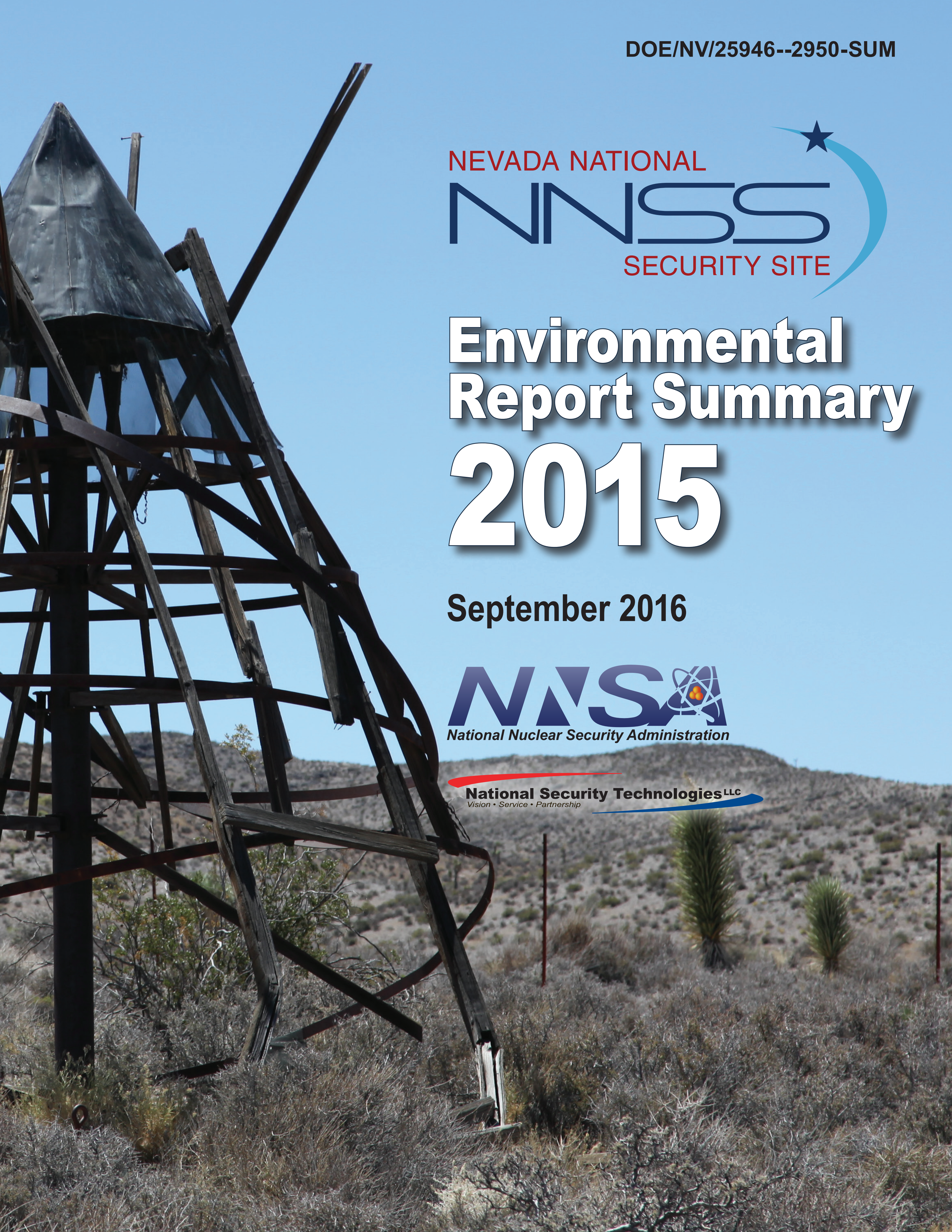
DOE/NV/25946--2950-SUM

NEVADA NATIONAL SECURITY SITE

Environmental Report Summary 2015

September 2016



National Nuclear Security Administration

National Security Technologies LLC
Vision • Service • Partnership

A Message from the Manager

The U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO) strives to achieve our missions in a safe, secure, sustainable, and environmentally responsible manner. Our staff, our contractor and laboratory partners, as well as other users of the Nevada National Security Site (NNSS) succeed through demonstrated teamwork, innovation, and continuous improvement.

The NNSA/NFO presents this environmental report to summarize actions taken in 2015 to protect the environment and the public while achieving our mission goals. It is prepared for the public and our stakeholders in hopes that it is readily understandable and usable. It is a key component in our efforts to keep the public informed of environmental conditions at the NNSS and its support facilities in Las Vegas, Nevada. The NNSA/NFO ensures the validity and accuracy of the data contained in this report.

We invite you to help us improve the usefulness and readability of this Environmental Report by providing your comments and concerns to Peter A. Sanders, (peter.sanders@nnsa.doe.gov).

Steven J. Lawrence

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Nevada Field Office
Manager

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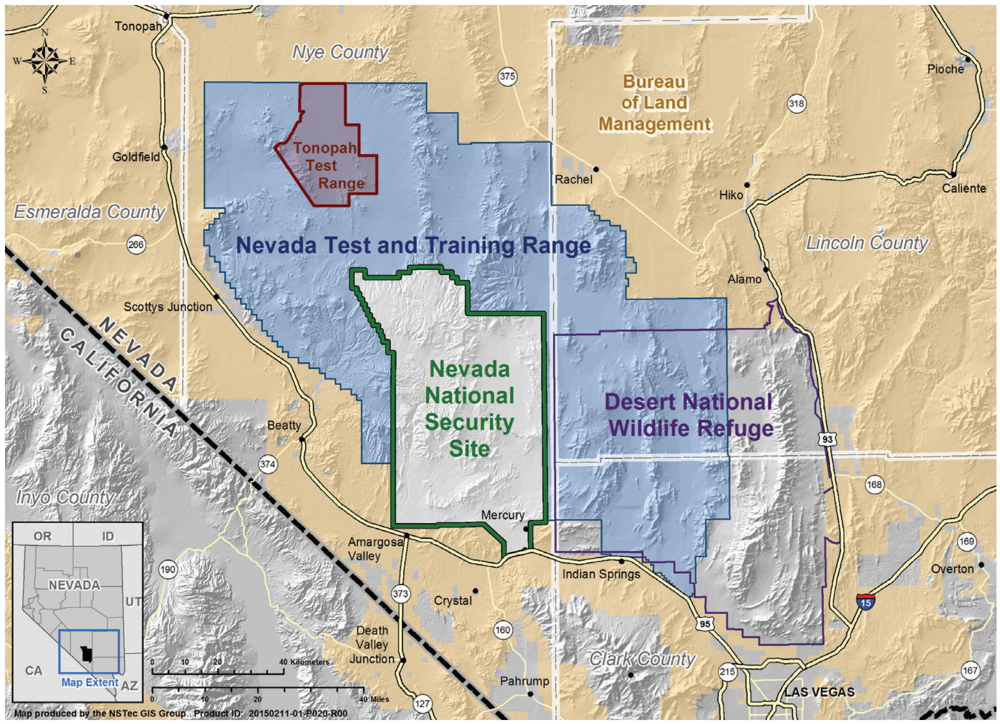
Nevada National Security Site Environmental Report Summary 2015

This document is a summary of the full *2015 Nevada National Security Site Environmental Report* (NNSSER) prepared by the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office (NNSA/NFO). This summary provides an abbreviated and more readable version of the full NNSSER. The reader is provided with an electronic file of the full NNSSER and of *Attachment A: Site Description* on a compact disc (see inside back cover). The reader may obtain a hard copy of the full NNSSER as directed on the inside back cover of this summary report.

NNSA/NFO prepares the NNSSER to provide the public an understanding of the environmental monitoring and compliance activities that are conducted on the Nevada National Security Site (NNSS) to protect the public and the environment from radiation hazards and from potential nonradiological impacts. It is a comprehensive report of environmental activities performed at the NNSS and offsite facilities over the previous calendar year.

The NNSS is currently the nation's unique site for ongoing national security–related missions and high-risk operations. The NNSS is located about 65 miles northwest of Las Vegas. The approximately 1,360-square-mile site is one of the largest restricted access areas in the United States. It is surrounded by federal installations with strictly controlled access as well as by lands that are open to public entry.



History of the NNSS

Between 1940 and 1950, the area now known as the NNSS was part of the Las Vegas Bombing and Gunnery Range. In 1950, the NNSS was established as the primary location for testing the nation's nuclear explosive devices. Such testing took place from 1951 to 1992.

Tests conducted through the 1950s were predominantly atmospheric tests. These involved a nuclear explosive device detonated while either on the ground surface, on a steel tower, suspended from tethered balloons, dropped from an aircraft, or placed on a rocket. Several tests were categorized as "safety experiments" and "storage-transportation tests," involving the destruction of a nuclear device with non-nuclear explosives. Some of these tests resulted in dispersion of plutonium in the test vicinity. Some of these test areas are on the Nevada Test and Training Range (NTTR) and on the Tonopah Test Range (TTR).

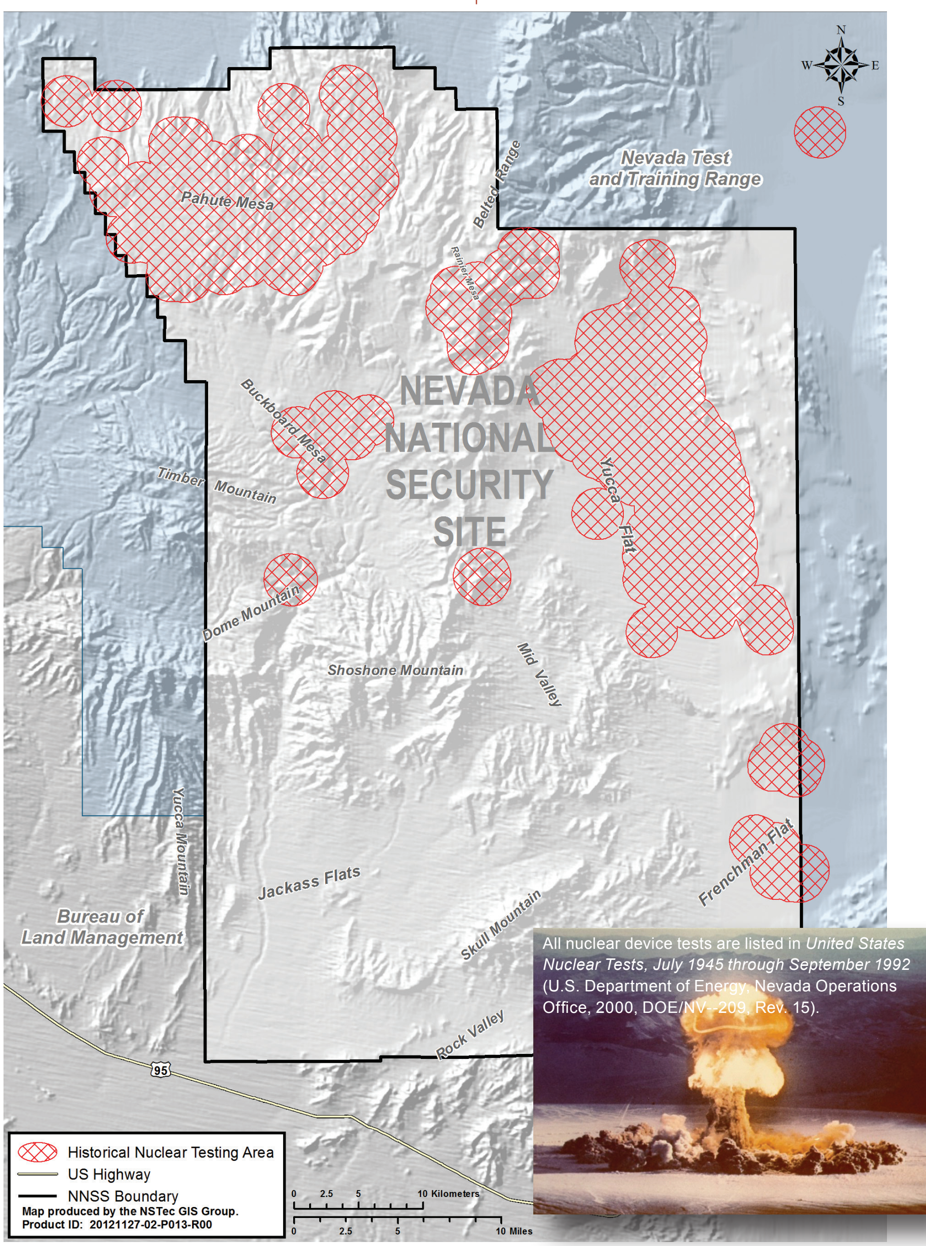
The first underground test, a cratering test, was conducted in 1951. The first fully contained underground nuclear test was conducted in 1957. Testing was discontinued during a moratorium that began October 31, 1958, but was resumed in September 1961 after tests by the Union of Soviet Socialist Republics began. Beginning in late 1962, nearly all tests were conducted in sealed vertical shafts drilled into Yucca Flat and Pahute Mesa or in horizontal tunnels mined into Rainier Mesa. From 1951 to 1992, a total of 828 underground nuclear tests were conducted at the NNSS. Approximately one-third of these tests were detonated near or below the water table.

Five earth-cratering (shallow-burial) tests were conducted from 1962 to 1968 as part of the Plowshare Program, which explored peaceful uses of nuclear explosives. The first and highest yield Plowshare crater test, Sedan, was detonated at the northern end of Yucca Flat. The second-highest yield crater test was Schooner

Continued on Page 2 ...

in the northwest corner of the NNSS. Mixed fission products, tritium, and plutonium from these tests were entrained in the soil, ejected from the craters, and deposited on the ground surrounding the craters.

