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2016 ANNUAL SITE ENVIRONMENTAL REPORT SANDIA NATIONAL LABORATORIES TONOPAH TEST RANGE, NEVADA AND KAUA'I TEST FACILITY, HAWAI'I

Prepared by
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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 U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525.

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2016 Annual Site Environmental Report for Sandia National Laboratories, Tonopah Test Range, Nevada, and Kauaʻi Test Facility, Hawaiʻi

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for
Department of Energy
National Nuclear Security Administration
Sandia Field Office

Abstract

Sandia National Laboratories (SNL) 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 U.S. Department of Energy's (DOE's), National Nuclear Security Administration (NNSA) under contract DE-NA0003525. The DOE/NNSA Sandia Field Office administers the contract and oversees contractor operations at the SNL, Tonopah Test Range (SNL/TTR) in Nevada and the SNL, Kauaʻi Test Facility (SNL/KTF) in Hawaiʻi. SNL personnel manage and conduct operations at SNL/TTR in support of the DOE/NNSA's Weapons Ordnance Program and have operated the site since 1957. Navarro Research and Engineering personnel perform most of the environmental programs activities at SNL/TTR. The DOE/NNSA/Nevada Field Office retains responsibility for cleanup and management of SNL/TTR Environmental Restoration sites. SNL personnel operate SNL/KTF as a rocket preparation launching and tracking facility. This *Annual Site Environmental Report* (ASER) summarizes data and the compliance status of sustainability, environmental protection, and monitoring programs at SNL/TTR and SNL/KTF during calendar year 2016. Major environmental programs include air quality, water quality, groundwater protection, terrestrial and biological surveillance, waste management, pollution prevention, environmental restoration, oil and chemical spill prevention, and implementation of the National Environmental Policy Act. This ASER is prepared in accordance with and as required by DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*.

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Note to the Reader

The SNL/TTR and SNL/KTF 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. We continually strive to improve the quality of the contents as well as to include information that is important to you. Please provide feedback, comments, questions, or requests for copies of this report and/or appendices to:

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The SNL/TTR and SNL/KTF Annual Site Environmental Report can be found at the following website:
http://www.sandia.gov/news/publications/environmental/index.html

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Acronyms and Abbreviations

Term	Definition
A	
AP	air permit
ARCOC	analysis request and chain of custody
ASER	Annual Site Environmental Report
AST	aboveground storage tank
B	
BD	below detection
bgs	below ground surface
BLM	Bureau of Land Management
C	
CAA	Clean Air Act
CAS	Corrective Action Site
CAU	Corrective Action Unit
CDX	Countermeasure Demonstration Experiment
CEMP	Community Environmental Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
D	
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOECAP	DOE Consolidated Audit Program
DRI	Desert Research Institute
E	
EDE	effective dose equivalent
EHS	extremely hazardous substance
EMS	environmental management system
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community-Right-to-Know Act
ER	Environmental Restoration
ESA	Endangered Species Act
ES&H	Environment, Safety, and Health
F	
FDID	Fire Department Identification
FFACO	Federal Facility Agreement and Consent Order
FIN	facility identification number
FTU	Flight Test Unit
FWS	U.S. Fish and Wildlife Service
FY	fiscal year

Term	Definition
H	
HAP	hazardous air pollutant
I	
IOC	inorganic compound
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
K	
KTF	Kaua'i Test Facility
M	
MBTA	Migratory Bird Treaty Act
MDC	minimum detectable concentration
MEI	maximally exposed individual
N	
NA	not applicable
NAC	Nevada Administrative Code
NAFR	Nellis Air Force Range
ND	not detected
NDEP	Nevada Division of Environmental Protection
NELAC	National Environmental Laboratory Accreditation Conference
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFO	Nevada Field Office
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
NPDES	National Pollutant Discharge Elimination System
NRS	Nevada Revised Statute
NTNC	non-transient non-community
NTTR	Nevada Test and Training Range
NV	Nevada
O	
O&M	Operation and Maintenance
P	
PCB	polychlorinated biphenyl
Permit, the	Department of the Air Force Permit to the National Nuclear Security Administration to Use Property Located on the Nevada Test and Training Range, Nevada
pH	potential of hydrogen

Term	Definition
P	
PIC	pressurized ion chamber
PL	Public Law
PM_{10}	particulate matter that has a diameter equal to or less than 10 microns
PMRF	Pacific Missile Range Facility
Pu	plutonium
PWS	public water system
Q	
QA	quality assurance
QC	quality control
R	
RCRA	Resource Conservation and Recovery Act
ROC	Range Operations Center
RPDP	Radiation Protection Dosimetry Program
RPSD	Radiation Protection Sample Diagnostics
S	
SAP	sample analysis plan
SARA	Superfund Amendments and Reauthorization Act
SDS	Safety Data Sheet
SFO	Sandia Field Office
SHPO	State Historic Preservation Office
SMO	Sample Management Office
SNL	Sandia National Laboratories
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
SOW	statement of work
SPCC	Spill Prevention, Control, and Countermeasure
STARS	Strategic Target System
SWPPP	Stormwater Pollution Prevention Plan

Term	Definition
T	
TLD	thermoluminescent dosimeter
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TTR	Tonopah Test Range
U	
USAF	U.S. Air Force
USC	U.S. Code
USFS	U.S. Forest Service
V	
VOC	volatile organic compound
W	
WRCC	Western Regional Climate Center

Units of Measure

Unit	Definition
Bq/m^3	Becquerel per cubic meter
Ci/m^3	curies per cubic meter
°F	degrees Fahrenheit
ft	feet
gal	gallon
hp	horsepower
kg	kilogram
lb	pound
µ	micron
µCi/mL	microcuries per milliliter
$µg/m^3$	micrograms per cubic meter
m	meter
mg/kg	milligrams per liter
mph	miles per hour
mrem/yr	millirems per year
mR/yr	milliroentgen per year
pCi/g	picocuries per gram
ppb	parts per billion
ppm	parts per million

SNL/TTR and SNL/KTF Executive Summary

Kaua'i Test Facility

Sandia National Laboratories (SNL) 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 U.S. Department of Energy's (DOE's) National Nuclear Security Administration (NNSA). SNL personnel manage and operate the Tonopah Test Range (TTR) in Nevada and the Kaua'i Test Facility (KTF) in Hawai'i for DOE/NNSA. DOE/NNSA/Sandia Field Office (SFO) personnel administer the contract and oversee contractor operations at the sites. This Annual Site Environmental Report (ASER) was prepared in accordance with and as required by DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*.

This ASER summarizes the environmental protection and monitoring programs in place at SNL/TTR and SNL/KTF for calendar year 2016. It also discusses compliance with environmental statutes, regulations, and permit provisions, and it highlights significant environmental programs and efforts. This report is a key component of DOE efforts to keep the public informed about environmental conditions throughout the DOE/NNSA complex.

Sandia National Laboratories, Tonopah Test Range

SNL personnel conduct operations at SNL/TTR in support of the DOE/NNSA Weapons Ordnance Program. SNL activities 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 air drops and rocket launches, which Tonopah Test Range can provide. There were no reportable environmental occurrences at SNL/TTR in 2016. While all 2016 program activities were performed continuously, they are reported in this ASER on a calendar year basis unless noted otherwise (programs based on the fiscal year operate from October 1 through September 30, annually).

SNL environmental and waste management programs comply with the requirements of federal, state, and local environmental regulations, as well as with DOE directives in the SNL Prime Contract.

Environmental Management System

The SNL EMS is the primary management approach for minimizing environmental impact and for supporting environmental compliance and sustainability practices; it is implemented through SNL environmental programs. The SNL EMS is International Organization for Standardization (ISO) 14001-certified for the primary SNL operating locations. The management approach of the SNL EMS is followed at all SNL locations, as verified by an internal assessment to the ISO 14001 standard (ISO 2004) every three years. The last EMS ISO 14001 assessment of SNL/TTR operations was conducted in 2014. See Section 2.1 for more information.

Site Sustainability Plan

Sustainability strategies and goals are defined in an annual Site Sustainability Plan. As of fiscal year 2016, SNL is meeting or exceeding sustainability goals in several key areas. See Section 2.2 for more information.

Air Quality Compliance Program

The Radiological NESHAP Program ensures that SNL operations are in compliance with NESHAP requirements on radiological air emissions. The only radionuclide sources at SNL/TTR are the three Clean Slate sites, which are sources of diffuse radionuclide emissions as a result of the resuspension of contaminated soils. Compliance with NESHAP for these sites is currently being addressed by DOE/NNSA/SFO. The calculated dose for the maximally exposed individual was 0.024 mrem/yr, which is approximately 400 times less than the 10 mrem/yr standard set by the U.S. Environmental Protection Agency (EPA) as specified in Title 40 Code of Federal Regulations 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities." Based on this value, it is not required that an annual dose assessment be calculated for the SNL/TTR site. See Section 3.2 for more information.

The Class II Air Quality Operating Permit for SNL/TTR requires emission reports from significant nonradionuclide sources. At SNL/TTR, these sources include a portable screen, generators, and maintenance shop activities. Maintenance shop activities at SNL/TTR include painting, welding, and carpentry. In 2016, there were emissions from the portable screen, the generators, and activities at the maintenance shop. See Section 3.2 for more information.

Environmental Restoration Project

ER Project activities at SNL/TTR and the Nevada Test and Training Range (NTTR) are conducted through the DOE/NNSA/Nevada Field Office. ER sites that are scheduled for remediation or that have been closed at SNL/TTR include areas impacted from target tests and detonations, including nonimpacted surface debris, and areas impacted by ordnance, depleted uranium, heavy metals, and fuel spills. ER activities in 2016 included characterizing and packaging waste and low-level waste from Clean Slate I, Clean Slate II, Clean Slate III, and Project 57. The waste was generated during site investigation activities, interim corrective measures, and corrective actions and was managed by the DOE/NNSA Nevada Field Office. See Section 3.3 for more information.

Other ER activities conducted on the SNL/TTR and NTTR sites in 2016 consisted of the annual post-closure inspections of closed and use-restricted industrial sites and inspections of radiological postings at the Clean Slate and Double Tracks sites. The inspections were conducted in May 2016.

In addition, air samples were collected routinely throughout the year at various locations on the SNL/TTR and NTTR sites.

National Environmental Policy Act Program

At SNL/TTR, NEPA compliance is coordinated between personnel from SNL/TTR, SNL, New Mexico (SNL/NM), and DOE/NNSA/SFO. Personnel from SNL/TTR and the SNL/NM NEPA team supported DOE/NNSA/SFO in analyzing projects at SNL/TTR, including preparations for the next series of B61-12 flight tests. See Section 3.4 for more information.

In addition to these activities, the SNL/NM NEPA team completed seven NEPA checklists for SNL/TTR, five of which were transmitted to DOE/NNSA/SFO for review and completion. In addition, the SNL/NM NEPA team is actively managing four SNL/TTR NEPA checklists that were created in 2016 and are still in progress.

Oil Storage Program

The SNL/TTR Spill Prevention Control and Countermeasures Plan (required under the Clean Water Act) describes the oil storage facilities on-site and the mitigation controls in place to prevent inadvertent discharges of oil. Additional oil storage capacity in 55 gal drums, mobile and portable containers, mobile refuelers, and oil-filled operational equipment (transformers, hydraulic elevators, etc.) occurs throughout the site on an as-needed basis. In 2016, there were 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. See Section 3.5 for more information.

Terrestrial Surveillance Program

The Terrestrial Surveillance Program at SNL/TTR is designed and conducted to address the requirements of 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 of exposure to radiation associated with radiological activities under the control of DOE. Environmental media (soil) samples are collected and then analyzed for 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 thermoluminescent dosimeters. These surveillance activities are conducted at designated locations that are on-site, off-site, and around the perimeter of SNL/TTR. Results of the 2016 sampling events are consistent with previous years. See Section 3.6 for more information.

Waste Management Program

Waste generated during 2016 at SNL/TTR included hazardous waste regulated by the Resource Conservation and Recovery Act and nonhazardous industrial and sanitary solid waste. All hazardous waste was shipped to permitted treatment, storage, and disposal facilities. Waste minimization and recycling efforts are integrated into the Waste Management Program. Waste generated by ER activities is handled by Navarro Research and Engineering. See Section 3.7 for more information.

Water Quality Programs

The Nevada Division of Environmental Protection permits the public water system at SNL/TTR as a non-transient non-community water system under identification number NV003014. Production Well 6 supplies potable water for the SNL/TTR Area 3 Drinking Water Distribution System and the Area 3 Fire Protection Water Distribution System. See Section 3.8 for more information.

The public water system water is routinely sampled and analyzed per the Nevada Division of Environmental Protection requirements to demonstrate conformance with primary drinking

water standards. In 2016, all public water system sample results were below the maximum contaminant levels established for the substances monitored.

Wastewater discharges at SNL/TTR did not negatively impact the U.S. Air Force-held National Pollutant Discharge Elimination System permit in 2016.

Five septic tank systems are located on-site at SNL/TTR (the newest of which is inactive); they are owned by DOE/NNSA. None of these systems required maintenance, sampling, or pumping in 2016.

Sandia National Laboratories, Kaua'i Test Facility

SNL/KTF personnel provide rocket preparation, launching, and tracking support for DOE/NNSA, and also provide support to other U.S. government agencies. SNL/KTF exists as a facility within the boundaries of the U.S. Department of Defense Pacific Missile Range Facility (PMRF). SNL/KTF is located on the island of Kaua'i at the north end of PMRF near Nohili Point; it has been used as an active rocket launching facility since 1962.

The EPA recommended continued reevaluation for environmental contamination at SNL/KTF due to past ordnance activity near the site. Rocket exhaust continues to be the main source of metals and other nonreportable air emission releases. The EPA's recommendation is addressed by collecting environmental soil samples for Target Analyte List metal analysis every five years. See Chapter 8 for more information.

Environmental Management System

The SNL EMS is the primary management approach for minimizing environmental impact and for supporting environmental compliance and sustainability practices; it is implemented through SNL environmental programs. The SNL EMS is ISO 14001-certified for the primary SNL operating locations. The management approach of the SNL EMS is followed at all SNL locations, as verified by an internal assessment to the ISO 14001 standard (ISO 2004) every three years. An EMS ISO 14001 assessment of SNL/KTF operations was conducted in 2014. See Section 7.1 for more information.

Site Sustainability Plan

Sustainability strategies and goals are defined in an annual Site Sustainability Plan. As of fiscal year 2016, SNL is meeting or exceeding sustainability goals in several key areas. See Section 7.2 for more information.

Air Quality Compliance Program

SNL/KTF operations were in compliance with all air quality permit conditions in 2016. The State of Hawai'i requires annual and semiannual reports to document emissions and monitoring activities. The two Semi-Annual Monitoring Report Forms and the Annual Emissions Report for 2016 were submitted to the State of Hawai'i within specified timelines. These reports document that the site was in compliance with permitted operating limits. See Section 8.1 for more information.

Meteorological Program

Due to the infrequency of launches, no formal meteorological monitoring equipment is in place for SNL/KTF. See Section 8.3 for more information.

National Environmental Policy Act Program

At SNL/KTF, NEPA compliance is coordinated between personnel from SNL/KTF, SNL/NM, and DOE/NNSA/SFO. In 2016, the SNL/NM NEPA team continued to provide support to several programmatic activities performed at either SNL/KTF or PMRF. See Section 8.4 for more information.

In addition to these activities, the SNL/NM NEPA team is actively managing three SNL/KTF NEPA checklists that were created in 2016 and are still in progress.

Oil Storage Program

SNL/KTF programs operate under the PMRF Spill Prevention Control and Countermeasures Plan (required under the Clean Water Act), which describes the oil storage facilities at the SNL/KTF site and the mitigation controls in place to prevent inadvertent discharges of oil. In 2016, there are four DOE-owned storage tanks at SNL/KTF; one underground storage tank, one aboveground storage tank, and two generator base tanks. See Section 8.6 for more information.

Terrestrial Surveillance Program

Terrestrial surveillance is conducted every five years at SNL/KTF. Sampling was conducted in 2012, which confirmed that SNL/KTF operations made no detectable environmental impact. Sampling was not conducted in 2016. See Section 8.5 for more information.

Waste Management Program

Hazardous waste may be generated through normal operations at SNL/KTF. SNL is classified as a conditionally exempt small-quantity generator, and follows applicable Resource Conservation and Recovery Act requirements. See Section 8.7 for more information.

Water Quality Program

In 2016, there were no compliance issues with respect to any state or federal water pollution regulations at SNL/KTF. See Section 8.8 for more information.

Drinking water at SNL/KTF is obtained through local facilities and suppliers. No wells provide drinking water at the site.

The limited quantity of sanitary sewage released at the facility does not impact any protected waters. In 2016, all three on-site septic tanks were inspected and one tank was pumped. Historically, no contaminants have been identified above the reporting limits from past sampling events. During 2016, no septic tank systems were sampled at SNL/KTF.

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PART ONE

SANDIA NATIONAL LABORATORIES
TONOPAH TEST RANGE, NEVADA

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Chapter 1. SNL/TTR Introduction

Pronghorn (*Antilocapra americana*)

OVERVIEW ■ Sandia National Laboratories manages and operates the Tonopah Test Range (TTR) in Nevada for the DOE/National Nuclear Security Administration (NNSA). TTR is located on approximately 280 square miles (179,200 acres) of withdrawn land within the boundaries of the Nevada Test and Training Range. SNL personnel conduct operations at SNL/TTR in support of the DOE/NNSA's Weapons Ordnance Program. No nuclear devices are tested at SNL/TTR.

This Annual Site Environmental Report (ASER) was prepared in accordance with and as required by the U.S. Department of Energy (DOE) per DOE O 231.1B, Admin Change 1, *Safety, and Health Reporting*. Sandia National Laboratories (SNL) 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 (NNSA). SNL personnel manage and operate the Tonopah Test Range (TTR) in Nevada for DOE/NNSA. DOE/NNSA owns TTR, and DOE/NNSA/Sandia Field Office (SFO) personnel in Albuquerque, New Mexico, oversee contractor operations.

Part One of this ASER summarizes the environmental protection and monitoring programs in place at Sandia National Laboratories, Tonopah Test Range (SNL/TTR) during calendar year 2016 unless otherwise noted. This report is made available to the general public in printed and electronic form.

1.1 Mission

The Laboratories' enduring core mission is to provide science and engineering support for the nation's nuclear weapons stockpile. The mission encompasses additional critical aspects of national security, including developing technologies and strategies for responding to emerging threats, protecting and preventing the disruption of critical infrastructures, and supporting

the nonproliferation of weapons of mass destruction. SNL personnel also collaborate with representatives from other government agencies, the industrial sector, and universities to develop and commercialize new technologies. Information about recent technologies developed at Sandia National Laboratories can be found at:

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

1.1.1 Operating Contract and DOE Directives

The Prime Contract for management and operations at Sandia National Laboratories defines the contractual obligations for SNL. 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 the events that have affected or could adversely affect the health, safety, and security of the public or workers, the environment, the operations of DOE facilities, or DOE's credibility. This ASER is prepared in accordance with this directive.
- DOE O 232.2 Admin Change 1, *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's 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 the environment. Under this directive, contractors that 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. The directive is implemented through an International Organization for Standardization (ISO) 14001-certified Environmental Management System. SNL/TTR operations do not need to be included in the ISO 14001 Certification provided that an internal assessment to the ISO 14001 standard (ISO 2004) at the site is conducted every three years. Conformance to the standard is verified through internal Environmental Management System assessments. SNL/TTR assessments were conducted in 2011 and 2014.
- 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.

DOE and SNL personnel have a commitment to environmental protection, compliance, and sustainability and to ensuring the validity and accuracy of the monitoring data presented in this ASER.

1.2 Location Description

SNL/TTR is located on approximately 280 square miles (179,200 acres) of withdrawn land (Figure 1-1), which is permitted from the U.S. Air Force (USAF) within the boundaries of the Nevada Test and Training Range (NTTR); it is used to support DOE/NNSA 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 also is 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.

1.3 SNL/TTR History and Operations

In 1940, President Franklin Delano Roosevelt withdrew approximately 5,000 square miles of federal land in Nevada to establish the Las Vegas Bombing and Gunnery Range (now referred to as NTTR), which is part of Nellis Air Force Base.

Before establishing SNL/TTR in 1956, SNL personnel used three other 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. SNL/TTR was selected as a test range after these facilities became inadequate. Testing weapons in a full range of altitudes facilitated moving the testing from Los Lunas to Salton Sea. The atmosphere at Salton Sea Test Base became permeated with haze, which limited visibility and hampered photography in the mid-1950s. Testing temporarily moved to the Yucca Flat Test Site, which was quickly determined to be inadequate, since it did not offer the flat terrain and long approach corridor required for the increasing emphasis on low-altitude approaches and deliveries.

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.

The SNL/TTR site is located in the northwest corner of the (then) Las Vegas Bombing and Gunnery Range. A land-use permit was obtained from the USAF in 1956, and SNL/TTR became operational to test new weapon systems in 1957. The facilities built at SNL/TTR were designed and equipped to gather data on aircraft-delivered inert test vehicles under U.S. Atomic Energy Commission cognizance (now DOE). As technologies changed, the facilities and capabilities at SNL/TTR were expanded to accommodate tests related to the DOE/NNSA Weapons Ordnance Program.

The Nellis Air Force Base Complex includes several auxiliary small arms ranges and the NTTR, 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 and South ranges at NTTR. The entire Nellis Air Force Base Complex is comprised of approximately 3 million acres. SNL/TTR is located 32 miles southeast of Tonopah, Nevada. In April 2002, the USAF and NNSA 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" (the Permit) (USAF/DOE/NNSA 2002). The Permit is valid from April 26, 2002, until October 5, 2019. The Permit reduced the size of SNL/TTR from approximately 335,655 acres to approximately 179,200 acres.

1.4 SNL/TTR Activities and Facilities

SNL/TTR personnel provide research and development test support for DOE weapons programs, and it offers a unique test environment for use by other government agencies and their contractors. Capabilities such as modern electronic tracking instrumentation and data acquisition systems assure complete and accurate test data. The facilities, large land area, and site security are available for conducting a wide variety of tests.

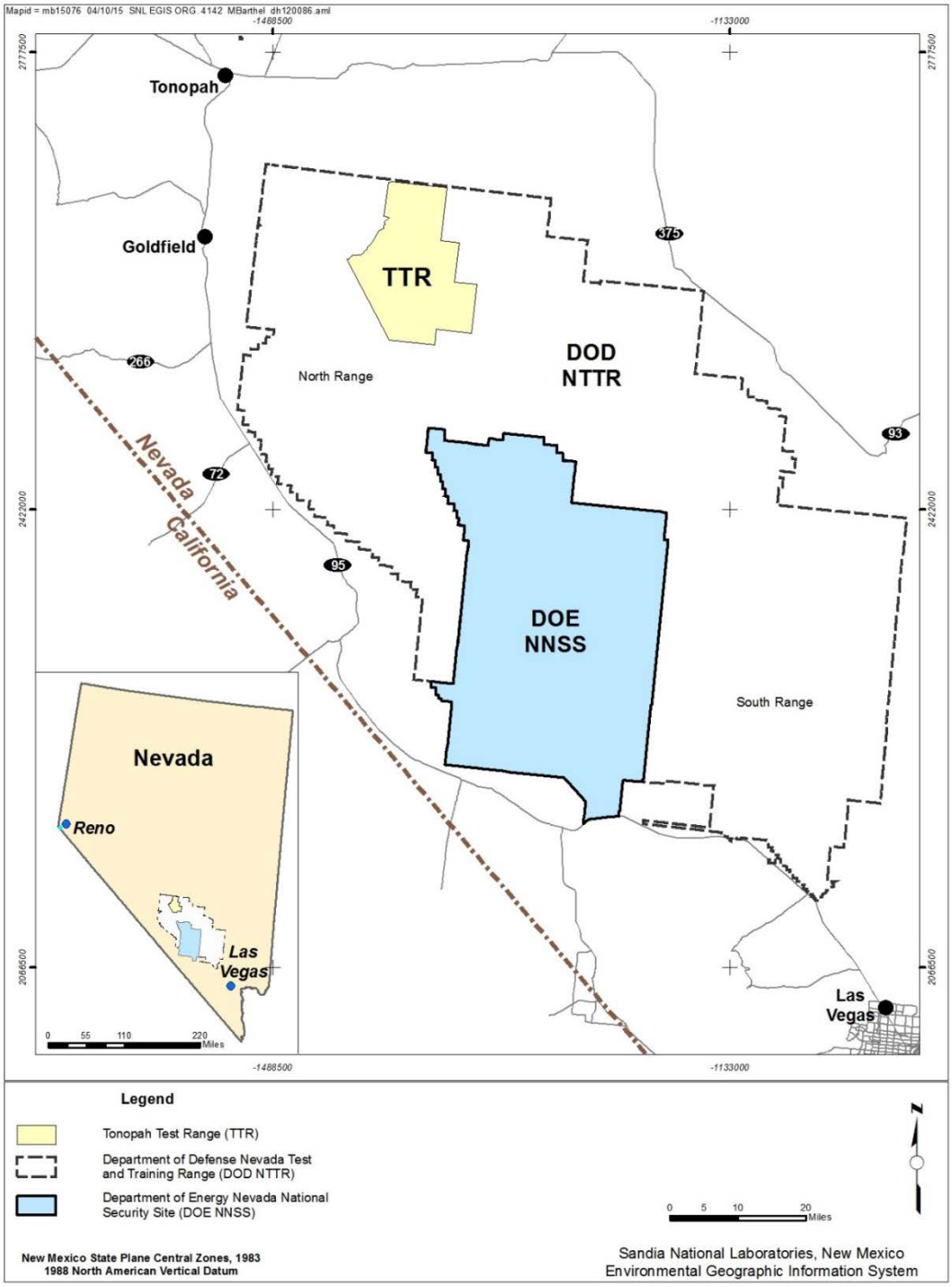

Figure 1-1. SNL/TTR location within the boundaries of NTTR

Operations at SNL/TTR are conducted in support of the DOE/NNSA Weapons Ordnance Program. Activities 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 air drops and rocket launches, which Tonopah Test Range can provide. Other activities include explosives tests and gun firings. No nuclear devices are tested at SNL/TTR.

Current DOE/NNSA 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)

These activities require a remote range for both public safety and to maintain national security. The majority of test activities at SNL/TTR occur within Cactus Flat, a valley with almost no topographical relief flanked by mountains and hills.

Navarro Research and Engineering performs or supports most environmental program functions at SNL/TTR on behalf of the management and operating contractor for SNL, including air monitoring, ER activities, National Environmental Policy Act 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 and radar units and recovering test objects.

Figure 1-2. SNL/TTR Operations Center

1.4.1 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. The control tower houses the test director, camera control operators, Range Safety Officer, telemetry control operators, test engineer, computer operator, Test and Evaluation Command and Control System operator, telemetry personnel, and visitors during test operations. The fourth floor (Operations Center) of this facility was remodeled during 2014. Windows, lighting, flooring, and control electronics were replaced (Figure 1-2). A project to renovate the facility's first, second, and third floors—including elevator replacement and heating, venting, and air conditioning systems—began in December 2015 and was completed in mid-2016.

SNL/TTR is instrumented with a wide array of signal-tracking equipment, including video, high-speed cameras, telemetry, and radar tracking devices that are used to characterize ballistics, aerodynamics, and parachute performance of test units.

1.4.2 Environmental Restoration Project

The ER Project at SNL/TTR was initiated in 1980 to address contamination resulting primarily from nuclear weapons 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 responsibility for all ER sites to the DOE/Nevada Field Office (NFO). The NNSA was established in 2000, and responsibility for all ER sites in Nevada still resides with NNSA/NFO, with the exception that National Emission Standards for Hazardous Air Pollutants compliance and reporting for ER activities is currently being addressed by DOE/NNSA/SFO. However, environmental program management at SNL/TTR is a joint effort between SNL/TTR and SNL/NM personnel, with oversight from DOE/NNSA/SFO.

1.5 Environmental Setting

The topography at SNL/TTR is characterized by a broad, flat valley bordered by two north- and south-trending mountain ranges: the Cactus Range to the west (occurring mostly within the boundaries of SNL/TTR) and the 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 ft at the valley floor to 7,482 ft at Cactus Peak. The elevation of the town of Tonopah is 6,030 ft.

1.6 Demographics

The nearest residents are located in the towns of Goldfield, Nevada (2010 Census population 268) and Tonopah, Nevada (2010 Census population 2,478). Census data indicate a net resident loss of 550 people from the towns of Goldfield (loss of 88 residents) and Tonopah (loss of 462 residents) between the 2000 Census and the 2010 Census. Goldfield is located approximately 22 miles west of the site boundary, and Las Vegas, Nevada, is approximately 140 miles southeast of SNL/TTR. The total population within the 50-mile radius around SNL/TTR is approximately 6,450, which includes the potential population at SNL/TTR if all housing units at the site were occupied.

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 (Sinnock 1982).

The 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).

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

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).

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 ft 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 ft bgs (below ground surface) at the site. Approximate groundwater levels have been recorded as follows:

- Antelope Mine Well in the Cactus Range at 21 ft bgs
- EH2 Well near the Tonopah Test Range Airport at 454 ft bgs
- Area 9 Well located near the northern end of the site at 131 ft bgs
- Production Well 6 in Area 3 at 350 ft bgs.

1.6.4 Ecology

An ecosystem is a network of living organisms and nonliving components that interact with one another to comprise the overall environment. The ecosystem at SNL/TTR includes the interactions of human, animal, insect, plant, fungal, and many other living component varieties 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 things 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.

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

In general, the NTTR 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 teens °F.

Rainfall, which is sparse, is dependent on elevation. Annual average rainfall in the desert valley floor is 4 inches, while in nearby mountains as much as 12 inches occurs (USAF 1999).

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 mph. 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.

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

1.7 Double Tracks and Clean Slate Sites

In May and June 1963, Project Roller Coaster was conducted and included a series of four nuclear weapons destruction tests 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 NTTR just west of SNL/TTR. The three Project Roller Coaster test sites at SNL/TTR are referred to as Clean Slate 1, Clean Slate 2, and Clean Slate 3. The fourth test site at NTTR is referred to as Double Tracks. In 1996 and 1997, interim corrective actions were performed at Double Tracks and Clean Slate 1. In 2016, NNSA/NFO completed the remaining corrective actions at Double Tracks and Clean Slate 1 and NDEP 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 2 and Clean Slate 3 are currently being investigated to determine the nature and extent of contamination. This information will be used to determine the appropriate corrective action alternative. These sites are currently fenced and posted. The areas are inspected visually each year to determine whether any fence repairs or sign replacement is required.

Table 1-1 summarizes test information related to the four Project Roller Coaster sites. DOE/NNSA/NFO is responsible for remediation of these and all other ER sites at SNL/TTR (refer to Chapter 3). DOE/NNSA/NFO and SNL personnel will continue to be responsible for all other environmental compliance at these sites.

Table 1-1. SNL/TTR Project Roller Coaster test information

Test Name	CAU Number	Date of Test	Location	Status
Double Tracks	411	May 15, 1963	NTTR, North Range (west of SNL/TTR)	Closed
Clean Slate 1	412	May 25, 1963	SNL/TTR	Closed
Clean Slate 2	413	May 31, 1963	SNL/TTR	In the investigation phase
Clean Slate 3	414	June 9, 1963	SNL/TTR	In the investigation phase

NOTES: Source: Sampling and Analysis Plan for Clean Slate 1, September 1996 (IT 1996).
CAU = Corrective Action Unit SNL/TTR = Sandia National Laboratories, Tonopah Test Range
NTTR = Nevada Test and Training Range

1.7.1 Air Monitoring at Environmental Restoration Sites

Remediation activities were conducted at Clean Slate 1 in 1997. The Desert Research Institute (DRI) 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/NNSA/NFO in the form of a draft report (DRI 1997). The report documented the as-left condition at the site, but did not require follow-up action.

During 2016, at the request of DOE/NNSA/NFO, DRI maintained three portable environmental monitoring stations (two installed in 2008 and the third installed in 2011) at SNL/TTR as part of the ER Project Soils Activity (Figure 1-3). 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 Soils Activity Corrective Action Units (CAUs) associated with Operation Roller Coaster at SNL/TTR.

One monitoring station (400) is located in the general vicinity of the Range Operations Center (ROC), the second station (401) is located on the north edge of Clean Slate 3, and the newest station (402) is located on the north edge of Clean Slate 1. The ROC station measures potential radionuclide concentrations associated with airborne particulates at the closest location where there are regular site workers. The station at Clean Slate 3 is located at the perimeter of the largest of the three SNL/TTR Soils Activity CAUs. The station at Clean Slate 1 is located on the north perimeter of the soil CAU. The stations at Clean Slate 3 and Clean Slate 1 both measure the radionuclide concentration associated with airborne particulates at the boundaries of the sites in one of the predominant downwind directions.

The TTR 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. Data are provided to the Western Regional Climate Center (WRCC) for management and incorporation into a TTR-specific database. The stations at the ROC and Clean Slate 3 have been in continuous operation since July 2008; the station installed at Clean Slate 1 became operational in August 2011.

