846 3050B/6020B
S-28	Vanadium	22.3	0.293	0.977		None	SW-846 3050B/6020B
S-28	Zinc	108	0.781	1.95	*	J	SW-846 3050B/6020B

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

MDL = method detection limit

PQL = practical quantitation limit; the lowest concentration of analytes in a sample that can be determined reliably within specified limits of precision and accuracy by that indicated method under routine laboratory operating conditions

**Laboratory Data Qualifier**

B = analyte detected in the blank

J = estimated value, the analyte concentration fell above the effective MDL and below the effective PQL

N = Results associated with a spike analysis that was outside control limits

U = the analyte was analyzed for, but not detected; or organic and inorganic analytes the result is less than the effective MDL concentration

\* = recovery or percent RPD not within acceptance limits and/or spike amount not compatible with the sample or the duplicate RPS's are not applicable where the concentrations is below the effective PQL

**Data Validation Qualifier**

J = associated value is an estimated quantity

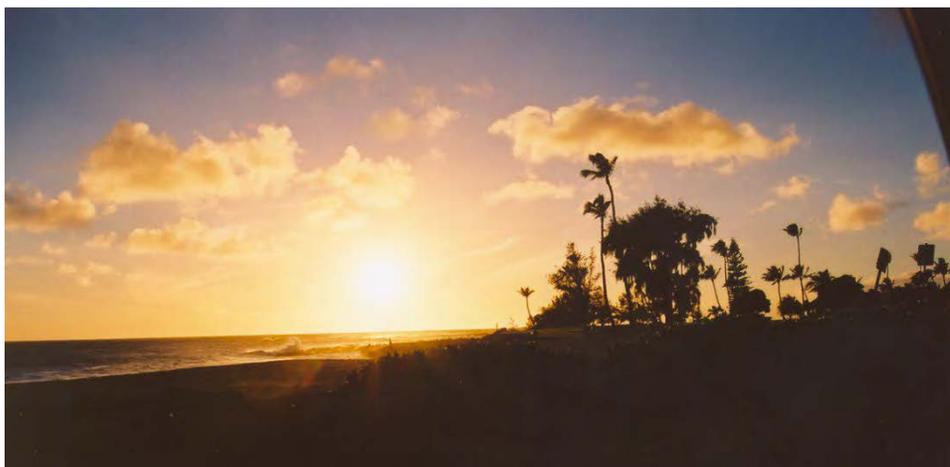
J+ = The associated numerical value is an estimated quantity with a suspected positive base

None = no data validation for corrected gross alpha activity

U = The analyte was analyzed for but was not detected. The associated numerical value is the sample quantitation limit

UJ = The analyte was analyzed for but was not detected. The associated value is an estimate and may be inaccurate or imprecise

## Glossary



Sunset in Hawai'i

### A

**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 and vegetable).

**ambient air** Any unconfined portion of the atmosphere: open air, surrounding air.

**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.

**biogeographic province** A large region characterized as distinct from other regions, mostly on the basis of different dominant vegetation and wildlife habitat types.

### D

**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.

**environmental release** Any spilling, leaking, pouring, emitting, emptying, discharging, injecting, pumping, escaping, leaching, dumping, or disposing into the environment, which may include (but is not limited to) soil, air, and drain systems.

**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.

### G

**groundwater** The water found beneath the earth's surface in pore spaces and in fractures of rock formations.

## H

**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 the EPA requires to be reported if a designated quantity of the substance is spilled in the waters of the U.S. or is otherwise released into the environment.

## I

**impact** Any changes in the environment, whether adverse or beneficial, wholly or partially resulting from activities, products, or services.

**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

**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

**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 illness 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.

## Q

**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.

**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.

**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

**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 grade, covered with earth, and used to contain oil of any kind (petroleum, non-petroleum, synthetic, animal, or vegetable). Sandia USTs are double-wall, fiberglass-reinforced plastic construction.

## W

**wastewater** The spent or used water from a home, community, farm, or industry that contains dissolved or suspended matter.

## References



SNL/TTR blacktop

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