Other nuclear-related experiments at the NNSS included the Bare Reactor Experiment–Nevada series in the 1960s. These tests were performed with a neutron generator mounted on a 1,527-foot steel tower to study neutron and gamma-ray interactions on various materials and to assess radiation doses experienced by the nuclear bomb survivors of Hiroshima and Nagasaki. From 1959 through 1973, a series of open-air nuclear reactor, engine, and furnace tests were conducted in Area 25, and a series of tests with a nuclear ramjet engine were conducted in Area 26. The tests released mostly gaseous radioactivity (radioiodines, radio-xenons, radiokryptons) and some fuel particles that resulted in negligible deposition on the ground.



All nuclear device tests are listed in *United States Nuclear Tests, July 1945 through September 1992* (U.S. Department of Energy, Nevada Operations Office, 2000, DOE/NV--209, Rev. 15).

Historical Nuclear Testing Areas on and adjacent to the NNSS

NNSS – Continental Test Site

After the end of World War II, the United States tested nuclear weapons at Bikini Atoll and Enewetak in the Marshall Islands of the Central Pacific.

In June 1950, with the outbreak of hostilities in Korea and U.S. relations with the Soviet Union continuing to deteriorate, the search began for a continental test site to overcome the difficulties with remoteness and security experienced with testing in the Pacific. The final choices included Dugway Proving Ground–Wendover Bombing Range in western Utah, Alamogordo–White Sands Guided Missile Range in south-central New Mexico, and a North Site and a South Site on the Las Vegas Bombing and Gunnery Range in southern Nevada.

On December 18, 1950, President Truman approved the recommendations of Los Alamos testing officials and the Atomic Energy Commission, christening the South Site on the Las Vegas Bombing and Gunnery Range as the nation's continental test site. It was called the Nevada Proving Ground.

On January 27, 1951, an Air Force B-50D bomber dropped a 1-kiloton yield nuclear bomb over Frenchman Flat. It was the world's tenth nuclear detonation and was the first test at the newly established Nevada Test Site (NTS).

On September 23, 1992, the last underground nuclear test was conducted on the NTS, after which Congress imposed a moratorium on nuclear weapons testing. Since 1951, a total of 100 atmospheric and 828 underground nuclear weapons tests have been conducted at the NTS.

Source: T. R. Fehner and F. G. Gosling, 2000. *Origins of the Nevada Test Site*, DOE/MA-0518, History Division, Executive Secretariat, Management and Administration, U.S. Department of Energy.

On August 23, 2010, the NTS was renamed the Nevada National Security Site to reflect the diversity of nuclear, energy, and homeland security activities conducted at the site.

The NNSS Now

NNSA/NFO conducts three major missions and their programs on the NNSS. Experimental programs are sponsored mainly by Los Alamos, Lawrence Livermore, and Sandia National Laboratories. During the conduct of all missions and their programs, NNSA/NFO complies with applicable environmental and public health protection regulations and strives to manage the land and facilities at the NNSS as a unique and valuable national resource. In 2015, National Security Technologies, LLC (NSTec), was the NNSS Management and Operations Contractor accountable for ensuring work was performed in compliance with environmental regulations.

NNSS activities in 2015 continued to be diverse, with the primary goal to ensure that the existing U.S. stockpile of nuclear weapons remains safe and reliable. Other activities included weapons of mass destruction first responder training; the controlled release of hazardous material at the Nonproliferation Test and Evaluation Complex (NPTEC); remediation of legacy contamination sites; characterization of waste destined for the Waste Isolation Pilot Plant in Carlsbad, New Mexico, or the Idaho National Laboratory in Idaho Falls, Idaho; disposal of low-level and mixed low-level radioactive waste; and environmental research. Facilities and centers that support the National Security/Defense mission include the U1a Facility, Big Explosives Experimental Facility (BEEF), Device Assembly Facility (DAF), National Criticality Experiments Research Center (NCERC) located in the DAF, Joint Actinide Shock Physics Experimental Research (JASPER) Facility, Dense Plasma Focus (DPF) Facility located in the Los Alamos Technical Facility (LATF), and the Radiological/Nuclear Countermeasures Test and Evaluation Complex (RNCTEC). Facilities that support the Environmental Management mission include the Area 5 Radioactive Waste Management Complex (RWMC) and the Area 3 Radioactive Waste Management Site (RWMS), which has been in cold standby since 2006.

NNSS Missions and Their Programs

National Security/Defense

Stockpile Stewardship and Management Program — Conducts high-hazard operations in support of defense-related nuclear and national security experiments.

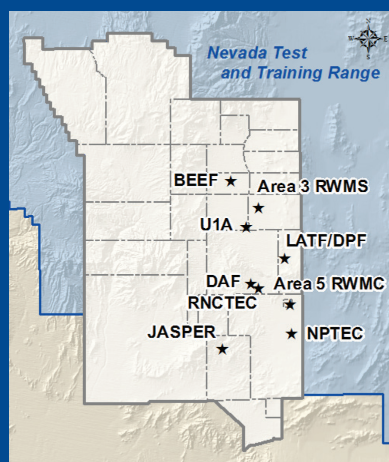
Nuclear Emergency Response, Nonproliferation, and Counterterrorism Programs — Provides support facilities, training facilities, and capabilities for government agencies involved in emergency response, nonproliferation technology development, national security technology development, and counterterrorism activities.

Strategic Partnership Projects — Provides support facilities and capabilities for other agencies/organizations involved in defense-related activities.

Environmental Management

Environmental Restoration Program — Characterizes and remediates the environmental legacy of nuclear weapons and other testing at the NNSS and NTTR locations, and develops and deploys technologies that enhance environmental restoration.

Waste Management Program — Manages and safely disposes of low-level waste and mixed low-level waste received from U.S. Department of Energy (DOE)- and U.S. Department of Defense (DoD)-approved facilities throughout the U.S. and wastes generated in Nevada by NNSA/NFO. Safely manages and characterizes hazardous and transuranic wastes for offsite disposal.



Nondefense

General Site Support and Infrastructure Program — Maintains the buildings, roads, utilities, and facilities required to support all NNSS programs and to provide a safe environment for NNSS workers.

Conservation and Renewable Energy Programs — Operates the pollution prevention program and supports renewable energy and conservation initiatives at the NNSS.

Other Research and Development — Provides support facilities and NNSS access to universities and organizations conducting environmental and other research unique to the regional setting.

Environmental Compliance

Activities on the NNSS are subject to federal and state laws intended to protect the environment and public health. These laws define emission limits or prohibit the emission of toxic substances into the air, water, and ground; require plans to prevent spills, unplanned releases, and accidents; and call for programs to monitor, measure, document, and report on compliance to regulatory agencies and the public.

The U.S. Environmental Protection Agency (EPA) and the Nevada Division of Environmental Protection (NDEP) are the principal regulators of NNSS activities.

The following table defines and summarizes results for a few of the many federal regulations with which NNSA/NFO must comply.

Summary of NNSA/NFO's Compliance with Major Federal Statutes in 2015

Environmental Statute or Order and What It Covers	2015 Status
Atomic Energy Act (through compliance with DOE O 435.1, "Radioactive Waste Management"): Management of low-level waste (LLW) and mixed low-level waste (MLLW) generated or disposed on site	1,334,186 cubic feet of waste was disposed on site in LLW and MLLW disposal cells at the Area 5 RWMC. Some of this volume also included classified low-level and nonradioactive items. Waste volumes were within permit limits; vadose zone and groundwater monitoring continued to verify that disposed LLW and MLLW are not migrating to groundwater or threatening biota or the environment.
Clean Air Act: Air quality and emissions into the air from facility operations	Onsite air sampling stations detected man-made radionuclides at levels comparable to previous years and well below the regulatory dose limit for air emissions to the public of 10 millirem per year (mrem/yr). The estimated dose from all 2015 NNSS air emissions to the maximally exposed individual (MEI) is 0.04 mrem/yr. Nonradiological air emissions from permitted equipment and facilities were all below emission and opacity limits, with the exception of one generator at RSL-Nellis that exceeded its opacity limit; the generator was removed from service.
Clean Water Act: Water quality and effluent discharges from facility operations	All domestic and industrial wastewater systems and groundwater monitoring well samples were within permit limits for regulated water contaminants and water chemistry parameters.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA): Cleanup of waste sites containing hazardous substances	No NNSS cleanup operations are regulated under CERCLA or SARA; they are regulated under the Resource Conservation and Recovery Act (RCRA) instead *(see below)*.
DOE O 458.1, "Radiation Protection of the Public and the Environment": Measuring radioactivity in the environment and estimating radiological dose to the public due to NNSA/NFO activities	Radiological monitoring of air, water, and direct radiation was conducted. The total annual dose to the MEI from all exposure pathways due to NNSA/NFO activities was estimated to be 2.91 mrem/yr, well below the DOE limit of 100 mrem/yr.
Emergency Planning and Community Right to Know Act (EPCRA): The public's right to know about toxic chemicals being stored, released to the environment, and/or managed through recycling or treatment	72,323 lb of lead, 6,473 lb of mercury, and 30.4 lb of polychlorinated biphenyls (PCBs) were released as a result of NNSS activities. The majority of lead (67%) and PCBs (66%) released and all but 0.12 lbs of mercury released was for onsite disposal.
Endangered Species Act (ESA): Threatened or endangered species of plants and animals	Field surveys for 5 projects in desert tortoise habitat and 8 projects in other habitats on the NNSS were conducted; no tortoise habitat was disturbed, and no tortoises were harmed at or displaced from project sites. Two tortoises were accidently killed by vehicles on paved roads, 17 were moved off roads to safety, and 6 were fitted with radio transmitters. All actions were in compliance with permit requirements.
Federal Facility Agreement and Consent Order (FFACO): Cleanup of waste sites containing hazardous substances	All 2015 corrective action milestones under the FFACO were met. A total of 24 corrective action sites were closed in accordance with state-approved corrective action plans.
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA): Storage and use of pesticides and herbicides	Only nonrestricted-use pesticides were applied by state-certified personnel. Storage and use of pesticides were in compliance with federal and state regulations.
Migratory Bird Treaty Act (MBTA): Protecting migratory birds, nests, and eggs from harm	Bird nests at proposed project sites were avoided, 1 active hawk nest was moved from a crane, 1 injured kestrel and 1 immature hawk were taken to Wild Wing Project for care, and 15 accidental bird deaths from human-related activities occurred.
National Environmental Policy Act (NEPA): Evaluating projects for environmental impacts	25 proposed projects/activities were reviewed under the NEPA compliance procedures and none required further NEPA analysis.
National Historic Preservation Act (NHPA): Identifying and preserving historic properties	Archival research for 29 proposed projects was conducted, and 318 acres were surveyed for 11 of the projects; 10 historic or prehistoric sites and 20 historic structures were identified.
Resource Conservation and Recovery Act (RCRA): Generation, management, disposal of hazardous waste (HW) and MLLW and cleanup of inactive, historical waste sites	1,379 tons of MLLW were disposed on site, 0.75 tons of MLLW were shipped off site for disposal, 6.9 tons of HW and 0.005 tons of PCB wastes were received for temporary onsite storage and/or treatment, and 7.75 tons of HW and 0.92 tons of PCB waste were shipped off site for disposal, all in accordance with state permits. Groundwater monitoring of wells at the Area 5 RWMS confirmed that buried MLLW remains contained, and vadose zone monitoring and post-closure inspections of historical RCRA closure sites confirmed that buried HW remains contained.
Safe Drinking Water Act: Quality of drinking water	All three permitted public water systems (PWSs) on the NNSS met applicable national and state water quality standards. Levels of aluminum and iron, which had exceeded Nevada's Secondary Standards in 2014 in the Area 25 PWS, returned to within their permit limits in 2015.
Toxic Substances Control Act (TSCA): Management and disposal of polychlorinated biphenyls (PCBs)	Seven drums and one pail of PCB-contaminated materials totalling 0.92 tons were shipped off site to permitted disposal and treatment facilities.

The Legacy of NNSS Nuclear Testing

Approximately one-third of the 828 underground nuclear tests on the NNSS were detonated near or below the water table, resulting in radioactive contamination of groundwater in some areas. In addition, the 100 atmospheric nuclear tests conducted on the NNSS and numerous nuclear-related experiments resulted in radioactive contamination of surface soils, materials, equipment, and structures, mainly on the NNSS.

The NNSA/NFO Environmental Management mission was established to address this legacy contamination. Within Environmental Management, Environmental Restoration is responsible for remediating contaminated sites, and Waste Management is responsible for safely managing and disposing of radioactive waste.

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Aerial view of Yucca Flat showing subsidence craters from historical underground nuclear tests.

Legacy Contamination

Groundwater — The total amount of radiation remaining below the groundwater table is approximately 40 to 60 million Ci, based on the most recent estimate, which incorporates corrections for radioactive decay since the last underground test in 1992. The areas of known and potential groundwater contamination on the NNSS due to underground nuclear testing are called Underground Test Area (UGTA) corrective action units.

Soil — Radioactively contaminated surface soils directly resulting from nuclear weapons testing exist at over 100 locations on and around the NNSS. The soils may contain contaminants including radioactive materials, oils, solvents, and heavy metals, as well as contaminated instruments and test structures used during testing activities.

Air — Airborne radioactive contamination from the resuspension of contaminated soils at legacy sites and from current activities is monitored continuously on and off the NNSS. Airborne concentrations of monitored contaminants have been decreasing at most sample locations on the NNSS over the past decade. Total curies estimated to be released across the entire NNSS fluctuate annually; the highest annual estimates since 1992 have been 2,200 Ci for tritium, 0.40 Ci for plutonium, and 0.049 Ci for americium. In air measured in communities surrounding the NNSS, emissions from the NNSS cannot be distinguished from background airborne radiation.

Structures/Materials — There are 1,865 sites where facilities, equipment, structures, and/or debris were contaminated by historical nuclear research, development, and testing activities. These structures/materials are referred to as Industrial Sites and include disposal wells, inactive tanks, contaminated buildings, contaminated waste sites, inactive ponds, muck piles, spill sites, drains and sumps, and ordnance sites.