Monitoring Station Locations and Capabilities

Station 400 (a Portable Environmental Monitoring Station) is located south of the ROC. This station was located to provide data at the ROC, which has the greatest concentration of SNL personnel at SNL/TTR. In addition, Station 400 was located where line power was available to operate the instruments. Station 401 and Station 402 are solar-powered with battery backup power; the batteries are recharged during daylight hours by solar panels. All three stations consist of two primary components: an air sampler and an auxiliary meteorological tower. Station 401 is located along the fenced perimeter of the north end of Clean Slate 3. Station 402 is located along the fenced perimeter of the north end of Clean Slate 1. Their locations 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 1-3 shows the location of the monitoring stations at SNL/TTR.

All three monitoring stations are equipped with continuous low-volume air samplers (having a flow rate of approximately 2 cubic feet per minute), and filters are collected routinely every two weeks. These filters are delivered to the Radiological Services Laboratory at the University of Nevada, in Las Vegas, Nevada, for analyses. Standard analyses include gross alpha and beta measurements and gamma spectral analysis; samples may undergo alpha spectral analysis if initial gamma spectral analyses indicate the presence of americium-241, which could indicate that plutonium particles are being transported.

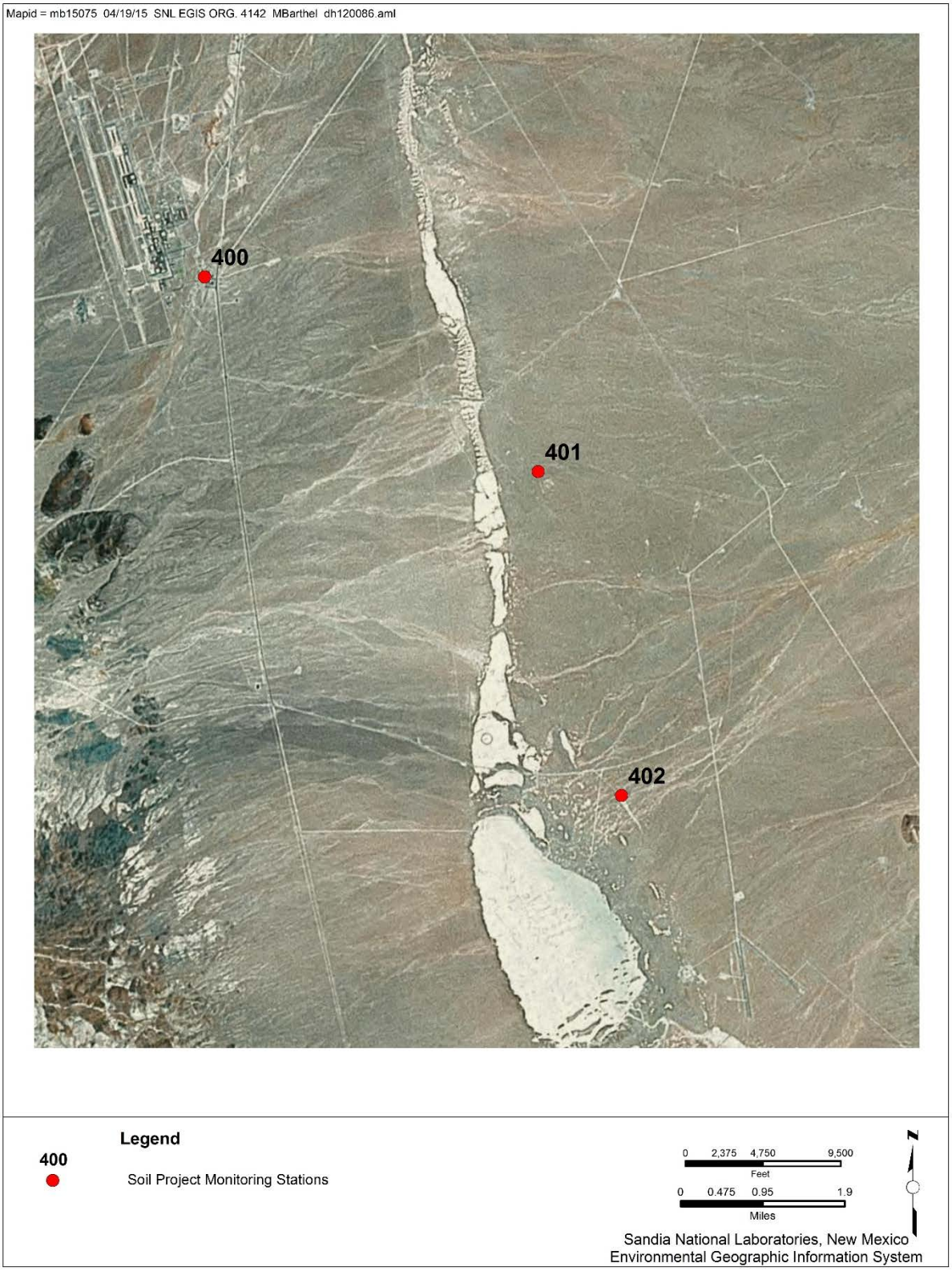

Figure 1-3. TTR soils project air-monitoring stations located at the Range Operations Center (400), Clean Slate 1 (402), and Clean Slate 3 (401)

Station 400: Range Operations Center

Station 400 is a portable station with all monitoring and sampling systems mounted on a 7 ft by 14 ft trailer. The station is located approximately 100 yards south–southwest of the ROC. Airborne dust particles are collected continuously using a Hi-Q air sampler. Filters are recovered and new filters deployed every two weeks. Sensors include an anemometer, a wind direction vane, a pyranometer, a tipping rain bucket, a temperature and relative humidity probe, a barometer, a TDR soil moisture probe, a soil temperature probe, a pressurized ion chamber (PIC), and an ambient air particulate size profiler. Data from these sensors are collected and stored on a Campbell Scientific data logger and are then transmitted through a Geostationary Operational Environmental Satellite transmitter to the WRCC. Regular quality assurance procedures include checking the PIC response and the calibration of air volume passing through the air sampler on a monthly basis, as well as performing data quality checks on the WRCC database. In addition to the real-time instruments and continuous air sampler, this station is equipped with a manually activated low-volume air sampler (AirMetrics MiniVol) 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 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 is also equipped with an ambient air particulate size profiler (Met-One). The Met-One measures the concentration of suspended particulates in real time. Data can be used to determine whether high wind events are always associated with higher concentrations of suspended particulates, and whether there are correlations between particulate concentrations and radionuclide concentration. The station configuration as currently deployed is shown in Figure 1-4.

Figure 1-4. TTR Station 400 measures radiological and meteorological conditions near the ROC

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 and then delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, on a monthly basis for batch processing. Between December 23, 2015, and December 21, 2016, 26 air particulate filter samples were collected and then analyzed by gamma spectroscopy and for gross alpha and beta activity. Only naturally occurring radionuclides were identified and measured on these samples; beryllium-7 (26 samples) and lead-210 (10 samples) were the most commonly identified radionuclides, with occasional detections of potassium-40 (3 samples). No anthropogenic gamma-emitting radionuclides such as cesium-137, cobalt-60, or americium-241 have been detected. The mean annual gross alpha activity from all samples (Table 1-2) was 1.79×10^{-15} µCi/mL, with a maximum of 5.70×10^{-15} µCi/mL, a minimum of 0.32×10^{-15} µCi/mL, and a standard deviation of 1.16×10^{-15} µCi/mL. The mean annual gross beta activity from all samples (Table 1-3) was 1.56×10^{-14} µCi/mL, with a maximum of 2.91×10^{-14} µCi/mL, a minimum of 0.92×10^{-14} µCi/mL, and a standard deviation of 0.44×10^{-14} µCi/mL.

Table 1-2. Gross alpha results for sampling stations, 2016

Sampling Location	Number of Samples	Concentration (×10^{-15} µCi/mL [3.7 × 10^{-5} Bq/m^3])			
		Mean	Standard Deviation	Minimum	Maximum
400	26	1.79	1.16	0.32	5.70
401	26	1.67	1.02	0.27	3.50
402	26	2.01	1.17	0.45	5.09

Table 1-3. Gross beta results for sampling stations, 2016

Sampling Location	Number of Samples	Concentration (×10^{-14} µCi/mL [3.7 × 10^{-4} Bq/m^3])			
		Mean	Standard Deviation	Minimum	Maximum
400	26	1.56	0.44	0.92	2.91
401	26	1.37	0.35	0.71	2.26
402	26	1.84	0.51	1.09	3.06

Station 401: Clean Slate 3

Station 401 consists of a solar-powered air sampler (sampler and solar panels) mounted on a 7 ft by 14 ft trailer, plus a portable meteorological tower. The station is located on the north end of Clean Slate 3. Sensors include an anemometer, a wind direction vane, a tipping rain bucket, a TDR soil moisture probe, a soil temperature probe, a temperature and relative humidity probe, a PIC, and an ambient air particulate size profiler (Met-One). The Met-One measures the concentration of suspended particulates in real time. Data from these sensors are collected and stored on a Campbell Scientific data logger and are then transmitted through a Geostationary Operational Environmental Satellite transmitter to the WRCC. Regular quality assurance procedures include checking the PIC response and the calibration of air volume passing through the air sampler on a monthly basis, as well as performing data quality checks on the WRCC database. Working with Hi-Q Products Inc., DRI constructed this mobile version of a solar-powered air sampler based on a design currently being used by the USAF at NTTR. Internal airflow monitoring and self-adjustment capabilities allow the air sampler to maintain a near-constant flow rate. An internal totalizer computes the volume of air passed through the collection filter and the collector's run time. A saltation sensor was installed at Station 401 in August 2011. This instrument measures sand and particle movement by aeolian transport close

to the ground surface. Saltation is a wind-driven process and is an important mechanism for transport of soil material in desert environments. DRI monitors the frequency of saltation events as a function of wind speed and wind direction at Station 401. Solar panels, with battery assist, provide power for the air sampler and the meteorological station. The configurations of the solar-powered air sampler and the portable meteorological station are shown in Figure 1-5.

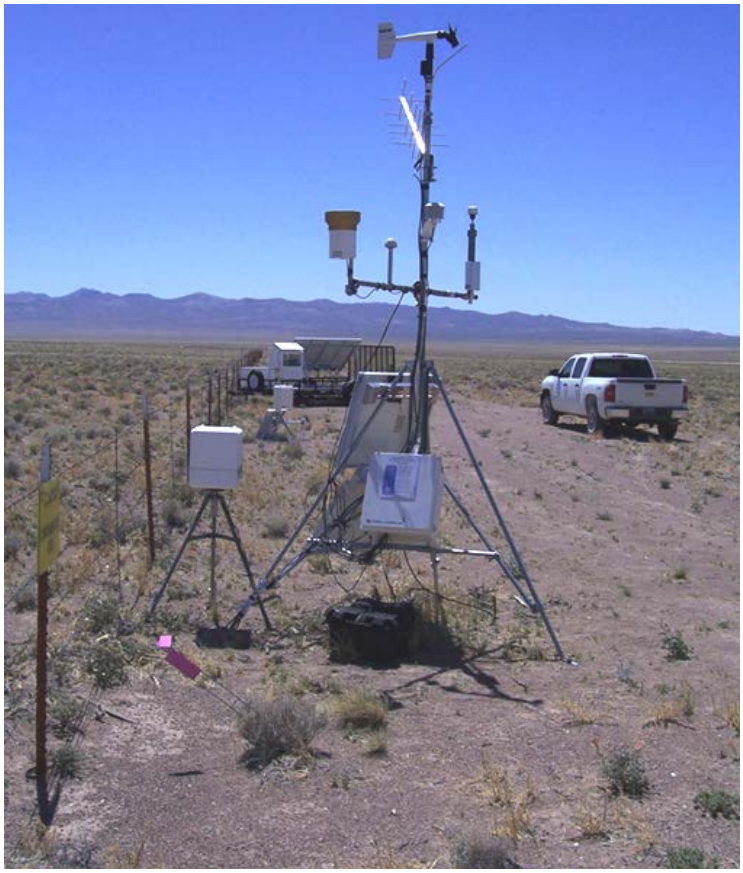

Figure 1-5. TTR solar-powered air sampler, saltation sensor, and meteorological tower (background, center, and foreground, respectively) at Station 401, located along the north fence that bounds the Clean Slate 3 contamination area

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 and then delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, on a monthly basis for batch processing. Between December 23, 2015, and December 21, 2016, 26 air particulate filter samples were collected and then analyzed by gamma spectroscopy and for gross alpha and beta activity. Only naturally occurring radionuclides were identified and measured on these samples; beryllium-7 (26 samples) and lead-210 (17 samples) were the most commonly identified radionuclides, with minor detections of potassium-40 (2 samples) and protactinium-234m (1 sample). No anthropogenic gamma-emitting radionuclides such as cesium-137, cobalt-60, or americium-241 have been detected. The mean annual gross alpha activity (Table 1-2) from all samples was 1.67×10^{-15} µCi/mL, with a maximum of 3.50×10^{-15} µCi/mL, a minimum of 0.27×10^{-15} µCi/mL, and a standard deviation of 1.02×10^{-15} µCi/mL. The mean annual gross beta activity (Table 1-3) from all samples was 1.37×10^{-14} µCi/mL, with a maximum of 2.26×10^{-14} µCi/mL, a minimum of 0.71×10^{-14} µCi/mL, and a standard deviation of 0.35×10^{-14} µCi/mL.

Station 402: Clean Slate 1

In May 2011, DRI established Station 402 and installed a portable meteorological tower with an anemometer, a pyranometer, a tipping rain bucket, a TDR soil moisture probe, a soil temperature probe, a temperature and relative humidity probe, and a Met-One ambient air particulate size profiler, as well as a Geostationary Operational Environmental Satellite transmitter. During August 2011, DRI installed a solar-powered air sampler (sampler and solar panels) mounted on a trailer, and a PIC was installed in September 2011. Internal airflow monitoring and self-adjustment capabilities allow the air sampler to maintain a near-constant flow rate. An internal totalizer computes the volume of air passed through the collection filter and the collector's run time. Data from the sensors are collected and stored on a Campbell Scientific data logger. DRI installed a saltation monitoring station at Station 402 in August 2011. This instrument measures sand and particle movement by aeolian transport close to the ground surface. Saltation is a wind-driven process and is an important mechanism for transport of soil material in desert environments. DRI monitors for frequency of saltation events as a function of wind speed and wind direction at Station 402. Solar panels, with battery assistance, provide power for the air sampler and the meteorological station. The configurations of the solar-powered air sampler and the portable meteorological station are shown in Figure 1-6.

Figure 1-6. TTR solar-powered air sampler, saltation sensor, and meteorological tower (center right, foreground left, and center left, respectively) at Station 402, located along the north fence that bounds the Clean Slate 1 contamination area

Station 402: Air Sampling Results

Station 402 is equipped with a continuous air particulate sampler from which a 4-inch glass-fiber air filter sample is collected every two weeks and then delivered to the Radiological Services Laboratory at the University of Nevada, Las Vegas, on a monthly basis for batch processing.

Between December 23, 2015, and December 21, 2016, a total of 26 air particulate samples were collected and then analyzed by gamma spectroscopy and for gross alpha and beta activity. Only naturally occurring radionuclides were identified and measured on these samples; beryllium-7 (26 samples) and lead-210 (9 samples) were the most commonly identified radionuclides, with minor detections of potassium-40 (4 samples) and protactinium-234m (1 sample). No anthropogenic gamma-emitting radionuclides such as cesium-137, cobalt-60, or americium-241 have been detected. The mean gross alpha activity (Table 1-2) from all samples was 2.01×10^{-15} µCi/mL, with a maximum of 5.09×10^{-15} µCi/mL, a minimum of 0.45×10^{-15} µCi/mL, and a standard deviation of 1.17×10^{-15} µCi/mL. The mean gross beta activity (Table 1-3) from all samples was 1.84×10^{-14} µCi/mL, with a maximum of 3.06×10^{-14} µCi/mL, a minimum of 1.09×10^{-14} µCi/mL, and a standard deviation of 0.51×10^{-14} µCi/mL.

1.7.2 Alpha Spectroscopy Results for Stations 400, 401 and 402

During 2016, alpha spectroscopy analysis for plutonium (Pu) isotopes was conducted on air filters collected in 2015. Two filters from each quarter of the year were selected semi-randomly and submitted to TestAmerica Laboratories for alpha spectroscopy analysis. These quarterly samples included the sample with the highest gross alpha result plus one random sample each from stations 400, 401, and 402, for a total of eight samples per station. Note that previous gamma spectroscopy on the samples did not detect americium-241.

Table 1-4 summarizes the results of alpha spectroscopy analyses for Pu-238 and Pu-239/240. No Pu-238 was identified above the minimum detectable concentration. Pu-239/240 was detected at the Clean Slate stations 401 and 402, but not at station 400, the Range Operations Center. The mean Pu-239/240 activity at station 401 was 1.69×10^{-16} µCi/mL, with a maximum of 3.66×10^{-16} µCi/mL, a minimum of 0.32×10^{-16} µCi/mL, and a standard deviation of 1.17×10^{-16} µCi/mL. The mean Pu-239/240 activity at station 402 was 1.52×10^{-16} µCi/mL, with a maximum of 4.34×10^{-16} µCi/mL, a minimum of 0.55×10^{-16} µCi/mL, and a standard deviation of 1.32×10^{-16} µCi/mL.

Table 1-4. Alpha Spectroscopy Results for Stations 400, 401 and 402, for samples collected in 2015

Sampling Location	Number of Samples > MDC Pu-238	Number of Samples >MDC Pu-239/240	Concentration (×10^{-16} µCi/mL [3.7 × 10^{-6} Bq/m³])		
			Mean ± Standard Deviation	Minimum	Maximum
400	0	0	NA	NA	NA
401	0	7	1.69 ± 1.17	0.32	3.66
402	0	6	1.52 ± 1.32	0.55	4.34

NOTES: > = greater than
MDC = minimum detectable concentration
NA = not applicable

1.7.3 Station 400, Station 401, and Station 402: Air Particulate Migration

At Station 400 (ROC), wind speed of 15 mph or less was observed 91.4 percent of the time; wind speeds exceeded 30 mph for 7 hours and 50 minutes during the year, and sustained winds over 35 mph were registered for approximately 20 minutes during the year. Slightly higher wind speeds were observed at Station 401 (Clean Slate 3), where winds of 15 mph or less were observed 91.3 percent of the time and wind speed exceeded 30 mph for approximately 12 hours for the entire year. At Station 402 (Clean Slate 1), wind speeds of 15 mph or less were observed

approximately 91.8 percent of the time, and the wind speed exceeded 30 mph for approximately 9 hours and 40 minutes of the year. Figure 1-7 shows the average respirable particulate matter (having a diameter equal to or less than 10 μ [PM_{10}]) concentrations for 5 mph wind speed intervals at all three stations. The PM_{10} concentrations increased approximately exponentially as wind speed increased at all stations. PM_{10} concentrations at all three stations were less than approximately 10 μg/m³ for wind speeds below 15 mph. At Station 400, PM_{10} concentrations peaked at 55 μg/m³ for wind speeds over 35 mph. At Station 401, PM_{10} concentrations rose to 240 μg/m³ for wind speeds over 35 mph. At Station 402, PM_{10} concentrations peaked at 475 μg/m³ for wind speeds over 35 mph. Generally, the dust concentrations were significantly lower for sustained winds over 25 mph when compared to 2015.

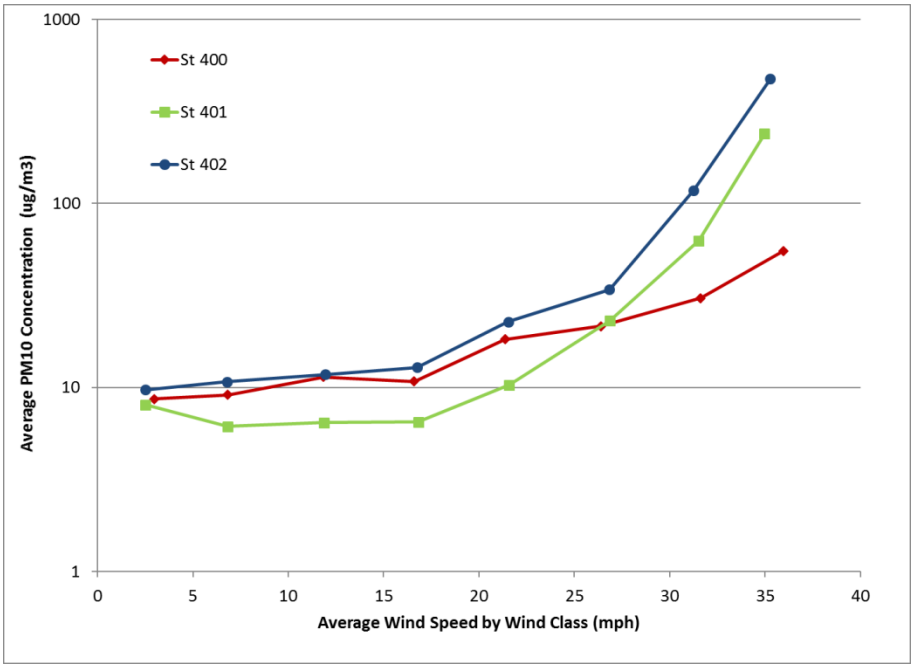

Figure 1-7. Wind speed and lognormal PM_{10} trends for stations 400, 401, and 402, January 1–December 31, 2016

Chapter 2. SNL/TTR Compliance Summary

SNL/TTR, blacktop

OVERVIEW ■ SNL/TTR operations comply with federal, state, and local environmental regulations. Releases and occurrences are reported according to numerous permit requirements. Regular audits, appraisals, and inspections identify areas for improvement as well as noteworthy practices.

Sandia National Laboratories (SNL) personnel conduct operations at SNL, Tonopah Test Range (SNL/TTR) in compliance with federal, state, and local environmental requirements, including U.S. Department of Energy (DOE) directives and Presidential Executive Orders (EOs). As a part of this compliance, SNL operations 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, ESH100, which states:

> It is the policy of Sandia National Laboratories to perform work in a safe and environmentally responsible manner by committing to: maintain a safe workplace, prevent incidents, and protect the public; protect the environment, conserve resources, and prevent pollution; maintain compliance with legal and other requirements; and strive for continual improvement. DOE's Integrated Safety Management System (ISMS) is a key element of the Sandia Management Model. ISMS provides the framework for managing ES&H activities and functions while integrating them into all SNL operations.

2.1 Environmental Management System

SNL 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. The Environmental Management System (EMS)—the primary

management approach to minimizing environmental impact and supporting environmental compliance and sustainability practices—is also implemented through SNL environmental programs.

The EMS encompasses all SNL activities, products, and services that have the potential to interact with the environment. Specifically, the EMS is used to establish policy, objectives, and targets that enable personnel to reduce environmental impacts and increase operating efficiencies through a continuing cycle of planning, implementing, evaluating, and improving processes.

DOE O 436.1, *Departmental Sustainability*, was established to ensure that environment management systems and site sustainability are at the forefront of environmental excellence. This directive is implemented through an International Organization for Standardization (ISO) 14001-certified (ISO 2004) EMS. Initial ISO 14001 certification was achieved in June 2009 for primary SNL operating locations, and certification was retained in the 2015 recertification audit. SNL/TTR operations do not need to be included in the ISO 14001 Certification provided that an internal assessment to the ISO 14001 standard (ISO 2004) at the site is conducted every three years. An EMS ISO 14001 assessment of SNL/TTR operations was conducted in 2014. Additional information can be found on the SNL external EMS website:

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

The benefits of the SNL EMS include:

- 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 personnel awareness of environmental issues and responsibilities

For FY 2016, the EMS identified natural resource use, hazardous materials use, and hazardous waste production as the top three significant *aspects* (any elements of activities, products, or services that can interact with the environment). When significant aspects and negative *impacts* (any changes in the environment, whether adverse or beneficial, wholly or partially resulting from activities, products, or services) have been identified, objectives and measurable targets—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts.

2.2 Site Sustainability Plan

Sustainability strategies and goals are defined in an annual Site Sustainability Plan, and many of these efforts have been adopted as EMS objectives and targets. The Site Sustainability Plan (SNL/NM 2015) articulates the performance status and planned actions for meeting DOE's Strategic Sustainability Performance Plan (DOE 2016) goals and broader sustainability program set forth in EO 13693, *Planning for Federal Sustainability in the Next Decade*. The EMS is used as a platform for implementing the Site Sustainability Plan and other programs with objectives and measurable targets that contribute to meeting sustainability goals. As of FY 2016, sustainability goals are being met or exceeded in several key areas.

2.3 Environmental Performance Measures

Environmental performance is tracked through performance measures and indicators. The results are reported through the internal ES&H Assurance Dashboard, the Sandia Performance Scorecard, the management review process, and management reports.

Environmental performance is assessed as part of the SNL Performance Evaluation Measurement Plan with DOE/National Nuclear Security Administration (NNSA)/Sandia Field Office (SFO). On the basis of the Performance Evaluation Measurement Plan, DOE/NNSA/SFO prepares an annual Performance Evaluation Report that assesses the management and operating contractor's performance for the fiscal year. For FY 2016, the overall performance was rated as excellent, earning performance ratings of excellent in several mission objectives. SNL operations met or exceeded expectations in the areas of environment, safety, and health.

2.4 Air Quality

Air quality at SNL/TTR is monitored and assessed to ensure compliance with clean air requirements.

2.4.1 Clean Air Act

Per the Clean Air Act (CAA) of 1970 and CAA Amendments of 1990, air quality at SNL/TTR is regulated by State of Nevada air quality regulations. Air emissions from nonradionuclide sources, such as a portable screen or maintenance shop activities, are permitted under a Class II Air Quality Operating Permit. Emissions are tracked, and payment of the standard $500 permit fee is presented to the State of Nevada on an annual basis. All air quality permit conditions at SNL/TTR were met in 2016.

2.4.2 National Emission Standards for Hazardous Air Pollutants Compliance

The U.S. Environmental Protection Agency (EPA) retains compliance authority for all radionuclide air releases, which are regulated by National Emission Standards for Hazardous Air Pollutants (NESHAP) and implemented under 40 Code of Federal Regulations (CFR) 61, Subpart H (40 CFR 61). The Clean Slate sites, as discussed in Chapter 1, have been the only source of radionuclide air emissions at SNL/TTR. Continuous air monitoring was conducted from February 22, 1996, to February 25, 1997 (SNL/NM 1997a). It was determined that the SNL/TTR airport was the location of the maximally exposed individual. The result of 0.024 mrem/yr was below the threshold of 0.1 mrem/yr, for which continuous air monitoring would be required, and approximately 400 times less than the EPA standard of 10 mrem/yr. The *Radiological NESHAP Annual Report for CY 2016, Sandia National Laboratories, Tonopah Test Range* (SNL/NM 2017) and Chapter 3 of this report discuss these monitoring results.

2.5 Chemical Management

Chemicals are managed through compliance with several requirements. Reporting is specified in these requirements.

2.5.1 Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986, also known as the Superfund Amendments and Reauthorization Act (SARA) Title III, requires the submittal of a Toxic Release Inventory report for chemical releases over a given threshold quantity. Table 2-1 lists SARA Title III reporting requirements.

Table 2-1. SNL/TTR applicable EPCRA reporting requirements, 2016

Section	EPCRA Section Title	Requires Reporting?		Description
		Yes	No	
302–303	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. DOE/NNSA/SFO distributes the report to the required entities.
304	Emergency Release Notification		✓	Submit notification of reportable quantity releases of an EHS, as defined by CERCLA, to the required entities.
311–312	Hazardous Chemical Inventory	✓		Report on two "Community Right-to-Know" requirements: • Complete EPA Tier II forms for (1) all hazardous chemicals present at the SNL/TTR facility at any one time in amounts equal to or greater than 10,000 lb and (2) all EHSs present at the facility in amounts equal to or greater than 500 lb or the Threshold Planning Quantity, whichever is lower. This report is provided to DOE/NNSA/SFO for distribution to the required entities. • Record SDSs for each chemical entry on a Tier II form and provide the report to DOE/NNSA/SFO prior to distribution to the required entities.
313	Toxic l Release Inventory		✓	Submit a TRI report to the required entities for facilities that release toxic chemicals listed in SARA Title III over a threshold value.

NOTES: CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
DOE = U.S. Department of Energy
EHS = extremely hazardous substance
EPA = U.S. Environmental Protection Agency
EPCRA = Emergency Planning and Community Right-to-Know Act
NNSA = National Nuclear Security Administration
SARA = Superfund Amendments and Reauthorization Act
SDS = Safety Data Sheet
SFO = Sandia Field Office
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TRI = Toxic Release Inventory

Emergency Release Notification

The Emergency Release Notification requirements were established under Section 304 of EPCRA. An accidental release of an extremely hazardous substance that exceeds the applicable reporting quantity must be reported. In 2016, there were no reportable quantity releases of an extremely hazardous substance requiring notification.

Toxic Release Inventory Reporting

The Toxic Release Inventory (TRI) reporting requirement was established under Section 313 of EPCRA. Environmental releases and other waste management quantities of chemicals listed on the EPCRA Section 313 list of toxic chemicals must be reported for certain facilities in covered industry sectors if they manufacture, process, or otherwise use more than established threshold quantities of these chemicals.

In 2016, no releases resulting from SNL/TTR operations were reported above the threshold requiring a TRI report.

2.5.2 Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act, enacted in 1910 and amended in 1972, regulates pesticide use. Chemical pesticides used at SNL/TTR include herbicides, rodenticides, and insecticides, as needed. All these chemicals are EPA approved and are applied in accordance with applicable label guidelines and regulations. Records of the quantities and types of pesticides

that are used as well as Safety Data Sheets for each pesticide are retained. There were no violations of the Federal Insecticide, Fungicide, and Rodenticide Act in 2016.

2.5.3 Toxic Substances Control Act

The Toxic Substances Control Act (TSCA), enacted in 1976 and later amended, provides regulations regarding the manufacture, processing, distribution, use, and disposal of specific chemical substances and/or mixtures. At SNL/TTR, compliance with TSCA primarily involves management of asbestos and polychlorinated biphenyls (PCBs). The provisions of TSCA apply based on the concentrations above a specific level. Accordingly, an electrical transformer with a concentration of PCBs greater than or equal to 500 ppm is considered a PCB transformer; a transformer with concentrations that contain between 50 ppm and 499 ppm are considered PCB-contaminated transformers.

In 1993, sampling was performed on SNL/TTR transformers to determine whether PCBs were present (IT 1993). All samples contained less than 50 ppm of PCBs. During 2015, the U.S. Air Force (USAF) assumed all responsibility for maintaining the Tonopah Test Range High Voltage Power Transmission Facilities. In December 2015, all known high-voltage transformers in the SNL/TTR transformer storage yard inventory were transferred to the USAF and moved to their facilities. In November 2016, nine transformers that had been staged pending transfer for reapplication were moved to the transformer storage yard where they will remain until their final disposition is determined. These transformers are tagged and do not contain any PCBs.

Asbestos-containing materials at SNL/TTR were identified in a comprehensive 1993 Asbestos Site Survey, which is available on the SNL/TTR server. The survey is updated periodically when new information (such as sample results or abatement activities) is available. All asbestos-related activities are conducted in accordance with applicable regulatory requirements.

2.6 Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and amended in 1986, also known as the "Superfund," defines assessment activities and reporting requirements for inactive waste sites at federal facilities. As required by CERCLA, a Preliminary Assessment was submitted in 1988 for all facilities listed on the federal agency hazardous waste compliance docket. Sites with significant contamination were put on the National Priorities List for cleanup (EPA 2013). There are no National Priorities List, or "Superfund," sites located at SNL/TTR. SARA Title III amended CERCLA requirements for reportable quantity releases and chemical inventory reporting.

2.7 Cultural and Natural Resources

Cultural and natural resources are protected at SNL/TTR.

2.7.1 Cultural Resources Acts

Cultural resources management responsibilities are applicable to activities at SNL/TTR. These include, but are not limited to, compliance with the following laws and their implementing regulations:

- National Historic Preservation Act, enacted in 1966 and amended in 2000
- American Indian Religious Freedom Act, enacted in 1978 and amended in 1994
- Archaeological Resources Protection Act, enacted in 1979 and amended in 1988

At SNL/TTR, National Environmental Policy Act (NEPA) Program personnel coordinate cultural resources compliance. Actions that could adversely affect cultural resources are analyzed initially in a NEPA checklist review. DOE/NNSA/SFO is responsible for ensuring that impacts to cultural resources are assessed and appropriate actions are taken to mitigate impacts. In 2016, no operations generated impact on cultural resources at SNL/TTR.

Historic Building Assessment

In 2011, DOE/NNSA/SFO completed consultation with the Nevada State Historic Preservation Office (SHPO), reaching an agreement on 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/NNSA/SFO provided the Nevada SHPO with samples of the documentation created to mitigate the effect of future demolition of properties within the SNL/TTR Historic District. The Nevada SHPO reviewed the sample documentation and agreed with its suitability. In 2016, DOE/NNSA/SFO met with the Nevada SHPO to finalize details of a memorandum of agreement covering the historic district and mitigative efforts for future demolition and renovation at the site. Negotiation is ongoing.

Once the memorandum of agreement is signed, the Historic American Buildings Survey/ Historic American Engineering Record Western Region office will provide instructions on the format for the final report on the SNL/TTR Historic District. SNL personnel will then produce the report.

Archaeological Survey

In 2014, preparatory to the proposed installation of a fiber-optic cable line to improve communications at SNL/TTR, an archaeological survey of the affected area was undertaken. In 2015, DOE/NNSA/SFO engaged in consultation with the Nevada SHPO regarding the results of the survey and necessary actions to avoid or mitigate the impact on archaeological sites within SNL/TTR. In 2016, the fiber-optic cable line was completed with no effect on any archaeological sites; a cut through Mellan Airfield was repaired per planning and agreement with the Nevada SHPO.

Old times at Tonopah Test Range

2.7.2 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (U.S. Code [USC] 668-668d), enacted in 1940, prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions. At SNL/TTR, Ecology Program personnel coordinate compliance with this act. This act is a major component of the SNL/TTR avian protection plan.

2.7.3 Endangered Species Act

The Endangered Species Act of 1973, amended in 1982, applies to both private individuals and federal agencies. Federal agencies must ensure that any action authorized, funded, or carried out by them will not jeopardize the continued existence of a threatened or endangered species, or result in adverse modifications of its habitat. At SNL/TTR, NEPA Program and Ecology Program personnel address Endangered Species Act compliance. If potentially significant impacts to sensitive species or habitats are found as a result of a proposed action, an environmental assessment or an environmental impact statement must be prepared.

2.7.4 Fish and Wildlife Coordination Act

The Fish and Wildlife Conservation Act (Public Law [PL] 96-366), enacted in 1980, and the Lacey Act Amendments (PL 97-79), enacted in 1981, were established so that wildlife will receive equal consideration with other natural resources in regard to maintenance of the ecosystem. Relevancy toward an ecological program is stated in 16 USC 661; the purpose is: "(1) to provide assistance to, and cooperate with, Federal, State, and public or private agencies and organizations in the development, protection, rearing, and stocking of all species . . .; (2) to make surveys and investigations of the wildlife public domain." Ecology Program personnel consider Fish and Wildlife Conservation Act compliance when evaluating NEPA checklists.

2.7.5 Floodplain Management

As amended, EO 11988 of 1977, *Floodplain Management*, requires federal agencies to consider impacts associated with the occupancy and modification of floodplains; reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains. There are no floodplains or significant wetlands at SNL/TTR; however, some very limited wetlands exist in the vicinity of several springs. These provide an important source of drinking water for wildlife in the area.

2.7.6 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"

The purpose of the Memorandum of Understanding between the U.S. Department of Energy and the U.S. Fish and Wildlife Service [FWS] Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds," signed in 2013, is to strengthen migratory bird conservation through enhanced collaboration between DOE and the FWS, in coordination with state, tribal, and local governments. This Memorandum of Understanding identifies specific areas in which cooperation between DOE and the FWS will substantially contribute to the conservation and management of migratory birds and their habitats. At SNL/TTR, Ecology Program personnel coordinate responsibilities under this Memorandum of Understanding with requirement of the Migratory Bird Treaty Act (MBTA) through NEPA reviews.

2.7.7 Migratory Bird Treaty Act

The MBTA of 1918 (and amendments) 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. At SNL/TTR, the MBTA is coordinated through NEPA reviews and the Ecology Program.

2.7.8 Planning for Federal Sustainability in the Next Decade

Issued in March 2015, EO 11988 establishes an integrated strategy toward sustainability to safeguard the health of our environment and make the reduction of greenhouse gas emissions and enhanced climate resilience a priority for all federal agencies. EO 13693 sets goals in the areas of promoting sustainable buildings, increasing renewable energy, reducing water use, promoting electronics stewardship through sustainable acquisition, preventing pollution, and reducing solid waste. Sustainability-related data for SNL/TTR was reported to the Site Sustainability Plan team for submittal to DOE/NNSA/SFO.

2.7.9 Protection of Wetlands

As amended, EO 11990 of 1977, *Protection of Wetlands*, requires federal agencies to minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands. There are no floodplains or significant wetlands at SNL/TTR; however, some very limited wetlands exist in the vicinity of several springs. These provide an important source of drinking water for wildlife in the area.

2.7.10 Sikes Act

The 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. The Sikes Act protects and enhances fish, wildlife, and other natural resources that exist on and are associated with military lands in the U.S. Ecology Program personnel consider Sikes Act compliance when evaluating NEPA checklists.

Joshua tree (*Yucca brevifolia*)

2.7.11 Wild Free-Roaming Horses and Burros Act

The Wild Free-Roaming Horses and Burros Act (PL 92-195), enacted in 1971, and amendments 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. The Bureau of Land Management's Las Vegas District is responsible for management of wild horses at TTR.

2.8 Hazardous Waste

Hazardous waste at SNL/TTR is handled and managed in compliance with the following requirements.

2.8.1 Federal Facility Agreement and Consent Order

The Federal Facility Agreement and Consent Order (FFACO) is an ongoing action with the State of Nevada that started in 1996. This agreement was implemented in May 1996 between the State of Nevada, DOE, and the U.S. Department of Defense (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 FFACO is an enforceable agreement with stipulated penalties for violations. The Environmental Restoration sites subject to the FFACO for which DOE has assumed responsibility are:

- 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)

A summary of DOE/NNSA's Environmental Restoration sites in Nevada can be found in the FFACO document (DoD, DOE, and State of Nevada 1996). The list of sites has been modified for consistency with NDEP requirements and grouped into Corrective Action Units (CAUs), which are listed by Corrective Action Site (CAS) numbers. Each CAU and CAS is listed in the FFACO in the following appendices:

- Appendix II, "Corrective Action Sites/Units" (includes inactive CAUs and CASs)
- Appendix III, "Corrective Action Investigations/Corrective Actions" (includes active CAUs and CASs)
- Appendix IV, "Closed Corrective Action Units" (lists CAUs and CASs where corrective actions are complete)

The FFACO is updated every six months. A discussion of Environmental Restoration sites located at SNL/TTR is provided in Chapter 3.

2.8.2 Federal Facility Compliance Act

The Federal Facility Compliance Act of 1992 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. Extended storage at DOE facilities is typically associated with mixed wastes (wastes that have hazardous and radioactive components) that have been generated on-site. Since SNL/TTR operations do not generate mixed waste and there is currently no mixed waste stored on-site, these requirements are not applicable to operations at SNL/TTR.

2.8.3 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA), enacted in 1976, and the Nevada Revised Statutes regulate the generation, transportation, treatment, storage, and disposal of hazardous chemical waste and nonhazardous solid wastes. Applicable regulations, including Nevada implementing regulation, are listed in the References section ("State of Nevada Environmental Regulations").

SNL/TTR operations usually generate a small quantity of hazardous waste through normal operations each month, which classifies the site for small-quantity generator status requirements. (See Chapter 3 for a summary of hazardous waste management activities during 2016.) During the 2015 Nevada Division of Environmental Protection (NDEP) hazardous waste audit, it was discovered that SNL/TTR was listed incorrectly as a large-quantity generator in the State's records. The NDEP auditor recommended that SNL personnel submit an EPA 8700-12 form to NDEP in order to change SNL/TTR back to small-quantity generator status. SNL personnel submitted the EPA form to NDEP in February 2016, and confirmation of SNL/TTR status as small-quantity generator was received from NDEP on March 7, 2016. Effective October 26, 2011, 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.

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

Under the small-quantity generator designation, hazardous waste can only be stored on-site for 180 days before it must be shipped off-site for treatment and disposal at an EPA-permitted facility. SNL/TTR hazardous waste shipments are scheduled to occur at least two to three times a year (as needed).

Sanitary solid waste, which is also regulated under RCRA, 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. In January 2014, Lunas Recycling in Las Vegas, Nevada, was contracted to recycle tires generated at SNL/TTR. Lunas Recycling accepts all tire sizes that SNL/TTR is currently using (including loader tires). The Lunas Recycling contract was the only SNL/TTR recycling contract in effect in 2016.

The National Environmental Policy act requires federal agencies to consider environmental issues during project planning and decision making.

2.9 National Environmental Policy Act

NEPA of 1969 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. Proposed actions that would not significantly impact the human environment are categorically excludable from additional NEPA documentation (as identified in DOE 10 CFR 1021, *National Environmental Policy Act Implementing Procedures*). Other proposed actions may fit within a class of actions that have environmentally significant impacts associated with them. For this class of proposed actions, the agency must prepare an environmental assessment or an environmental impact statement before making an irretrievable commitment of resources or funding. Although a major NEPA objective is to preserve the environment for future generations, the law does not require an agency to choose a course of action with the least environmental impacts. At SNL/TTR, DOE/NNSA/SFO coordinates NEPA compliance with personnel from SNL/NM and SNL/TTR. NEPA activities are discussed in Chapter 3.

2.10 Nevada State Regulations

The State of Nevada administers most environmental regulations applicable to SNL/TTR (Table 2-2). Specific state regulations (State of Nevada Environmental Regulations) include those governing air quality, solid and hazardous waste management, wildlife, water quality, and radiation control. The EPA administers radionuclide air emissions directly.

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

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

NOTES: The Nevada Administrative Code is accessed through https://www.leg.state.nv.us/NAC/CHAPTERS.HTML. The Nevada Revised Statute is accessed through https://www.leg.state.nv.us/NRS/.

NAC = Nevada Administrative Code
NRS = Nevada Revised Statute
PCB = polychlorinated biphenyl
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

2.11 Pollution Prevention and Waste Minimization

Pollution prevention concepts first appeared in RCRA. An expressed concern was to minimize the generation of hazardous waste through process substitution, materials recovery, recycling, reuse, and treatment. RCRA established the reduction or elimination of hazardous waste as national policy, and required that hazardous waste generators and RCRA permit holders have a program in place to minimize waste. As required, waste generation and recycling information is reported annually to DOE through the Site Sustainability Plan.

2.11.1 Pollution Prevention Goals of Site Sustainability Plan

The Site Sustainability Plan establishes a commitment to meet pollution prevention goals identified in DOE's Strategic Sustainability Performance Plan and EO 13693, *Planning for Federal Sustainability in the Next Decade*. Pollution prevention and waste minimization data are reported in the Site Sustainability Plan. Additional information about pollution prevention activities is provided in Chapter 3.

2.11.2 Pollution Prevention Act

The Pollution Prevention Act of 1990 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. See Section 2.5.1 for additional information on EPCRA reporting requirements.

2.12 Radiation Protection and the Atomic Energy Act

The purpose of the Atomic Energy Act of 1946 is to assure the proper management of source, special nuclear, and byproduct materials (42 USC § 2011 et seq.). The DOE sets radiation protection standards and retains authority for radionuclides through Department directives and CFRs. Operations at SNL/TTR are subject to the DOE requirements established in DOE O 435.1 Change 1, *Radioactive Waste Management*, DOE O 458.1 Admin Change 3, *Radiation Protection of the Public and the Environment*, and 10 CFR 835, *Occupational Radiation Protection.*

2.12.1 Atomic Energy Act

The purpose of the Atomic Energy Act of 1946 is to assure the proper management of source, special nuclear, and byproduct materials (42 USC § 2011 et seq.). The DOE sets radiation protection standards and retains authority for radionuclides through Department directives. Operations at SNL/TTR are subject to the requirements established in DOE O 435.1 Change 1, *Radioactive Waste Management*, and DOE O 458.1 Admin Change 3, *Radiation Protection of the Public and the Environment*.

The radiation protection standards are set for DOE operations so that radiation exposures to members of the public and the environment are as low as reasonably achievable and are maintained within established limits. DOE O 458.1 limits the total annual effective dose equivalent of all potential exposure pathways to the public (including air, water, and the food chain) to 100 mrem/yr. Pathway guidelines are as follows:

- **Water pathways.** DOE drinking water guidelines are based on an annual effective dose equivalent not to exceed 4 mrem/yr. DOE O 458.1 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. 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. See Chapter 3 for information about the public water system at SNL/TTR.
- **Air pathways.** DOE facilities are required to comply with EPA standards for radiation protection as given in NESHAP Subpart H, specific to radionuclides emitted from DOE facilities (with the exception of radon). This rule mandates that air emissions from DOE facilities shall not cause any individual of the public to receive an effective dose equivalent of greater than 10 mrem/yr from air pathways. At SNL/TTR, the only current pathway for potential exposure is through air (see Chapter 3 for details).

In addition to requirements in DOE 458.1, DOE O 435.1 also 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 (see Chapter 3 for details).

The control and clearance of real and personal property with residual radioactivity is specified in DOE O 458.1. 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 DOE O 458.1 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. In 2016, Radiation Protection Department personnel did not process any personal property clearance surveys (including trackable property).

Sandia National Laboratories manages radioactive waste in a manner that protects workers, the public, and the environment.

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.

Excess property with residual radioactivity above the limits 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.

A summary of 2016 property clearance activities includes the following:

- Radiation Protection personnel did not process any personal property clearance surveys.
- No trackable property was cleared.
- No metals subject to the moratorium or the suspension were cleared.
- No real property was cleared.

Protection of biota, as specified in DOE O 458.1, ensures 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. 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. See Chapter 3 for Terrestrial Surveillance Program activities.

2.13 Water Quality and Protection

SNL/TTR operations are subject to the requirements of the Clean Water Act and corresponding Nevada requirements.

2.13.1 Clean Water Act

The Clean Water Act (CWA) of 1972 and amendments establishes a permitting structure and regulatory direction to protect the "waters of the United States" by restoring and maintaining the chemical, physical, and biological integrity of U.S. waters; protecting fish, wildlife and recreation;

and reducing pollutant discharges. The Energy Independence and Security Act of 2007, Section 438 of the CWA, requires federal agencies to manage stormwater runoff from federal development projects for the protection of water resources. At SNL/TTR, the CWA applies to sanitary and septic system wastewater effluents, stormwater runoff, and surface water discharges.

2.13.2 Wastewater

SNL/TTR wastewater discharges are controlled by NDEP, which administers regulations relevant to water pollution and sanitary waste systems. Wastewater that enters the sanitary sewer system is treated in the USAF TTR sewage lagoons. The USAF operates these lagoons under a National Pollution Discharge Elimination System (NPDES) permit issued by NDEP. Five SNL septic tank systems (the newest of which is inactive) are in remote areas at SNL/TTR, which are used for domestic sanitary sewage collection only. Three of the tanks are located in areas now controlled by the USAF (Station 36, the Firing Range, and the Main Gate). The only septic tank being used by SNL personnel at this time is located at Building 24-01. Additional information can be found in Chapter 3.

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

Stormwater

The issuance of an NPDES stormwater permit is generally based on whether or not stormwater runoff is discharged to "waters of the U.S." 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. New construction activities that exceed one acre of soil disturbance require permitting under the Construction General Permit. On October 9, 2014, SNL/TTR personnel submitted a Notice of Intent to operate under Nevada Stormwater Construction Permit NVR100000 for a project titled "Tonopah Test Range Fiber Optic Cable Installation." A Stormwater Pollution Prevention Plan for Construction Activities was developed for this project and will be maintained until a Notice of Termination is submitted to NDEP. On March 24, 2015, SNL/TTR personnel submitted a Notice of Intent to operate under Nevada Stormwater Construction Permit NVR100000 for a project titled "Tonopah Test Range (TTR) Test Unit Recovery Operations." A similar Stormwater Pollution Prevention Plan for Construction Activities was developed for this project and will be maintained until a Notice of Termination is submitted to NDEP.

Johnson's fishhook cactus (*Echinomastus johnsonii*)

2.13.3 Safe Drinking Water Act

SNL/TTR meets standards for drinking water as defined in the Safe Drinking Water Act of 1974 and amendments and NDEP public water supply and public water system regulations. Production

Well 6 normally provides all drinking water for the Area 3 compound. SNL/TTR operates under permits issued by NDEP (one for the public water system and one for the arsenic treatment system). The USAF public water system and the SNL/TTR public water system are designed such that they can, on an as-needed basis, provide backup drinking water to each other. The USAF public water system provided drinking water to the SNL/TTR Area 3 compound for several months during 2016 while the SNL/TTR elevated water storage tower underwent maintenance for corrosion control. Monitoring activities are discussed in Chapter 3. The NDEP Bureau of Safe Drinking Water characterizes this public water system as a non-transient non-community system.

2.13.4 Oil Pollution Act

As required under the Oil Pollution Act of 1990 (§ 311) (and codified in 40 CFR 112, *Oil Pollution Prevention*), SNL maintains and implements a Spill Prevention, Control, and Countermeasure plan that describes oil handling operations, spill prevention practices, discharge or drainage controls, and the personnel, equipment, and resources that are used to prevent oil spills from reaching waters of the U.S. Bulk oil storage containers and oil-filled operational equipment with a capacity of 55 gal or more are subject to EPA regulations 40 CFR 112 and 40 CFR 110, *Discharge of Oil*. See Chapter 3 for more information.

2.14 Department of Energy Directives

DOE directives in the Management and Operating Contract for SNL define the primary contractual obligations for management and operating of SNL/TTR. Directives that pertain to environmental protection and management are discussed in Chapter 1. In 2016, the management and operating contractor for SNL adhered to all requirements stated in these DOE directives.

2.15 Audits, Appraisals, and Inspections in 2016

Environmental programs at SNL/TTR are routinely subjected to audits, appraisals, and/or inspections by external agencies (Table 2-3). The summaries in Table 2-3 include the number of findings, notices of violation, and other environmental occurrences. The SNL 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 2-3. Environmental-related external audits, appraisals, inspections, and violations, 2016

Appraising Agency	Title	Date	Summary
Nevada Division of Environmental Protection	Resource Conservation and Recovery Act Hazardous Waste Compliance Inspection	March 2016	No findings or discrepancies
Nevada Division of Environmental Protection, Bureau of Air Quality	Compliance audit of the TTR Class II Air Quality Permit	May 2016	No findings or discrepancies

Note: TTR = Tonopah Test Range

2.16 Summary of Environmental Permits

Environmental compliance permits for SNL/TTR include those for hazardous materials storage, public water supply, stormwater, RCRA, and air quality. The State of Nevada issues permits for these SNL/TTR activities directly to DOE/NNSA/SFO, and Navarro Research and Engineering administers them on behalf of the management and operating contractor for SNL.

SNL and Navarro Research and Engineering personnel ensure that all permit conditions are met. Table 2-4 lists all permits and registrations in effect at SNL/TTR in 2016.

Table 2-4. SNL/TTR permits, 2016

Permit Type and Location	Permit Number	Issue Date	Expiration Date	Comments
Air Quality				
Class II Air Quality Operation Permit	AP 8733-0680.03, FIN A0025	August 2011 (amended with corrections October 2011 and administratively amended to update Surface Area Disturbance Conditions/Fugitive Dust Control Plan 2014)	July 23, 2016 (permit application submitted to NDEP May 2016 and renewal pending NDEP approval)	• Portable screen • Welding operation • Carpenter area • Paint booth • Generators (nine systems) • Surface area disturbance (< 5 acres)
Hazardous Waste (RCRA)				
Hazardous Waste Generator	NV1890011991[a]	January 7, 1993	Indefinite	State of Nevada
Hazardous Waste (Nevada State Fire Marshal)				
Hazardous Materials Permit	FDID Number: 13007 Permit Number: 48316	March 2016	February 29, 2017	State of Nevada
Stormwater Construction (SWPPP)				
Fiber-Optic Cable Installation	DOE Number CSW-40066 SNL Number CSW-39893	October 16, 2014	Renew by July 1, 2017, until Notice of Termination is submitted	State of Nevada
TTR Test Unit Recovery Operations	DOE Number CSW-41616 SNL Number CSW-41615	March 24, 2016	Renew by July 1, 2017, until Notice of Termination is submitted	State of Nevada
Production Well (Drinking Water)				
Production Well 6	NY-3014-12NTNC[b]	September 6, 2016	September 30, 2017	State of Nevada
Permit to Operate a Treatment Plant	NY-3014-TP11-12NTNC	September 6, 2016	September 30, 2017	State of Nevada
PWS Improvement Project: Repairs to 200,000 Gallon Elevated Water Storage Vessel	(NY-5602-16)A	July 20, 2016	October 25, 2016	State of Nevada
Temporary Ground Water Discharge Permit (Chlorinated Water)	TNS-42332	August 24, 2016	September 22, 2016	State of Nevada

See notes at end of table.

Table 2-4. SNL/TTR permits, 2016 (continued)

Permit Type and Location	Permit Number	Issue Date	Expiration Date	Comments
Production Well (Drinking Water) (continued)				
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 NRS § 540.131

NOTES: [a]Generator identification number (not a permit number).
[b]The State of Nevada Bureau of Health Protection Services renews the permit for Production Well 6 (NV-3014-12NTNC) annually.
AP = air permit
DOE = U.S. Department of Energy
FDID = Fire Department Identification
FIN = facility identification number
NDEP = Nevada Division of Environmental Protection
NRS = Nevada Revised Statute
NTNC = non-transient non-community
NV = Nevada
PWS = public water system
RCRA = Resource Conservation and Recovery Act
SNL = Sandia National Laboratories
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
SWPPP = Stormwater Pollution Prevention Plan
TTR = Tonopah Test Range

2.17 Occurrences and Release Reporting

Under DOE O 232.2 Admin Change 1, the current order for occurrence reporting, an *occurrence* is defined as "one or more (i.e., recurring) events or conditions that adversely affect, or may adversely affect, DOE (including NNSA) 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." There are environmental releases that may not meet DOE O 232.2 reporting thresholds; however, they may still be reportable to outside agencies. There were no DOE O 232.2 reportable occurrences at SNL/TTR in 2016.

On May 10, 2016, there was an environmental release of approximately 50 gal of chlorinated (80–100 ppm chlorine) water to the ground. The plumbing in Building 03-57 was being disinfected after an extensive renovation; when flushing the chlorinated water from the system after the allotted hold time, it was discovered that the water was discharged directly to the ground through the rainwater drain pipe on the east side of the building. DOE/NNSA/SFO contacted the Nevada State Spill Hotline, and Nevada personnel determined that the release was not a reportable event. The building's plumbing system was connected to the sanitary sewage system correctly before being brought online again.

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Chapter 3. SNL/TTR Environmental Programs

Great Basin fritillary (*Speyeria egleis*)

OVERVIEW ■ Sandia National Laboratories takes the responsibility of protecting the environment seriously. Numerous programs monitor the air, water, and soil at SNL/TTR to help prevent pollution and conserve natural resources.

Sandia National Laboratories (SNL) personnel conduct terrestrial, water, and air monitoring as part of environmental programs at SNL, Tonopah Test Range (SNL/TTR), Nevada. These programs comply with federal, state, and local requirements.

3.1 Environmental Programs

Environmental programs personnel collect environmental data at Tonopah Test Range (TTR), Nevada, to determine and report the impact of existing SNL operations on the environment. Environmental programs include monitoring and surveilling air, water, and soil. The environmental program activities at SNL/TTR meet or exceed federal, state, and local environmental requirements, as well as U.S. Department of Energy (DOE) directives in the SNL Prime Contract. Presidential Executive Orders and DOE guidance documents are also used to establish program criteria.

The following environmental programs and focus areas are presented in this chapter:

- Air Quality Compliance Program
- Environmental Restoration (ER) Project
- National Environmental Policy Act (NEPA) Program
- Oil Storage Program
- Terrestrial Surveillance Program
- Waste Management Program
- Water quality programs

3.2 Air Quality Compliance Program

SNL/TTR operations do not involve activities that release radioactive emissions from either point sources (stacks and vents) or diffuse sources, such as outdoor testing. However, diffuse radiological emissions are produced from the resuspension of americium and plutonium, which are present at the Clean Slate ER sites. Other ER sites with minor radiological contamination, such as depleted uranium, do not produce significant air emission sources from resuspension.

3.2.1 National Emission Standards for Hazardous Air Pollutants

The Radiological National Emission Standards for Hazardous Air Pollutants (NESHAP) Program ensures that SNL programs are in compliance with radiological NESHAP requirements. The EPA regulates radionuclide air emissions in accordance with 40 Code of Federal Regulations (CFR) 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities." The U.S. Environmental Protection Agency (EPA) has set a maximally exposed individual (MEI) radiological dose limit of 10 mrem/yr resulting from all radiological air emissions produced from a DOE facility. Per 40 CFR 61 Subpart H, each DOE/National Nuclear Security Administration (NNSA) site where facility sources contribute a public radiological dose of over 0.1 mrem/yr is required to submit an annual report. The report includes the calculated effective dose equivalent (EDE) in millirems per year for the MEI (SNL/NM 2017).

The 1996 Radiological NESHAP report for SNL/TTR described a calculated EDE to the MEI of 1.1 mrem/yr as a result of diffuse emissions from the Clean Slate sites (SNL/NM 1997a). Because the EPA requires continuous air monitoring for any radionuclide source that contributes a dose in excess of 0.1 mrem/yr to the MEI, continuous air monitoring was instituted at a sampling site for one year from February 22, 1996, to February 25, 1997. The monitoring site was at the SNL/TTR airport, the location of the highest calculated dose for a member of the public. This site selection is discussed in the 1996 NESHAP report (SNL/NM 1997b). The dose assessment result from the continuous monitoring was 0.024 mrem/yr (Table 3-1). This was approximately four times less than the 0.1 mrem/yr threshold cutoff for which continuous monitoring would be required by the EPA. The average air concentrations are provided in Table 3-2.

Table 3-1. SNL/TTR calculated dose assessment results for on-site receptor, 1996–1997

Dose to Receptor	Location	1997 Measured Dose[a]	EPA and DOE Dose Limit for Air Pathway	Natural Background
On-site receptor (EDE to the MEI)	Airport area	0.024 mrem/yr	10 mrem/yr	350 mrem/yr[b]

NOTES: [a]Dose was calculated from continuous monitoring from February 1996 to February 1997.
[b]Natural background is estimated at 350 mrem/yr nationwide.
DOE = U. S. Department of Energy
EDE = effective dose equivalent
EPA = U. S. Environmental Protection Agency
MEI = maximally exposed individual
NESHAP = National Emission Standards for Hazardous Air Pollutants
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Table 3-2. SNL/TTR average air concentration

Radionuclide	Average (Ci/m^3)
Americium-241	4.1×10^{-18}
Plutonium-238	1.6×10^{-18}
Plutonium-239/240	9.5×10^{-19}

NOTE: SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Although an annual calculated dose assessment is not required for the site, SNL personnel continue to produce an annual Radiological NESHAP report for SNL/TTR (SNL/NM 2017). The results from the 1996 to 1997 monitoring will continue to be used; however, if new sources or modifications to the existing sources are anticipated, they will be evaluated for applicability with radiological NESHAP guidelines.

3.2.2 Nonradiological Air Emissions

The Class II Air Quality Operating Permit for SNL/TTR requires emission reports from significant nonradionuclide sources. At SNL/TTR, these sources include a portable screen, generators, and maintenance shop activities. Maintenance shop activities at SNL/TTR included painting, welding, and carpentry. In 2016, there were emissions from the portable screen, the generators, and activities at the maintenance shop. The portable screen was operated for 46.5 hours during 2016, and contributed 0.003 tons of particulate matter emissions. Four generators operated in 2016 are part of the Class II Air Quality Operating Permit and are permitted to operate up to 500 hours per year. The first generator is 670 hp, was operated for 4.5 hours, and contributed 0.05 tons of combined emissions (nitrogen oxide, carbon monoxide, sulphur oxide, particulate matter with diameter equal to or less than 10 microns [PM_{10}], volatile organic compounds [VOCs], and hazardous air pollutants [HAPs]). The second generator is 268 hp, was operated for 50.2 hours, and contributed 0.4 tons of combined emissions (nitrogen oxide, carbon monoxide, sulphur oxide, PM_{10}, VOCs, and HAPs). The third generator is 268 hp, was operated for 1.3 hours, and contributed 0.01 tons of combined emissions (nitrogen oxide, carbon monoxide, sulphur oxide, PM_{10}, VOCs, and HAPs). The fourth generator is 134 hp, was operated for 4.7 hours, and contributed 0.01 tons of combined emissions (nitrogen oxide, carbon monoxide, sulphur oxide, PM_{10}, VOCs, and HAPs). The maintenance shop activities (painting, welding, and woodworking) contributed 0.004 tons of emissions (particulate matter, VOCs, and HAPs). The actual emissions for all of these sources were well within the permit limits.

3.2.3 Other Air Quality Monitoring Activities at SNL/TTR

In addition to SNL 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 (CEMP) to collect samples from off-site air-monitoring equipment set up at 23 locations within communities surrounding the Nevada National Security Site (NNSS). 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 equipment and sends collected samples to Test America Laboratories in St. Louis, Missouri, for analysis and reporting of gross alpha and gross beta activity of individual filters, and for gamma spectroscopy on quarterly composite samples from each station. Stations also record real-time gamma readings measured in a pressurized ion chamber, and an environmental thermoluminescent dosimeter is analyzed quarterly to confirm gamma readings.

DRI provides external quality assurance on samples collected at CEMP stations through duplicate sampling of 10 percent of the station samples. Duplicate samples are analyzed by the

University of Nevada, Las Vegas's radioanalytical laboratory. Data collected at CEMP stations are reported in the NNSS Annual Site Environmental Report.

Three DRI portable monitoring stations are in use at SNL/TTR, and they are modeled in part after the CEMP stations. Station 400 is located near the SNL/TTR Range Operations Center, Station 401 is located near Clean Slate 3, and Station 402 is located near Clean Slate 1 (see Chapter 1 for details on these monitoring stations).

DRI also performs other monitoring as requested by DOE, such as archeological surveys. No cultural resource surveys were performed at SNL/TTR at the request of DOE or SNL personnel in 2016.

3.3 Environmental Restoration Project

ER Project activities at SNL/TTR and the Nevada Test and Training Range (NTTR) were initiated in 1980 to address contamination resulting primarily from nuclear weapons testing and related support activities. DOE/NNSA/Nevada Field Office (NFO) is responsible for all SNL/TTR and NTTR ER sites.

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

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

The FFACO took effect in 1996 and accomplished the following:

- Established a framework for identifying Corrective Action Sites (CASs)
- Grouped CASs into Corrective Action Units (CAUs)
- Prioritized CAUs
- Implemented corrective action activities

Two ER activities are addressed by CAUs located at SNL/TTR and NTTR:

- **Industrial sites activity.** Activity at sites historically used to support nuclear testing and SNL activities. Industrial sites include historical septic tank systems, landfills, sewage lagoons, depleted uranium sites, and ordnance testing sites.
- **Soil activity.** Activity 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.

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

Corrective Action Site Identification

The initial identification, description, and listing of CASs at SNL/TTR and NTTR was derived from the Preliminary Assessment and the Federal Facility Preliminary Assessment Review (E&E 1989). Twelve additional potential CASs, not included in the Preliminary Assessment, were identified using the following methods: ER site inventory processes, ordnance removal activities,

geophysical surveys, former worker interviews, archive reviews, site visits, and aerial radiological and multispectral surveys (1993–1996).

The remediation activities at the Clean Slate and Double Tracks sites (Operation Roller Coaster) located at SNL/TTR are discussed in Chapter 1. These sites are listed under soil CAUs/CASs in Table 3-3 as CAUs 411, 412, 413, and 414. One additional site still subject to further activities, Project 57 (located on Nellis Range 13), is listed under soil CAUs in Table 3-3 as CAU 415. CAU 541, Small Boy (located on NTTR), was closed in 2016. A listing of closed CAUs/CASs is available in appendices II, III, and IV of the FFACO (DoD, DOE, and State of Nevada 1996).

Table 3-3. SNL/TTR status of CAU remediation activities, 2016

Soil Site CAUs/CASs		
CAS Number	**CAS Description**	**General Location**
CAU 411— *Closed*. Double Tracks plutonium dispersion (NAFR)		
NAFR-23-01	Pu contaminated soil	Nellis Range 71
CAU 412— *Closed.* Clean Slate 1 plutonium dispersion (SNL/TTR)		
TA-23-01CS	Pu contaminated soil	Tonopah Test Range
CAU 413—*Investigation phase.* Clean Slate 2 plutonium dispersion (SNL/TTR)		
TA-23-02CS	Pu contaminated soil	Tonopah Test Range
CAU 414— *Investigation Phase.* Clean Slate 3 plutonium dispersion (SNL/TTR)		
TA-23-03CS	Pu contaminated soil	Tonopah Test Range
CAU 415—*Remediation phase.* Project 57 No. 1 plutonium dispersion (NTTR)		
NAFR-23-02	Pu contaminated soil	Nellis Range 13
CAU 541—*Closed.* Small Boy		
05-23-04	Atmospheric tests (six), BFa[a] site	BFa, NTTR
05-45-03	Atmospheric test site, Small Boy	Frenchman Flat, Area 5, NTTR

NOTES: A listing of closed CAU/CASs is available in appendices II, III, and IV of the FFACO (DOD, DOE, and State of Nevada 1996).

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

Environmental Restoration Project Activities in 2016

ER activities in 2016 included characterizing, packaging, and shipping approximately 480 cubic feet of low-level waste from Clean Slate 1, Clean Slate 2, and Clean Slate 3 to NNSS. This waste was generated during site investigation activities and interim corrective actions. Approximately 140 cubic feet of waste was characterized, packaged, and shipped from Project 57 (CAU 415) during corrective action activities. DOE/NNSA/NFO manages all waste generated from ER activities. Final approval of closure from Nevada Division of Environmental Protection (NDEP) was received for Double Tracks (CAU 411), Clean Slate 1 (CAU 412), and the Small Boy Site (CAU 541).