Waste Disposal — Low-level and mixed low-level radioactive wastes have been generated by historical nuclear research, development, and testing activities and environmental cleanup activities. From the 1960s, when waste disposal began, through December 31, 2015, nearly 1.75 million cubic yards** of waste have been safely disposed at the Area 3 and Area 5 RWMSs. The estimated cumulative radioactivity of all wastes at the time of disposal is 16.3 million Ci. The radioactive content of the waste decays over time, however, at a varied rate depending on the radionuclide.

**This cumulative total through 2014 was previously reported as "nearly 1.8 million cubic yards." Due to discrepancies in historical shipping records prior to 1976, the total through 2015 was corrected and is believed to be more accurate.

Curie (Ci) is the traditional measure of radioactivity based on the observed decay rate of 1 gram of radium. One curie of radioactive material will have 37 billion disintegrations in 1 second.

The Legacy of NNSS Nuclear Testing *... continued from Page 5*

The Federal Facility Agreement and Consent Order (FFACO) between the State of Nevada, DOE, and DoD identifies corrective action units (CAUs), which are groupings of corrective action sites (CASs) that delineate areas of historical contamination. The FFACO establishes corrective actions and schedules for the remediation and closure of CASs. Approximately 3,000 CASs have been identified, the majority of which have already been remediated and/or closed. The public is kept informed of Environmental Management activities through periodic newsletters, exhibits, and fact sheets, and Environmental Management provides the opportunity for public input via the Nevada Site Specific Advisory Board (NSSAB), consisting of 15–20 citizen volunteers from Nevada.


Schooner Crater in Area 20 formed during a 1968 crater test exploring peaceful uses of nuclear explosives.

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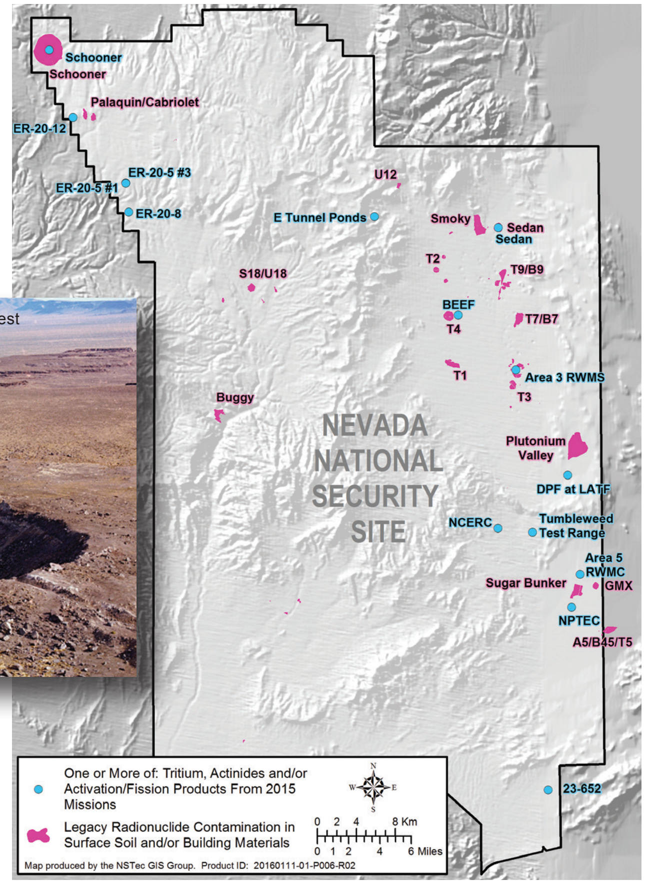
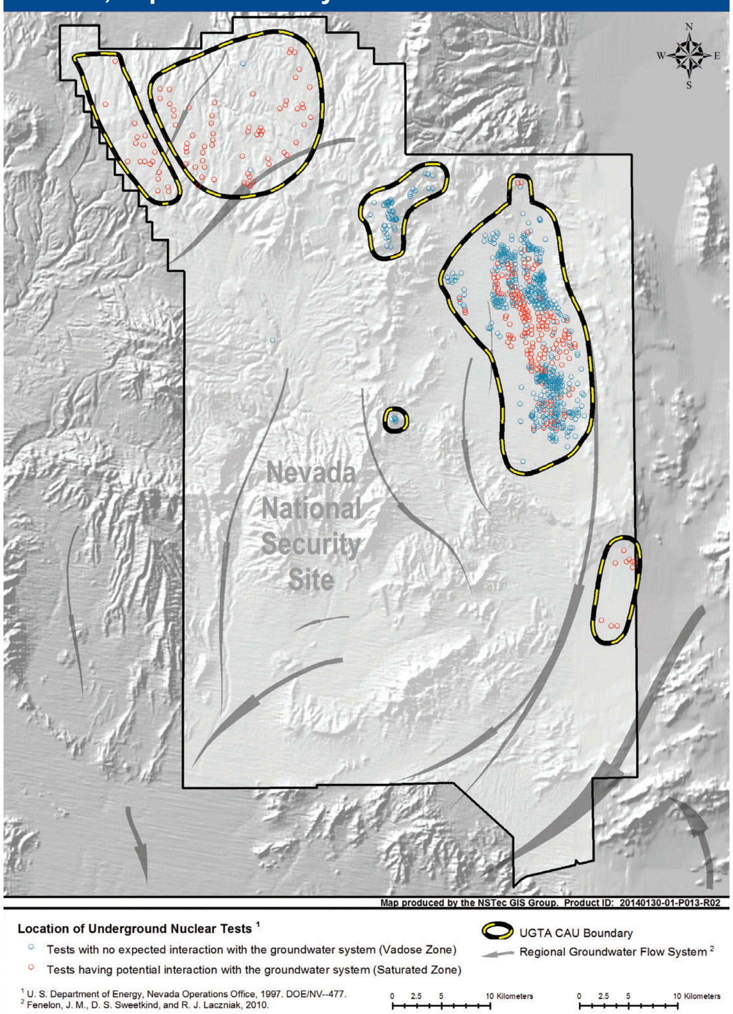
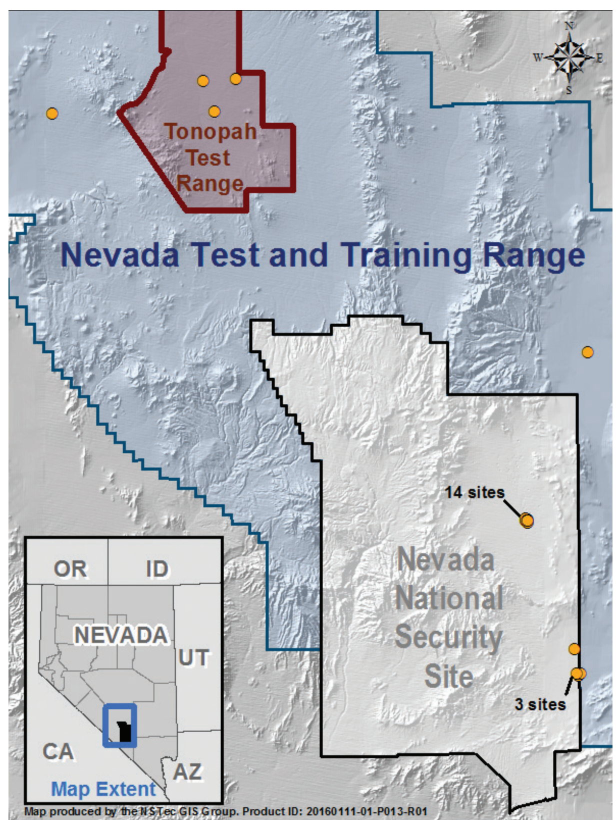


Sources of Radiological Air Emissions on the NNSS

The direction of groundwater flow, shown by the arrows, is predominantly southwest.



Areas of Potential Groundwater Contamination on the NNSS



Locations of Soil Contamination on and off the NNSS that Remain to be Remediated and/or Closed

The Legacy of NNSS Nuclear Testing

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Numerous man-made and naturally occurring radionuclides occur on the NNSS. The radionuclides produce ionizing radiation in the form of alpha particles, beta particles, and gamma rays, which are emitted from the unstable radionuclides as they decay to form more stable atoms. Almost all human exposure to ionizing radiation (82% in the United States) comes from natural sources that include cosmic radiation from outer space, terrestrial radiation from materials like uranium and radium in the earth, and naturally occurring radionuclides in food, water, and the aerosols and gases in the air we breathe. Man-made sources and applications of ionizing radiation in our everyday life include smoke detectors, X-rays, CT scans, and nuclear medicine procedures. For people living in areas around the NNSS, less than 2% of their total radiation exposure is attributable to past nuclear testing or to current NNSS activities.

Forms of Radiation

Alpha particles are heavy, positively charged particles given off by some decaying atoms. Alpha particles can be blocked by a sheet of paper. Atoms emitting alpha particles are hazardous only if they are swallowed or inhaled.

Beta particles are electrons or positrons (positively charged electrons) ejected from the nucleus of a decaying atom. More penetrating than alpha radiation, beta particles can pass through several millimeters of skin. A sheet of aluminum only a fraction of an inch thick will stop beta radiation. Beta particles can damage skin but are most hazardous if swallowed or inhaled.

Gamma rays are waves of pure energy similar to X-rays, light, microwaves, and radio waves. Gamma rays are emitted by certain radionuclides when their nuclei transition from a higher to a lower energy state. They can readily pass into the human body. They can be almost completely blocked by about 40 inches of concrete, 40 feet of water, or a few inches of lead. Gamma rays can be both an external and internal hazard.

X-rays are a more familiar form of electromagnetic radiation, usually with a limited penetrating power, typically used in medical or dental examinations. Television sets, especially color, give off soft (low-energy) X-rays; thus, they are shielded to greatly reduce the risk of radiation exposure.

Neutrons are uncharged heavy particles contained in the nucleus of every atom heavier than ordinary hydrogen. They induce ionization only indirectly in atoms that they strike, but they can damage body tissues. Neutrons are released, for example, during the fission (splitting) of uranium atoms in the fuel of nuclear power plants. They can also be very penetrating. In general, efficient shielding against neutrons can be provided by materials containing hydrogen, such as water. Like gamma rays, neutrons are both an external and internal hazard.

Radionuclides Detected on the NNSS

	Name*	Abbreviation	Primary Type(s) of Radiation	Major NNSS Source
Man-Made	Americium-241	^{241}Am	Alpha, gamma	In soil at and near legacy sites of aboveground nuclear testing. Detected in soil and air.
	Cesium-137	^{137}Cs	Beta, gamma	
	Plutonium-238	^{238}Pu	Alpha	
	Strontium-90	^{90}Sr	Beta	
	Cobalt-60	^{60}Co	Gamma	In soil at and near legacy sites of aboveground nuclear testing. Detected in soil.
	Europium-152	^{152}Eu	Gamma	
	Europium-155	^{155}Eu	Gamma	
	Plutonium-239+240	$^{239+240}Pu$	Alpha	In soil at and near legacy sites of plutonium dispersal experiments. Detected in soil and air.
	Tritium	^{3}H	Beta	In groundwater in areas of underground nuclear tests, in surface ponds used to contain contaminated groundwater, in soil at nuclear test locations, and in waste packages buried in pits at waste management sites. Detected in groundwater and air.
Naturally Occurring	Beryllium-7	^{7}Be	Gamma	Produced by interactions between cosmic radiation from the sun and the earth's upper atmosphere. Detected in air.
	Potassium-40	^{40}K	Beta, gamma	Naturally occurring in the earth's crust. Detected in groundwater, soil, and air.
	Radium-226	^{226}Ra	Alpha, gamma	
	Thorium-232	^{232}Th	Alpha	
	Uranium-234**	^{234}U	Alpha	
	Uranium-235**	^{235}U	Alpha, gamma	
	Uranium-238**	^{238}U	Alpha	

*The number given with the name of the radionuclide is the atomic mass number, which is the total number of protons and neutrons in the nucleus of the atom. Atoms with the same number of protons are the same element; atoms of the same element with different mass numbers are called isotopes of one another.

**These uranium isotopes, though of natural origin, can also be detected at specific NNSS locations where man-made depleted uranium has been released during experiments, resulting in an alteration of the relative amounts of each isotope.

Cleanup and Closure of Corrective Action Sites

UGTA Sites

Environmental Restoration gathers data to characterize the groundwater aquifers beneath the NNSS and adjacent lands. The data are used to develop hydrogeologic models for the CAUs and the larger UGTA model areas that will forecast the groundwater movement and transport of radiological contaminants from the CAUs. Closure of the UGTA CAUs under the FFACO will involve long-term groundwater monitoring because cost-effective technologies have not been developed to effectively remove or stabilize the radiological contaminants produced during historical underground nuclear testing. The progress towards closure of each UGTA CAU is summarized below. The design and results to date of all wells in NNSA/NFO's groundwater sampling network are presented on Pages 11 and 12.

Central and Western Pahute Mesa CAUs – These CAUs are in the middle of the investigation stage of the closure process. The Phase I Central and Western Pahute Mesa Transport Model, completed in 2009, forecasts that tritium in groundwater may migrate off the northwestern boundary of the NNSS within 50 years of the first nuclear detonation (in 1965) and that offsite concentrations of tritium may be above the Safe Drinking Water Act limit of 20,000 picocuries per liter (pCi/L) *(see figure on next page)*.

Consistent with the transport model forecast, tritium was detected in well ER-EC-11 on the NTTR in 2009. ER-EC-11 is located approximately 2,350 feet west of the NNSS boundary and approximately 2 miles from the nearest underground nuclear tests, Benham and Tybo, conducted in 1968 and 1975, respectively. Well ER-EC-11 was sampled in 2014 and tritium was detected at 16,100 pCi/L. It is scheduled to be resampled in 2016.

A Phase II Central and Western Pahute Mesa Corrective Action Investigation Plan was completed in 2009. The plan outlines the field investigation program that is currently being implemented. The program's objective is to collect additional data to test the assumptions of the Phase I groundwater flow and contam-

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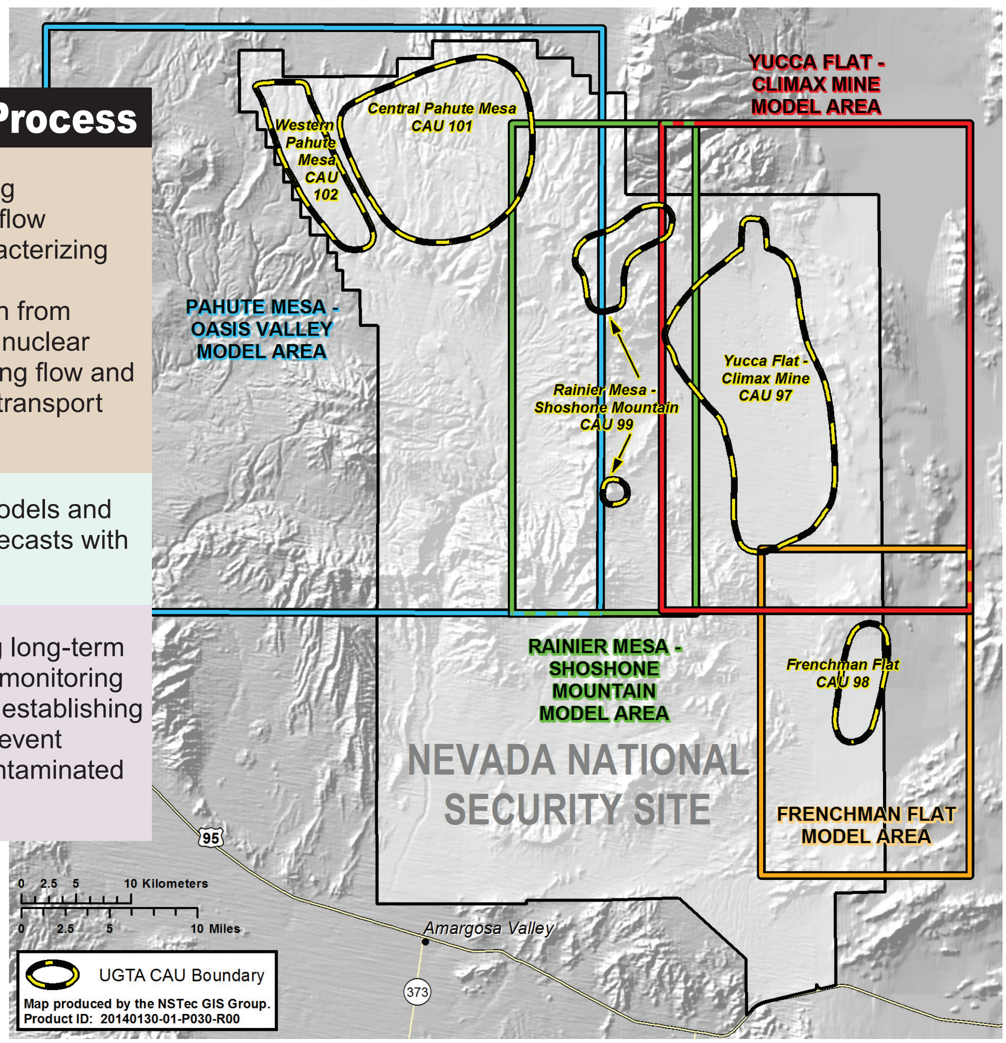
UGTA Sites Closure Process

Investigation Stage	Characterizing groundwater flow system, characterizing groundwater contamination from underground nuclear testing, building flow and contaminant transport models
Model Evaluation	Evaluating models and modelling forecasts with field data
Closure Stage	Implementing long-term groundwater monitoring program and establishing controls to prevent access to contaminated groundwater



Location of UGTA Activity CAUs and Model Areas

inant transport models, improve data quality, and increase confidence in the transport model results used to forecast contaminant boundaries. Twelve new wells were proposed, ten of which have been drilled. Drilling of an additional Phase II well, ER-20-12, was initiated in October 2015 and was completed in January 2016. A report of the Phase II hydrostratigraphic framework model was being revised by the end of 2015.

Frenchman Flat CAU – This CAU is the first to advance to the closure stage. In 2015, the draft Closure Report was written and reviewed by UGTA participants, NDEP, and the NSSAB. The report will also be reviewed by the USAF before it is finalized and approved by NDEP. The use-restrictions presented in the report include controls to limit drilling and groundwater pumping. The monitoring program described in the report proposes to use six wells sampled annually for the next five years, beginning in 2016. Water levels will also be measured quarterly in 16 wells. After five years, the sampling and water-level monitoring networks and frequencies will be evaluated and possibly modified. The Closure Report is expected to be approved by NDEP in 2016.

Rainier Mesa–Shoshone Mountain CAU – This CAU is near the end of the investigation stage of the closure process. In 2013, a revised modeling and closure strategy for this CAU, which is unique from the other UGTA CAUs, was accepted by NDEP. The closure strategy for this CAU does not involve the identification of contaminant boundaries due to their expected irreducible uncertainty and cost prohibitions. A more robust conceptual model for the unsaturated zone is being developed. New modeling activities began in

A significant milestone was achieved in 2015 when the Frenchman Flat CAU became the first UGTA CAU to reach the closure stage. It represents a validation of the characterization approach spanning 20 years of investigation, and the success of open, transparent work with the State of Nevada.

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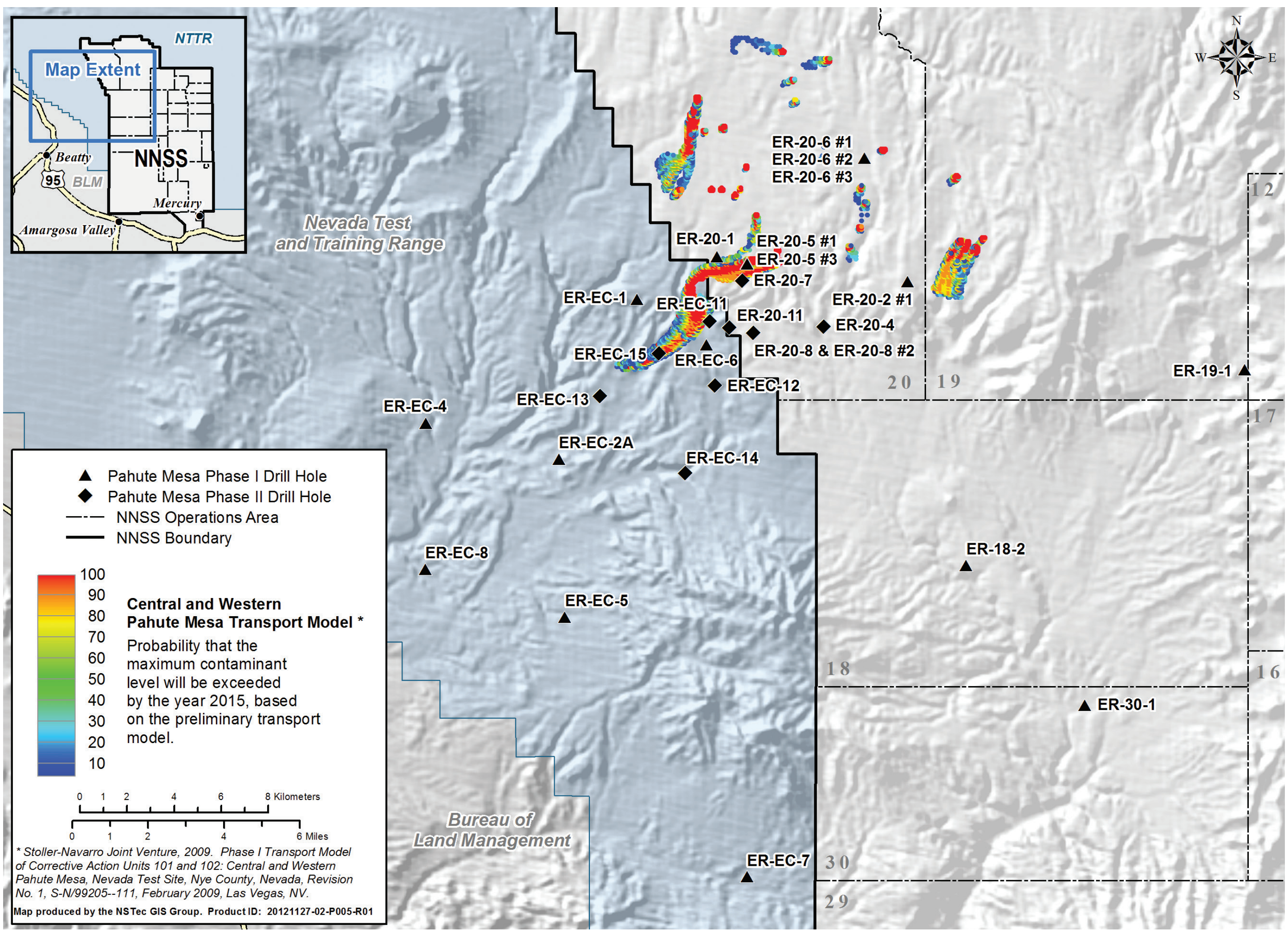


Results of Phase I Central and Western Pahute Mesa Transport Modeling

2015 to support the new conceptual model and the implementation of the revised closure strategy. The initial hydrostratigraphic model, which was rebuilt in 2014, was reviewed in 2015 by the preemptive review committee.

Yucca Flat–Climax Mine CAU – This CAU is in the latter part of the investigation stage of the closure process. Several recommendations from the 2014 external peer review of the Phase I Flow and Transport Model report were pursued in 2015. They included clarifying decisions and assumptions made during the model's development, sampling five wells with historically reported tritium detections, performing additional model simulations, and drilling three new wells. These activities will be completed prior to closing out the external peer review and advancing to the model evaluation stage. The new wells are near three of the most likely detonations to have impacted the lower carbonate aquifer (LCA) in the Yucca Flat basin. Understanding radionuclide transport to the LCA is high priority because the LCA, a regional aquifer, is the only pathway for radionuclides to migrate out of the basin. Drilling was initiated in 2015 and will be completed in 2016.

Dust suppression activities at 1 of the 24 Soils CASs on the NNSS that were closed in 2015 in accordance with state-approved corrective action plans.

Soils Sites

NNSA/NFO has identified 142 Soils CASs for which they are responsible to characterize, manage, and, where necessary, clean up. Some of these sites occur on TTR and NTTR. Corrective actions range from the removal of soil to closure-in-place with restricted access controls such as fencing and posting. Historical research and the preparation of short summary reports of research findings have been completed for all 142 CASs. In 2015, 24 Soils CASs from 2 CAUs on the NNSS were closed, and work was conducted towards closure at 15 CASs in 8 CAUs on the NNSS. Closure of CASs on the TTR and NTTR require negotiation with the State of Nevada and the U.S. Department of Defense. As of December 31, 2015, the State has approved closure of 119 Soils CASs in accordance with the FFACO.

The anticipated date for completing the closure of all Soils CASs is 2027, and 23 Soils CASs remain to be formally closed.

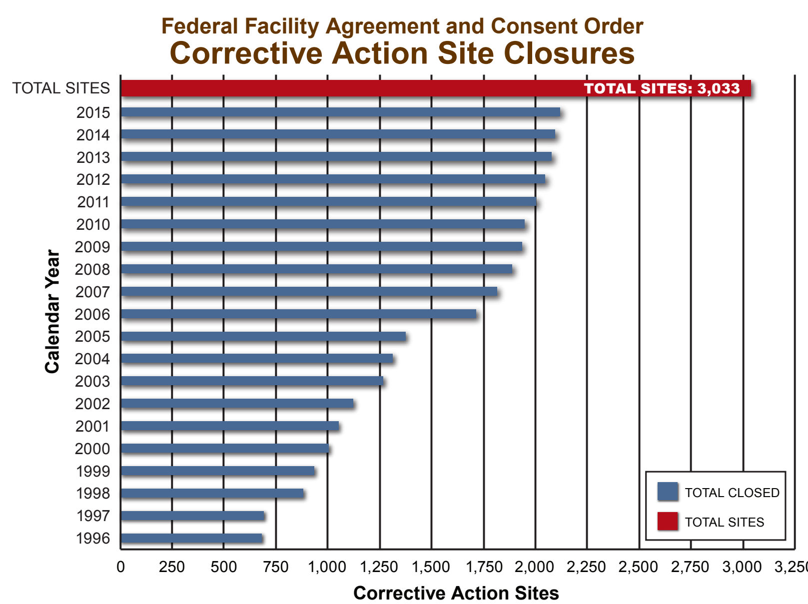
Industrial Sites

NNSA/NFO is responsible to safely close 1,865 Industrial Sites. Closure strategies have included the removal and disposal of debris, complete excavation of the site, decontamination and decommissioning activities, closure-in-place, no further action, and subsequent monitoring.

In 2015, no Industrial Sites CASs were closed and no interim work related to closure was conducted. Only three Industrial Sites CAUs remained to be closed at the end of 2015: CAU 114, the Area 25 Engine Maintenance, Assembly, and Disassembly (EMAD) Facility; CAU 572, the Test Cell C Ancillary Buildings and Structures; and CAU 575, the Area 15 Miscellaneous Sites. They comprise the final 12 Industrial Sites CASs to be closed. Their closure will occur prior to the end of the NNSS Environmental Restoration Activity, which is currently planned for 2030. As of December 31, 2015, the state has approved closure of 1,853 Industrial Sites CASs in accordance with the FFACO.

Restoration Progress under FFACO

In 2015, 24 CASs were closed and all 2015 FFACO cleanup and closure activity milestones were met. The majority (913) of the remaining 929 CASs yet to be closed by NNSA/NFO are UGTA CASs for which closure-in-place with long-term monitoring is the corrective action.