Other ER activities conducted on the SNL/TTR and NTTR sites in 2016 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 in May 2016.

Air samples were also collected throughout the year at various locations on SNL/TTR and NTTR. (Details of air sample collection activities are provided in Chapter 1.)

3.4 National Environmental Policy Act Program

At SNL/TTR, NEPA compliance is coordinated between personnel from SNL/TTR, SNL, New Mexico (SNL/NM), and the DOE/NNSA/Sandia Field Office (SFO).

Personnel from SNL/TTR and the SNL/NM NEPA team continued to support projects at SNL/TTR, including Environment, Safety, and Health organization preparations for the next series of B61-12 flight tests. This support included continued collaboration with personnel from DOE/NNSA/SFO, SNL/TTR, SNL/NM, and Los Alamos National Laboratory.

In 2016, the SNL/NM NEPA team completed seven NEPA checklists for SNL/TTR, five of which were transmitted to DOE/NNSA/SFO for review and completion. In addition, four SNL/TTR NEPA checklists created in 2016 are still in progress and are being actively managed by the SNL/NM NEPA team.

Old settlement at Tonopah Test Range

3.5 Oil Storage Program

The *Spill Prevention Control and Countermeasures (SPCC) Plan for SNL Tonopah Test Range* (SNL/NM 2014b) pertains to oil storage equipment and secondary containments subject to 40 CFR 112, *Oil Pollution Prevention*, and 40 CFR 110, *Discharge of Oil*. The SPCC Plan must be updated at least every five years.

In 2016, there were 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. Inspections were conducted monthly, per the SPCC Plan. Any issues identified during the inspections are corrected promptly or are tracked via the work request process.

The following SPCC-related items occurred during 2016:

- In 2015, the U.S. Air Force (USAF) assumed responsibility for all high-voltage power distribution work at TTR. In January 2016, all the electrical transformers located in the TTR Area 3 transformer storage yard containment were transferred to the USAF. In November 2016, nine transformers that had been staged pending transfer for reapplication were moved to the transformer storage yard where they will remain until their final disposition is determined.
- A portable generator and its associated 500 gal aboveground storage tank located at Building 24-05 were removed from service in October 2016.
- In a continuing effort to prevent oil spills at TTR, concrete secondary containments for mobile remote generators were poured at 10 new remote sensing system stations.

3.6 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 thermoluminescent dosimeters (TLDs). 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 TLDs are 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.

3.6.1 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 the SNL Environmental Management System, which is certified to the International Organization for Standardization 14001 standard. Reporting is done in accordance with DOE O 231.1B, Admin Change 1, *Environment, Safety and Health Reporting.*

3.6.2 Sample Locations and Media

Three sample location classifications are used: 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 TLDs are used to measure the cumulative ambient external radiation dose and to closely approximate the dose potentially received from natural and nonnatural sources.

The on-site sample locations (Table 3-4, Figure 3-1) are in areas of known contamination CASs and areas of potential release (sites with current outdoor testing activities).

Perimeter sample locations (Table 3-5, Figure 3-2) are located around the boundaries of SNL/TTR. Off-site sample locations (Table 3-6, Figure 3-3) are located in remote areas and 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 not sampled in 2016 (the next sampling will be in 2018).

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

Surveillance Location	Location Number	Sample Location	Soil[a]	TLD[b]
Range Operations Center	S-40	Wastewater monitoring station	X[c]	
	S-41	"Danger Powerline Crossing" sign	X[c]	
	S-42	Main Road/Edward's Freeway	X[c]	
	S-43	Range Operation Center (southwest corner)	X[c]	
	S-44	Range Operation Center (northeast corner)	X[c]	
	S-45	Storage shelters 03-38 and 03-39	X[c]	
	S-46	Sand Building	X[c]	
	S-47	Generator storage area	X[c]	
South Plume Area	S-48	North/south Mellan Airstrip–Antelope Tuff	X[d]	
	S-49	North/south Mellan Airstrip–southwest of S-48	X[d]	
	S-50	North/south Mellan Airstrip–signpost	X[d]	
	S-51	North/south Mellan Airstrip–northeast of S-50	X[d]	
	S-52	Northeast of northwest/southeast Mellan Airstrip	X[d]	
Various on-site	S-01	Antelope Lake area fence, cultural area sign	X[d]	X
	S-02	North/south Mellan Airstrip (south fencepost)	X[d]	X
	S-03	TLD at Clean Slate 2	X[d]	X
	S-04	TLD at Clean Slate 3	X[d]	X
	S-09	Roller Coaster Decontamination Area	X[d]	X
	S-10	Brownes Road/Denton Freeway	X[d]	X
	S-13	Area 3 between Building 100 and "Caution" sign		X
	S-14	Area 3 control point southwest side of fence		X
	S-15	Moody Avenue by cattle guard and entrance to chow hall and airport		X
	S-16	Area 9, near Well 7		X
	S-17	Main Lake–south, near Neutron Bunkers		X
	S-38	Mellan Hill–Rock Mound/Orange Block	X[d]	
	S-39	Mellan Hill–north	X[d]	
	S-53	Main Road/Lake Road southeast	X[d]	

NOTES: [a]Soil samples are analyzed for radionuclides by gamma spectroscopy annually.
[b]TLDs are analyzed for gamma radiation.
[c]Soil samples are analyzed for Target Analyte List metals every five years (last sampled in 2013).
[d]Soil samples are analyzed for Target Analyte List metals annually.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TLD = thermoluminescent dosimeter

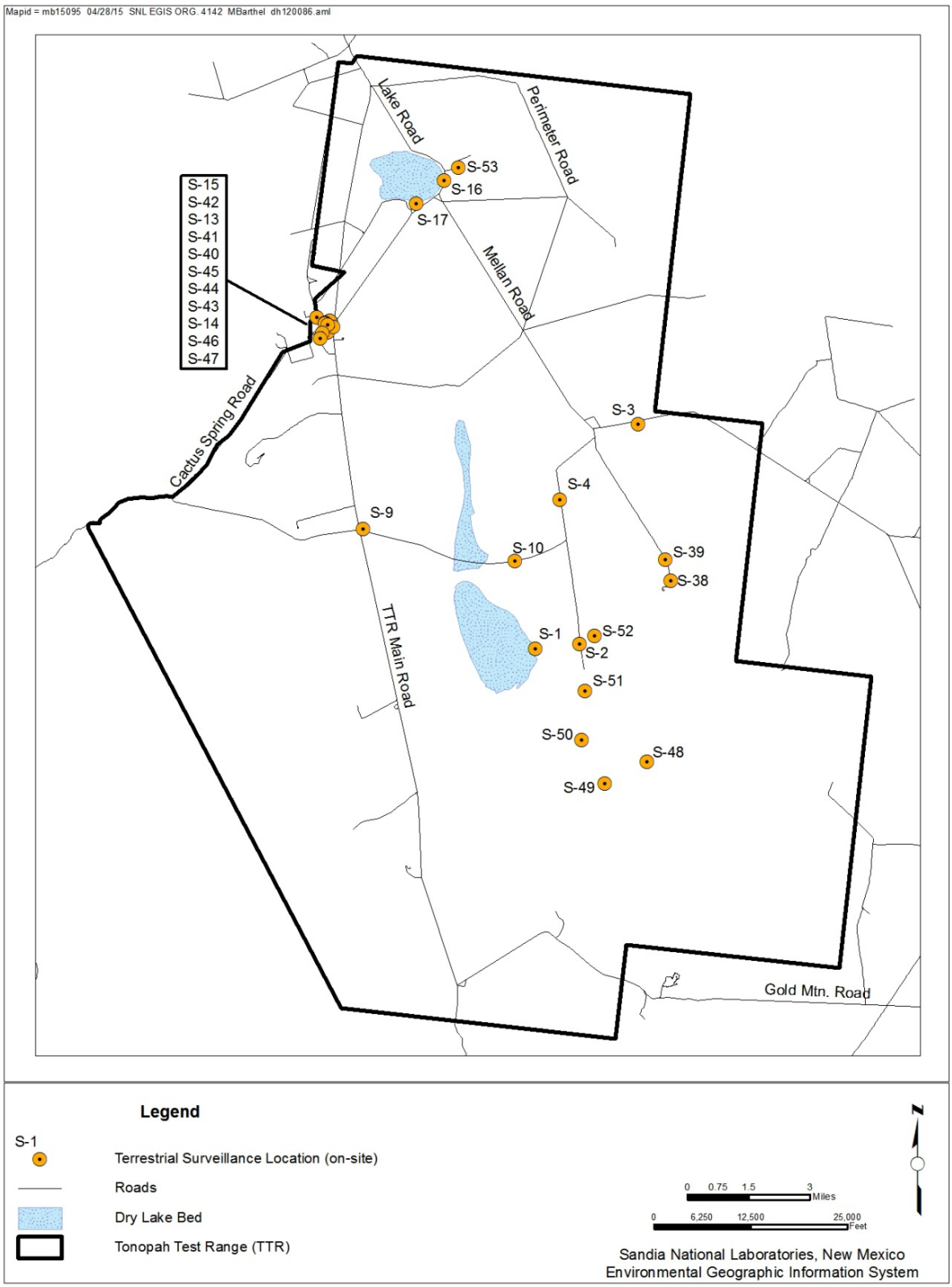

Figure 3-1. SNL/TTR on-site terrestrial surveillance locations

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

Surveillance Location	Location Number	Sample Location	Soil[a,b]	TLD[c]
Perimeter	P-05	O&M 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 (TLD south of P-35)	X	X
	P-12	TLD at "U.S. Government Property" sign	X	X
	P-34	O&M 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	

NOTES: [a]Soil samples are analyzed for radionuclides by gamma spectroscopy annually.
[b]Soil samples are analyzed for Target Analyte List metals every five years (last sampled in 2013).
[c]TLDs are analyzed for gamma radiation.
O&M = Operation and Maintenance
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TLD = thermoluminescent dosimeter

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

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

NOTES: [a]Off-site samples were previously called "community" samples, thus the *C* label in the location number (maintained for the database).
[b]Soil samples are analyzed for radionuclides by gamma spectroscopy annually.
[c]Soil samples are analyzed for Target Analyte List metals every five years (last sampled in 2013).
[d]TLDs are analyzed for gamma radiation.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
TLD = thermoluminescent dosimeter

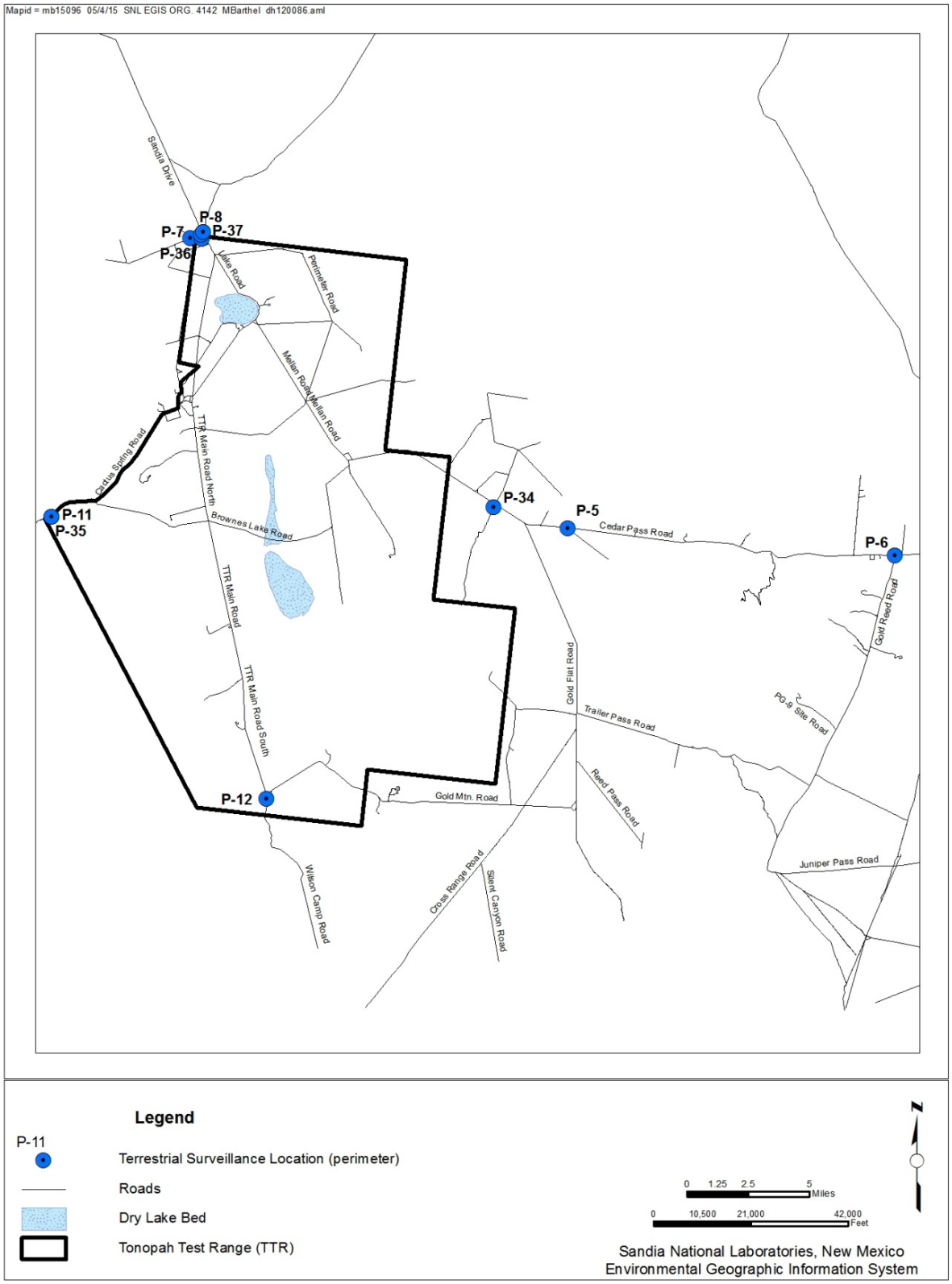

Figure 3-2. SNL/TTR perimeter terrestrial surveillance locations

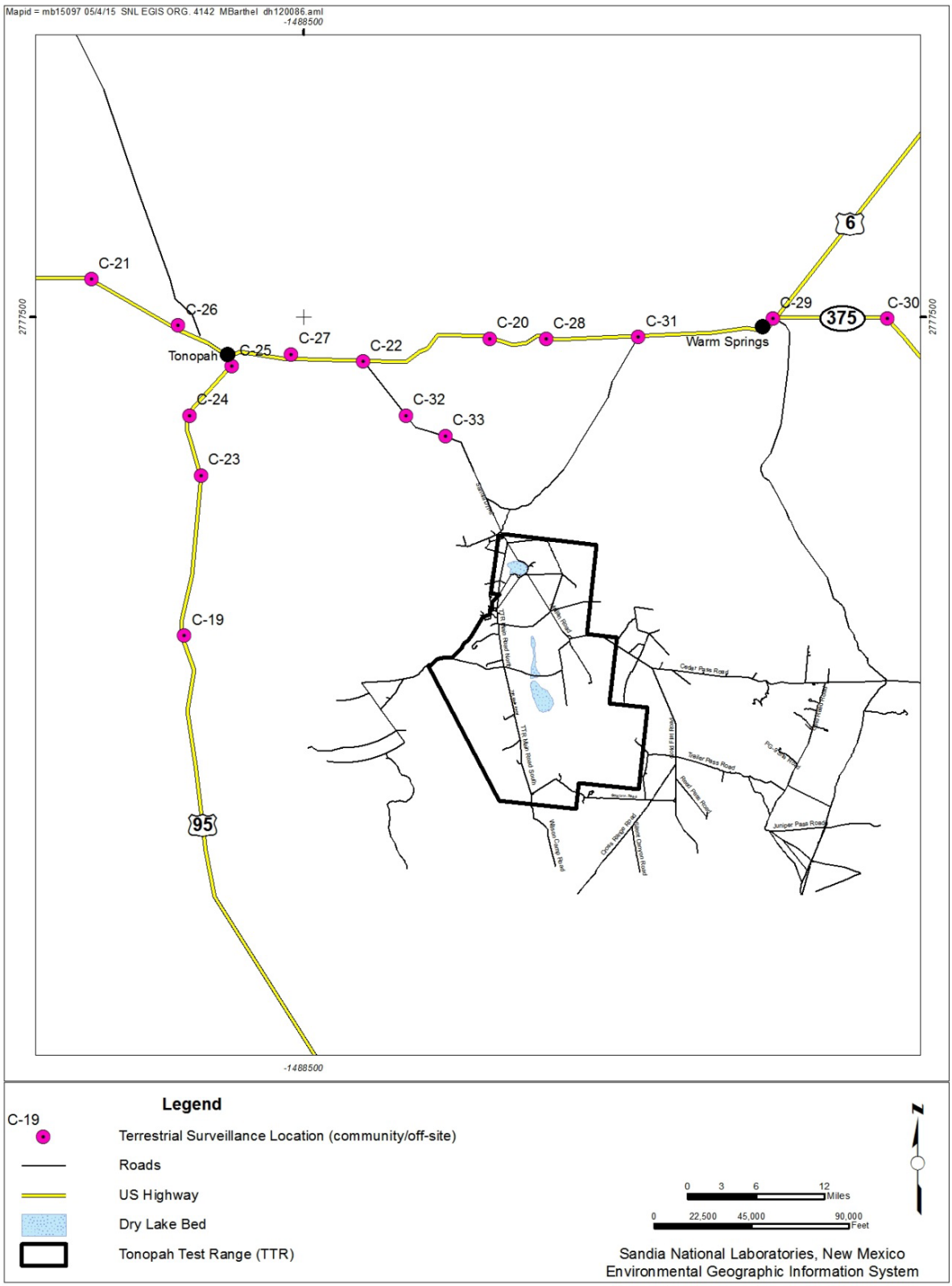

Figure 3-3. SNL/TTR off-site terrestrial surveillance locations

3.6.3 Field Methods, Analytical Parameters, and Quality Control Procedures

All SNL/TTR samples were collected in accordance with applicable SNL/NM 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 Administrative Operation Procedure 00-03, *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 pollutant 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).

The Radiation Protection Dosimetry Program at SNL/NM issues and processes environmental TLDs. The TLD network was established to determine the regional gamma exposure rate due to natural sources and to determine the impact, if any, of operations on those exposure rates. The technical basis for the environmental TLD monitoring program is provided in *Description and Procedures of the Environmental Radiation Dosimetry Program* (SNL/NM 1987). Dosimeters are issued and processed quarterly following established Radiation Protection Dosimetry Program protocols.

Indian paintbrush (*Castilleja ssp.*) at SNL/TTR

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.

3.6.4 Sample Result Analysis and Methodology

No regulatory limits are available to directly compare concentrations of radiological or nonradiological constituents in surface soils. Statistical analyses are conducted to compare the results from on-site and perimeter samples to off-site results, and to establish trends that may indicate the possible release of contaminants.

Statistical Analysis and Methodology

Samples are collected from specified locations to effectively enable 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 results of the statistical analyses are used to prioritize 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. The decision matrix is shown in Table 3-7.

Table 3-7. SNL/TTR priority decision matrix and actions

Priority[a]	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.

NOTES: [a]Based on a statistical analysis prioritization methodology (Shyr, Herrera, and Haaker 1998).
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Other Standards for Comparison

In addition to the statistical analysis, sample results for metals in soil and sediment 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 2016)
- 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 TLD data is compared to the annual radiation dose from natural sources estimated equivalent of 70 mrem (NCRP 2009). No regulatory limits are available to directly compare concentrations of radiological or nonradiological constituents in surface soils.

Table 3-8. SNL/TTR various reference values for metals in soil (all units in mg/kg)

Analyte	Nevada Soil Concentrations[a]		EPA Risk-Based Screening Levels[b]		U.S. Soil Concentrations[c]	
	Lower Limit	Upper Limit	Residential Soil	Industrial Soil	Lower Limit	Upper Limit
Aluminum	5,000	100,000	77,000	1,100,000	4,500	100,000
Antimony	< 1.0	1.0	31	470	0.25	0.6
Arsenic	2.9	24	0.687	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	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	50	1,500	22,000	5	150
Potassium	1,900	63,000	—	—	—	—
Selenium	< 0.1	1.1	390	5,800	0.1	4
Silver	0.5	5	390	5,800	0.2	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
Vanadium	30	150	390	5,800	0.7	98
Zinc	25	128	23,000	350,000	13	300

NOTES: [a]Dragun and Chekiri 2005.
[b]EPA Risk-Based Screening Levels (Target Hazard Quotient = 1.0), EPA, updated May 2016.
[c]Kabata-Pendias 2000.
— = not available
EPA = U.S. Environmental Protection Agency
ND = not detected
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

3.6.5 Summary of Terrestrial Surveillance Program Activities and Results in 2016

The following Terrestrial Surveillance Program activities occurred in 2016:

- The annual sampling of soil at on-site locations occurred in June 2016 at designated locations.
- Environmental TLDs were exchanged and analyzed at designated locations quarterly.

The analytical results for radiological (including environmental TLDs) and nonradiological parameters for the 2016 sampling event are summarized in the following subsections, and the data are provided in Appendix A, "2016 SNL/TTR Terrestrial Surveillance Results."

Radiological Results

The summary statistics for radiological results for 2000 through 2016 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, 2000–2016

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	140	0.022	0.022	0.055	-0.24 U	0.15 U
	On-site	355	0.314	0.054	1.10	-0.23 U	11
	Off-site	242	0.025	0.025	0.046	-0.20 U	0.16 U
Cesium-137	Perimeter	140	0.20	0.16	0.15	0.012	0.89
	On-site	366	0.24	0.22	0.18	0.0 U	1.49
	Off-site	242	0.20	0.16	0.15	-0.0017 U	0.93
Plutonium-238	Perimeter	17	0.0042	0.0028	0.0076	-0.0056	0.03
	On-site	115	0.16	0.018	0.84	-0.010	8.43
	Off-site	34	0.0028	0.00094	0.0054	-0.0037	0.02
Plutonium-239/240	Perimeter	17	0.021	0.016	0.017	0.0014	0.07
	On-site	115	15	0.51	113	-0.0082	1200 J
	Off-site	34	0.014	0.011	0.013	-0.0011	0.05
Plutonium-242	On-site	5	3.51	3.49	0.032	3.49	3.56
Uranium-235	Perimeter	140	0.076	0.071	0.054	-0.059	0.25
	On-site	366	0.087	0.079	0.062	-0.071 BD	0.39
	Off-site	242	0.084	0.077	0.059	-0.10 BD	0.29
Uranium-238	Perimeter	140	1.25	1.27	0.51	0.0029	2.65
	On-site	365	1.31	1.26	0.51	0.032	3.13
	Off-site	238	1.27	1.21	0.51	0.14	3.09 J
Analyte	**Location Classification**	**Number of Samples**	**Mean (mg/kg)**	**Median (mg/kg)**	**Standard Deviation (mg/kg)**	**Minimum (mg/kg)**	**Maximum (mg/kg)**
Uranium, total	Perimeter	72	0.71	0.69	0.18	0.43	1.49
	On-site	274	0.72	0.71	0.15	0.43	1.51
	Off-site	126	0.75	0.69	0.20	0.46	1.55

NOTES: BD = below detection limit as used in radiochemistry to identify results that are not statistically different from zero
J = the associated numerical value is an estimated quantity
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

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 3.4 pCi/g. There was one on-site location (S-09 soil) identified as Priority-2 for americium-241 with a value of 1.25 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. Historical results for americium-241 at S-51 are presented in Figure 3-4.

No locations were identified as Priority-3 for americium-241.

Table 3-10. SNL/TTR radiological summary statistics for Priority-1, Priority-2, and Priority-3 soil sample locations, 2016

Priority	Analyte	Location	Units	Mean	Median	SD	Minimum	Maximum	2016 Result
Priority-1	Americium-241	S-51	pCi/g	3.6	3.9	3.3	-0.0095	11	3.4
Priority-2	Americium-241	S-09	pCi/g	1.7	1.3	1.1	0.47	3.6	1.25
Priority-2	Plutonium-239/240	S-09	pCi/g	85	4.9	298	2.0 J	1,200 J	8.46
Priority-3	Plutonium-239/240	S-49	pCi/g	1.3	0.59	1.57	0.11	5.76 J-	5.76 J-
Priority-3	Uranium, total	S-38	mg/kg	0.64	0.63	0.11	0.51	0.86	0.70

NOTES: J = the associated numerical value is an estimate
J- = the associated numerical value is an estimated quantity with a suspected negative bias
SD = standard deviation
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Plutonium-239/240

The results of the statistical analysis for plutonium-239/240 identified one Priority-2 on-site location (S-09 soil) with a result of 8.46 pCi/g.

The result for S-09 is consistent with historical values. This is related to the elevated americium-241 results discussed previously. Sampling and trend analysis will continue for plutonium-239/240 (and americium-241) at S-51 and S-09. Historical results for plutonium-239/240 at S-51 are presented in Figure 3-4. The 2016 result for plutonium-239/240 was qualified as rejected during the data validation process due to not meeting criteria for the replicate error ratio. Therefore, the 2016 plutonium-239/240 result at S-51 is not plotted on Figure 3-4.

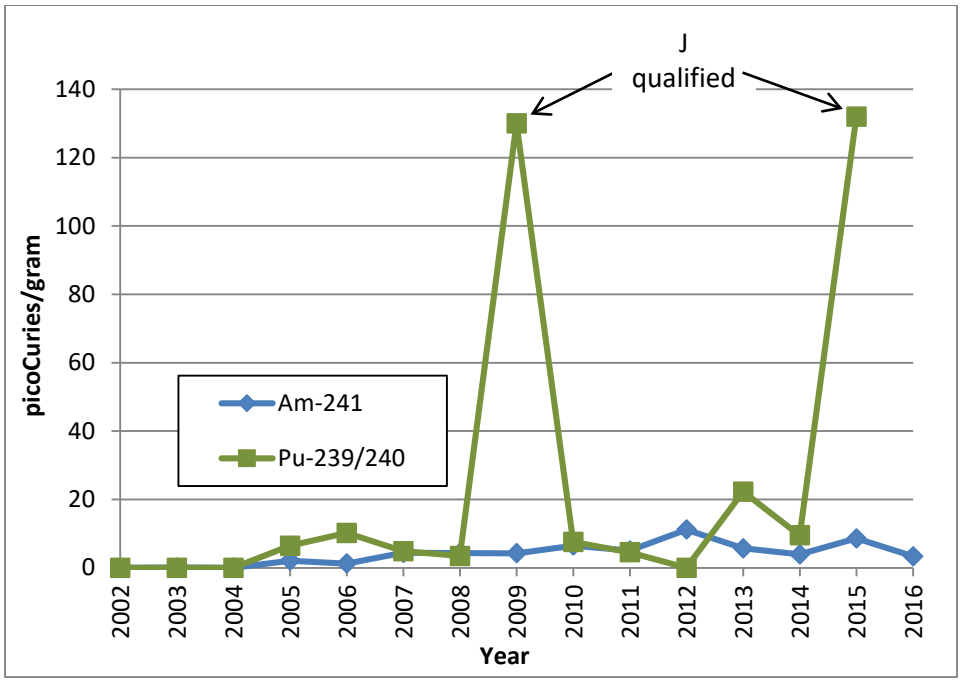

Figure 3-4. SNL/TTR historical americium-241 and plutonium-239/240 at sampling location S-51 (2016 plutonium-239/240 not plotted, see text)

One-site location (S-49 soil) was identified as a Priority-3 with a result of 5.76 J- pCi/g. The J- qualified data is an estimated quantity.

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 0.07 mg/kg. The result was within the range of values for uranium, total, as shown in Table 3-9.

Thermoluminescent Dosimeter Statistical Results

TLDs were deployed, collected, and analyzed at SNL/TTR on a quarterly basis in 2016. TLD summary statistics for fiscal year (FY) 2001–2016 are provided in Figure 3-5 and Table 3-11. The results for on-site and perimeter locations were statistically different, with higher values, from the off-site locations.

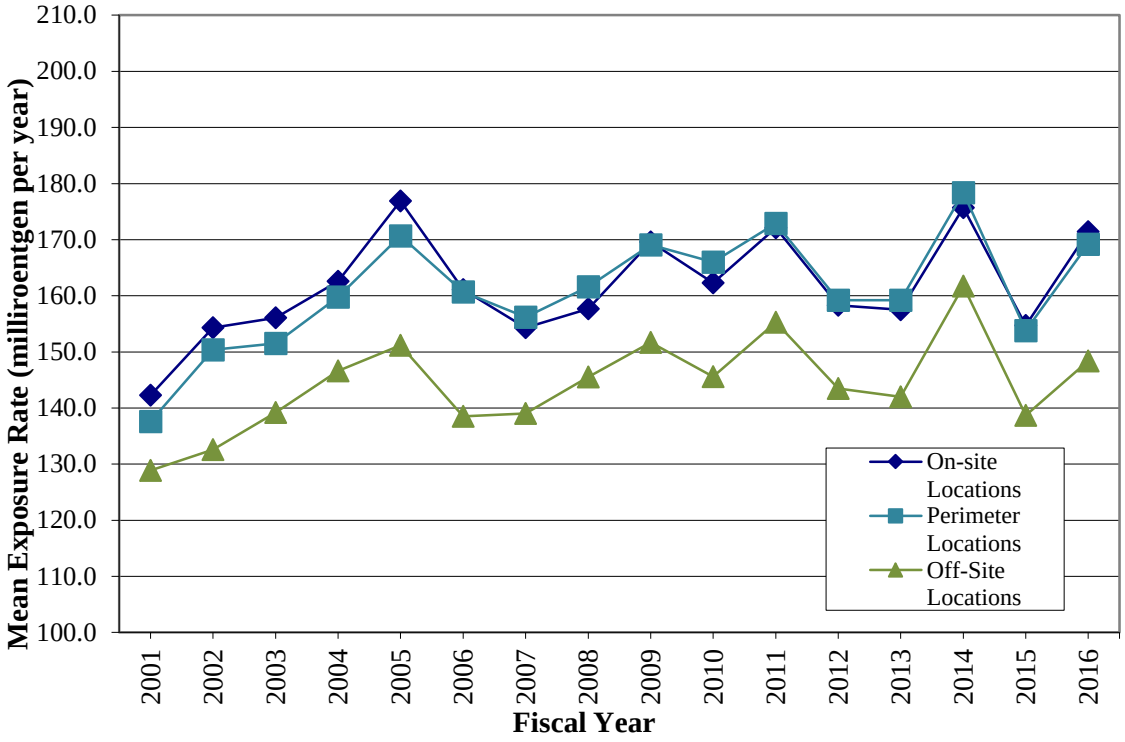

Figure 3-5. SNL/TTR TLD exposure rates by year and location classification

Table 3-11. SNL/TTR TLD exposure rate summary statistics by location classification, 2001–2016

Location Classification	Number of Observations	Mean mR/yr	Median mR/yr	Standard Deviation mR/yr	Minimum mR/yr	Maximum mR/yr	2016[a] Result mR/yr
On-site	164	160	160	14	130	219	171
Perimeter	89	162	158	16	131	208	169
Off-site	47	144	147	16	116	174	148

NOTES: [a]TLD data is reported on a fiscal year basis.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range TLD = thermoluminescent dosimeter

Although not apparent in Figure 3-5, there was an increase in average annual dose for all three location classifications between FY 2015 and FY 2016. This was due to an update made by the SNL Radiation Protection Dosimetry Program in the dose calculation causing the dose results to increase by 15 percent.

Nonradiological Parameters and Results

Nonradiological parameters include modified Target Analyte List metals. In addition to the statistical analysis, all results may also be compared to values from the references listed in Section 3.6.4 and provided in Table 3-8.

In 2016, soil samples were collected at the locations listed in Table 3-4, Table 3-5, and Table 3-6. Thirteen locations were sampled for metals analysis; other locations are only sampled for metals every five years and were not sampled in 2016 (the next sampling will be in 2018). The results of the statistical analyses for metals are provided in Table 3-12.

Table 3-12. SNL/TTR metals summary statistics for Priority-3 sample locations, 2016

Priority	Analyte	Location	Sample Matrix	Mean (mg/kg)	Median (mg/kg)	Standard Deviation (pCi/g)	Minimum (pCi/g)	Maximum (pCi/g)	2016 Result (mg/kg)
Priority-3	Cadmium	S-03	Soil	0.17	0.21	0.06	0.04	0.23	0.22

NOTE: SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Cadmium

One on-site location (S-03 soil) was identified as Priority-3 for cadmium, with a result of 0.22mg/kg. The result was within the range of values for cadmium in Nevada soils, as shown in Table 3-8.

No other locations were identified as Priority-1, Priority-2, or Priority-3 for any of the Target Analyte List metals.

Additional Activities and Variances

There were no other Terrestrial Surveillance Program activities at SNL/TTR in 2016. There were no variances from the planned activities.

3.7 Waste Management Program

Navarro Research and Engineering manages all waste generated at SNL/TTR—which excludes any waste generated by ER activities—under the Waste Management Program. Waste categories include radioactive waste, Resource Conservation and Recovery Act 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 2016 is presented in Table 3-13 and Table 3-14. All regulated waste was shipped off-site to permitted treatment, storage, and disposal facilities.

Table 3-13. SNL/TTR waste generated, 2016

Waste Type	Weight (kg)	Weight (lb)
Total RCRA hazardous waste	645	1,419
Total non-RCRA-regulated waste	353	777
Total recycled materials	3,101	6,823
Toxic Substances Control Act waste (PCB)	16	35.2
Toxic Substances Control Act waste (asbestos)	1,268	2,790
Radioactive waste	0	0

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

Table 3-14. SNL/TTR waste shipped, 2016

Waste Type/Facility	Weight (kg)	Weight (lb)
Sanitary landfill (USAF Sanitary Landfill)	18,873	41,520
Construction debris (USAF Construction Landfill)	174,920	384,824
Tires (Lunas Tire Recycling)	0	0
Battery recycling (National Automotive Parts Association and Veolia)	1,480[a]	3,257
Hydrocarbon contaminate waste (Veolia)	228[b]	502

NOTES: [a]This total is also included in the "Total recycled materials" total located in Table 3-13.
[b]This total is also included in the "Total non-RCRA-regulated waste" total located in Table 3-13.
SNL/TTR = Sandia National Laboratories, Tonopah Test Range
USAF = U.S. Air Force

Waste Minimization Program

SNL/TTR is 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:

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

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 2016 are presented in Table 3-15.

Table 3-15. SNL/TTR material recycled or energy-recovered and shipped off-site, 2016

Recycled or Energy-Recovered Waste	Shipped (kg)	Shipped (lb)
Automotive type batteries	1,480	3,257
Universal waste batteries	202	444
Universal waste lamps	199	438
Mercury-containing articles	0	0
Non-PCB light ballasts	233	513
Antifreeze	0	0
Used oil[a]	987	2,171
Used oil filters	0	0
Tires	0	0
Total	**3,101**	**6,823**

NOTES: [a]One thousand gallons of used oil was sent for recycle to Safety Kleen from a vault tank.
PCB = polychlorinated biphenyl
SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Radioactive Waste Management

There were no radioactive waste shipments in 2016.

3.8 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.

3.8.1 Production Well Monitoring

SNL/TTR personnel use three active wells: Production Well 6 (Figure 3-6), 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 (PWS) well that supplies drinking water to the SNL/TTR Main Compound in Area 3. 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.

Figure 3-6. SNL/TTR Production Well 6 pump house provides Area 3 drinking water

All PWS drinking water sampling is conducted in accordance with requirements set by NDEP. Analytes are sampled at different intervals, as shown in Table 3-16. NDEP currently provides public monitoring and reporting requirements for each PWS around March annually. The

PWS at SNL/TTR is permitted by NDEP as a Non-Transient, Non-Community Water system under identification number NV003014. Production Well 6 supplies potable water for the SNL/TTR Area 3 Drinking Water Distribution System and the Area 3 Fire Protection Water Distribution System. The well water is routinely sampled and analyzed per NDEP requirements to demonstrate conformance with primary drinking water standards.

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

https://ndep.nv.gov/BSDW/

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, color, 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) *also known as* Bis(2-ethylhexyl) phthalate	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

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

There is also an NDEP-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.

Summary of Production Well Monitoring Activities and Results in 2016

In 2016, no SNL/TTR PWS Drinking Water Public Notice warnings were issued, and all sample results were below the maximum contaminant levels established for the substances monitored.

Four compliance arsenic samples were collected in 2016. All samples contained 4 ppb arsenic or less. The maximum contaminant level for arsenic in drinking water is 10 ppb as a running annual average. The running annual average for arsenic in the drinking water at SNL/TTR during 2016 was 2.64 ppb.

During 2016, Production Well 6 produced 749,000 gal of water that was chlorinated and sent to the elevated water storage tower. This equals an average monthly production of approximately 62,400 gal during 2016. Daily production during 2016 averaged approximately 2,052 gal. Usage was higher than normal because the tank (200,000 gal) had to be drained once to perform maintenance on it.

Also during 2016, approximately 355,600 gal of water was treated in the PWS Treatment Plant (identification number NV003014-TP11) to remove arsenic (Figure 3-7) before being sent to the drinking water distribution system. This equates to a monthly average of approximately 29,600 gal and a daily consumption rate of 987 gal.

A total of 280 lb of carbon dioxide (Figure 3-8) was used during 2016 for pH adjustment (23.4 lb per month, or 0.77 lb per day on average).

Figure 3-7. SNL/TTR water treatment facility arsenic removal system

Figure 3-8. SNL/TTR water treatment facility carbon dioxide pH adjustment system

3.8.2 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).

3.8.3 Sewage System and Septic Tank Monitoring

Wastewater discharges from SNL/TTR activities conducted at facilities in the Main Compound at Area 3 go to the USAF facultative sewage lagoon for treatment. As a best management practice, either SNL or Navarro Research and Engineering personnel take annual wastewater samples from Area 3 at the point where wastewater leaves SNL/TTR property and enters the USAF system.

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, SNL personnel provided quarterly sampling results to the USAF for inclusion into their USAF Discharge Monitoring Report; however, the National Pollutant Discharge Elimination System permit was modified in 1997. Quarterly data is no longer required; therefore, SNL personnel now only provide annual wastewater sampling results. These systems are sampled as a best management practice and do not require sampling per the NDEP. During 2016, 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:

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

The analytical results for wastewater sampled at Area 3 are provided in Appendix B, "2016 SNL/TTR Wastewater Sampling Results."

Septic tank systems are sampled as needed. DOE/NNSA 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). These septic tank systems are used in remote locations and are maintained by the SNL/TTR Facilities group. The sewage from these locations flows into septic tank systems and associated drain fields. None of these systems required maintenance, sampling, or pumping in 2016. All other remaining septic tank systems have been closed or are undergoing closure and are being addressed by the ER Project.

3.8.4 Stormwater Sampling

Currently, stormwater sampling is not required at SNL/TTR.

Chapter 4. SNL/TTR Ecology Program

Western Fence Lizard (*Sceloporus occidentalis*)

OVERVIEW ■ Sandia National Laboratories management takes the responsibility of protecting the environment seriously. Numerous programs monitor the air, water, and soil at SNL/TTR to help prevent pollution and conserve natural resources.

At Sandia National Laboratories, Tonopah Test Range (SNL/TTR), 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/TTR. These are primarily bird surveys conducted in late spring to measure diversity and abundance. As part of the Avian Protection Plan for the Tonopah Test Range, utility poles associated with SNL/TTR projects are also surveyed for any potential risks to birds that may roost or nest on the poles.

Data collected include information on species diversity, abundance, and land-use patterns. The data are used to support National Environmental Policy Act 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 ft at the valley floor to 7,482 ft 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 (BLM) and the U.S. Forest Service (USFS). The land is currently used to graze cattle. There is a substantial irrigated farming operation north of the

range. To the east of SNL/TTR is the Nevada Wild Horse Range, which is administered by BLM (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 on the basis of 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 (vegetation height of less than or equal to 0.5 m), and is typified by shadscale (*Atriplex confertilfolia*), budscale (*Artemisia spinescens*), winter fat (*Krasheninnikovia lanata*), and Indian ricegrass (*Achnatherum hymenoides*). Intermediate elevation slopes are dominated by Great Basin mixed desert scrub, and the shrub cover tends to be taller (greater than or equal to 0.5 m) with some grassland characterized by various species of horsebrush (*Tetradymia spp.*), rabbitbrush (*Chrysothamnus vicidiflorus* and *Ericameria nauseosa*), hopsage (*Grayia spinosa*), shadscale (*Atriplex confertilfolia*), and budsage (*Artemisia spinescens*). 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 (1/2 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. 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 U.S. Department of Energy (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.

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

4.1.2 Wildlife

The wildlife that is known to occur at SNL/TTR is fairly typical of the Great Basin biogeographic province. With the exception of the Roller Coaster Construction Pond, there are no 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.

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

From the valley floor, going up in elevation, the vegetation changes to include Joshua trees and junipers, and the bird diversity increases. Common birds in this zone include: Loggerhead Shrike (*Lanius ludovicianus*), Mourning Dove (*Zenaida macroura*), Black-throated Sparrow (*Amphispiza*

bilineata), Scott's Orioles (*Icterus spurius*), 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 (*Corvus corax*) 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, and should the playas have water, ducks, geese, and water birds can be found at these playas as well as 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 deciduous trees and wetland obligate vegetation and attract 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, Vermillion 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 wisilenii*), and Great Basin Rattlesnake (*Crotalus viridis luteosus*). Mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), desert bighorn (*Ovis canadensis*), mountain lion (*Puma concolor*), and feral horses (*Equus ferus*), also known as: wild horse or mustang, 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/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.

Pronghorn (*Antilocapra americana*)

Common medium-sized mammals found within the SNL/TTR area include the following: coyote (*Canis latrans*), American badger (*Taxisdea 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*), whitetail 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 Department of Defense 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: long-legged myotis (*Myotis volans*), fringe-tailed myotis (*M. thysanodes*), California myotis (*M. californicus*), canyon bat (*Parastrellus hespereus*), Townsend's big-eared bat (*Plecotus townsendii*), and pallid bat (*Antrozous pallidus*).

4.2 Federal and State, Threatened, Endangered 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 on the Nevada Test and Training Range is the desert tortoise (*Gopherus agassazii*) (USAF 1997). Table 4-1 is a list of federally protected species under the Endangered Species Act 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/succulents, such as cottontop cactus (*Echinocactus polycephalus*), spinystar/beehive cactus (*Escobaria vivipara*), and branched pencil cholla (*Cylindropuntia ramosissima*). Table 4-1 also includes those species that may potentially occur in Nye County and those species that have been observed at SNL/TTR.

Table 4-1. Federal and state threatened and endangered species and other State of Nevada protected species potentially occurring in Nye County

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
Plants				
Amargosa niterwort	*Nitrophila mohavensis*	Endangered	Endangered	
armored hedgehog cactus	*Echinocereus engelmannii var. armatus*	—	Protected	
Ash Meadows blazingstar	*Mentzelia leucophylla*	Threatened	Endangered	
Ash Meadows gumplant	*Grindelia fraxinopratensis*	Threatened	Endangered	
Ash Meadows milkvetch	*Astragalus phoenix*	Threatened	Endangered	
Ash Meadows mousetails	*Ivesia kingii var. eremica*	Threatened	Endangered	
Ash Meadows sunray	*Enceliopsis nudicaulis var. corrugata*	Threatened	Endangered	
Blaine pincushion	*Sclerocactus blainei*	—	Protected	
branched pencil cholla	*Cylindropuntia ramosissima*	—	Protected	✓

See notes at end of table.

Table 4-1. Federal and state threatened and endangered species and other State of Nevada protected species potentially occurring in Nye County (continued)

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
Plants (continued)				
Clokey pincushion	*Coryphantha vivipara var. rosea*	—	Protected	
cottontop cactus	*Echinocactus polycephalus*	—	Protected	✓
Eastwood milkweed	*Asclepias eastwoodiana*	—	Protected	✓
Joshua tree	*Yucca brevifolia*	—	Protected	✓
Mojave barrel cactus	*Ferocactus cylindraceus var. lecontei*	—	Protected	
mountain cactus	*Pediocactus simpsonii*	—	Protected	
Nye pincushion cactus	*Sclerocactus nyensis*	—	Protected	
old-man pricly-pear	*Opuntia erinacea*	—	Protected	✓
pineapple cactus	*Sclerocactus polyancistrus*	—	Protected	✓
sand/sagebrush cholla	*Grusonia pulchella*	—	Protected	✓
silver cholla	*Cylindropuntia echinocarpa*	—	Protected	✓
Sodaville milkvetch	*Astragalus lentiginosus var. sesquimetralis*	—	Endangered	
spinystar/beehive cactus	*Escobaria vivpara*	—	Protected	✓
spring-loving centaury	*Centaurium namophilum*	Threatened	Endangered	
sunnyside green gentian	*Frasera gypsicola*	—	Endangered	
Williams combleaf	*Polyctenium williamsiae*	—	Endangered	
Animals				
Invertebrates				
Ash Meadows naucorid	*Ambrysus amargosus*	Threatened	—	
Fishes				
Ash Meadows Amargosa pupfish	*Cyprinodon nevadensis mionectes*	Endangered	Threatened	
Ash Meadows speckled dace	*Rhinichthys osculus nevadensis*	Endangered	Endangered	
Big Smoky Valley speckled dace	*Rhinichthys osculus lariversi*	—	Sensitive	
Big Smoky Valley tui chub	*Siphateles bicolor spp 8*	—	Sensitive	
Devils Hole pupfish	*Cyprinodon diabolis*	Endangered	Endangered	
Lahontan cutthroat trout	*Oncorhynchus clarkii henshawi*	Threatened	Threatened	
Moapa dace	*Moapa coriacea*	Endangered	Endangered	
Monitor Valley speckled dace	*Rhinichthys osculus spp 5*	—	Sensitive	
Moorman White River springfish	*Crenichthys baileyi thermophilus*	—	Protected	
Oasis Valley speckled dace	*Rhinichthys osculus spp 6*	—	Sensitive	
Railroad Valley springfish	*Crenichthys nevadae*	Threatened	Threatened	
Railroad Valley tui chub	*Siphateles bicolor spp 7*	—	Sensitive	
Warm Springs Amargosa pupfish	*Cyprinodon nevadensis pectoralis*	Endangered	Endangered	
White River desert sucker	*Catostomus clarkia intermedius*	—	Protected	
White River spinedace	*Lepidomeda albivallis*	Endangered	Endangered	

See notes at end of table.

Table 4-1. Federal and state threatened and endangered species and other State of Nevada protected species potentially occurring in Nye County (continued)

Common Name	Scientific Name	Federal ESA Status	Nevada Status	Observed at SNL/TTR
Reptiles/Amphibians				
Amargosa Toad	*Anaxyrus nelsonii*	—	Protected	
Columbia Spotted Frog	*Rana luteiventris pop 3*	—	Protected	
Gila Monster	*Heloderma suspectum*	—	Protected	
Mojave Desert Tortoise	*Gopherus agassizii*	Threatened	Threatened	
Northern Leopard Frog	*Lithobates pipiens*	—	Protected	
Short-horned Lizard	*Phrynosoma douglasii*	—	Sensitive	
Sonoran Mountain King Snake	*Lampropeltis pyromelana*	—	Protected	
Mammals				
Allen's big-eared bat	*Idionycteris phyllotis*	—	Protected	
American pika	*Ochotona princeps*	—	Protected	
Ash Meadows montane vole	*Microtus montanus nevadensis*	—	Sensitive	
California leaf-nosed bat	*Macrotus californicus*	—	Sensitive	
dark kangaroo mouse	*Microdipodops megacephalus*	—	Protected	
Mexican free-tailed bat	*Tadarida brasiliensis*	—	Protected	
pale kangaroo mouse	*Microdipodops pallidus*	—	Protected	
pallid bat	*Antrozous pallidus*	—	Protected	
Palmer's chipmunk	*Neotamias palmeri*	—	Sensitive	
ringed myotis	*Myotis thysanodes*	—	Protected	
spotted bat	*Euderma maculatum*	—	Threatened	
Townsend's big-eared bat	*Corynorhinus townsendii*	—	Sensitive	
western red bat	*Lasiurus blossevillii*	—	Sensitive	
Birds				
Bald Eagle	*Haliaeetus leucocephalus*	—	Endangered	
Brewer's Sparrow	*Spizella breweri*	—	Sensitive	✓
Golden Eagle	*Aquila cgrysaetos*	—	Sensitive	✓
Loggerhead Shrike	*Lanius ludovicianus*	—	Sensitive	✓
Northern Goshawk	*Accipiter gentilis*	—	Sensitive	
Peregrine Falcon	*Falco peregrinus*	—	Endangered	
Sage Thrasher	*Oreoscoptes montanus*	—	Sensitive	✓
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	Endangered	
Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened	Sensitive	
Yuma Clapper Rail	*Rallus longirostris yumanensis*	Endangered	Endangered	

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

4.3 Avian Surveillance

Avian surveys were established in 2004 to monitor patterns of bird richness and abundance in the basic habitats found at SNL/TTR within the DOE-controlled land. There are eight bird survey routes/locations; see Table 4-2 for location and habitat descriptions. Six of these locations consist of driving routes/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.

From 2004 through 2016, the surveys typically have been conducted one time each year, during late spring (mid-May to early June). The surveys were not conducted in 2006 and 2015. From these surveys, 114 species of birds have been recorded at SNL/TTR. Table 4-2 is a list of those species and the survey locations where they were encountered. **Note:** 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.

Over the 11 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 Horned Larks. On average across the 11 years, 9 Common Ravens were encountered per year.

As these surveys were being conducted in late spring, many of the species encountered were migrants. As seen in Table 4-3, a large percentage of the total number of species encountered during these surveys were found at the Roller Coaster Construction Pond (76 of the 114 bird species [67 percent]) and at Cactus Spring (34 of the 114 species [30 percent]). The surface water along with the associated emergent vegetation and tall deciduous trees provide for major stop habitat for migrant birds as well as the resident birds.

Table 4-2. Bird survey locations and habitat descriptions at SNL/TTR

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. **Note:** 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

NOTES: SNL/TTR = Sandia National Laboratories, Tonopah Test Range

Table 4-3. Bird species encountered at SNL/TTR

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
American Avocet	*Recurvirostra americana*						●			●
American Coot	*Fulica americana*						●			
American Kestrel	*Falco sparverius*				●					●
American Pipit	*Anthus rubescens*						●	●		
American Robin	*Turdus migratorius*						●	●		
Ash-throated Flycatcher	*Myiarchus cinerascens*		●							
Barn Swallow	*Hirundo rustica*	●								●
Belted Kingfisher	*Ceryle alcyon*						●			
Black Phoebe	*Contupus nigrican*						●			
Black-crowned Night Heron	*Nycticorax nycticorax*						●			
Black-headed Grosbeak	*Pheucticus melanocephalus*						●	●		
Black-necked Stilt	*Himantopus mexicanus*						●			●
Black-throated Gray Warbler	*Setophaga nigrescens*						●			
Black-throated Sparrow	*Amphispiza bilineata*		●	●	●	●		●		
Blue Grosbeak	*Passerina caerulea*						●			
Blue-gray Gnatcatcher	*Polioptila caerulea*						●			
Bonaparte's Gull	*Chroicocephalus philadelphia*									●
Brewer's Blackbird	*Euphagus cyanocephalus*						●	●		
Brewer's Sparrow	*Spizella breweri*				●	●	●	●		
Brown-headed Cowbird	*Molothrus ater*						●			
Buflehead	*Bucephala albeola*									●
Bullock's Oriole	*Icterus bullockii*			●			●	●		
Burrowing Owl	*Athene cunicularia*									●
Calliope Hummingbird	*Selasphorus calliope*							●		
Canvasback	*Aythya valisineria*									●
Canyon Wren	*Catherpes mexicanus*				●			●		
Cassin's Kingbird	*Tyrannus vociferans*		●							
Cassin's Sparrow	*Peucaea cassinii*				●					
Cassin's Vireo	*Vireo cassinii*						●			
Chipping Sparrow	*Spizella passerina*						●	●		
Chukar	*Alectoris chukar*				●			●		
Cinnamon Teal	*Anas cyanoptera*						●			
Cliff Swallow	*Petrochelidon pyrrhonota*	●					●			●

See notes at end of table.

Table 4-3. Bird species encountered at SNL/TTR (continued)

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
Common Raven	*Corvus corax*	●	●	●	●	●		●	●	●
Common Yellowthroat	*Geothlypis trichas*						●			
Cooper's Hawk	*Accipiter cooperii*						●			
Dusky Flycatcher	*Empidonax oberholseri*						●	●		
Eared Grebe	*Podiceps nigricollis*									●
Eurasian Collared-Dove	*Streptopelia decaocto*	●					●			
European Starling	*Sturnus vulgaris*	●					●			
Ferruginous Hawk	*Buteo regalis*									●
Gadwall	*Anas strepera*						●			●
Golden Eagle	*Aquila chrysaetos*			●				●		●
Gray Flycatcher	*Empidonax wrightii*						●	●		
Great Egret	*Ardea alba*						●			●
Great Horned Owl	*Bubo virginianus*	●	●							
Great-tailed Grackle	*Quiscalus mexicanus*	●					●			
Green-tailed Towhee	*Pipilo chlorurus*				●					
Green-winged Teal	*Anas crecca*						●			●
Hermit Thrush	*Catharus guttatus*						●			
Herring Gull	*Larus argentatus*									●
Horned Grebe	*Podiceps auritus*									●
Horned Lark	*Eremophila alpestris*	●	●	●	●	●	●	●	●	●
House Finch	*Carpodacus mexicanus*	●				●		●		
House Sparrow	*Passer domesticus*	●								●
House Wren	*Troglodytes aedon*						●			
Killdeer	*Charadrius vociferus*						●			
Ladder-backed Woodpecker	*Picoides scalaris*							●		
Lark Sparrow	*Chondestes grammacus*	●	●				●			
Lazuli Bunting	*Passerina amoena*					●	●			
Lincoln's Sparrow	*Melospiza lincolnii*						●			
Loggerhead Shrike	*Lanius ludovicianus*		●	●	●	●		●		
MacGillivray's Warbler	*Geothlypis tolmiei*						●			
Mourning Dove	*Zenaida macroura*	●					●	●		
Nashville Warbler	*Oreothlypis ruficapilla*						●			
Northern Mockingbird	*Mimus polyglottos*		●		●	●		●		
Northern Pintail	*Anas acuta*						●			●
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	●					●			●
Northern Shoveler	*Anas clypeata*						●			

See notes at end of table.

Table 4-3. Bird species encountered at SNL/TTR (continued)

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
Northern Water Thrush	*Parkesia noveboracensis*						●			
Olive-sided Flycatcher	*Contupus cooperi*				●		●			
Orange-crowned Warbler	*Oreothlypis celata*						●			
Pacific-slope Flycatcher	*Empidonax difficilis*						●			
Palm Warbler	*Setophaga palmarum*						●			
Pine Siskin	*Carduelis pinus*							●		
Prairie Falcon	*Falco mexicanus*				●	●	●		●	
Redhead	*Aythya americana*									●
Red-tailed Hawk	*Buteo jamaicensis*	●	●	●	●		●			●
Red-winged Blackbird	*Agelaius phoeniceus*						●			
Ring-billed Gull	*Larus delawarensis*									●
Rock Wren	*Salpinctes obsoletus*				●	●		●		
Ruby-crowned Kinglet	*Regulus calendula*			●			●	●		
Sage Thrasher	*Oreoscoptes montanus*				●	●		●		
Sagebrush Sparrow	*Artemisiospiza nevadensis*		●			●			●	
Savannah Sparrow	*Passerculus sandwichensis*						●		●	
Say's Phoebe	*Sayornis saya*	●	●						●	
Scott's Oriole	*Icterus parisorum*				●			●		
Sharp-shinned Hawk	*Accipiter striatus*						●			
Snowy Egret	*Egretta thula*						●			●
Sora	*Porzana carolina*						●			
Spotted Sandpiper	*Actitis macularia*						●			●
Spotted Towhee	*Pipilo maculatus*						●			
Summer Tanager	*Piranga rubra*						●			
Swainson's Hawk	*Buteo swainsoni*	●		●	●					●
Townsend's Warbler	*Setophaga townsendi*						●	●		
Tree Swallow	*Tachycineta bicolor*	●					●			●
Turkey Vulture	*Cathartes aura*	●	●				●		●	
Vermilion Flycatcher	*Pyrocephalus rubinus*						●			
Vesper Sparrow	*Pooecetes gramineus*			●				●		
Violet-green Swallow	*Tachycineta thalassina*	●	●				●			●
Virginia Rail	*Rallus limicola*						●			
Virginia's Warbler	*Oreothlypis virginiae*						●			
Warbling Vireo	*Vireo gilvus*						●			

See notes at end of table.

Table 4-3. Bird species encountered at SNL/TTR (continued)

Common Name	Scientific Name	A3	A9	A49	AP	AS	CP	CS	MA	Other
Western Kingbird	*Tyrannus verticalis*	●	●	●						
Western Tanager	*Piranga ludoviciana*				●		●			
Western Wood Pewee	*Contopus sordidulus*				●	●	●	●		
White-crowned Sparrow	*Zonotrichia leucophrys*				●		●	●	●	
White-faced Ibis	*Plegadis chihi*									●
White-winged Dove	*Zenaida asiatica*	●					●			
Wilson's Phalarope	*Phalaropus tricolor*						●			●
Wilson's Warbler	*Cardellina pusilla*						●	●		
Yellow Warbler	*Setophaga petechia*						●	●		
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*						●		●	
Yellow-rumped Warbler	*Setophaga coronata*			●	●		●	●	●	

NOTES: A3 = Area 3
A9 = Area 9
A49 = Area 4
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

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Chapter 5. SNL/TTR Quality Assurance

Coyote (*Canis latrans*)

OVERVIEW ■ Sandia National Laboratories' 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 the samples meet statistically established control criteria or prescribed acceptance control limits. In 2016, DOE Consolidated Audit Program audits at the primary Sample Management Office contract laboratories had no findings.

Sandia National Laboratories (SNL) personnel take responsibility and assume accountability for implementing quality assurance (QA) for its operations as specified in International Organization for Standard 9001 (ISO 2008), the Contractor Requirements Document of the U.S. Department of Energy (DOE) Order 414.1D (DOE O 414.1D), *Quality Assurance*, and 10 Code of Federal Regulations (CFR) 830 (10 CFR 830), Subpart A, "Quality Assurance," via policy statements, processes, and procedures, and by executing the actions specified in those processes and procedures. SNL 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 (SAPs), work plans, or Quality Assurance Plans, which contain applicable QA elements. These documents meet appropriate federal, state, and local requirements for conducting sampling and analysis activities. Personnel in various programs collect environmental samples and analyze the samples for radiological and nonradiological constituents.

Project SAPs (or equivalent) include critical elements, such as procedures for sample collection, sample preservation and handling, sample control, laboratory quality control (QC), required

limits of detection, field QC, health and safety, schedules and frequency of sampling, data review, data acceptability, and reporting, along with references to analytical methods and analyte lists and known potential matrix interference.

5.1.1 Sample Management Office

The Sample Management Office (SMO), located at SNL, New Mexico (SNL/NM), packages, ships, and tracks environmental samples to off-site (contracted) laboratories. The SNL/NM Radiation Protection Sample Diagnostics (RPSD) laboratory processes and analyzes some samples for radiological constituents in accordance with RPSD procedures.

SMO 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.

There are instances when SNL, Tonopah Test Range (SNL/TTR) personnel ship samples directly to off-site laboratories, rather than to SMO. 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 2016a). All laboratories must employ U.S. Environmental Protection Agency (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 SMO Statement of Work (SOW) for Analytical Laboratories (SNL/NM 2013b). All calibrations and detection limits must be verified before sample analysis and data reporting. Once a laboratory has passed an initial appraisal and has been awarded a contract, the SMO is responsible for continuously monitoring laboratory performance to ensure that the laboratory meets its contractual requirements during annual audits.

SMO contract laboratories perform work in compliance with the SMO SOW 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. SMO 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 (NELAC) Standard.

5.1.3 Quality Control for Samples

Project-specified QC samples are submitted to contract laboratories in order to meet project data quality objectives and SAP requirements. Various field QC samples are 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 SNL/TTR sample batch, laboratory QC samples are prepared concurrently at defined frequencies and analyzed in accordance with established methods. The contract laboratory

determines the analytical accuracy, precision, contamination, and matrix effects associated with each analytical measurement.

QC sample results are compared either to statistically established control criteria or to prescribed acceptance control limits. Analytical results generated concurrently with QC sample results within established limits are considered acceptable. If QC 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 SOW and laboratory procedures. QC sample summaries are included in analytical reports prepared by contract laboratories.

The Radiation Protection Dosimetry Program at SNL/NM issues and processes thermoluminescent dosimeters used to measure gamma radiation.

The SNL/NM Radiation Protection Dosimetry Program (RPDP) issues and processes thermoluminescent dosimeters used to measure gamma radiation. The technical basis for the environmental dosimeter monitoring program is provided in *Description and Procedures of the Environment Radiation Dosimetry Program* (SNL/NM 1987). Dosimeters are issued and processed from SNL/NM to SNL/TTR personnel quarterly following established protocols and QA/QC requirements specified in the RPDP operating procedures and the RPDP Quality Plan (SNL/NM 2016c). Automated dosimeter equipment is used to manage environmental dosimeters. RPDP external dosimetry technical personnel perform data reduction and dose calculations.

5.1.4 Data Validation and Records Management

Sample collection, analysis request and chain of custody (ARCOC) 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 following sources are reviewed and the data validated at a minimum of three levels:

- The analytical laboratory validates data according to the laboratory's QA plan, standard operating procedures, and client-specific requirements.
- SMO personnel review the analytical reports and corresponding sample collection and ARCOC 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-specified requirements.

5.2 Sample Management Office Activities in 2016

SMO activities in 2016 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 2016, the SMO processed a total of 88 samples in support of the Terrestrial Surveillance Program. Of these, 10 samples were submitted as field and analytical QC samples to assist with data validation and decision making.

During 2016, General Engineering Laboratories in Charleston, South Carolina, was employed to analyze SNL/TTR soil samples.

In 2016, the Sample Management Office processed 88 samples in support of the SNL/TTR Terrestrial Surveillance Program.

5.2.2 Laboratory Quality Assurance Assessments and Validation

In 2016, SMO personnel continued independent, on-site assessments and validation at the NELAC-approved laboratories used by SNL personnel. Specific checks were made for documentation completeness, proper equipment calibration, proper laboratory practices, and batch QC data.

5.2.3 Quality Assurance Audits

The DOE Consolidated Audit Program (DOECAP) conducted audits in 2016 at the primary SMO contract laboratories using DOE/Department of Defense *Consolidated Quality Systems Manual* requirements. The audit reports, laboratory responses, and closure letters are all posted and tracked through the DOECAP website. The SMO worked closely with the contract laboratories to resolve audit findings expeditiously. Decisions regarding sample distribution to contract laboratories were based on audit information, including outstanding corrective actions.

No findings for SNL/TTR samples were issued in 2016 in either the DOECAP audit or the Mixed Analyte Performance Evaluation Program audit.

PART TWO

SANDIA NATIONAL LABORATORIES
KAUAʻI TEST FACILITY, HAWAIʻI

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Chapter 6. SNL/KTF Introduction

Hanalei Bay, Kaua'i

OVERVIEW ■ Kaua'i Test Facility has been an active rocket launching facility since 1962. The Remote Range Department, Sandia National Laboratories, manages and conducts the rocket launching activities at SNL/KTF, including two rocket launches in 2016. The site has been used for testing rocket systems with scientific and technological payloads, advanced development of maneuvering reentry vehicles, and scientific studies of atmospheric and exoatmospheric phenomena, and it currently supports Missile Defense Agency programs.

This *Annual Site Environmental Report* (ASER) was prepared in accordance with and as required by the U.S. Department of Energy (DOE) per DOE O 231.1B, Admin Change 1, *Environment, Safety, and Health Reporting*. Sandia National Laboratories (SNL) 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 (NNSA). SNL personnel manage and operate the Sandia National Laboratories, Kaua'i Test Facility (SNL/KTF) in Hawai'i for DOE/NNSA. The DOE/NNSA/Sandia Field Office (SFO) in Albuquerque, New Mexico, administers the contract and oversees contractor operations at the site.

Part Two of this ASER summarizes the environmental protection and monitoring programs in place at SNL/KTF during calendar year 2016 unless otherwise noted. This report is made available to the general public in printed and electronic form.

6.1 Mission

The Laboratories' enduring core mission is to provide science and engineering support for the nation's nuclear weapons stockpile. Today, the mission encompasses additional critical aspects of national security, including developing technologies and strategies for responding to emerging threats, protecting and preventing the disruption of critical infrastructures, and supporting the nonproliferation of weapons of mass destruction. SNL personnel also collaborate with representatives from other government agencies, the industrial sector, and universities to develop and commercialize new technologies. Information about recent technologies developed at Sandia National Laboratories can be found at:

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

6.1.1 Operating Contract and DOE Directives

The Prime Contract for management and operations at Sandia National Laboratories defines the contractual obligations for SNL. 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 operations of DOE facilities, or DOE's credibility. This ASER is prepared in accordance with this directive.
- DOE O 232.2 Admin Change 1, *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's 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 the environment. Under this directive, contractors that 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 (EMSs) and site sustainability are at the forefront of environmental excellence. This directive is implemented through an International Organization for Standardization (ISO) 14001-certified EMS. Although it is not part of the scope of the certification, SNL personnel implement an EMS at SNL/KTF that is consistent with the ISO 14001 standard (ISO 2004). Conformance to the standard is verified through internal EMS assessments. SNL/KTF assessments were conducted in 2011 and 2014.