Radiological Monitoring of Groundwater

For decades NNSA/NFO has sampled groundwater from monitoring wells on and off the NNSS to detect radionuclides that may be present due to historical underground nuclear testing. In 2013, NNSA/NFO developed the NNSS Integrated Groundwater Sampling Plan, a comprehensive, integrated approach for collecting and analyzing groundwater samples to meet the requirements for UGTA CAU closures *(see Page 8)* and for all other compliance and environmental protection objectives.

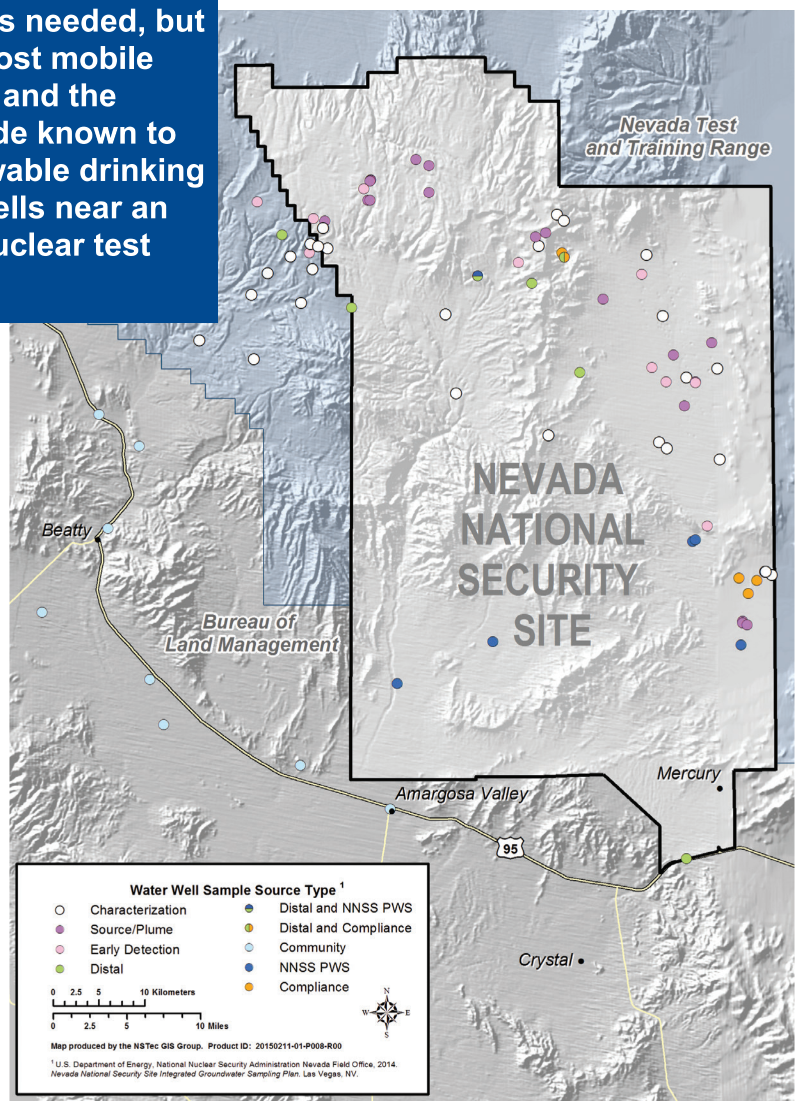
The water sampling network under the Plan consists of 74 sampling locations categorized into five types: Characterization, Source/Plume, Early Detection, Distal, and Community locations. An additional six public water system (PWS) wells and five wells/surface waters are sampled to comply with specific federal/state regulations or permits.

The tritium analysis results for all sampling locations in the network are shown on the map on Page 12. The well sites are color coded based on the tritium concentration of their most recent water sample. The maximum contaminant level (MCL) allowed for tritium in drinking water, set by the EPA under the Safe Drinking Water Act (SDWA), is 20,000 pCi/L. The color codes represent tritium levels expressed as a percentage of this MCL. For example, the 5%–50% category means that tritium was found to be between 5% to 50% of the MCL, or between 1,000 and 10,000 pCi/L.

The 15 wells that currently exceed the SDWA MCL (coded red on the map) are all located on the NNSS and are either Source/Plume or Characterization wells. All Community sampling

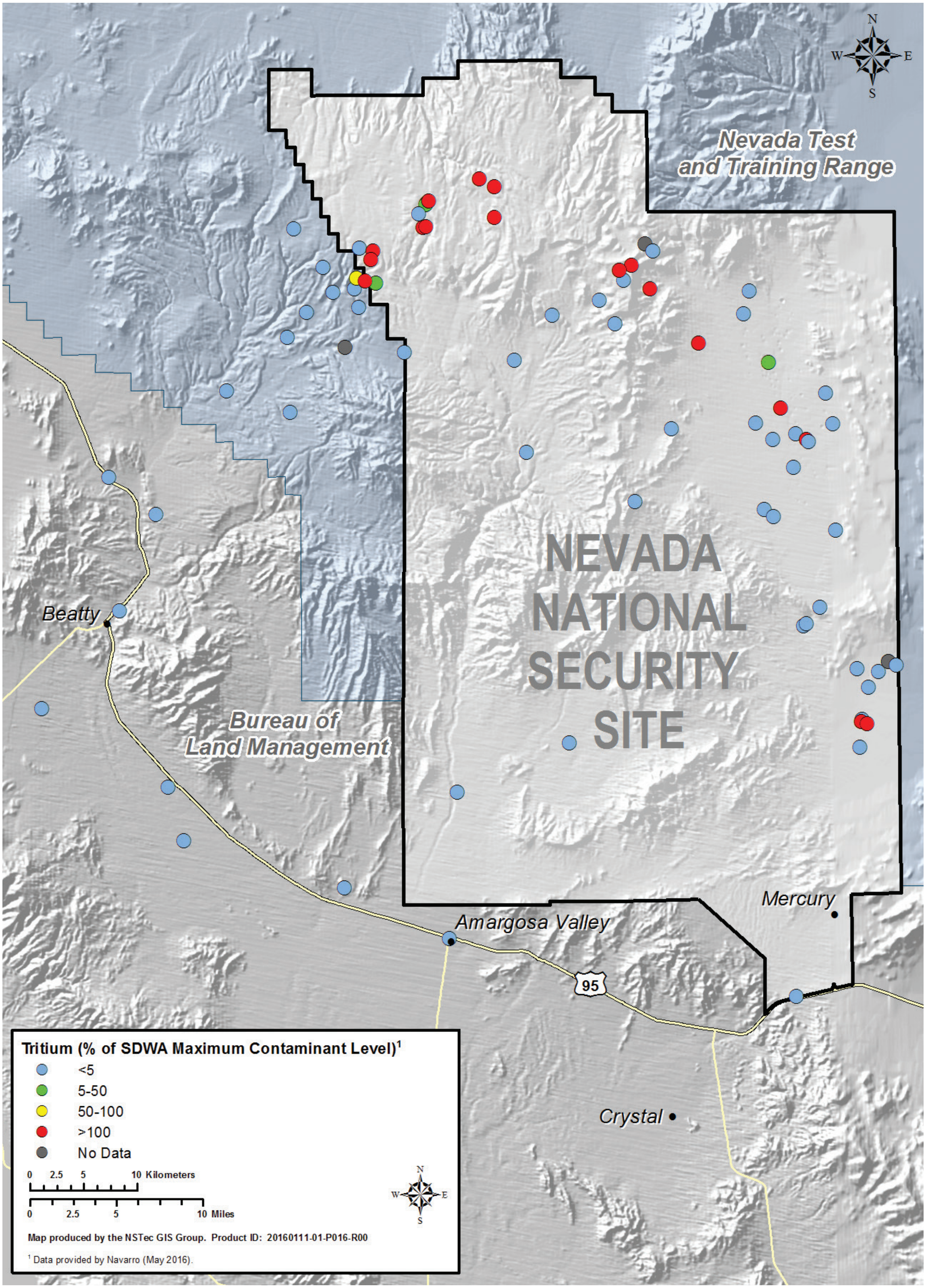
Continued on Page 13...

Tritium is the single contaminant of concern and is analyzed in water samples from all locations. Samples may be analyzed for other radionuclides as needed, but tritium is the most mobile in groundwater and the only radionuclide known to exceed its allowable drinking water limit in wells near an underground nuclear test cavity.



NNSA/NFO Water Sampling Network

Types of Groundwater Sampling Locations	
Characterization	Used for groundwater characterization or UGTA CAU model evaluation
Source/Plume	Located within the plume from an underground nuclear test; test-related contamination is currently present
Early Detection	Located downgradient of an underground test; no radioisotopes are detected above standard detection levels
Distal	Located outside the Early Detection area
Community	Located on BLM or private land; used as a water supply source or is near one
NNSS PWS	Potable water supply well that is part of a state-designated non-community public water system (PWS)
Compliance	Monitored to comply with specific regulations or permits



Tritium in NNSA/NFO Groundwater Monitoring Wells locations, which are on Bureau of Land Management (BLM) or private land, have undetectable levels of tritium (coded blue on the map). Characterization well ER-EC-11 on the NTTR just west of the NNSS is the only offsite well in the network that has tritium concentrations greater than 10,000 pCi/L (coded yellow on the map). Tritum has not been detected in any NNSS PWS wells, and all wells and surface waters that are monitored to ensure compliance with NNSS permits had either undetectable levels of tritium or tritium levels that were below permit limits.

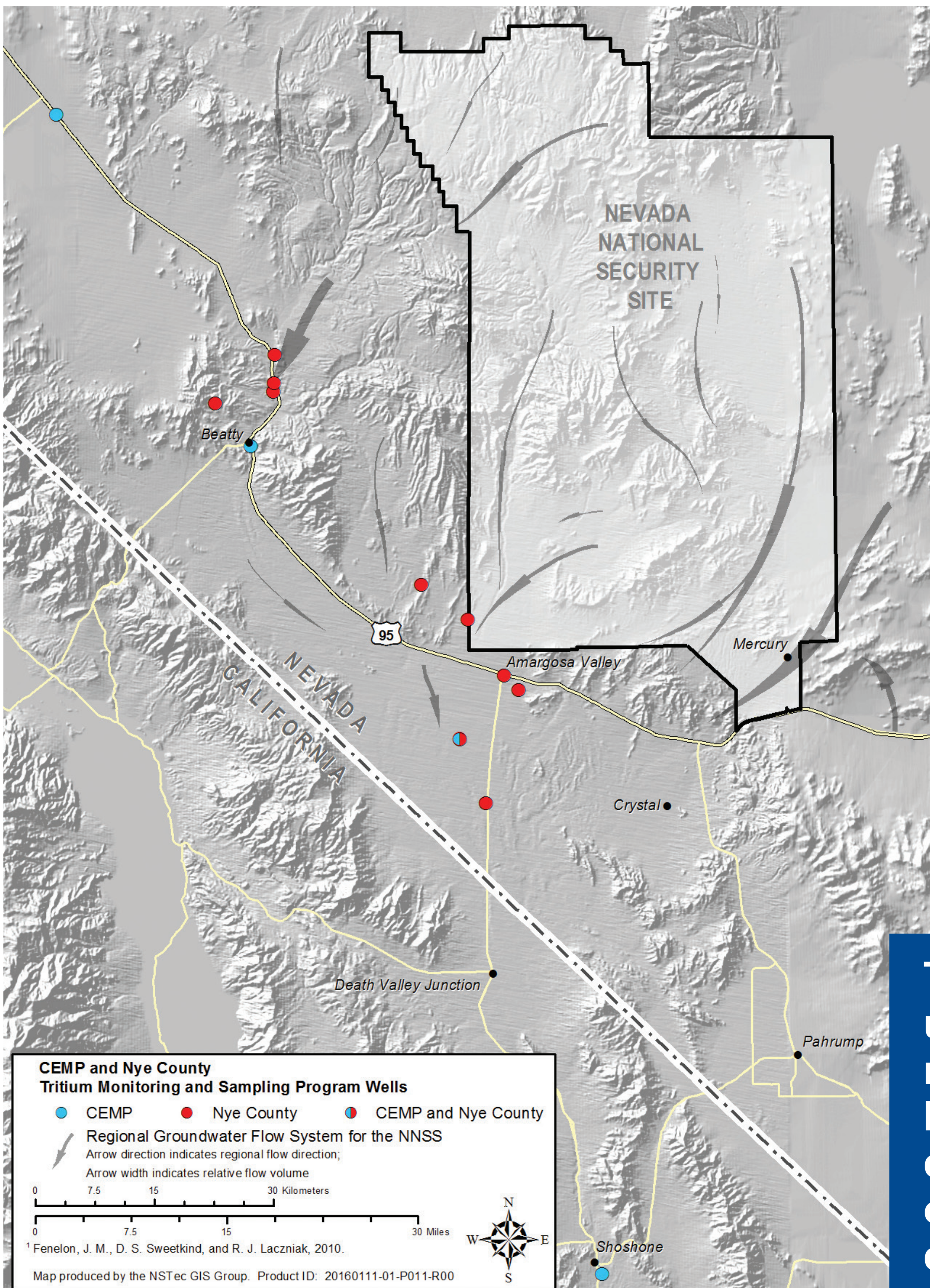
Community Environmental Monitoring Program

Offsite water supply wells are also monitored for the presence of tritium by the independent Community Environmental Monitoring Program (CEMP), which is coordinated by the Desert Research Institute (DRI) of the Nevada System of Higher Education under contract with NNSA/NFO. The CEMP provides the public with these data as part of a non-regulatory public informational and outreach program.

In 2015, the CEMP limited monitoring to four groundwater wells in communities located within the regional groundwater flow system that are downgradient or perceived to be downgradient of the NNSS *(see map to the left)*. As in previous years, none of these wells had detectable levels of tritium.