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

6.2 Location Description

SNL/KTF exists as a facility within the boundaries of the U.S. Department of Defense (DoD) Pacific Missile Range Facility (PMRF). SNL/KTF is located on the island of Kaua'i at the north end of the PMRF (Figure 6-1). Remote facilities used in support of SNL/KTF operations include Mount Haleakala (Maui) and Kahili Point (Kaua'i).

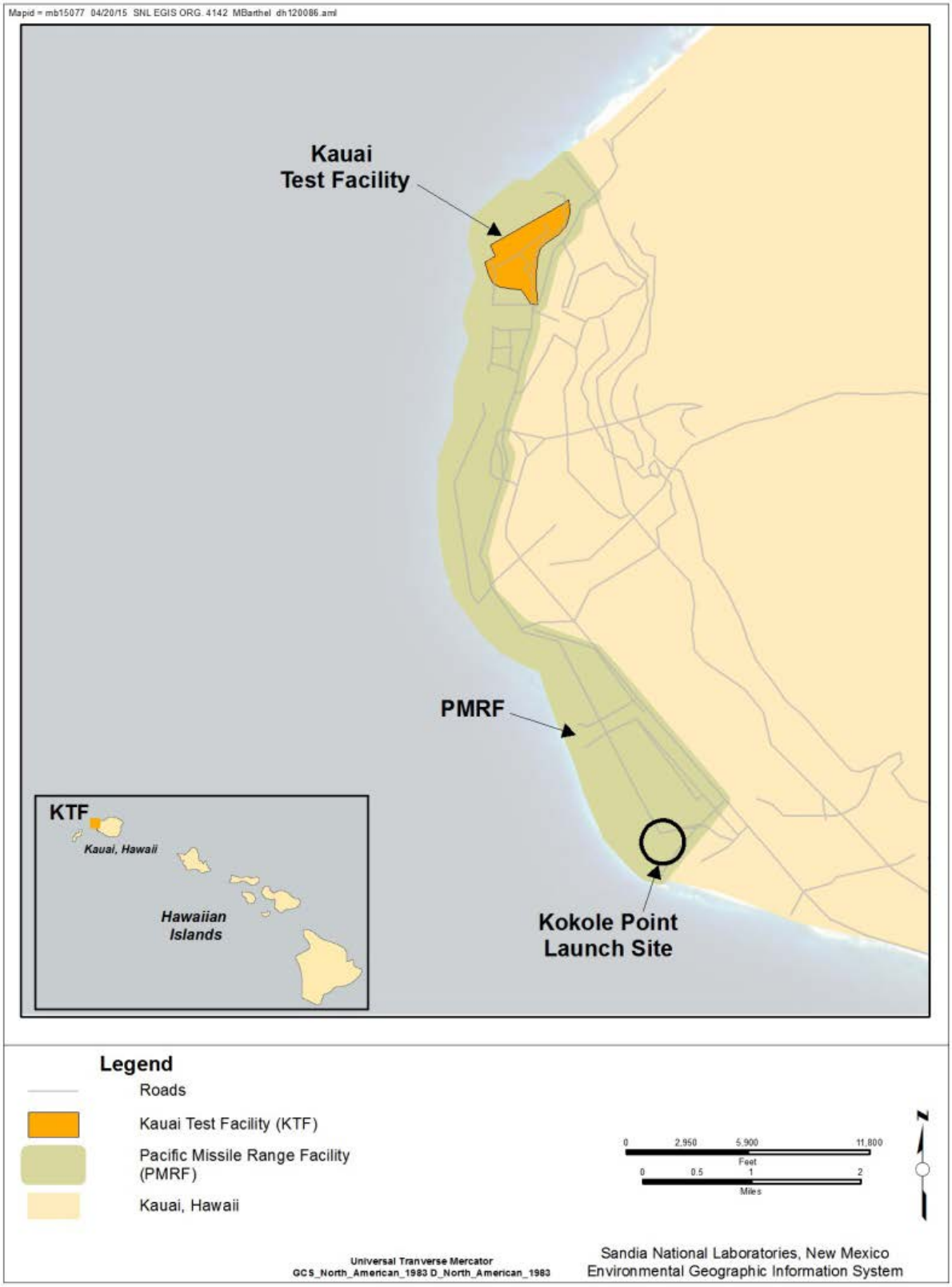

Figure 6-1. SNL/KTF location on Kaua'i, Hawai'i

6.3 Facilities and Operations

The Kauaʻi Test Facility (KTF) has been an active rocket launching facility since 1962. SNL Remote Range Department personnel manage and conduct rocket launching activities at SNL/KTF. The site has been used for testing rocket systems with scientific and technological payloads, advanced development of maneuvering reentry vehicles, and scientific studies of atmospheric and exoatmospheric phenomena, and it currently supports Missile Defense Agency programs. Nuclear devices have never been launched from SNL/KTF, only monitoring rockets associated with atmospheric testing. Operations at SNL/KTF do not (currently or in the past) involve radioactive materials.

The first facilities at KTF were constructed in the early 1960s to support the National Readiness Program. 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 2016, SNL/KTF personnel have supported 93 launches from SNL/KTF, PMRF, or 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) and one at Pad 42 (Missile Service Tower). In addition to rocket launchpad sites, SNL/KTF 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.

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 PMRF. Inside the compound, a number of trailers and structures are connected together with a network of concrete docks and covered walkways. The majority of these facilities are used during mission operations to support customer and defense contractor personnel and technical staff from SNL, New Mexico; general maintenance activities are performed during noncampaign operations. Additionally, there are a number of 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. Remote facilities include Mount Haleakala (Maui) and Kahili Point (Kauaʻi), but SNL personnel have not used them for several years. In 2015, a Mount Haleakala Advanced Actions Decontamination and Demolition Pre-Action Study was signed since Kauaʻi Test Facility no longer supports missions at this site. The Kokole Point launch complex and associated facilities were transferred to the U.S. Navy in 2013.

6.4 Rocket Launches in 2016

SNL/KTF personnel supported two rocket launches in 2016. The launches were covered by the SNL/KTF Environmental Assessment, published in July 1992 (DOE/AL 1992), and the U.S. Navy Hawaiʻi Range Complex Environmental Impact Statement (U.S. Navy 2008):

- AEGIS BMD, FTM-21, May 17, 2016 (launched from KTF)
- AEGIS BMD, FTM-27, December 14, 2016 (launched from KTF)

6.5 Demographics

There were 14 permanent on-site personnel at SNL/KTF in 2016. During campaign operations when rocket launches occurred, approximately 100 additional people worked at SNL/KTF. The closest population center to SNL/KTF are the towns of Kekaha and Waimea (Census 2010 population 5,561), which are eight and ten miles southeast from the site, respectively.

Chapter 7. SNL/KTF Compliance Summary

Raccoon butterflyfish (*Chaetodon lunula*) off the coast of Kaua'i

OVERVIEW ■ SNL/KTF operations comply with federal, state, and local environmental requirements. Releases and occurrences are reported according to numerous permit requirements. Regular audits, appraisals, and inspections identify areas for improvement as well as noteworthy practices.

Sandia National Laboratories (SNL) personnel conduct operations at SNL, Kaua'i Test Facility (SNL/ KTF) in compliance with federal, state, and local environmental requirements, including U.S. Department of Energy (DOE) directives and Presidential Executive Orders (EOs). As a part of this compliance, the corporation adheres to strict reporting and permitting requirements.

All SNL/KTF operations and activities, including those that are part of environmental programs, are performed under the Environment, Safety and Health (ES&H) policy, ESH100, which states:

> It is the policy of Sandia National Laboratories to perform work in a safe and environmentally responsible manner by committing to: maintain a safe workplace, prevent incidents, and protect the public; protect the environment, conserve resources, and prevent pollution; maintain compliance with legal and other requirements; and strive for continual improvement. DOE's Integrated Safety Management System (ISMS) is a key element of the Sandia Management Model. ISMS provides the framework for managing ES&H activities and functions while integrating them into all SNL operations.

7.1 Environmental Management System

SNL 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. The Environmental Management System (EMS)—the primary management approach to minimizing environmental impact and supporting environmental compliance and sustainability practices—is also implemented through SNL environmental programs.

The EMS encompasses all SNL activities, products, and services that have the potential to interact with the environment. Specifically, the EMS is used to establish policy, objectives, and targets that enable personnel to reduce environmental impacts and increase operating efficiencies through a continuing cycle of planning, implementing, evaluating, and improving processes.

DOE O 436.1, *Departmental Sustainability*, was established to ensure that environment management systems and site sustainability are at the forefront of environmental excellence. This directive is implemented through an International Organization for Standardization (ISO) 14001-certified (ISO 2004) EMS. Sandia National Laboratories received initial ISO 14001 certification in June 2009 for the primary SNL operating locations and retained certification in the 2015 recertification audit. SNL/KTF operations do not need to be included in the ISO 14001 Certification provided that an internal assessment to the ISO 14001 standard (ISO 2004) at the site is conducted every three years. An EMS ISO 14001 assessment of SNL/KTF operations was conducted in 2014. Additional information can be found on the external SNL EMS website:

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

The benefits of the SNL EMS include:

- 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 personnel awareness of environmental issues and responsibilities

For FY 2016, the EMS identified natural resource use, hazardous materials use, and hazardous waste production as the top three significant *aspects* (any elements of activities, products, or services that can interact with the environment). When significant aspects and negative *impacts* (any changes in the environment, whether adverse or beneficial, wholly or partially resulting from activities, products, or services) have been identified, objectives and measurable targets—at all operating levels—are established to guide efforts toward minimizing those aspects and impacts.

7.2 Site Sustainability Plan

Sustainability strategies and goals are defined in an annual Site Sustainability Plan, and many of these efforts have been adopted as EMS objectives and targets. The Site Sustainability Plan (SNL/NM 2015) articulates the performance status and planned actions for meeting DOE's Strategic Sustainability Performance Plan (DOE 2016) goals and broader sustainability program set forth in EO 13693, *Planning for Federal Sustainability in the Next Decade*. The EMS is used as a platform for implementing the Site Sustainability Plan and other programs with objectives and measurable targets that contribute to meeting sustainability goals. As of FY 2016, sustainability goals are being met or exceeded in several key areas.

7.3 Environmental Performance Measures

Environmental performance is tracked through performance measures and indicators. The results are reported through the internal ES&H Assurance Dashboard, the Sandia Performance Scorecard, the management review process, and management reports.

Environmental performance is assessed as part of the SNL Performance Evaluation Measurement Plan with DOE/National Nuclear Security Administration (NNSA)/Sandia Field Office (SFO). On the basis of the Performance Evaluation Measurement Plan, DOE/NNSA/SFO prepares an annual Performance Evaluation Report that assesses the management and operating contractor's performance for the fiscal year. For FY 2016, the overall performance was rated as excellent, earning performance ratings of excellent in several mission objectives. Expectations in the areas of environment, safety, and health were met or exceeded.

7.4 Air Quality

Air quality at SNL/KTF is monitored and assessed to ensure compliance with clean air requirements.

7.4.1 Clean Air Act

Per the Clean Air Act (CAA) of 1970 and CAA Amendments of 1990, 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. Currently, no facilities at SNL/KTF require federal air permits. Within the boundaries of the Pacific Missile Range Facility, the DOE holds no federal air emission permits for SNL/KTF. Rocket launches are mobile sources and do not require any reporting of reportable quantity releases.

Ambient air is any unconfined portion of the atmosphere: open air, surrounding air.

The two electrical generators at SNL/KTF are permitted for operation by the State of Hawai'i under a noncovered source permit (Hawaii 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 Code of Federal Regulations (CFR) 60 (40 CFR 60), *Standards of Performance for New Stationary Sources,* Subpart A, "General Provisions"
- 40 CFR 60, *Standards of Performance for New Stationary Sources*, Subpart IIII, "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines"

7.5 Chemical Management

Chemicals are managed through compliance with several requirements. Reporting is specified in these requirements.

7.5.1 Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right-to-Know Act (EPCRA) of 1986, also known as the Superfund Amendments and Reauthorization Act (SARA) Title III, establishes emergency planning requirements for federal, state, and local governments and industry. SARA Title III amended CERCLA requirements for releases to the environment and chemical inventory reporting as directed by EPCRA, sections 304, 311, and 312. All required information has been submitted to the State of Hawai'i. There were no reportable releases at SNL/KTF under EPCRA in 2016. Table 7-1 lists EPCRA reporting requirements.

Table 7-1. SNL/KTF applicable EPCRA reporting requirements, 2016

Section	EPCRA Section Title	Requires Reporting?		Description
		Yes	No	
302–303	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. DOE/NNSA/SFO distributes the report to the required entities.
304	Emergency Notification		✓	Submit notification of reportable quantity releases of an EHS, as defined by CERCLA, to the required entities.
311–312	SDS Chemical Purchase Inventory Report	✓		Report on two "Community Right-to-Know" requirements: • Complete EPA Tier II forms for (1) all hazardous chemicals present at the SNL/KTF facility at any one time in amounts equal to or greater than 10,000 lb and (2) all EHSs present at the facility in amounts equal to or greater than 500 lb or the Threshold Planning Quantity, whichever is lower. This report is provided to DOE/NNSA/SFO for distribution to the required entities. • Record SDSs for each chemical entry on a Tier II form and provide the report to DOE/NNSA/SFO prior to distribution to the required entities.
313	Toxic Chemical Release Form		✓	Submit a TRI report to the required entities for facilities that release toxic chemicals listed in SARA Title III over a threshold value.

NOTES: CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
DOE = U.S. Department of Energy
EHS = extremely hazardous substance
EPA = U.S. Environmental Protection Agency
EPCRA = Emergency Planning and Community Right-to-Know Act
NNSA = National Nuclear Security Administration
SARA = Superfund Amendments and Reauthorization Act
SDS = Safety Data Sheet
SFO = Sandia Field Office
SNL/KTF = Sandia National Laboratories, Kaua'i Test Facility
TRI = Toxic Release Inventory

Emergency Release Notification

The Emergency Release Notification requirements were established under Section 304 of EPCRA. An accidental release of an extremely hazardous substance that exceeds the applicable reporting quantity must be reported. In 2016, there were no reportable quantity releases of an extremely hazardous substance requiring notification.

Toxic Release Inventory Reporting

The Toxic Release Inventory (TRI) reporting requirement was established under Section 313 of EPCRA. Environmental releases and other waste management quantities of chemicals listed on the EPCRA Section 313 list of toxic chemicals must be reported for certain facilities in covered industry sectors if they manufacture, process, or otherwise use more than established threshold quantities of these chemicals.

In 2016, no releases resulting from SNL/KTF operations were reported above the threshold requiring a TRI report.

7.5.2 Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act, enacted in 1910 and amended in 1972, controls the distribution and application of pesticides including herbicides, insecticides, and rodenticides. All pesticide use at SNL/KTF follows EPA requirements.

7.5.3 Toxic Substances Control Act

The Toxic Substances Control Act, enacted in 1976 and later amended, regulates polychlorinated biphenyls (PCBs) and asbestos. The transformers on the SNL/KTF site have been tested and are free of PCBs. A comprehensive asbestos survey was conducted by the SNL/NM Asbestos Management Team 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.

7.6 Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, and amended in 1986, also known as the "Superfund," addresses areas of past spills and releases. No current Environmental Restoration areas are located on-site at SNL/KTF.

The U.S. Environmental Protection Agency (EPA) designated ongoing oversight of SNL/KTF to the Hawai'i Department of Health Hazard Evaluation and Emergency Response Office. The EPA recommended continued reevaluation for environmental contamination due to the rocket launching facility at SNL/KTF (EPA 1996). Rocket exhaust continues to be the main source of metals and other nonreportable air emission releases at SNL/KTF.

7.7 Cultural and Natural Resources

Cultural and natural resources are protected at SNL/KTF.

7.7.1 Cultural Resources Acts

Cultural resources management responsibilities are applicable at SNL/KTF. The three primary cultural resources acts applicable at SNL/KTF are:

- National Historic Preservation Act, enacted in 1966 and amended in 2000
- American Indian Religious Freedom Act, enacted in 1978 and amended in 1994
- Archaeological Resources Protection Act, enacted in 1979 and amended in 1988

NEPA Program personnel coordinate cultural resources compliance. Actions that could adversely affect cultural resources are analyzed initially in a NEPA checklist review. DOE/NNSA/SFO is responsible for ensuring that impacts to cultural resources are assessed and appropriate actions are taken to mitigate impacts. In 2016, no historic properties were threatened; no buildings previously unassessed were modified or demolished. DOE/NNSA/SFO did not have occasion to consult with the Hawai'i State Historic Preservation Officer.

7.7.2 Natural Resources Acts

The following natural resources acts are applicable to SNL/KTF (for additional information on these acts see Chapter 2):

- Endangered Species Act (Section 7.7.3)
- Fish and Wildlife Coordination Act (Section 2.7.4)
- Migratory Bird Treaty Act (Section 2.7.7)
- Sikes Act (Section 2.7.10)

At SNL/KTF, these acts are coordinated through NEPA reviews and the Ecology Program.

7.7.3 Endangered Species Act

The Endangered Species Act of 1973, amended in 1982, applies to both private individuals and federal agencies. Federal agencies must ensure that any action they authorize, fund, or carried out by them will not jeopardize the continued existence of a threatened or endangered species, or result in adverse modifications of its habitat. At SNL/KTF, Endangered Species Act compliance is addressed under the NEPA Program and the Ecology Program. If potentially significant impacts to sensitive species or habitats are found as a result of a proposed action, an environmental assessment or an environmental impact statement must be prepared.

Table 7-2 presents the threatened and endangered species on state and federal lists potentially occurring on the island of Kauaʻi.

Table 7-2. SNL/KTF threatened and endangered species potentially occurring on Kauaʻi, Hawaiʻi

Common Name	Scientific Name	Federal Status	State Status
Plants			
Ferns and Allies			
Pendant kihi fern	*Adenophorus periens*	Endangered	Endangered
No common name	*Asplenium diellaciniatum*	Proposed endangered	Proposed endangered
No common name	*Asplenium dielmannii*	Endangered	Endangered
No common name	*Asplenium dielpallidum*	Endangered	Endangered
Pauoa	*Ctenitis squamigera*	Endangered	Endangered
Asplenium-leaved diellia	*Diellia erecta*	Endangered	Endangered
No common name	*Diplazium molokaiense*	Endangered	Endangered
No common name	*Doryopteris angelica*	Endangered	Endangered
Palapalai aumakua	*Dryopteris crinalis var. podosorus*	Endangered	Endangered
kilau	*Dryopteris glabra var. pusilla*	Proposed endangered	Proposed endangered
Wawaeʻiole	*Huperzia mannii*	Endangered	Endangered
Wawaeʻiole	*Huperzia nutans*	Endangered	Endangered
Flowering Plants			
Liliwai	*Acaena exigua*	Endangered	Endangered
No common name	*Achyranthes mutica*	Endangered	Endangered
Mahoe	*Alectryon macrococcus*	Endangered	Endangered
Paʻiniu	*Astelia waialealae*	Endangered	Endangered
No common name	*Bonamia menziesii*	Endangered	Endangered
Olulu	*Brighamia insignis*	Endangered	Endangered
ʻAwikiwiki	*Canavalia napaliensis*	Endangered	Endangered
ʻAwikiwiki	*Canavalia pubescens*	Endangered	Endangered
Awiwi	*Centaurium sebaeoides*	Endangered	Endangered
Papala	*Charpentiera densiflora*	Endangered	Endangered
Haha	*Cyanea asarifolia*	Endangered	Endangered
Haha	*Cyanea dolichopoda*	Endangered	Endangered
Haha	*Cyanea eleeleensis*	Endangered	Endangered
Haha	*Cyanea kolekoleensis*	Endangered	Endangered
Haha	*Cyanea kuhihewa*	Endangered	Endangered
Haha	*Cyanea recta*	Threatened	Threatened
Haha	*Cyanea remyi*	Endangered	Endangered
Haha	*Cyanea rivularis*	Endangered	Endangered
Haha	*Cyanea undulata*	Endangered	Endangered
No common name	*Cyperus pennatiformis*	Endangered	Endangered
Puʻukaʻa	*Cyperus trachysanthos*	Endangered	Endangered

See note at end of table.

Table 7-4. SNL/KTF threatened and endangered species potentially occurring on Kaua'i, Hawai'i (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Flowering Plants (continued)			
Mapele	*Cyrtandra cyaneoides*	Endangered	Endangered
Ha'iwale	*Cyrtandra limahuliensis*	Threatened	Threatened
Ha'iwale	*Cyrtandra oenobarba*	Endangered	Endangered
Haiwale	*Cyrtandra paliku*	Endangered	Endangered
No common name	*Delissea rhytidosperma*	Endangered	Endangered
No common name	*Delissea undulata*	Endangered	Endangered
Na'ena'e	*Dubautia imbricata imbricata*	Endangered	Endangered
Naenae	*Dubautia kalalauensis*	Endangered	Endangered
Naenae	*Dubautia kenwoodii*	Endangered	Endangered
Koholapehu	*Dubautia latifolia*	Endangered	Endangered
Na'ena'e	*Dubautia pauciflorula*	Endangered	Endangered
Na'ena'e	*Dubautia plantaginea magnifolia*	Endangered	Endangered
Na'ena'e	*Dubautia waialealae*	Endangered	Endangered
'Akoko	*Euphorbia eleanoriae*	Endangered	Endangered
'Akoko	*Euphorbia haeleeleana*	Endangered	Endangered
'Akoko	*Euphorbia halemanui*	Endangered	Endangered
'Akoko	*Euphorbia remyi var. Kaua'iensis*	Endangered	Endangered
'Akoko	*Euphorbia remyi var. remyi*	Endangered	Endangered
Heau	*Exocarpos luteolus*	Endangered	Endangered
Mehamehame	*Flueggea neowawraea*	Endangered	Endangered
Nanu	*Gardenia remyi*	Proposed endangered	Proposed endangered
Nohoanu	*Geranium Kaua'iense*	Endangered	Endangered
No common name	*Gouania meyenii*	Endangered	Endangered
Honohono	*Haplostachys haplostachya*	Endangered	Endangered
No common name	*Hesperomannia lydgatei*	Endangered	Endangered
Kaua'i hau kuahiwi	*Hibiscadelphus distans*	Endangered	Endangered
Hau kuahiwi	*Hibiscadelphus woodii*	Endangered	Endangered
Clay's hibiscus	*Hibiscus clayi*	Endangered	Endangered
Koki'o ke'oke'o	*Hibiscus waimeae ssp. hannerae*	Endangered	Endangered
Hilo ischaemum	*Ischaemum byrone*	Endangered	Endangered
Aupaka	*Isodendrion laurifolium*	Endangered	Endangered
Aupaka	*Isodendrion longifolium*	Threatened	Threatened
'Ohe	*Joinvillea ascendens ascendens*	Proposed endangered	Proposed endangered
'Awiwi	*Kadua cookiana*	Endangered	Endangered
Kampua'a	*Kadua (=Hedyotis) fluviatilis*	Proposed endangered	Proposed endangered
No common name	*Kadua haupuensis*	Proposed endangered	Proposed endangered
No common name	*Kadua st.-johnii*	Endangered	Endangered
No common name	*Keysseria (=Lagenifera) erici*	Endangered	Endangered
No common name	*Keysseria (=Lagenifera) helenae*	Endangered	Endangered
Koki'o	*Kokia Kaua'iensis*	Endangered	Endangered
Kamakahala	*Labordia helleri*	Endangered	Endangered
Kamakahala	*Labordia lydgatei*	Endangered	Endangered
Kamakahala	*Labordia pumila*	Endangered	Endangered
Kamakahala	*Labordia tinifolia var. wahiawaensis*	Endangered	Endangered
No common name	*Lepidium orbiculare*	Proposed endangered	Proposed endangered
Nehe	*Lipochaeta fauriei*	Endangered	Endangered

See note at end of table.

Table 7-4. SNL/KTF threatened and endangered species potentially occurring on Kauaʻi, Hawaiʻi (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Flowering Plants (continued)			
Nehe	*Lipochaeta micrantha*	Endangered	Endangered
No common name	*Lobelia niihauensis*	Endangered	Endangered
lehua makanoe	*Lysimachia daphnoides*	Endangered	Endangered
No common name	*Lysimachia filifolia*	Endangered	Endangered
No common name	*Lysimachia iniki*	Endangered	Endangered
No common name	*Lysimachia pendens*	Endangered	Endangered
No common name	*Lysimachia scopulensis*	Endangered	Endangered
No common name	*Lysimachia venosa*	Endangered	Endangered
Alani	*Melicope degeneri*	Endangered	Endangered
Alani	*Melicope haupuensis*	Endangered	Endangered
Alani	*Melicope knudsenii*	Endangered	Endangered
Alani	*Melicope pallida*	Endangered	Endangered
Alani	*Melicope paniculata*	Endangered	Endangered
Alani	*Melicope puberula*	Endangered	Endangered
Alani	*Melicope quadrangularis*	Endangered	Endangered
Uhi uhi	*Mezoneuron kavaiense*	Endangered	Endangered
Kolea	*Myrsine fosbergii*	Proposed endangered	Proposed endangered
Kolea	*Myrsine knudsenii*	Endangered	Endangered
Kolea	*Myrsine linearifolia*	Threatened	Threatened
Kolea	*Myrsine mezii*	Endangered	Endangered
ʻAiea	*Nothocestrum latifolium*	Proposed endangered	Proposed endangered
ʻAiea	*Nothocestrum peltatum*	Endangered	Endangered
Lau ʻehu	*Panicum niihauense*	Endangered	Endangered
Makou	*Peucedanum sandwicense*	Threatened	Threatened
No common name	*Phyllostegia helleri*	Proposed endangered	Proposed endangered
No common name	*Phyllostegia knudsenii*	Endangered	Endangered
No common name	*Phyllostegia renovans*	Endangered	Endangered
No common name	*Phyllostegia waimeae*	Endangered	Endangered
No common name	*Phyllostegia wawrana*	Endangered	Endangered
Hoʻawa	*Pittosporum napaliense*	Endangered	Endangered
No common name	*Platanthera holochila*	Endangered	Endangered
Pilo kea lau liʻi	*Platydesma rostrata*	Endangered	Endangered
Mann's bluegrass	*Poa mannii*	Endangered	Endangered
Hawaiʻian bluegrass	*Poa sandvicensis*	Endangered	Endangered
No common name	*Poa siphonoglossa*	Endangered	Endangered
No common name	*Polyscias bisattenuata*	Endangered	Endangered
No common name	*Polyscias flynnii*	Endangered	Endangered
No common name	*Polyscias racemosa*	Endangered	Endangered
Loʻulu (=Naʻenaʻe)	*Pritchardia hardyi*	Endangered	Endangered
Loʻulu	*Pritchardia napaliensis*	Endangered	Endangered
Loʻulu	*Pritchardia viscosa*	Endangered	Endangered
Kopiko	*Psychotria grandiflora*	Endangered	Endangered
Kopiko	*Psychotria hobdyi*	Endangered	Endangered
Kaulu	*Pteralyxia Kauaʻiensis*	Endangered	Endangered
Makou	*Ranunculus mauiensis*	Proposed endangered	Proposed endangered
No common name	*Remya Kauaʻiensis*	Endangered	Endangered

See note at end of table.

Table 7-4. SNL/KTF threatened and endangered species potentially occurring on Kauaʻi, Hawaiʻi (continued)

Common Name	Scientific Name	Federal Status	State Status
Plants (continued)			
Flowering Plants (continued)			
No common name	*Remya montgomeryi*	Endangered	Endangered
No common name	*Santalum involutum*	Proposed endangered	Proposed endangered
Dwarf naupaka	*Scaevola coriacea*	Endangered	Endangered
Maʻoliʻoli	*Schiedea apokremnos*	Endangered	Endangered
No common name	*Schiedea attenuata*	Endangered	Endangered
No common name	*Schiedea helleri*	Endangered	Endangered
No common name	*Schiedea Kauaʻiensis*	Endangered	Endangered
Kuawawaenohu	*Schiedea lychnoides*	Endangered	Endangered
No common name	*Schiedea membranacea*	Endangered	Endangered
No common name	*Schiedea nuttallii*	Endangered	Endangered
No common name	*Schiedea spergulina var. leiopoda*	Endangered	Endangered
No common name	*Schiedea spergulina var. spergulina*	Threatened	Threatened
Laulihilihi	*Schiedea stellarioides*	Endangered	Endangered
No common name	*Schiedea viscosa*	Endangered	Endangered
Ohai	*Sesbania tomentosa*	Endangered	Endangered
No common name	*Sicyos lanceoloideus*	Proposed endangered	Proposed endangered
No common name	*Silene lanceolata*	Endangered	Endangered
Popolo ku mai	*Solanum incompletum*	Endangered	Endangered
Popolo	*Solanum nelsonii*	Proposed endangered	Proposed endangered
ʻAiakeakua, popolo	*Solanum sandwicense*	Endangered	Endangered
No common name	*Spermolepis Hawaiʻiensis*	Endangered	Endangered
No common name	*Stenogyne campanulata*	Endangered	Endangered
No common name	*Stenogyne kealiae*	Endangered	Endangered
No common name	*Viola helenae*	Endangered	Endangered
Nani waiʻaleʻale	*Viola Kauaʻiensis var. wahiawaensis*	Endangered	Endangered
No common name	*Wikstroemia skottsbergiana*	Proposed endangered	Proposed endangered
Dwarf iliau	*Wilkesia hobdyi*	Endangered	Endangered
No common name	*Xylosma crenatum*	Endangered	Endangered
Aʻe	*Zanthoxylum Hawaiʻiense*	Endangered	Endangered
Animals			
Mammals			
Hawaiʻian hoary bat	*Lasiurus cinereus semotus*	Endangered	Endangered
Birds			
Koloa (Hawaiian Duck)	*Anas wyvilliana*	Endangered	Endangered
Nēnē (Hawiian Goose)	*Branta sandvicensis*	Endangered	Endangered
ʻAlae keʼokeʻo (Hawaiian Coot)	*Fulica alai*	Endangered	Endangered
ʻAlae ʻula (Hawaiian Moorhen)	*Gallinula chloropus sandvicensis*	Endangered	Endangered
Nuku puʻu (Honeycreeper)	*Hemignathus lucidus*	Endangered	Endangered
Kauaʻi ʻAkialoa (Honeycreeper)	*Hemignathus procerus*	Endangered	Endangered
Kauaʻi ʻamakihi	*Hemignathus kauaiensis*	--	Vulnerable
Lesser ʻamakihi	*Hemignathus parvus*	--	Vulnerable
Aeʻo (Hawaiian Stilt)	*Himantopus mexicanus knudseni*	Endangered	Endangered
Akekee (Kauai Akepa)	*Loxops caeruleirostris*	Endangered	Endangered
Kauaʻi ʻ oʻo (Honeyeater)	*Moho braccatus*	Endangered	Endangered
Kāmaʻo (Large Kauai Thrush)	*Myadestes myadestinus*	Endangered	Endangered

See note at end of table.

Table 7-4. SNL/KTF threatened and endangered species potentially occurring on Kaua'i, Hawai'i (continued)

Common Name	Scientific Name	Federal Status	State Status
Animals (continued)			
Birds (continued)			
Puaiohi (Small Kauai Thrush)	*Myadestes palmeri*	Endangered	Endangered
Kioea (Bristle-thighed Curlew)	*Numenius tahitiensis*	--	Vulnerable
Band-rumped Storm Petrel	*Oceanodroma castro*	Endangered	Endangered
Short-tailed Albatross	*Phoebastria albatrus*	--	Threatened
Laysan Albatross	*Phoebastria immutabilis*	--	Near threatened
'Akikiki (Kauai Creeper)	*Oreomystis bairdi*	Endangered	Endangered
'O'u	*Psittirostra psittacea*	Endangered	Endangered
Hawaiian Petrel	*Pterodroma sandwichensis*	Endangered	Endangered
Newell's Shearwater	*Puffinus newelli*	Threatened	Endangered
'I'iwi	*Vestiaria coccinea*	Proposed Threatened	Vulnerable
Reptiles			
Green sea turtle	*Chelonia mydas*	Threatened	Threatened
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	Endangered
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	Endangered
Olive Ridley sea turtle	*Lepidochelys olivacea*	Threatened	Threatened
Snails			
Newcomb's snail	*Erinna newcombi*	Threatened	Threatened
Arachnids			
Kaua'i cave wolf, or Pe'e pe'e maka 'ole spider	*Adelocosa anops*	Endangered	Endangered
Insects			
Pomace fly (no common name)	*Drosophila musaphilia*	Endangered	Endangered
Hawai'ian picture-wing fly	*Drosophila sharpi*	Endangered	Endangered
Pacific Hawai'ian damselfly	*Megalagrion pacificum*	Endangered	Endangered
Orangeblack Hawai'ian damselfly	*Megalagrion xanthomelas*	Proposed endangered	Proposed endangered
Crustaceans			
Kaua'i cave amphipod	*Spelaeorchestia koloana*	Endangered	Endangered

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

7.7.4 Floodplain Management

As amended, EO 11988 of 1977, *Floodplain Management*, requires federal agencies to consider impacts associated with the occupancy and modification of floodplains; reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare; and restore and preserve the natural and beneficial values served by floodplains.

7.7.5 Planning for Federal Sustainability in the Next Decade

Issued in March 2015, EO 13693, *Planning for Federal Sustainability in the Next Decade*, establishes an integrated strategy toward sustainability to safeguard the health of our environment and make the reduction of greenhouse gas emissions and enhanced climate resilience a priority for all federal agencies. EO 13693 sets goals in the areas of promoting sustainable buildings, increasing renewable energy, reducing water use, promoting electronics stewardship through sustainable acquisition, preventing pollution, and reducing solid waste. Sustainability-related data for SNL/KTF was reported to the Site Sustainability Plan team for submittal to DOE/NNSA/SFO.

7.7.6 Protection of Wetlands

As amended, EO 11990 of 1977, *Protection of Wetlands*, requires federal agencies to minimize the destruction, loss, or degradation of wetlands and preserve and enhance the natural and beneficial values of wetlands. There are no floodplains or significant wetlands at SNL/TTR; however, some very limited wetlands exist in the vicinity of several springs. These provide an important source of drinking water for wildlife in the area.

7.8 Hazardous Waste

Hazardous waste at SNL/KTF is handled and managed in compliance with the following requirements.

7.8.1 Federal Facility Compliance Act

The Federal Facilities Compliance Act of 1976 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. Extended storage at DOE facilities is typically associated with mixed wastes (wastes that have hazardous and radioactive components) that have been generated on-site. 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.

7.8.2 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act, enacted in 1976, and the Hawai'i Revised Statutes regulate the generation, transportation, treatment, storage, and disposal of hazardous chemical waste and nonhazardous solid wastes. Applicable regulations, including Hawai'i implementing regulations, are listed in the References section ("State of Hawai'i Environmental Regulations"). Some hazardous waste is generated through normal operations at SNL/KTF. SNL/KTF is classified as a conditionally exempt small-quantity generator and is subject to the applicable requirements.

Hawai'ian Goose (*Branta sandvicensis*)

7.9 National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969 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. Proposed actions that would not significantly impact the human environment are categorically excludable from additional NEPA documentation (as identified in DOE 10 CFR 1021, *National Environmental Policy Act Implementing Procedures*).

Other proposed actions may fit within a class of actions that have environmentally significant impacts associated with them. For this class of proposed actions, the agency must prepare an environmental assessment or an environmental impact statement before making an irretrievable commitment of resources or funding. Although a major objective of NEPA is to preserve the environment for future generations, the law does not require an agency to choose a course of action with the least environmental impacts. DOE/NNSA/SFO coordinates NEPA compliance at SNL/KTF with personnel from SNL/NM and SNL/KTF.

7.10 Pollution Prevention and Waste Minimization

Pollution prevention concepts first appeared in the Resource and Conservation Recovery Act (RCRA). An expressed concern was to minimize the generation of hazardous waste through process substitution, materials recovery, recycling, reuse, and treatment. RCRA established the reduction or elimination of hazardous waste as national policy, and required that hazardous waste generators and RCRA permit holders have a program in place to minimize waste. As required, waste generation and recycling information is reported annually to DOE through the Site Sustainability Plan.

7.10.1 Pollution Prevention Goals of Site Sustainability Plan

The Site Sustainability Plan establishes a commitment to meet pollution prevention goals identified in DOE's Strategic Sustainability Performance Plan and EO 13693, *Planning for Federal Sustainability in the Next Decade*. Pollution prevention and waste minimization data are reported in the Site Sustainability Plan. Additional information about pollution prevention activities is provided in Chapter 8.

7.10.2 Pollution Prevention Act

The Pollution Prevention Act of 1990 declares, as national policy, that pollution should be prevented or reduced at the source (42 U.S. Code [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. See Section 7.5.1 for additional information on EPCRA reporting requirements.

Operations at Sandia National Laboratories comply with the Quiet Community Act, ensuring that noises do not jeopardize the health and welfare of the public.

7.11 Quiet Communities Act

In accordance with the Quiet Communities Act of 1978 (42 USC 4901 et seq.), noise monitoring was conducted in February 1993 during a STARS FTU-1 launch to confirm the determination made in the STARS Environmental Impact Statement that noise produced from the largest launch at SNL/KTF would be below maximum acceptable levels (SNL/NM 1993). Data collected in the nearest town of Kekaha indicated that levels were no louder than noise generated from passing vehicles on a nearby highway.

7.12 Water Quality and Protection

SNL/KTF operations are subject to the requirements of the Clean Water Act and corresponding State of Hawai'i requirements.

7.12.1 Clean Water Act

The Clean Water Act of 1972 and amendments establishes a permitting structure and regulatory direction to protect the "waters of the United States" by restoring and maintaining the chemical, physical, and biological integrity of U.S. waters; protecting fish, wildlife and recreation; and reducing pollutant discharges. There were no compliance issues at SNL/KTF with respect to any state or federal water pollution regulations in 2016.

7.12.2 Safe Drinking Water Act

The Safe Drinking Water Act of 1974 and amendments do not apply directly to activities at SNL/KTF because all drinking water at the site is either supplied by the Pacific Missile Range Facility drinking water system or purchased from commercial suppliers.

7.12.3 Oil Pollution Act

Bulk oil storage containers and oil-filled operational equipment with a capacity of 55 gal or more are subject to EPA regulations 40 CFR 112, *Oil Pollution Prevention*, and 40 CFR 110 *Discharge of Oil*. Underground storage tanks are regulated under the Hawai'i Administrative Rules, Title 11, Chapter 281, *Underground Storage Tanks*. See Chapter 8 for details.

7.13 Department of Energy Directives

DOE directives in the Management and Operating Contract define the primary contractual obligations for management and operating of SNL/KTF. Directives that pertain to environmental protection and management are discussed in Chapter 6. In 2016, the management and operating contractor for SNL adhered to requirements stated in these DOE directives.

7.14 Occurrence and Release Reporting

Under DOE O 232.2 Admin Change 1, the current order for occurrence reporting, an *occurrence* is defined as "one or more (i.e., recurring) events or conditions that adversely affect, or may adversely affect, DOE (including NNSA) 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." There are environmental releases that may not meet DOE O 232.2 reporting thresholds; however, they may still be reportable to outside agencies. There were no DOE O 232.2 reportable occurrences at SNL/KTF in 2016.

7.15 Summary of Environmental Permits

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

Table 7-3. SNL/KTF permits in place, 2016

Type	Permit Number	Date Issued	Expiration Date	Regulatory Agency
Noncovered source permit (two stand-by diesel generators)	NSP 0429-01-N	September 28, 2015	September 28, 2020	State of Hawai'i
Underground storage tank (2,500 gal)	P-2016-064	June 8, 2016	June 8, 2021	Hawai'i Department of Health

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

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Chapter 8. SNL/KTF Environmental Programs

Green sea turtle off the coast of Kaua'I (*Chelonia mydas*)

OVERVIEW ■ Sandia National Laboratories' environmental programs monitor air, soil, and water at the Kaua'i Test Facility. In addition, personnel surveilled wastewater, meteorological, and noise emissions. SNL is classified as a conditionally exempt small-quantity generator, and follows applicable requirements for managing hazardous waste generated through normal operations.

Sandia National Laboratories (SNL) personnel conduct environmental, terrestrial, water, and air monitoring programs at SNL, Kaua'i Test Facility (SNL/KTF) in Hawai'i. SNL/KTF programs comply with federal, state, and local requirement.

Environmental programs and focus areas at SNL/KTF include the following:

- Air Quality Compliance Program
- Environmental Restoration (ER) Project
- Meteorological Program
- National Environmental Policy Act (NEPA) Program
- Oil Storage Program
- Terrestrial Surveillance Program
- Waste Management Program
- Water quality programs

Environmental surveillance activities at SNL/KTF in 2016 included wastewater, air emission, meteorological, and noise monitoring.

8.1 Air Quality Compliance Program

Based on air-monitoring results from the Strategic Target System (STARS) Flight Test Unit (FTU) 1 in February 1993 (SNL/NM 1993) and the Countermeasures Demonstration Experiment (CDX) rocket launch in the summer of 1992 (NDEP 2011; SNL/NM 1992), it was determined that rocket launches at SNL/KTF were not a significant source of air pollutants. Launches are infrequent, and recorded emissions did not exceed federal or state standards. Because the STARS-type rocket produces the greatest air emissions of those launched at SNL/KTF and remained within acceptable limits, it can be assumed that future launches of this type will also be within acceptable limits. Therefore, no further air emission monitoring is planned at this time. If a new rocket type is launched from SNL/KTF that differs in emission substance from the STARS rocket or air emission requirements change, then future monitoring may be considered.

As required by the State of Hawai'i, the 2016 Annual Emissions Report for air emissions was submitted to the State of Hawai'i in 2017 (DOE/NNSA/SFO 2016a). The annual fee was submitted to the State of Hawai'i for 2016, as required by the permit. Operations were in compliance with air quality regulations at SNL/KTF in 2016.

The two semiannual monitoring reports for 2016 were submitted to the State of Hawai'i within the required timelines (DOE/NNSA/SFO 2016a and DOE/NNSA/SFO 2016b); they indicated that operation of the Kaua'i Test Facility's generators are in compliance with the permitted operating limits. The highest total combined operating hours for a rolling 12-month period was 1,149.6 hours, which occurred in the period from June 2015 to May 2016.

Lawai, Hawai'i

8.2 Environmental Restoration Project

There are currently no ER sites at SNL/KTF. On September 30, 1996, the EPA granted a Site Evaluation Accomplished determination for the three ER 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 in the three areas.

8.3 Meteorological 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 (PMRF), and severe weather notifications are automatically issued by the PMRF Emergency Operations Center to all SNL/KTF resident personnel.

8.4 National Environmental Policy Act Program

In 2016, the SNL, New Mexico (SNL/NM) NEPA Program supported several customers with their associated programmatic activities performed at either SNL/KTF or PMRF, and provided support for various facilities proposed for decontamination and demolition.

The NEPA team completed four NEPA checklists for SNL/KTF, all of which were transmitted to the U.S. Department of Energy, National Nuclear Security Administration (DOE/NNSA), Sandia Field Office for review and completion in 2016. In addition, three SNL/KTF NEPA checklists created in 2016 are still in progress and are being actively managed by the SNL/NM NEPA team.

8.5 Oil Storage Program

SNL/KTF programs operate under the PMRF Spill Prevention Control and Countermeasures Plan (required under the Clean Water Act), which describes the oil storage facilities at the SNL/KTF site and the mitigation controls in place to prevent inadvertent discharges of oil. Additional oil storage capacity in 55 gal drums, mobile and portable containers, mobile refuelers, and oil-filled operational equipment (transformers, hydraulic elevators, etc.) occurs throughout the site on an as-needed basis. There are four DOE-owned storage tanks at SNL/KTF—one underground storage tank, one aboveground storage tank, and two generator base tanks.

8.6 Terrestrial Surveillance Program

The Terrestrial Surveillance Program at SNL/KTF collects and analyzes surface soil samples every five years for Target Analyte List metals to determine whether there has been release to the environment due to SNL/KTF operations. The last sampling event was conducted in 2012, confirming that operations made no detectable environmental impact (from metals) to the soil. The results and the baseline concentrations at the SNL/KTF site were presented in the *Calendar Year 2012 Annual Site Environmental Report for Tonopah Test Range, Nevada and Kaua'i Test Facility, Hawai'i* (SNL/NM 2013a). The next sampling event will be conducted in 2017/2018 under a modified sampling and analysis plan (in development).

8.7 Waste Management Program

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

8.8 Water Quality Programs

Water quality-related programs at SNL/KTF include wastewater discharge and stormwater. There are no drinking water or groundwater monitoring wells in the vicinity of SNL/KTF. All drinking water at the site is either supplied by the PMRF drinking water system or purchased from commercial suppliers.

8.8.1 Wastewater Discharge Program

Activities at SNL/KTF produce only sanitary sewage, which is directed into three DOE/NNSA-owned and state-registered septic tanks; all the tanks are currently in use. 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. Historically, no contaminants have been identified above the reporting limits from past sampling events. During 2016, all three septic tank systems were inspected, and one was pumped.

8.8.2 Stormwater Program

Stormwater runoff is directed into two French drains and four area drains with pumping systems in accordance with Hawai'i Underground Injection Control regulations (Hawai'i Administrative Rules Title 11, Chapter 23).

Chapter 9. SNL/KTF Quality Assurance

The coast of Kaua'I

OVERVIEW ■ Sandia National Laboratories' 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 the samples meet statistically established control criteria or prescribed acceptance control limits. In 2016, DOE Consolidated Audit Program audits at the primary Sample Management Office contract laboratories had no findings.

Sandia National Laboratories (SNL) personnel take responsibility and assume accountability for implementing quality assurance (QA) for its operations as specified in International Organization for Standard 9001 (ISO 2008), the Contractor Requirements Document of the U.S. Department of Energy (DOE) Order 414.1D (DOE O 414.1D), *Quality Assurance*, and 10 Code of Federal Regulations (CFR) 830 (10 CFR 830), Subpart A, "Quality Assurance," via policy statements, processes, and procedures, and by executing the actions specified in those processes and procedures. SNL 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.

9.1 Environmental Monitoring for Quality Assurance

Environmental monitoring (which includes sampling) is conducted in accordance with program-specific sampling and analysis plans (SAPs), work plans, or Quality Assurance Plans, which contain applicable QA elements. These documents meet appropriate federal, state, and local requirements for conducting sampling and analysis activities. Personnel in various programs collect environmental samples and analyze the samples for radiological and nonradiological constituents.

Project SAPs (or equivalent) include critical elements, such as procedures for sample collection, sample preservation and handling, sample control, laboratory quality control (QC), required limits of detection, field QC, health and safety, schedules and frequency of sampling, data review, data acceptability, and reporting, along with references to analytical methods and analyte lists and known potential matrix interference.

9.1.1 Sample Management Office

The Sample Management Office (SMO), located at SNL, New Mexico (SNL/NM), packages, ships, and tracks environmental samples to off-site (contracted) laboratories.

SMO 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.

There are instances when samples are shipped directly to off-site laboratories, rather than to SMO. The Terrestrial Surveillance Program soil samples are shipped directly to an off-site laboratory.

9.1.2 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 U.S. Environmental Protection Agency (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 SMO Statement of Work (SOW) for Analytical Laboratories (SNL/NM 2013b). All calibrations and detection limits must be verified before sample analysis and data reporting. Once a laboratory has passed an initial appraisal and has been awarded a contract, the SMO is responsible for continuously monitoring laboratory performance to ensure that the laboratory meets its contractual requirements during annual audits.

SMO contract laboratories perform work in compliance with the SMO SOW 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. SMO 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 (NELAC) Standard.

9.1.3 Quality Control for Samples

Project-specified QC samples are submitted to contract laboratories in order to meet project data quality objectives and SAP requirements. Various field QC samples are 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 SNL/KTF sample batch, laboratory QC samples are prepared concurrently at defined frequencies and analyzed in accordance with established methods. The contract laboratory

determines the analytical accuracy, precision, contamination, and matrix effects associated with each analytical measurement.

QC sample results are compared either to statistically established control criteria or to prescribed acceptance control limits. Analytical results generated concurrently with QC sample results within established limits are considered acceptable. If QC 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 SOW and laboratory procedures. QC sample summaries are included in analytical reports prepared by contract laboratories.

9.1.4 Data Validation and Records Management

Sample collection, analysis request and chain of custody (ARCOC) 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 following sources are reviewed and the data validated at a minimum of three levels:

- The analytical laboratory validates data according to the laboratory's QA plan, standard operating procedures, and client-specific requirements.
- SMO personnel review the analytical reports and corresponding sample collection and ARCOC 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-specified requirements.

Kaua'i Test Facility

9.2 Sample Management Office Activities in 2016

SMO activities in 2016 included sample packaging, shipping, and tracking to off-site (contracted) laboratories, and reviewing all data deliverables for compliance with contract and data quality requirements.

9.2.1 Sample Handling and Analyses

In 2016, no samples were collected for the Terrestrial Surveillance Program or other environmental programs or projects at SNL/KTF.

9.2.2 Laboratory Quality Assurance Assessments and Validation

In 2016, SMO personnel continued independent, on-site assessments and validation at the NELAC-approved laboratories used by SNL personnel. Specific checks were made for documentation completeness, proper equipment calibration, proper laboratory practices, and batch QC data.

9.2.3 Quality Assurance Audits

The DOE Consolidated Audit Program (DOECAP) conducted audits in 2016 at the primary SMO contract laboratories using DOE/Department of Defense *Consolidated Quality Systems Manual* requirements. The audit reports, laboratory responses, and closure letters are all posted and tracked through the DOECAP website. The SMO worked closely with the contract laboratories to resolve audit findings expeditiously. Decisions regarding sample distribution to contract laboratories were based on audit information, including outstanding corrective actions.

No findings were issued in 2016 in either the DOECAP audit or the Mixed Analyte Performance Evaluation Program audit.

Glossary

SNL/TTR, Playa lake, Tonopah Test Range

A

aboveground storage tank (AST) 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).

aeolian Relating to or arising from the action of the wind.

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

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.

biographic 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.

ephemeral spring A spring that flows only briefly in the immediate locality.

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 United States or is otherwise released into the environment.

I

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 the Resource Conservation and Recovery Act, 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.

S

saltation The movement of hard particles such as sand over an uneven surface in a turbulent flow of air or water.

Sandia Management Model A web-based, interactive description of SNL activities, responsibilities, and success rates. This model is a high-level depiction intended to be viewed by a broad audience for a comprehensible and dynamic experience in understanding how the corporation operates.

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 (UST) 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). SNL USTs are double-wall, fiberglass-reinforced plastic construction.

U.S. Forest Service (USFS) withdrawal area A portion of Kirtland Air Force Base consisting of land within the Cibola National Forest that has been withdrawn from public access for use by the U.S. Air Force and the DOE.

W

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

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Toxic Substances Control Act (TSCA) of 1976 (15 USC §2601 et seq.).

Note: USC = United States Code.

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State of Nevada Environmental Regulations

Nevada regulatory information can be found at the Nevada State Legislature website: *http://www.leg.state.nv.us/*.

A listing of the Nevada Administration Code (NAC) can be found at *http://www.leg.state.nv.us/NAC*.

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Appendix A. 2016 SNL/TTR Terrestrial Surveillance Analytical Results

Bighorn sheep (*Ovis canadensis*)

Contents

Appendix A presents the SNL/TTR terrestrial surveillance analytical results for 2016.

Table A-1. Radiological results for off-site soil sampling locations at SNL/TTR, 2016

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
C-20	Americium-241	0.0501 ± 0.0654	0.11	U	BD	HASL-300
	Cesium-137	0.0538 ± 0.023	0.0282		J	HASL-300
	Uranium-235	0.124 ± 0.139	0.152	U	BD	HASL-300
	Uranium-238	1.69 ± 1.33	0.933		J	HASL-300
C-21	Americium-241	0.113 ± 0.104	0.169	U	BD	HASL-300
	Cesium-137	0.0979 ± 0.0324	0.0306		None	HASL-300
	Uranium-235	0.054 ± 0.102	0.183	U	BD	HASL-300
	Uranium-238	1.87 ± 1.6	1.33		J	HASL-300
C-22	Americium-241	0.109 ± 0.0928	0.137	U	BD	HASL-300
	Cesium-137	0.0153 ± 0.0212	0.0311	U	BD	HASL-300
	Uranium-235	0.0142 ± 0.157	0.165	U	BD	HASL-300
	Uranium-238	1.02 ± 1.26	1.17	U	BD	HASL-300
C-23	Americium-241	0.046 ± 0.0985	0.174	U	BD	HASL-300
	Cesium-137	0.0662 ± 0.0304	0.0331		J	HASL-300
	Uranium-235	0.0519 ± 0.139	0.183	U	BD	HASL-300
	Uranium-238	1.64 ± 1.37	1.41		J	HASL-300
C-24	Americium-241	-0.024 ± 0.0914	0.155	U	BD	HASL-300
	Cesium-137	0.0723 ± 0.0307	0.0369		J	HASL-300
	Uranium-235	0.119 ± 0.185	0.19	U	BD	HASL-300
	Uranium-238	1.63 ± 1.24	1.36		J	HASL-300
C-25	Americium-241	0.126 ± 0.105	0.143	U	BD	HASL-300
	Cesium-137	0.205 ± 0.0398	0.0331		None	HASL-300
	Uranium-235	0.192 ± 0.148	0.173		J	HASL-300
	Uranium-238	1.73 ± 1.34	1.18		J	HASL-300
C-26	Americium-241	0.00479 ± 0.0539	0.0918	U	BD	HASL-300
	Cesium-137	0.0879 ± 0.0301	0.0284		None	HASL-300
	Uranium-235	0.029 ± 0.15	0.178	U	BD	HASL-300
	Uranium-238	1.49 ± 0.959	0.833		J	HASL-300
C-27	Americium-241	0.062 ± 0.119	0.122	U	BD	HASL-300
	Cesium-137	0.2 ± 0.0402	0.0325		None	HASL-300
	Uranium-235	0.166 ± 0.149	0.176	U	BD	HASL-300
	Uranium-238	1.11 ± 0.974	1.05		J	HASL-300
C-28	Americium-241	0.0382 ± 0.0299	0.0395	U	BD	HASL-300
	Cesium-137	0.122 ± 0.0278	0.0266		None	HASL-300
	Uranium-235	0.0772 ± 0.102	0.12	U	BD	HASL-300
	Uranium-238	1.23 ± 0.577	0.397		None	HASL-300
C-29	Americium-241	0.0375 ± 0.0255	0.0375	U	BD	HASL-300
	Cesium-137	0.137 ± 0.0207	0.0215		None	HASL-300
	Uranium-235	0.0447 ± 0.0994	0.111	U	BD	HASL-300
	Uranium-238	1.57 ± 0.518	0.335		None	HASL-300

See notes at end of appendix.

Table A-1. Radiological results for off-site soil sampling locations at TTR, 2016 (continued)

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
C-30	Americium-241	0.0173 ± 0.0379	0.0661	U	BD	HASL-300
	Cesium-137	0.221 ± 0.025	0.0172		None	HASL-300
	Uranium-235	0.166 ± 0.0936	0.0934		J	HASL-300
	Uranium-238	0.966 ± 0.789	0.574		J	HASL-300
C-31	Americium-241	0.0511 ± 0.0326	0.0512	U	BD	HASL-300
	Cesium-137	0.0977 ± 0.0248	0.0253		None	HASL-300
	Uranium-235	0.0414 ± 0.109	0.112	U	BD	HASL-300
	Uranium-238	0.83 ± 0.475	0.358		J	HASL-300
C-32	Americium-241	0.00926 ± 0.0468	0.079	U	BD	HASL-300
	Cesium-137	0.0765 ± 0.0261	0.0298		J	HASL-300
	Uranium-235	0.0392 ± 0.143	0.151	U	BD	HASL-300
	Uranium-238	1.4 ± 1	0.733		J	HASL-300
C-33	Americium-241	-0.00444 ± 0.0884	0.154	U	BD	HASL-300
	Cesium-137	0.107 ± 0.0284	0.0315		None	HASL-300
	Uranium-238	0.544 ± 1.46	1.29	U	BD	HASL-300

See notes at end of appendix.

Table A-2. Radiological results for perimeter soil sampling locations at SNL/TTR, 2016

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
P-06	Americium-241	0.0141 ± 0.0252	0.032	U	BD	HASL-300
	Cesium-137	0.167 ± 0.0235	0.0214		None	HASL-300
	Uranium-235	0.0772 ± 0.106	0.105	U	BD	HASL-300
	Uranium-238	1.22 ± 0.474	0.339		None	HASL-300
P-08	Americium-241	0.045 ± 0.0379	0.0558	U	BD	HASL-300
	Cesium-137	0.0545 ± 0.0158	0.0189		J	HASL-300
	Uranium-235	0.103 ± 0.126	0.104	U	BD	HASL-300
	Uranium-238	1.42 ± 0.669	0.503		J	HASL-300
P-11	Americium-241	0.0442 ± 0.0669	0.111	U	BD	HASL-300
	Americium-241	-0.00169 ± 0.0657	0.112	U	BD	HASL-300
	Americium-241	0.0538 ± 0.0767	0.115	U	BD	HASL-300
	Cesium-137	0.196 ± 0.029	0.0297		None	HASL-300
	Cesium-137	0.195 ± 0.0227	0.0211		None	HASL-300
	Cesium-137	0.198 ± 0.027	0.0226		None	HASL-300
	Uranium-235	0.0688 ± 0.112	0.124	U	BD	HASL-300
	Uranium-235	0.0685 ± 0.103	0.115	U	BD	HASL-300
	Uranium-235	0.145 ± 0.135	0.153	U	BD	HASL-300
	Uranium-238	1.76 ± 0.945	0.988		J	HASL-300
	Uranium-238	0.692 ± 0.996	0.95	U	BD	HASL-300
	Uranium-238	1.41 ± 1.07	0.923		J	HASL-300
P-12	Americium-241	0.0264 ± 0.0482	0.0826	U	BD	HASL-300
	Cesium-137	0.307 ± 0.0324	0.0217		None	HASL-300
	Uranium-235	0.148 ± 0.109	0.115		J	HASL-300
	Uranium-238	1.13 ± 0.869	0.712		J	HASL-300
P-34	Americium-241	0.019 ± 0.0282	0.0478	U	BD	HASL-300
	Cesium-137	0.267 ± 0.0316	0.0285		None	HASL-300
	Uranium-235	0.0139 ± 0.0872	0.134	U	BD	HASL-300
	Uranium-238	1.65 ± 0.795	0.462		None	HASL-300
P-35	Americium-241	0.0188 ± 0.137	0.217	U	BD	HASL-300
	Cesium-137	0.25 ± 0.0339	0.0289		None	HASL-300
	Uranium-235	0.0103 ± 0.148	0.174	U	BD	HASL-300
P-36	Americium-241	0.0447 ± 0.0308	0.0447	U	BD	HASL-300
	Cesium-137	0.11 ± 0.0273	0.0262		None	HASL-300
	Uranium-235	0.183 ± 0.14	0.127		J	HASL-300
	Uranium-238	0.926 ± 0.527	0.396		J	HASL-300
P-37	Americium-241	0.0729 ± 0.107	0.172	U	BD	HASL-300
	Cesium-137	0.0308 ± 0.0146	0.0251		J	HASL-300
	Uranium-235	0.155 ± 0.135	0.137		J	HASL-300
	Uranium-238	1.45 ± 1.42	1.31		J	HASL-300

See notes at end of appendix.

Table A-3. Radiological results for South Plume Area soil sampling locations at SNL/TTR, 2016

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-49	Americium-241	0.584 ± 0.118	0.101		None	HASL-300
	Cesium-137	0.407 ± 0.0317	0.0216		None	HASL-300
	Plutonium-238	0.0451 ± 0.0299	0.0461	U	BD	DOE EML HASL-300
	Plutonium-239/240	5.76 ± 0.752	0.0634		J-	DOE EML HASL-300
	Uranium-235	0.128 ± 0.111	0.126		J	HASL-300
	Uranium-238	1.51 ± 0.987	0.851		J	HASL-300
S-50	Cesium-137	0.359 ± 0.0428	0.0224		None	HASL-300
	Uranium-235	0.0312 ± 0.104	0.136	U	BD	HASL-300
	Uranium-238	1.41 ± 1.3	1.18		J	HASL-300
S-51	Americium-241	3.35 ± 0.46	0.0468		None	HASL-300
	Cesium-137	0.229 ± 0.0302	0.0275		None	HASL-300
	Plutonium-238	0.224 ± 0.184	0.298	*U	BD	DOE EML HASL-300
	Uranium-235	0.152 ± 0.132	0.142		J	HASL-300
	Uranium-238	1.6 ± 0.591	0.438		None	HASL-300
S-52	Americium-241	0.201 ± 0.121	0.12		J	HASL-300
	Cesium-137	0.254 ± 0.0247	0.0225		None	HASL-300
	Plutonium-238	0.0242 ± 0.0235	0.0495	U	BD	DOE EML HASL-300
	Plutonium-239/240	1.82 ± 0.289	0.0681		None	DOE EML HASL-300
	Uranium-235	0.131 ± .0116	0.125		J	HASL-300
	Uranium-238	0.711 ± 1.17	1.02	U	BD	HASL-300

See notes at end of appendix.

Table A-4. Radiological results for Range Operations Center on-site soil sampling locations at SNL/TTR, 2016

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-40	Americium-241	0.0387 ± 0.0396	0.0607	U	BD	HASL-300
	Cesium-137	0.0562 ± 0.0204	0.0218		J	HASL-300
	Uranium-235	0.114 ± 0.104	0.114	U	BD	HASL-300
	Uranium-238	1.15 ± 0.679	0.56		J	HASL-300
S-41	Americium-241	0.0348 ± 0.0453	0.0708	U	BD	HASL-300
	Cesium-137	0.0395 ± 0.0166	0.0216		J	HASL-300
	Uranium-235	0.0598 ± 0.0962	0.119	U	BD	HASL-300
	Uranium-238	1.17 ± 0.803	0.642		J	HASL-300
S-42	Americium-241	-0.0152 ± 0.0802	0.137	U	BD	HASL-300
	Cesium-137	0.318 ± 0.0488	0.036		None	HASL-300
	Uranium-235	0.11 ± 0.111	0.207	U	BD	HASL-300
	Uranium-238	1.15 ± 1.16	1.18	U	BD	HASL-300
S-43	Americium-241	0.0632 ± 0.0724	0.11	U	BD	HASL-300
	Cesium-137	0.0248 ± 0.0223	0.0237		J	HASL-300
	Uranium-235	0.13 ± 0.115	0.134	U	BD	HASL-300
	Uranium-238	1.87 ± 1.1	0.929		J	HASL-300
S-44	Americium-241	0.0623 ± 0.0647	0.0995	U	BD	HASL-300
	Cesium-137	0.0637 ± 0.0232	0.0223		J	HASL-300
	Uranium-235	0.143 ± 0.121	0.121		J	HASL-300
	Uranium-238	1.84 ± 1.11	0.842		J	HASL-300
S-45	Americium-241	0.0129 ± 0.0483	0.0813	U	BD	HASL-300
	Cesium-137	0.0216 ± 0.02	0.0236	U	BD	HASL-300
	Uranium-235	0.131 ± 0.0853	0.117		J	HASL-300
	Uranium-238	1.44 ± 0.904	0.692		J	HASL-300
S-46	Americium-241	0.0822 ± 0.121	0.118	U	BD	HASL-300
	Cesium-137	0.0523 ± 0.0187	0.0238		J	HASL-300
	Uranium-235	0.079 ± 0.127	0.124	U	BD	HASL-300
S-47	Americium-241	0.0365 ± 0.0336	0.0475	U	BD	HASL-300
	Cesium-137	0.131 ± 0.0312	0.0301		None	HASL-300
	Uranium-235	0.0158 ± 0.134	0.142	U	BD	HASL-300
	Uranium-238	1.54 ± 0.685	0.477		None	HASL-300

See notes at end of appendix.

Table A-5. Radiological results for various on-site soil sampling locations at SNL/TTR, 2016

Location	Analyte	Activity	MDA (pCi/g)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-02	Americium-241	0.0472 ± 0.0507	0.0604	U	BD	HASL-300
	Cesium-137	0.26 ± 0.0328	0.0213		None	HASL-300
	Uranium-235	0.0112 ± 0.104	0.117	U	BD	HASL-300
	Uranium-238	1 ± 0.674	0.561		J	HASL-300
S-03	Cesium-137	0.175 ± 0.0278	0.0229		None	HASL-300
	Uranium-235	0.0897 ± 0.142	0.132	U	BD	HASL-300
	Uranium-238	1.8 ± 1.44	1.02		J	HASL-300
S-04	Americium-241	0.00493 ± 0.0741	0.122	U	BD	HASL-300
	Cesium-137	0.219 ± 0.0284	0.0224		None	HASL-300
	Uranium-235	0.0129 ± 0.0683	0.114	U	BD	HASL-300
	Uranium-238	2.73 ± 1.42	0.952		J	HASL-300
S-09	Americium-241	1.25 ± 0.248	0.171		None	HASL-300
	Cesium-137	0.138 ± 0.0305	0.0331		None	HASL-300
	Plutonium-238	0.0735 ± 0.0504	0.077	U	BD	DOE EML HASL-300
	Plutonium-239/240	8.46 ± 1.34	0.106		None	DOE EML HASL-300
	Uranium-235	0.0041 ± 0.153	0.182	U	BD	HASL-300
	Uranium-238	1.76 ± 1.46	1.49		J	HASL-300
S-10	Americium-241	-0.00725 ± 0.0584	0.0961	U	BD	HASL-300
	Cesium-137	0.0875 ± 0.0254	0.03		J	HASL-300
	Uranium-235	0.0594 ± 0.113	0.128	U	BD	HASL-300
	Uranium-238	1.1 ± 0.972	0.838		J	HASL-300
S-38	Americium-241	0.0322 ± 0.0227	0.0322	U	BD	HASL-300
	Cesium-137	0.248 ± 0.0238	0.0232		None	HASL-300
	Uranium-235	0.0659 ± 0.0908	0.0931	U	BD	HASL-300
	Uranium-238	1.37 ± 0.504	0.29		None	HASL-300
S-39	Cesium-137	0.292 ± 0.027	0.026		None	HASL-300
	Uranium-235	0.242 ± .147	0.144		J	HASL-300
	Uranium-238	1.13 ± 1.01	0.933		J	HASL-300
S-53	Americium-241	0.0804 ± 0.0885	0.14	U	BD	HASL-300
	Cesium-137	0.17 ± 0.0294	0.033		None	HASL-300
	Uranium-235	-0.0395 ± 0.101	0.172	U	BD	HASL-300
	Uranium-238	1.61 ± 1.32	1.19		J	HASL-300

See notes at end of appendix.