Nye County Tritium Sampling and Monitoring Program

In 2015, NNSA/NFO expanded its support of offsite community-based monitoring of wells in Nye County. The DOE Environmental Management office issued a five-year grant to Nye County to monitor tritium annually in 10 wells downgradient from the NNSS in the first year and up to 20 wells annually thereafter. The grant also supports Nye County's involvement in technical reviews of the UGTA sites closure process. The Nye County Tritium Sampling and Monitoring Program selected ten wells to sample in 2015. None of the 10 wells had detectable levels of tritium.



2015 CEMP and Nye County Water Monitoring Locations

Tritium from underground nuclear testing has not been detected in any onsite or offsite drinking water wells.

Radiological Monitoring of Air

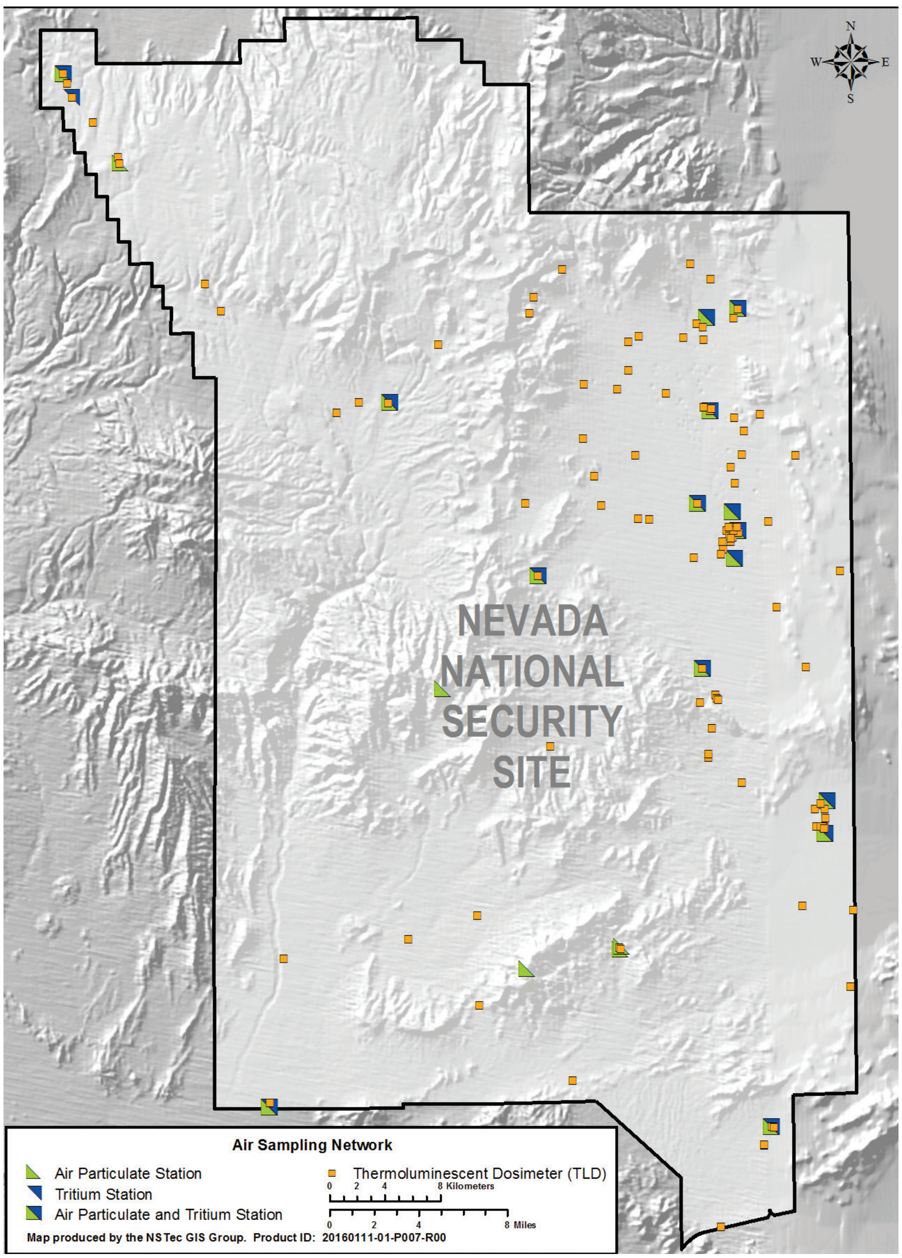
NNSS radioactive emissions are monitored to determine the public dose from inhalation and to ensure compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) under the Clean Air Act. A network of 17 air sampling stations and a network of 109 thermoluminescent dosimeters (TLDs) are located throughout the NNSS *(see map below)*. NNSS air sampling stations monitor tritium in water vapor, man-made radionuclides, and gross alpha and beta radioactivity in airborne particles. The TLD stations monitor direct gamma radiation exposure.

Range in Average Concentrations of Man-Made Radionuclides in Air Samples on the NNSS in 2015 Attributable to NNSS Operations

Radionuclide	Concentration (10^{-15} μCi/mL)[(a)]		
	Limit[(b)]	Lowest Average	Highest Average
^{241}Am	1.9	−0.0012	0.0436
^{137}Cs	19	−0.0187	0.0344
^{3}H	1,500,000	−20	91,740
^{238}Pu	2.1	0.0008	0.0063
$^{239+240}$Pu	2.0	0.0021	0.2981

(a) The scale of concentration units for radionuclides shown in the table has been standardized to 10^{-15} microcuries per milliliter (μCi/mL). This scale may differ from those reported in detailed radionuclide-specific data tables in the NNSSER.

(b) The concentration established by NESHAP as the compliance limit.



2015 NNSS Air Sampling Network

Radioactive emissions are also monitored at stations in selected towns and communities within 240 miles of the NNSS by the CEMP. A network of 23 CEMP stations was used in 2015 *(see map on Page 15)*. The CEMP stations monitor gross alpha and beta radioactivity in airborne particles using low-volume particulate air samplers, penetrating gamma radiation using TLDs, gamma radiation exposure rates using pressurized ion chamber (PIC) detectors, and meteorological (MET) parameters using automated weather instrumentation.

Several man-made radionuclides were detected at NNSS air sampling stations in 2015: ^{241}Am, ^{137}Cs, ^{3}H, ^{238}Pu, and $^{239+240}$Pu. None, however, exceeded concentration limits established by the Clean Air Act. The highest average levels of ^{241}Am, ^{238}Pu, and $^{239+240}$Pu were detected at Bunker 9-300 in Area 9, located within an area of known soil contamination from past nuclear tests. The highest average level of tritium was detected at Schooner, site of the second-highest yield Plowshare cratering experiment on the NNSS, where tritium-infused ejecta surrounds the crater.

The total amount of man-made radionuclides emitted to the air from tritium, americium, and plutonium was estimated to

Continued on Page 15 ...

Radiological Monitoring of Air ... *continued from Page 14*

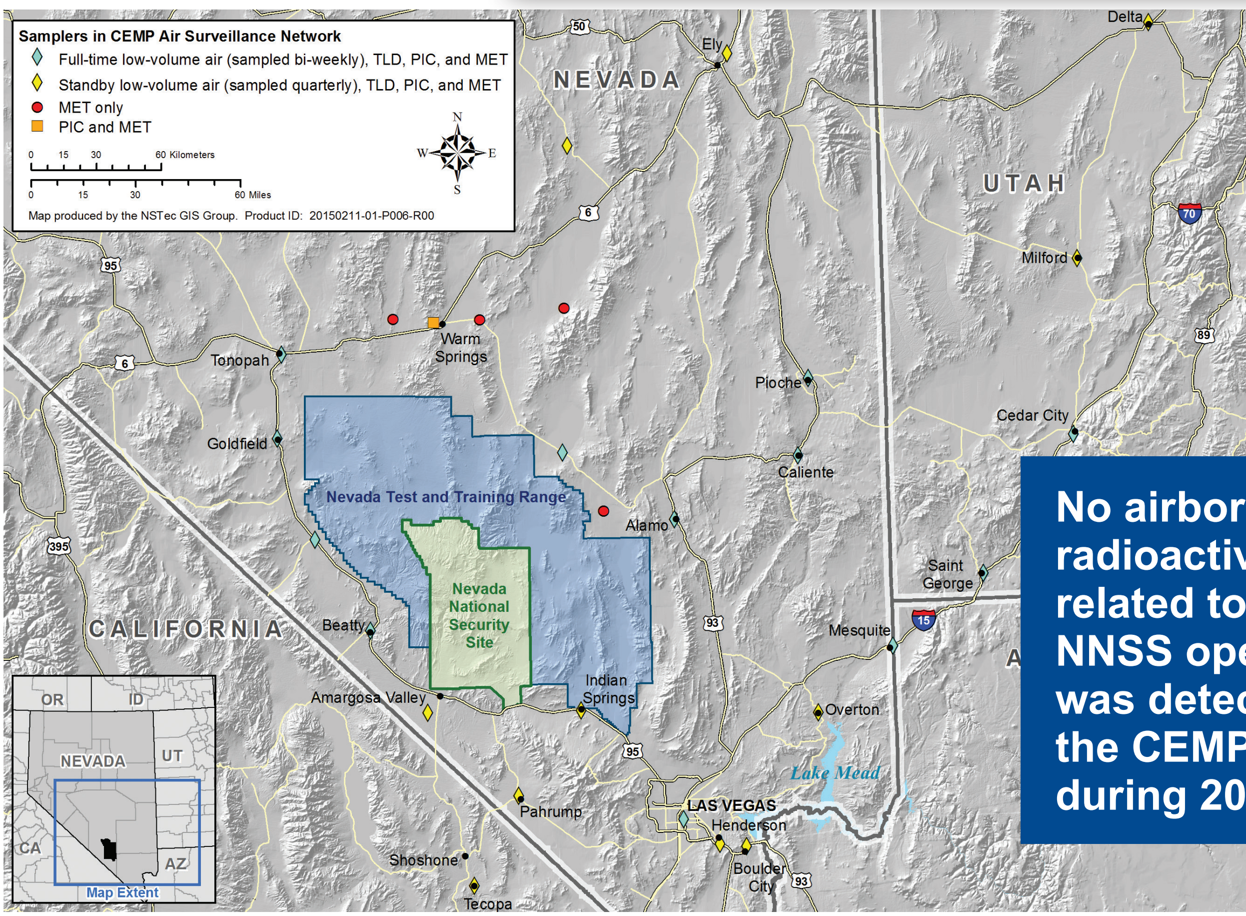
be 361 Ci. In 2015, these sources included contaminated soils at Schooner and Sedan craters, Area 3 and Area 5 RWMSs, and legacy sites; contaminated groundwater held in containment ponds or lagoons; and tests at DPF, NCERC, and NPTEC. A research project in Area 6 released 6,946 Ci of radioactive noble gases and other radionuclides that had half-lives ranging from a few minutes to 53 days. Given their half-lives and release quantities, they were not available to contribute measureable dose to the public at the distances over which they have to travel to reach the public. Over the past 10 years, total annual emissions have ranged from 42 to 878 Ci for tritium, 0.039 to 0.066 Ci for ^{241}Am, 0.041 to 0.050 Ci for ^{238}Pu, and 0.24 to 0.39 Ci for $^{239+240}$Pu.

Estimated Quantity of Man-Made Radionuclides Released into the Air from the NNSS in 2015 (in Curies)

	Tritium (^{3}H)	Americium (^{241}Am)	Plutonium (^{238}Pu)	Plutonium ($^{239+240}$Pu)	Noble Gases	Other Radionuclides	
	361	0.066	0.041	0.29	3,056	6,108	0.069
Half-life*	12 years	432 years	88 years	>6,500 years	<40 days	<3 hours	>3 hours

* Half-life is the time required for one-half of the radioactive atoms in a given amount of material to decay.

CEMP air monitoring station located in Caliente, Nevada.



2015 CEMP Air Surveillance Network

No airborne radioactivity related to any NNSS operations was detected at the CEMP stations during 2015.

Direct Radiation Monitoring

Ten NNSS TLD stations are located where radiation effects from past or present NNSS operations are negligible, and therefore measure only natural background levels of gamma radiation from cosmic and terrestrial sources. In 2015, the mean measured background level from the 10 stations was 118 milliroentgens per year (mR/yr). This is well within the range of variation in background levels observed in other parts of the U.S. of similar elevation above sea level. Background radiation varies not only by elevation but by the amounts of natural radioactive materials in soil and rock in different geographic regions.

The highest estimated mean annual gamma exposure measured at a TLD station on the NNSS was 497 mR/yr at Schooner, one of the legacy Plowshare sites on Pahute Mesa.

The CEMP offsite TLD and PIC results remained consistent with previous years' background radiation levels and are also well within the range of variation in background levels observed in other parts of the U.S. and with the 118 mR/yr level measured on the NNSS. The highest total annual gamma exposure measured off site, based on the PIC detectors, was 171 mR at Warm Springs Summit (at 7,570 feet elevation). The lowest offsite exposure rate, based on the PIC detectors, was 73 mR at Pahrump, Nevada (at 2,639 feet elevation).

TLD station (post with TLD attached) located at Schooner Crater.

2015 NNSS Background Gamma Radiation

118 mR/yr — This is the mean background radiation measured at 10 TLD stations in areas isolated from past and present nuclear activities.

Greater Roadrunner
(Geococcyx californianus)

Average Background Radiation of Selected U.S. Cities (Excluding Radon)

Ranked from Highest to Lowest

City	**Elevation Above Sea Level** (feet)	**Radiation** (mR/yr)
Denver, CO	5,280	164.6
Wheeling, WV	656	111.9
Rochester, NY	505	88.1
St. Louis, MO	465	87.9
Portland, OR	39	86.7
Los Angeles, CA	292	73.6
Las Vegas, NV	2,030	69.5
Fort Worth, TX	650	68.7
Richmond, VA	210	64.1
New Orleans, LA	39	63.7
Tampa, FL	0	63.7

Source: http://www.wrcc.dri.edu/cemp/Radiation.html, as accessed on July 21, 2016

Average Direct Radiation Measured in 2015 on and off the NNSS

Location	**Elevation Above Sea Level** (feet)	**Radiation Exposure** (mR/yr)
NNSS - Schooner TLD station	5,660	497
NNSS - 35 Legacy Site TLD stations (includes Schooner)	3,077–5,938	212
Warm Springs Summit, Nevada CEMP PIC station	7,570	171
NNSS - 17 Waste Operation TLD stations	3,176–4,021	113
NNSS - 10 Background TLD stations	2,755–5,938	118
St. George, Utah CEMP PIC station	2,688	94
Pahrump, Nevada CEMP PIC station	2,639	73
NNSS Mercury Fitness Track TLD station	3,769	58

Understanding Radiation Dose

Dose is a generic term to describe the amount of radiation a person receives. The energy deposited indicates the number of molecules disrupted. The energy the radiation deposits in tissue is called the absorbed dose. The units of measure of absorbed dose are the rad or the gray. The biological effect of radiation depends on the type of radiation (alpha, beta, gamma, or X-ray) and the tissues exposed. A measure of the biological risk of the energy deposited is the dose equivalent. The units of dose equivalent are called rems or sieverts. In the NNSSER, the term dose is used to mean dose equivalent measured in rems. A thousandth of a rem is called a millirem (mrem).

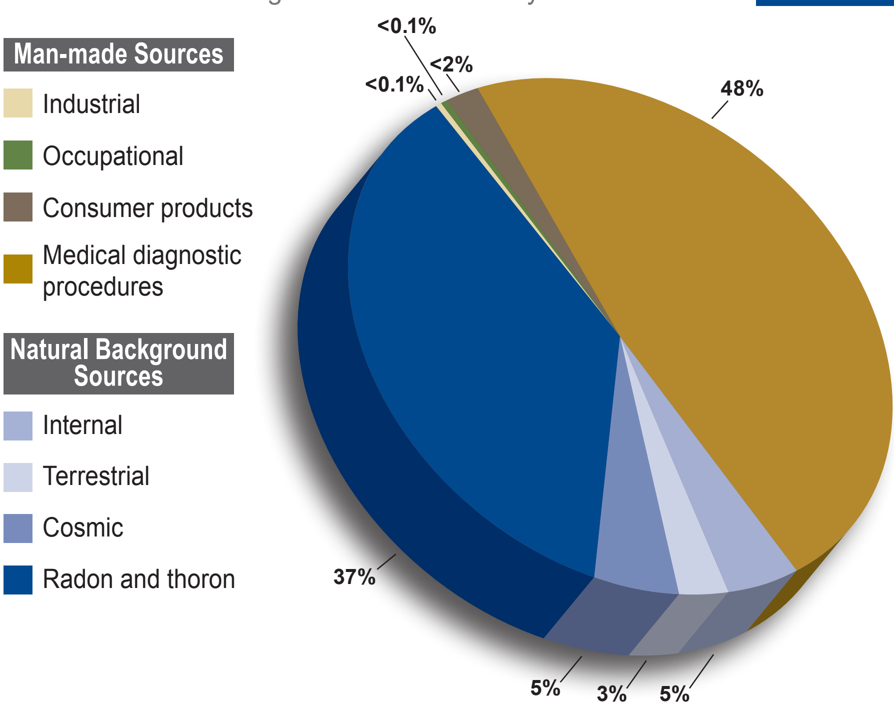
Average Doses from Radiation Sources

Source	Dose (mrem)
Living near a nuclear power station *(annual)*	<1
Chest X-ray *(single procedure)*	10
Terrestrial radioactivity *(annual)*	21
Radiation in the body *(annual)*	29
Cosmic *(at sea level) (annual)*	30
Mammogram *(single procedure)*	42
Cosmic *(in Denver) (annual)*	80
Head CT scan *(single procedure)*	200
Radon in average U.S. home *(annual)*	228
Upper gastrointestinal X-ray with fluoroscopy *(single procedure)*	600
Whole body CT scan *(single procedure)*	1,000

Source: https://www.epa.gov/radiation/radiation-sources-and-doses#tab-2, as accessed on July 21, 2016

Sources of Radiation Exposure for the Average Person in the U.S.

Average Dose = 620 mrem/yr



An average person in the United States receives about 310 mrem each year from natural sources and an additional 310 mrem from medical procedures and consumer products (Source: https://www.epa.gov/radiation/radiation-sources-and-doses). Whether there is a "safe" radiation dose equivalent is a controversial subject. Because the topic has yet to be settled scientifically, regulators take a conservative approach and assume that there is no such thing as a 100% safe dose equivalent. It is believed that the risk of developing an adverse health effect (such as cancer) is proportionate to the amount of radiation dose received.

Dose — The amount of radiation a person receives.

Absorbed dose — The energy the radiation deposits in tissue, where the energy deposited indicates the number of molecules disrupted. The units of measure of absorbed dose are the rad or the gray.

Dose equivalent — A measure of the biological risk of the energy deposited in tissue, which depends on the type of radiation (alpha, beta, gamma, or X-ray) and the tissues exposed. The units of measure of dose equivalent are called rems or sieverts.

Many human activities increase our exposure to radiation over and above the average background radiation dose of 310 mrem per year. These activities include, for example, uranium mining, airline travel, and operating nuclear power plants. Regulators balance the benefit of these activities with the risk of increasing radiation exposures above background and, as a result, set dose limits for the public and workers specific to these activities. DOE has set the dose limit to the public from exposure to DOE-related nuclear activities to 100 mrem/yr. This is the same public dose limit set by the U.S. Nuclear Regulatory Commission (NRC) and recommended by the International Commission on Radiological Protection and the National Commission on Radiological Protection and Measurements. The NRC has set the dose limit for radiation workers to 5,000 mrem/yr. There are no common or agreed-upon dose limits for workers or the public across industries, states, or countries.

Estimating Dose to the Public from NNSS Operations

The release of man-made radionuclides from the NNSS has been monitored since the first decade of atmospheric testing. After 1962, nuclear tests were conducted only underground, greatly reducing the radiation exposure in the areas surrounding the NNSS. Underground nuclear testing nearly eliminated atmospheric releases of radiation but resulted in the contamination of groundwater in some areas of the NNSS. After the 1992 moratorium on nuclear testing, radiation monitoring focused on detecting airborne radionuclides that are resuspended with historically contaminated soils on the NNSS and on detecting man-made radionuclides in groundwater.

There are three pathways in this dry desert environment by which man-made radionuclides from the NNSS might reach the surrounding public:

Sedan Crater in north Yucca Flat is a source of airborne radionuclides from resuspended soil (e.g., from wind) and from evapotranspiration of tritiated water.

Air Transport Pathway – Members of the public may inhale or ingest radionuclides that are resuspended by the wind from contaminated sites on the NNSS. However, such resuspended radiation measured off and on the NNSS is much lower than natural background radiation in all areas accessible to the public.

Ingestion Pathway – Members of the public may ingest game animals that have been exposed to contaminated soil or water on the NNSS, have moved off the NNSS, and have then been hunted.

Mule deer *(Odocoileus hemionus)* observed by NNSS biologists during a spotlighting census survey on Pahute Mesa.

Groundwater Pathway – Based on monitoring data, drinking contaminated groundwater is currently not a possible pathway for public exposure, given the restricted public access to the NNSS and the location of known contaminated groundwater on and off the NNSS. No man-made radionuclides have been detected in drinking water sources monitored off the NNSS, and no drinking water wells on the NNSS have measurable levels of man-made radionuclides.

NNSS scientists sampling a private water supply for radiation.

Continued on Page 19 ...

Public Dose Limits for NNSS Radiation

10 mrem/yr — This is the dose limit to the public (above natural background) from just the air transport pathway, as specified by the Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAP).

100 mrem/yr — This is the dose limit to the public (above natural background) from all possible pathways combined, as specified by DOE O 458.1, "Radiation Protection of the Public and the Environment."

Estimated 2015 Inhalation Dose to the Public

Compliance with radiation dose limits to the general public from the air transport pathway is demonstrated using air sampling results from six onsite "critical receptor" sampling stations, which were approved by the EPA in 2001. The radionuclides detected at one or more of the NNSS critical receptor samplers were ^{241}Am, ^{238}Pu, $^{239+240}$Pu, and ^{3}H.

As in previous years, the 2015 data from the six critical receptor samplers show that the NESHAP dose limit to the public of 10 mrem/yr was not exceeded. The Schooner critical receptor station, in the far northwest corner of the NNSS, had the highest concentrations of radioactive air emissions; an individual residing at this station would experience a dose from air emissions of 0.64 mrem/yr. A more realistic estimate of the maximum dose to a member of the offsite public would be to use the air sampling results from the Gate 510 sampling station in the far southwest corner of the NNSS, which is closest to the nearest populated place, Amargosa Valley. A person residing at the Gate 510 station would experience a dose from air emissions of 0.04 mrem/yr.

Estimated 2015 Ingestion Dose to the Public

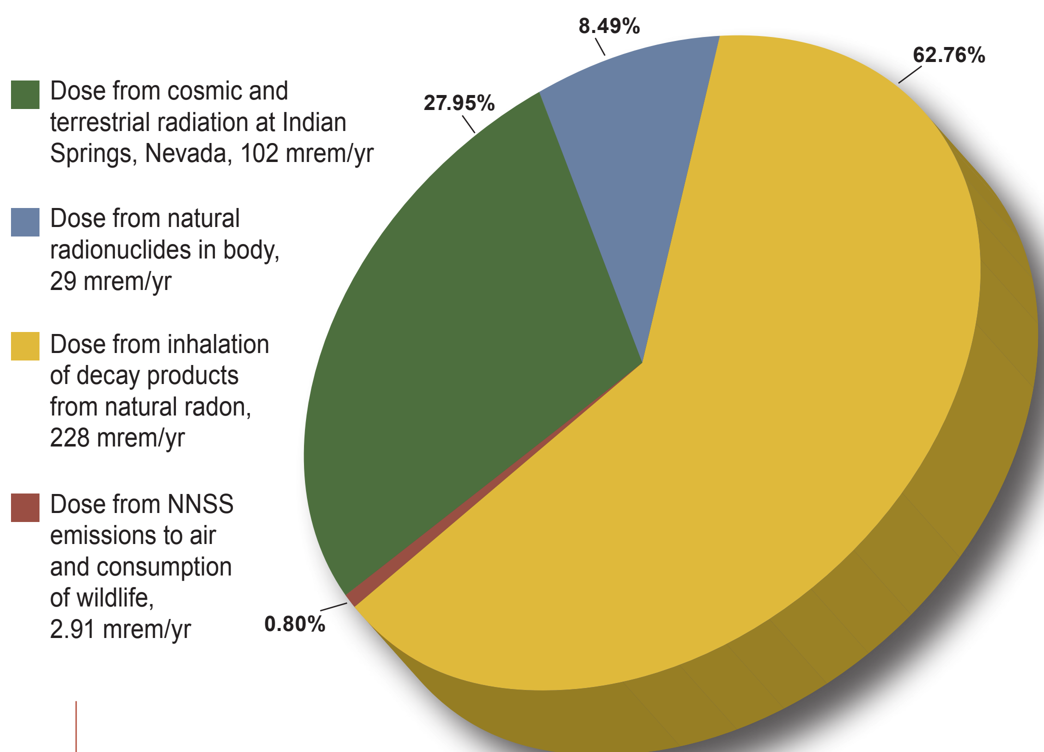
NNSS game animals include pronghorn antelope, mule deer, chukar, Gambel's quail, mourning doves, cottontail rabbits, and jackrabbits. Small game animals from different contaminated NNSS sites are trapped each year and analyzed for their radionuclide content. These results are used to construct worst-case scenarios for the dose to hunters who might consume these animals if the animals moved off the NNSS.

In 2015, tissue samples were collected from 2 jackrabbits trapped near Sedan crater and 2 cottontail rabbits trapped at Sedan's control site. In addition, 1 mule deer and 3 pronghorn antelope killed by vehicles were opportunistically sampled. Blood samples from 20 bighorn sheep captured on and off the NNSS and fitted with radio collars were also analyzed for radionuclides. Based on data from these samples, the 2015 estimated dose to a hunter from ingestion of game animals from the NNSS is 2.87 mrem/yr. This estimate assumes that a hunter consumes one game animal having tissue concentrations equal to the highest of those found in any animal sampled in 2015, which was a pronghorn antelope killed by a vehicle in Area 6.

Direct Exposure

No members of the public are expected to receive direct gamma radiation that is above background levels as a result of NNSS operations. Areas accessible to the public, such as the main entrance gate, had direct gamma radiation exposure rates comparable to natural background rates from cosmic and terrestrial radiation.

Dose to the Public from Natural Background Sources and from the NNSS



2015 Dose to the Public from All Pathways

2.91 mrem/yr — This is the maximum dose to the public from inhalation, ingestion, and direct exposure pathways that is attributable to NNSS operations. It is well below the dose limit of 100 mrem/yr established by DOE O 458.1 for radiation exposure to the public from all pathways combined. This total dose estimate is indistinguishable from natural background radiation experienced by the public residing in communities near the NNSS.

Nonradiological Monitoring of Air and Water

Nonradioactive Air Emissions

The release of air pollutants is regulated on the NNSS under a Class II air quality operating permit. Class II permits are issued for "minor" sources where annual emissions must not exceed 100 tons of any one "criteria pollutant," or 10 tons of any one of the 189 "hazardous air pollutants" (HAPs), or 25 tons of any combination of HAPs. Common sources of such air pollutants on the NNSS include particulates from construction, aggregate production, surface disturbances, fugitive dust from driving on unpaved roads, fuel-burning equipment, open burning, fuel storage facilities, and chemical release and detonation tests.

An estimated 11.76 tons of criteria air pollutants and 0.03 tons of HAPs were released on the NNSS in 2015. The majority of the emissions were nitrogen oxides from diesel generators. No emission limits for any air pollutants were exceeded.