Table A-6. Thermoluminescent dosimeter measurements by quarter and location class, fiscal year 2016

Location Class	Location Number	First Quarter (97 Days)		Second Quarter (91 Days)		Third Quarter (80 Days)		Fourth Quarter (91 Days)	
		Exposure (mR)	Error	Exposure (mR)	Error	Exposure (mR)	Error	Exposure (mR)	Error
On-Site	S-01	45.0	1.2	45.8	2.5	36.2	0.5	40.7	2.1
	S-02	46.1	0.8	45.6	4.3	39.5	0.6	41.5	0.9
	S-03	47.3	1.6	48.7	2.5	38.6	0.7	40.1	1.1
	S-04	87.9	10.8	50.5	2.6	39.7	1.1	40.5	1.6
	S-09	39.9	1.8	45.9	3.1	34.6	0.7	35.3	0.6
	S-10	59.5	1.9	NC	NC	38.7	2.6	39.2	1.2
	S-13	43.5	0.8	46.3	2.5	34.6	1.9	37.7	0.8
	S-14	41.4	2.5	44.5	2.5	36.0	1.0	35.6	1.1
	S-15	44.3	0.9	47.5	2.6	40.1	3.4	38.7	1.0
	S-16	45.8	0.9	48.0	2.9	36.7	1.0	39.9	1.6
	S-17	43.3	1.1	44.8	2.8	36.3	1.3	39.2	1.7
Perimeter	P-05	44.0	0.9	46.3	2.5	38.7	0.6	41.6	1.1
	P-06	41.5	1.4	46.6	2.9	36.2	0.6	36.4	1.4
	P-07	41.2	0.8	45.0	3.0	34.3	0.8	37.4	1.6
	P-08	39.3	0.9	47.2	4.5	39.7	3.9	35.5	0.7
	P-11	50.7	0.8	53.5	2.8	43.4	0.9	45.7	0.7
	P-12	44.2	1.1	48.2	3.0	38.1	1.7	40.7	0.5
Community	C-19	31.7	0.8	36.6	2.5	26.4	0.8	29.5	0.6
	C-21	41.8	0.9	45.7	2.7	38.5	2.5	35.8	1.1
	C-22	41.4	0.8	45.5	2.7	35.9	0.5	36.5	0.8

See notes at end of appendix.

Table A-7. Nonradiological results for South Plume Area soil sampling locations at SNL/TTR, 2016

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-49	Aluminum	10,300	14.9	49.5		J	SW-846 3050B/6020
	Antimony	0.311	0.311	0.942	U	None	SW-846 3050B/6010B
	Arsenic	2.26	0.198	0.99		None	SW-846 3050B/6020
	Beryllium	0.455	0.0198	0.099		None	SW-846 3050B/6020
	Cadmium	0.279	0.0198	0.198		None	SW-846 3050B/6020
	Chromium	4.88	0.198	0.594	B	None	SW-846 3050B/6020
	Copper	6.46	0.0653	0.198		None	SW-846 3050B/6020
	Iron	8,280	6.53	19.8		J	SW-846 3050B/6020
	Lead	17.2	0.099	0.396		None	SW-846 3050B/6020
	Magnesium	3,590	1.98	5.94		None	SW-846 3050B/6020
	Nickel	5.04	0.099	0.396		None	SW-846 3050B/6020
	Selenium	0.85	0.327	0.99	J	None	SW-846 3050B/6020
	Silver	0.0942	0.0942	0.471	U	None	SW-846 3050B/6010B
	Thallium	0.136	0.0594	0.396	JB	0.37U	SW-846 3050B/6020
	Uranium	0.518	0.0131	0.0396		None	SW-846 3050B/6020
	Zinc	31	0.396	1.98	BN	J+	SW-846 3050B/6020
S-50	Aluminum	10,300	14.6	48.5		J	SW-846 3050B/6020
	Antimony	0.326	0.326	0.988	U	None	SW-846 3050B/6010B
	Arsenic	2.84	0.194	0.971		None	SW-846 3050B/6020
	Beryllium	0.501	0.0194	0.0971		None	SW-846 3050B/6020
	Cadmium	0.332	0.0194	0.194		None	SW-846 3050B/6020
	Chromium	6.22	0.194	0.583	B	None	SW-846 3050B/6020
	Copper	7.4	0.0641	0.194		None	SW-846 3050B/6020
	Iron	9,610	32	97.1		J	SW-846 3050B/6020
	Lead	11.4	0.0971	0.388		None	SW-846 3050B/6020
	Magnesium	3,830	1.94	5.83		None	SW-846 3050B/6020
	Nickel	5.78	0.0971	0.388		None	SW-846 3050B/6020
	Selenium	0.805	0.32	0.971	J	None	SW-846 3050B/6020
	Silver	0.141	0.0988	0.494	J	None	SW-846 3050B/6010B
	Thallium	0.14	0.0583	0.388	JB	0.37U	SW-846 3050B/6020

See notes at end of appendix.

Table A-7. Nonradiological results for South Plume Area soil sampling locations at TTR, 2016 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-50	Uranium	0.529	0.0128	0.0388		None	SW-846 3050B/6020
	Zinc	37.1	0.388	1.94	BN	J+	SW-846 3050B/6020
S-51	Aluminum	11,700	14.9	49.6		J	SW-846 3050B/6020
	Antimony	0.318	0.318	0.963	U	None	SW-846 3050B/6010B
	Arsenic	3.96	0.198	0.992		None	SW-846 3050B/6020
	Beryllium	0.642	0.0198	0.0992		None	SW-846 3050B/6020
	Cadmium	0.327	0.0198	0.198		None	SW-846 3050B/6020
	Chromium	8.97	0.198	0.595	B	None	SW-846 3050B/6020
	Copper	9.95	0.0655	0.198		None	SW-846 3050B/6020
	Iron	12,100	32.7	99.2		J	SW-846 3050B/6020
	Lead	12	0.0992	0.397		None	SW-846 3050B/6020
	Magnesium	4,930	1.98	5.95		None	SW-846 3050B/6020
	Nickel	8.39	0.0992	0.397		None	SW-846 3050B/6020
	Selenium	0.85	0.327	0.992	J	None	SW-846 3050B/6020
	Silver	0.255	0.0963	0.482	J	None	SW-846 3050B/6010B
	Thallium	0.174	0.0595	0.397	JB	0.37U	SW-846 3050B/6020
	Uranium	0.845	0.0131	0.0397		None	SW-846 3050B/6020
	Zinc	41.1	0.397	1.98	BN	J+	SW-846 3050B/6020
S-52	Aluminum	11,000	14.9	49.6		J	SW-846 3050B/6020
	Antimony	0.33	0.33	1	U	None	SW-846 3050B/6010B
	Arsenic	3.96	0.198	0.992		None	SW-846 3050B/6020
	Beryllium	0.601	0.0198	0.0992		None	SW-846 3050B/6020
	Cadmium	0.286	0.0198	0.198		None	SW-846 3050B/6020
	Chromium	6.94	0.198	0.595	B	None	SW-846 3050B/6020
	Copper	8.65	0.0655	0.198		None	SW-846 3050B/6020
	Iron	9,910	32.7	99.2		J	SW-846 3050B/6020
	Lead	10.1	0.0992	0.397		None	SW-846 3050B/6020
	Magnesium	3,990	1.98	5.95		None	SW-846 3050B/6020
	Nickel	6.88	0.0992	0.397		None	SW-846 3050B/6020

See notes at end of appendix.

Table A-7. Nonradiological results for South Plume Area soil sampling locations at TTR, 2016 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-52	Selenium	0.813	0.327	0.992	J	None	SW-846 3050B/6020
	Silver	0.1	0.1	0.5	U	None	SW-846 3050B/6010B
	Thallium	0.166	0.0595	0.397	JB	0.37U	SW-846 3050B/6020
	Uranium	0.763	0.0131	0.0397		None	SW-846 3050B/6020
	Zinc	34.9	0.397	1.98	BN	J+	SW-846 3050B/6020

See notes at end of appendix.

Table A-8. Nonradiological results for various on-site soil sampling locations at SNL/TTR, 2016

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-02	Aluminum	7,460	2.82	9.4		J	SW-846 3050B/6020
	Antimony	0.337	0.319	0.965	J	2.8UJ	SW-846 3050B/6010B
	Arsenic	2.89	0.188	0.94		None	SW-846 3050B/6020
	Beryllium	0.392	0.0188	0.094		None	SW-846 3050B/6020
	Cadmium	0.166	0.0188	0.188	J	None	SW-846 3050B/6020
	Chromium	4.01	0.188	0.564	B	None	SW-846 3050B/6020
	Copper	4.03	0.062	0.188		None	SW-846 3050B/6020
	Iron	6,960	6.2	18.8		J	SW-846 3050B/6020
	Lead	7.33	0.094	0.376		None	SW-846 3050B/6020
	Magnesium	2,220	1.88	5.64		None	SW-846 3050B/6020
	Nickel	3.92	0.094	0.376		None	SW-846 3050B/6020
	Selenium	0.787	0.31	0.94	J	None	SW-846 3050B/6020
	Silver	0.0965	0.0965	0.483	U	None	SW-846 3050B/6010B
	Thallium	0.159	0.0564	0.376	JB	0.37U	SW-846 3050B/6020
	Uranium	0.871	0.0124	0.0376		None	SW-846 3050B/6020
	Zinc	27.5	0.376	1.88	BN	J+	SW-846 3050B/6020
S-03	Aluminum	7,940	2.93	9.77		J	SW-846 3050B/6020
	Antimony	0.356	0.312	0.945	J	2.8UJJ	SW-846 3050B/6010B
	Arsenic	3.8	0.195	0.977		None	SW-846 3050B/6020
	Beryllium	0.443	0.0195	0.0977		None	SW-846 3050B/6020
	Cadmium	0.216	0.0195	0.195		None	SW-846 3050B/6020
	Chromium	5.02	0.195	0.586	B	None	SW-846 3050B/6020
	Copper	5.58	0.0645	0.195		None	SW-846 3050B/6020
	Iron	8,080	6.45	19.5		J	SW-846 3050B/6020
	Lead	8.61	0.0977	0.391		None	SW-846 3050B/6020
	Magnesium	2,660	1.95	5.86		None	SW-846 3050B/6020
	Nickel	4.47	0.0977	0.391		None	SW-846 3050B/6020
	Selenium	0.625	0.322	0.977	J	None	SW-846 3050B/6020
	Silver	0.124	0.0945	0.473	J	None	SW-846 3050B/6010B
	Thallium	0.112	0.0586	0.391	JB	0.37U	SW-846 3050B/6020

See notes at end of appendix.

Table A-8. Nonradiological results for various on-site soil sampling locations at TTR, 2016 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-03	Uranium	0.696	0.0129	0.0391		None	SW-846 3050B/6020
	Zinc	26.1	0.391	1.95	BN	J+	SW-846 3050B/6020
S-04	Aluminum	6,760	2.85	9.51		J	SW-846 3050B/6020
	Antimony	0.303	0.303	0.919	U	None	SW-846 3050B/6010B
	Arsenic	2.17	0.19	0.951		None	SW-846 3050B/6020
	Beryllium	0.419	0.019	0.0951		None	SW-846 3050B/6020
	Cadmium	0.268	0.019	0.19		None	SW-846 3050B/6020
	Chromium	3.19	0.19	0.57	B	None	SW-846 3050B/6020
	Copper	4.36	0.0627	0.19		None	SW-846 3050B/6020
	Iron	6,980	6.27	19		J	SW-846 3050B/6020
	Lead	6.6	0.0951	0.38		None	SW-846 3050B/6020
	Magnesium	2,270	1.9	5.7		None	SW-846 3050B/6020
	Nickel	2.98	0.0951	0.38		None	SW-846 3050B/6020
	Selenium	0.721	0.314	0.951	J	None	SW-846 3050B/6020
	Silver	0.0919	0.0919	0.46	U	None	SW-846 3050B/6010B
	Thallium	0.085	0.057	0.38	JB	0.37U	SW-846 3050B/6020
	Uranium	0.741	0.0125	0.038		None	SW-846 3050B/6020
	Zinc	24.7	0.38	1.9	BN	J+	SW-846 3050B/6020
S-09	Aluminum	12,900	14.6	48.8		J	SW-846 3050B/6020
	Antimony	0.47	0.317	0.96	J	2.8UJ	SW-846 3050B/6010B
	Arsenic	4.23	0.195	0.977		None	SW-846 3050B/6020
	Beryllium	0.739	0.0195	0.0977		None	SW-846 3050B/6020
	Cadmium	0.233	0.0195	0.195		None	SW-846 3050B/6020
	Chromium	8.1	0.195	0.586	B	None	SW-846 3050B/6020
	Copper	9.75	0.0645	0.195		None	SW-846 3050B/6020
	Iron	15,300	32.2	97.7		J	SW-846 3050B/6020
	Lead	13.1	0.0977	0.391		None	SW-846 3050B/6020
	Magnesium	5,700	1.95	5.86		None	SW-846 3050B/6020
	Nickel	7.65	0.0977	0.391		None	SW-846 3050B/6020
	Selenium	0.814	0.322	0.977	J	None	SW-846 3050B/6020

See notes at end of appendix.

Table A-8. Nonradiological results for various on-site soil sampling locations at TTR, 2016 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-09	Silver	0.269	0.096	0.48	J	None	SW-846 3050B/6010B
	Thallium	0.213	0.0586	0.391	JB	0.37U	SW-846 3050B/6020
	Uranium	0.648	0.0129	0.0391		None	SW-846 3050B/6020
	Zinc	44.5	0.391	1.95	BN	J+	SW-846 3050B/6020
S-10	Aluminum	8,360	2.87	9.56		J	SW-846 3050B/6020
	Antimony	0.418	0.324	0.982	J	2.8UJ	SW-846 3050B/6010B
	Arsenic	2.61	0.191	0.956		None	SW-846 3050B/6020
	Beryllium	0.531	0.0191	0.0956		None	SW-846 3050B/6020
	Cadmium	0.223	0.0191	0.191		None	SW-846 3050B/6020
	Chromium	4.89	0.191	0.574	B	None	SW-846 3050B/6020
	Copper	5.8	0.0631	0.191		None	SW-846 3050B/6020
	Iron	8,260	6.31	19.1		J	SW-846 3050B/6020
	Lead	7.5	0.0956	0.382		None	SW-846 3050B/6020
	Magnesium	3,070	1.91	5.74		None	SW-846 3050B/6020
	Nickel	4.4	0.0956	0.382		None	SW-846 3050B/6020
	Selenium	0.752	0.315	0.956	J	None	SW-846 3050B/6020
	Silver	0.0982	0.0982	0.491	U	None	SW-846 3050B/6010B
	Thallium	0.126	0.0574	0.382	JB	0.37U	SW-846 3050B/6020
	Uranium	0.839	0.0126	0.0382		None	SW-846 3050B/6020
	Zinc	34.1	0.382	1.91	BN	J+	SW-846 3050B/6020
S-38	Aluminum	10,700	14.6	48.5		J	SW-846 3050B/6020
	Antimony	1.02	0.329	0.998		2.8UJ	SW-846 3050B/6010B
	Arsenic	4.38	0.194	0.971		None	SW-846 3050B/6020
	Beryllium	0.581	0.0194	0.0971		None	SW-846 3050B/6020
	Cadmium	0.243	0.0194	0.194		None	SW-846 3050B/6020
	Chromium	6.7	0.194	0.583	B	None	SW-846 3050B/6020
	Copper	6.47	0.0641	0.194		None	SW-846 3050B/6020
	Iron	9,560	6.41	19.4		J	SW-846 3050B/6020
	Lead	9.68	0.0971	0.388		None	SW-846 3050B/6020
	Magnesium	4,040	1.94	5.83		None	SW-846 3050B/6020

See notes at end of appendix.

Table A-8. Nonradiological results for various on-site soil sampling locations at TTR, 2016 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-38	Nickel	6.44	0.0971	0.388		None	SW-846 3050B/6020
	Selenium	0.6	0.32	0.971	J	None	SW-846 3050B/6020
	Silver	0.0998	0.0998	0.499	U	None	SW-846 3050B/6010B
	Thallium	0.147	0.0583	0.388	JB	0.37U	SW-846 3050B/6020
	Uranium	0.703	0.0128	0.0388		None	SW-846 3050B/6020
	Zinc	30.3	0.388	1.94	BN	J+	SW-846 3050B/6020
S-39	Aluminum	10,400	14.1	47		J	SW-846 3050B/6020
	Antimony	0.328	0.31	0.938	J	2.8UJ	SW-846 3050B/6010B
	Arsenic	4.77	0.188	0.94		None	SW-846 3050B/6020
	Beryllium	0.561	0.0188	0.094		None	SW-846 3050B/6020
	Cadmium	0.288	0.0188	0.188		None	SW-846 3050B/6020
	Chromium	7.24	0.188	0.564	B	None	SW-846 3050B/6020
	Copper	7.93	0.062	0.188		None	SW-846 3050B/6020
	Iron	10,900	31	94		J	SW-846 3050B/6020
	Lead	10.4	0.094	0.376		None	SW-846 3050B/6020
	Magnesium	4,160	1.88	5.64		None	SW-846 3050B/6020
	Nickel	6.5	0.094	0.376		None	SW-846 3050B/6020
	Selenium	0.658	0.31	0.94	J	None	SW-846 3050B/6020
	Silver	0.118	0.0938	0.469	J	None	SW-846 3050B/6010B
	Thallium	0.162	0.0564	0.376	JB	0.37U	SW-846 3050B/6020
	Uranium	0.782	0.0124	0.0376		None	SW-846 3050B/6020
	Zinc	40.1	0.376	1.88	BN	J+	SW-846 3050B/6020
S-53	Aluminum	3,790	2.78	9.26		J	SW-846 3050B/6020
	Antimony	0.323	0.323	0.978	U	None	SW-846 3050B/6010B
	Arsenic	3.17	0.185	0.926		None	SW-846 3050B/6020
	Beryllium	0.246	0.0185	0.0926		None	SW-846 3050B/6020
	Cadmium	0.14	0.0185	0.185	J	None	SW-846 3050B/6020
	Chromium	2.13	0.185	0.556	B	None	SW-846 3050B/6020
	Copper	2.77	0.0611	0.185		None	SW-846 3050B/6020
	Iron	3,980	6.11	18.5		J	SW-846 3050B/6020

See notes at end of appendix.

Table A-8. Nonradiological results for various on-site soil sampling locations at TTR, 2016 (continued)

Location	Analyte	Result (mg/kg)	MDL (mg/kg)	PQL (mg/kg)	Laboratory Data Qualifiers	Data Validation Qualifiers	Analytical Method
S-53	Lead	4.13	0.0926	0.37		None	SW-846 3050B/6020
	Magnesium	1,630	1.85	5.56		None	SW-846 3050B/6020
	Nickel	1.63	0.0926	0.37		None	SW-846 3050B/6020
	Selenium	0.703	0.306	0.926	J	None	SW-846 3050B/6020
	Silver	0.0978	0.0978	0.489	U	None	SW-846 3050B/6010B
	Thallium	0.113	0.0556	0.37	JB	0.37U	SW-846 3050B/6020
	Uranium	0.56	0.0122	0.037		None	SW-846 3050B/6020
	Zinc	13.3	0.37	1.85	BN	J+	SW-846 3050B/6020

See notes at end of appendix.

Appendix Notes

Units

mg/kg = milligrams per kilogram
mR = milliroentgen
pCi/g = picocuries per gram

MDL or MDA

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; the minimum concentration or activity that can be measured and reported with 99% confidence that the analyte is greater than zero; analyte is matrix specific

PQL

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 = a spike was outside limits
U = analyte is absent or below the method detection limit
* = a replicate was outside limits

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

Exposure

NC = not collected

Analytical Method

DOE (U.S. Department of Energy) Environmental Measurements Laboratory. 1997. *The Procedures Manual of the Environmental Measurements Laboratory*, HASL-300, 28th ed., vol. 1. New York, NY: DOE.
EPA (U.S. Environmental Protection Agency). 1986 (and updates). *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW-846, 3rd ed. Washington, D.C.: EPA.
HASL = Health and Safety Laboratory
EML = Environmental Measurements Laboratory

Appendix B. 2016 SNL/TTR Wastewater Sampling Results

SNL/TTR, Wild horse (*Equus ferus*)

Contents

Appendix B presents the SNL/TTR wastewater sampling results for June 2016.

Table B-1. Sanitary outfalls of inorganic analyses, June 2016

Station	Date Collected	Sample Identifier	Analyte	Result (mg/L)	MDL (mg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	29-Jun-2016	099786-001	Aluminum	0.101	0.015		EPA 200.8
		099786-001	Arsenic	0.00665	0.0017		EPA 200.8
		099786-001	Boron	0.713	0.04		EPA 200.8
		099786-001	Cadmium	0.000214	0.00011	J	EPA 200.8
		099786-001	Chromium	0.00208	0.002	J	EPA 200.8
		099786-001	Copper	0.0822	0.00035		EPA 200.8
		099786-001	Lead	0.00192	0.0005	J	EPA 200.8
		099786-001	Mercury	ND	0.000067	U	EPA 245.1/245.2
		099786-001	Molybdenum	0.0168	0.000165		EPA 200.8
		099786-001	Nickel	0.00497	0.0005		EPA 200.8
		099786-001	Selenium	0.00175	0.0015	J	EPA 200.8
		099786-001	Silver	0.000865	0.0002	J	EPA 200.8
		099786-001	Zinc	0.0933	0.0035	*N	EPA 200.8
		099786-002	Cyanide, total	0.00599	0.00167		EPA 335.4
		099786-003	Solids, total suspended	18.9	1.52	*	SM 2540D
		099786-007	Phenols, Total	0.0315	0.00167		SW-846 9066
		099786-008	Grease and oil	12.5	1.31		EPA 1664A/1664B
		099786-009	Grease and oil	ND	1.33	U	EPA 1664A/1664B
		099786-013	Chemical oxygen demand	213	8.95	B	EPA 410.4

See notes at end of appendix.

Table B-2. Summary of sanitary outfalls of radiological analyses, June 2016

Station	Date Collected	Sample Identifier	Analyte	Activity (pCi/L)	MDA (pCi/L)	Laboratory Data Qualifiers	Analytical Method
TTR	29-Jun-2016	099786-010	Actinium-228	-7.77 ± 11.9	12.6	U	EPA 901.1
		099786-010	Americium-241	-1.71 ± 6.62	9.75	U	EPA 901.1
		099786-010	Beryllium-7	8.26 ± 17.8	30.3	U	EPA 901.1
		099786-010	Bismuth-212	-27.2 ± 35.4	44.6	U	EPA 901.1
		099786-010	Bismuth-214	2.45 ± 9.68	7.34	U	EPA 901.1
		099786-010	Cesium-137	-1.1 ± 2.97	3.19	U	EPA 901.1
		099786-010	Cobalt-60	0.00725 ± 2.1	3.28	U	EPA 901.1
		099786-010	Lead-212	-0.73 ± 5.14	5.76	U	EPA 901.1
		099786-010	Lead-214	1.19 ± 5.95	6.99	U	EPA 901.1
		099786-010	Neptunium-237	0.569 ± 3.22	5.57	U	EPA 901.1
		099786-010	Potassium-40	12.7 ± 45.2	29.5	U	EPA 901.1
		099786-010	Radium-223	24.6 ± 38.3	57.2	U	EPA 901.1
		099786-010	Radium-224	-39.3 ± 39.7	54.3	U	EPA 901.1
		099786-010	Radium-226	17.4 ± 66.1	54.9	U	EPA 901.1
		099786-010	Radium-228	-7.77 ± 11.9	12.6	U	EPA 901.1
		099786-010	Sodium-22	0.415 ± 1.76	3.25	U	EPA 901.1
		099786-010	Thorium-227	-13.4 ± 15.1	19.7	U	EPA 901.1
		099786-010	Thorium-231	-22.1 ± 28.8	34.4	U	EPA 901.1
		099786-010	Thorium-234	105 ± 98.7	86	X	EPA 901.1
		099786-010	Uranium-235	1.13 ± 16.1	17.8	U	EPA 901.1
		099786-010	Uranium-238	105 ± 98.7	86	X	EPA 901.1
		099786-011	Alpha, gross	0.965 ± 2.76	4.77	U	EPA 900.0/SW-846 9310
		099786-011	Beta, gross	25.5 ± 4.9	3.1		EPA 900.0/SW-846 9310
		099786-012	Tritium	55.1 ± 107	183	U	EPA 906.0 Modified

See notes at end of appendix.

Table B-3. Summary of sanitary outfalls of semivolatile organic compounds, June 2016

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	29-Jun-2016	099786-006	Acenaphthene	ND	0.3	U	EPA 625
		099786-006	Acenaphthylene	ND	0.3	U	EPA 625
		099786-006	Anthracene	ND	0.3	NU	EPA 625
		099786-006	Benzidine	ND	3.9	NU	EPA 625
		099786-006	Benzo(a)anthracene	ND	0.3	U	EPA 625
		099786-006	Benzo(a)pyrene	ND	0.3	U	EPA 625
		099786-006	Benzo(b)fluoranthene	ND	0.3	U	EPA 625
		099786-006	Benzo(ghi)perylene	ND	0.3	U	EPA 625
		099786-006	Benzo(k)fluoranthene	ND	0.3	U	EPA 625
		099786-006	Bromophenyl phenyl ether, 4-	ND	3	U	EPA 625
		099786-006	Butylbenzyl phthalate	ND	3	U	EPA 625
		099786-006	Chloro-3-methylphenol, 4-	ND	3	U	EPA 625
		099786-006	Chloroethoxy)methane, bis(2-	ND	3	U	EPA 625
		099786-006	Chloroethyl)ether, bis(2-	ND	3	U	EPA 625
		099786-006	Chloroisopropyl)ether,bis(1-	ND	3	U	EPA 625
		099786-006	Chloronaphthalene, 2-	ND	0.41	U	EPA 625
		099786-006	Chlorophenol, 2-	ND	3	U	EPA 625
		099786-006	Chlorophenyl phenyl ether, 4-	ND	3	U	EPA 625
		099786-006	Chrysene	ND	0.3	U	EPA 625
		099786-006	Di-n-butyl phthalate	ND	3	U	EPA 625
		099786-006	Di-n-octyl phthalate	ND	3	U	EPA 625
		099786-006	Dibenz[a,h]anthracene	ND	0.3	U	EPA 625
		099786-006	Dichlorobenzidine, 3,3'-	ND	3	NU	EPA 625
		099786-006	Dichlorophenol, 2,4-	ND	3	U	EPA 625
		099786-006	Diethylphthalate	ND	3	U	EPA 625
		099786-006	Dimethylphenol, 2,4-	ND	3	U	EPA 625
		099786-006	Dimethylphthalate	ND	3	U	EPA 625
		099786-006	Dinitro-o-cresol	ND	3	U	EPA 625
		099786-006	Dinitrophenol, 2,4-	ND	5	U	EPA 625

See notes at end of appendix.

Table B-3. Summary of sanitary outfalls of semivolatile organic compounds, June 2016 (continued)

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	29-Jun-2016	099786-006	Dinitrotoluene, 2,4-	ND	3	*U	EPA 625
		099786-006	Dinitrotoluene, 2,6-	ND	3	U	EPA 625
		099786-006	Diphenyl amine	ND	3	NU	EPA 625
		099786-006	Diphenylhydrazine, 1,2-	ND	3	NU	EPA 625
		099786-006	Ethylhexyl)phthalate, bis(2-	ND	3	U	EPA 625
		099786-006	Fluoranthene	ND	0.3	U	EPA 625
		099786-006	Fluorene	ND	0.3	U	EPA 625
		099786-006	Hexachlorobenzene	ND	3	U	EPA 625
		099786-006	Hexachlorobutadiene	ND	3	U	EPA 625
		099786-006	Hexachlorocyclopentadiene	ND	3	U	EPA 625
		099786-006	Hexachloroethane	ND	3	U	EPA 625
		099786-006	Indeno(1,2,3-c,d)pyrene	ND	0.3	U	EPA 625
		099786-006	Isophorone	ND	3.5	U	EPA 625
		099786-006	Naphthalene	ND	0.3	U	EPA 625
		099786-006	Nitro-benzene	ND	3	NU	EPA 625
		099786-006	Nitrophenol, 2-	ND	3	U	EPA 625
		099786-006	Nitrophenol, 4-	ND	3	*U	EPA 625
		099786-006	Nitrosodimethylamine, n-	ND	3	U	EPA 625
		099786-006	Nitrosodipropylamine, n-	ND	3	U	EPA 625
		099786-006	Pentachlorophenol	ND	3	U	EPA 625
		099786-006	Phenanthrene	ND	0.3	U	EPA 625
		099786-006	Phenol	ND	3	U	EPA 625
		099786-006	Pyrene	ND	0.3	U	EPA 625
		099786-006	Trichlorobenzene, 1,2,4-	ND	3	U	EPA 625
		099786-006	Trichlorophenol, 2,4,6-	ND	3	U	EPA 625

See notes at end of appendix.

Table B-4. Summary of sanitary outfalls of volatile organic compounds, June 2016

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	29-Jun-2016	099786-005	Acrolein	ND	1.5	UH	EPA 624
		099786-005	Acrylonitrile	ND	1.5	UH	EPA 624
		099786-005	Benzene	ND	0.3	U	EPA 624
		099786-005	Bromodichloromethane	ND	0.3	U	EPA 624
		099786-005	Bromoform	ND	0.3	U	EPA 624
		099786-005	Bromomethane	ND	0.3	U	EPA 624
		099786-005	Carbon tetrachloride	ND	0.3	U	EPA 624
		099786-005	Chlorobenzene	ND	0.3	U	EPA 624
		099786-005	Chloroethane	ND	0.3	U	EPA 624
		099786-005	Chloroethyl vinyl ether, 2-	ND	1.5	NU	EPA 624
		099786-005	Chloroform	ND	0.3	U	EPA 624
		099786-005	Chloromethane	ND	0.3	U	EPA 624
		099786-005	Dibromochloromethane	ND	0.3	U	EPA 624
		099786-005	Dichlorobenzene, 1,2-	ND	0.3	U	EPA 624
		099786-005	Dichlorobenzene, 1,3-	ND	0.3	U	EPA 624
		099786-005	Dichlorobenzene, 1,4-	ND	0.3	U	EPA 624
		099786-005	Dichlorodifluoromethane	ND	0.3	U	EPA 624
		099786-005	Dichloroethane, 1,1-	ND	0.3	U	EPA 624
		099786-005	Dichloroethane, 1,2-	ND	0.3	U	EPA 624
		099786-005	Dichloroethene, 1,1-	ND	0.3	U	EPA 624
		099786-005	Dichloroethene, trans-1,2-	ND	0.3	U	EPA 624
		099786-005	Dichloropropane, 1,2-	ND	0.3	U	EPA 624
		099786-005	Dichloropropene, cis-1,3-	ND	0.3	U	EPA 624
		099786-005	Dichloropropene, trans-1,3-	ND	0.3	U	EPA 624
		099786-005	Ethyl benzene	ND	0.3	U	EPA 624
		099786-005	Methylene chloride	ND	1	U	EPA 624
		099786-005	Tetrachloroethane, 1,1,2,2-	ND	0.3	U	EPA 624
		099786-005	Tetrachloroethene	ND	0.3	U	EPA 624
		099786-005	Toluene	0.62	0.3	J	EPA 624

See notes at end of appendix.

Table B-4. Summary of sanitary outfalls of volatile organic compounds, June 2016 (continued)

Station	Date Collected	Sample Identifier	Analyte	Result (µg/L)	MDL (µg/L)	Laboratory Data Qualifiers	Analytical Method
TTR	29-Jun-2016	099786-005	Trichloroethane, 1,1,1-	ND	0.3	U	EPA 624
		099786-005	Trichloroethane, 1,1,2-	ND	0.3	U	EPA 624
		099786-005	Trichloroethene	ND	0.3	U	EPA 624
		099786-005	Trichlorofluoromethane	ND	0.3	U	EPA 624
		099786-005	Vinyl chloride	ND	0.3	U	EPA 624

See notes at end of appendix.

Appendix Notes

Units

mg/L = milligrams per liter
pCi/L – picocuries per liter
µg/L = micrograms per liter

Station

TTR = Tonopah Test Range

MDL or MDA

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

Results

ND = not detected about method detection level

Laboratory Data Qualifier

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 = Results associated with a spike analysis that was outside control limits.
U = The analyte was analyzed for, but not detected. For organic and inorganic analytes the result is less than the effective MDL concentration.
X = Data rejected due to peak not meeting identification criteria.
* = Recovery or %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 falls below the effective PQL.

PQL

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

Analytical Method

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