Estimated Quantity of Pollutants Released into the Air from NNSS Operations in 2015

Criteria Air Pollutants:	Tons
Particulate Matter[(a)]	0.52
Carbon Monoxide	1.74
Nitrogen Oxides	7.43
Sulfur Dioxide	0.39
Volatile Organic Compounds	1.69
Hazardous Air Pollutants (HAPs)	0.03

(a) Particulate matter equal to or less than 10 microns in diameter

Nonradiological Monitoring of Drinking Water and Wastewater

NNSA/NFO operates a network of seven permitted wells that comprise three permitted public water systems on the NNSS that supply the drinking water needs of NNSS workers and visitors. NNSA/NFO also hauls potable water to work locations at the NNSS that are not part of a public water system. Monitoring results for 2015 indicated that water samples from the three public water systems and from the potable water hauling trucks met all applicable National Primary and Secondary Drinking Water Standards. In 2014, the public water system in Area 25 exceeded the secondary standards for aluminum and iron. The monitoring frequency of this system was increased from annually to quarterly, and aluminum and iron levels dropped to within the compliance standard. The state approved the return to annual monitoring of the system and triennial monitoring for these specific contaminants.

NNSS Drinking Water

The public water systems that supply drinking water to NNSS workers and visitors meet all applicable Safe Drinking Water Act standards.

Industrial discharges on the NNSS are limited to three operating sewage lagoon systems: Area 6 Yucca, Area 23 Mercury, and Area 6 DAF. Under the requirements of the state operating permit, liquid discharges to these sewage lagoons were tested quarterly in 2015 for biological oxygen demand, pH, and total suspended solids. All sewage lagoon water measurements were within permit limits.

The discharge water from the E-Tunnel complex is sampled annually under a state water pollution control permit for 14 nonradiological contaminants, which are mainly metals. In 2015, none of these contaminants were detected at levels that exceeded permit limits.

Managing Cultural Resources

The historical landscape of the NNSS contains archaeological sites, buildings, structures, and places of importance to American Indians and others. These are referred to as "cultural resources." NNSA/NFO requires that NNSS activities and programs comply with all applicable cultural resources regulations and that such resources on the NNSS be monitored. The Cultural Resources Management program is implemented by DRI to meet this requirement.

In 2015, DRI archaeologists conducted archival research for 29 proposed NNSA/NFO projects that had the potential to impact cultural resources, which led archeologists to conduct 11 field inventories. The inventories identified 10 archaeological sites and 20 historic structures and buildings.

Work was completed in 2015 on the historical evaluation of the Shasta atmospheric test. The Shasta nuclear

Entrance to an underground shelter used during the 1957 Shasta test to evaluate its operational characteristics in a nuclear fallout zone.

Continued on Page 21 ...

device was detonated in August 1957 from the top of a 500-foot, 200-ton steel tower (T-2a) as one of the mid-series tests of Operation Plumbbob.

No mitigation actions to protect historic properties on the NNSS were required in 2015. DRI conducted numerous and varied field activities that included but was not limited to prehistoric site monitoring, photographing existing buildings, monitoring trench excavations, and setting access boundaries around sites. DRI continued to maintain and manage the NNSS Archaeological Collection, which contains over 400,000 artifacts.

NNSA/NFO's American Indian Consultation Program (AICP) conducts consultations with NNSS-affiliated American Indian tribes through the Consolidated Group of Tribes and Organizations (CGTO). The CGTO Spokesperson is appointed to the State Tribal Government Working Group (STGWG), joining 10 other tribes currently serving from New Mexico, Idaho, Washington, Oregon, and New York. The STGWG works closely with various DOE sites throughout the U.S. The CGTO Spokesperson is also formally appointed to the NSSAB to serve as a liaison giving advisory insight into activities conducted on the NNSS.

In 2015, the CGTO spokesperson attended two STGWG meetings, which focused on environmental management activities and methods for enhancing communications between the tribes and DOE, and the National Tribal Energy Summit hosted by the DOE Secretary. In October 2015, NNSA/NFO hosted an AICP tribal update meeting in Las Vegas, Nevada.

In 2015, NNSA/NFO did not receive any requests from culturally affiliated tribes to access the NNSS for ceremonial or traditional use.

Endangered Species Protection and Ecological Monitoring

The Ecological Monitoring and Compliance (EMAC) Program provides ecological support for activities and programs conducted on the NNSS. Important species known to occur on the NNSS include 18 sensitive plants, 1 mollusk, 2 reptiles, over 250 birds, and 27 mammals. They are classified as important due to their sensitive, protected, and/or regulatory status with state or federal agencies.

The desert tortoise is the only resident species on the NNSS that is protected under the Endangered Species Act and that can be adversely affected by NNSS activities. It is designated as a threatened species under the Act. Habitat of the desert tortoise is in the southern third of the NNSS. Activities conducted in desert tortoise habitat must comply with the terms and conditions of a Biological Opinion issued to NNSA/NFO by the U.S. Fish and Wildlife Service (FWS). In 2015, no desert tortoises were accidentally injured or killed at a project site, nor were any found, captured, or displaced from project sites. Two desert tortoises, however, were accidentally killed by vehicles on paved roads, and 17 were safely moved off of paved roads.

NNSA/NFO is committed to working collaboratively with other agencies to provide research opportunities on the NNSS that benefit ecological and conservation science.

Six desert tortoises were captured and fitted with radio transmitters for an ongoing study approved by the FWS. The study collects movement data from tortoises found near NNSS roads for the purpose of developing a strategy to minimize road mortalities. Two additional desert tortoise studies on the NNSS have been approved by the FWS and are being conducted solely, or in part, by NNSS biologists. They include:

One of 60 translocated juvenile desert tortoises (Gopherus agassizii) radio-tagged and monitored.

- **A study of the fate of 60 juvenile tortoises, which were translocated in 2012 from captivity at the Desert Tortoise Conservation Center located near Las Vegas to undisturbed tortoise habitat in Area 22 of the NNSS. The study was begun by staff biologists of the San Diego Zoo Institute for Conservation Research (ICR) and was transferred to NNSS biologists in the fall of 2013. By the end of 2015, 27 of the 60 translocated juveniles were still alive.**
- **A collaborative behavioral/health study of up to 20 translocated tortoises within each of three existing fenced enclosures in Rock Valley (Area 25). The study is led by the USGS in collaboration with the FWS, the San Diego Zoo ICR, and Pennsylvania State University. NNSS biologists provide support to the U.S. Geological Survey (USGS) as requested. In 2015, NNSS biologists received no request for providing data gathering assistance.**

Continued on Page 22 ...

In 2015, surveys of sensitive and protected/regulated animals focused on raptors, bats, wild horses, mule deer, desert bighorn sheep, and mountain lions. A major effort among the Nevada Department of Wildlife, USGS, U.S. Air Force, and NNSA/NFO to capture, radio-collar, and sample sheep occurred in 2015. Three sheep were radio-collared from the Bare Mountains near Beatty, 3 were radio-collared from the Specter Range, and 6 were captured and 5 of these radio-collared from the NNSS. Blood samples were taken from 8 sheep on the NTTR and 6 on the NNSS to assess disease prevalence, radiological burden, and relatedness to other southern Nevada populations. Radioanalysis results indicate that bighorn sheep from the NNSS and NTTR do not have radionuclide concentrations that could pose a hazard to them or to anyone eating them.

Desert bighorn sheep were rarely observed on the NNSS prior to 2009. They may have recolonized the NNSS in recent years from other sheep populations surrounding the NNSS. To better understand their populations, movements, health, radionuclide body burdens, and potential dose to humans via hunting, a collaborative effort to radio-collar and sample sheep occurred in November 2015.

Desert bighorn sheep on the NNSS.

NNSS biologists continued in 2015 to assist USGS as needed with a study of the movements, habitat use, and food habits of mountain lions on and around the NNSS. Of the 4 mountain lions captured and collared for this study in 2012, none were still alive or had functioning collars in 2015. Efforts were made to trap and radio-collar 4 more mountain lions in 2015, but trapping was unsuccessful. A minimum of 3 lions inhabited the NNSS in 2015 based on photographic data collected for another USGS collaborative study.

Environmental Stewardship

NNSA/NFO's Environmental Management System (EMS) is a business management practice that incorporates concern for environmental performance throughout the NNSS and its support facilities. The goal of the EMS is continual reduction of NNSA/NFO's impact on the environment. The EMS is designed to meet the requirements of the globally recognized International Organization for Standardization (ISO) 14001:2004 Environmental Management Standard. In 2008, the EMS obtained ISO 14001:2004 certification. Annual audits are required to maintain an EMS registration, and recertification audits of the entire EMS occur every 3 years. In 2014, the EMS was recertified for another three year period. In 2015, an annual audit was performed which verified that NNSA/NFO remains in conformance with the ISO 14001:2004 Standard.

Site-specific EMS objectives and targets are developed on a fiscal year (FY) schedule (October 1 through September 30). In FY 2015, the EMS objectives included:

- **Develop an electronic chemical management system that will serve environmental, safety, emergency planning, and operational needs.**
- **Identify biobased and environmentally preferable products for purchase that are readily available, affordable, and effective.**

The **Energy Management Program** was formed specifically to reduce the use of energy and water in NNSA/NFO facilities, to advance the use of solar and other renewable energy sources, and to help NNSA meet DOE's 2015 Site Sustainability Goals.

In December 2015, the Energy Management Program completed the FY 2016 NNSA/NFO Site Sustainability Plan, which reported the 2015 progress toward meeting DOE's Site Sustainability Goals. Thus far, the Energy Management Program is on track to meet the majority of the DOE long-term goals *(see Pages 23 and 24)*.

The **Pollution Prevention and Waste Minimization Program** helps to reduce the volume and toxicity of waste that must be disposed. In 2015, 31% of non-hazardous solid waste and 20% of construction waste was diverted from NNSS landfills through recycling or reuse.

Energy Efficiency and Management

- ► Energy intensity (energy use per square foot of building space) was 27.5% below the FY 2003 baseline – the goal was 30% reduction by FY 2015. New goal was set for 25% reduction by FY 2025 using an FY 2015 baseline.
- ► 82% of buildings are metered for electricity, 88% for natural gas, 40% for chilled water, and 26% for water – the goal is for all individual buildings to be metered where cost-effective and appropriate.
- ► 33 energy audits/assessments were conducted – meeting the goal to ensure that all eligible facilities under Section 432 of the Energy Independence and Security Act are assessed once every 4 years. The assessments identified energy conservation measures for several buildings at the NNSS and the NLVF.

Water Efficiency and Management

- ► Water intensity (gallons used per total gross square feet [gsf] of facility space) was 39% below the FY 2007 baseline – exceeds the goal of 36% reduction by FY 2025.
- ► Non-potable water production was 28.9% below the FY 2010 baseline – almost meets the goal of 30% reduction by FY 2025.

Wildlife watering trough that replaced the closed Well 5b sump.

Fleet Management

- ► Use of alternative fuel was 224% above the FY 2005 baseline – exceeds the goal of a 10% increase above the FY 2005 baseline by FY 2015.
- ► Use of petroleum was 70% less than the FY 2005 baseline – exceeds the goal of a 20% decrease from the FY 2005 baseline by FY 2015.
- ► 100% of light duty vehicle purchases were alternative fuel vehicles – exceeds the goal of 75%.

Clean and Renewable Energy

- ► 8% of NNSA/NFO's annual electrical consumption is from renewable sources (acquired mainly through the purchase of renewable energy credits) – the goal is at least 10% for FY 2016-2017, working towards 30% by FY 2025.

High Performance Sustainable Buildings (HPSBs)

- 15% of enduring buildings larger than 5,000 gsf are compliant with the Guiding Principles (GPs) for Federal Leadership in HPSB design – meets the goal to have at least 15% by FY 2025, with progress to 100% thereafter.

Pollution Prevention and Waste Minimization

- 31% of non-hazardous solid waste generated at NNSA/NFO facilities was diverted from landfills through recycling – the goal is 50%.
- 20% of construction materials were recycled and diverted from the landfill – the goal is 50%.

Electronic Stewardship and Data Centers

- Average Power Utilization Effectiveness (PUE) values range from 2.6-3.4 across the 3 data centers, where an ideal PUE is 1.0. The goal is a PUE of 1.2-1.4 for new data centers and a PUE less than 1.5 for existing data centers. Construction projects to meet this goal are planned for the near future.
- All leased computers continue to be Electronic Product Environmental Assessment Tool (EPEAT) registered.
- The U.S. General Services Administration (GSA) Energy Asset Disposal System program called GSAXcess® is used to recycle all eligible electronics. 100% of used electronic equipment that pass GSAXcess® screening is sold for reuse, and equipment considered high risk property is shredded through a certified recycler.

Greenhouse Gas (GHG) Emissions

- FY 2015 Scope 1 and 2 GHG emissions were the same as those of the FY 2008 baseline – the goal is a 50% reduction by FY 2025.
- FY 2015 Scope 3 GHG emissions were 19% greater than those of the FY 2008 baseline – the goal is a 25% reduction by FY 2025.

GHG emissions targeted for reduction are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (SF_6) and are classified depending on their source:

Scope 1 — from sources owned or controlled by a federal agency.

Scope 2 — resulting from the generation of electricity, heat, or steam purchased by a federal agency.

Scope 3 — from sources not owned or directly controlled by a federal agency but related to agency activities.

Climate Change Resilience

- Regional risks to NNSA/NFO facilities are flooding, wildland fires, facility power and water supply disruptions, and extreme weather events. Program and site evaluations are conducted to ensure they are resilient to climate change in accordance with the goals of DOE's Climate Change Adaptation Plan.

Sustainability Awards

NSTec Fleet, Fuel, and Equipment Service Staff who received the award pictured with Jim Holt (blue shirt), President of NSTec. From left to right: Steven Burns, Jim Holt, Ricky Tindall, and Douglas Trone. Not pictured: Ricky Medina, Brent Nordin, and Patrick Matthews.

2015 Government Green Fleets Award

In 2015, the 100 Best Fleets, Green Fleet Awards Organization rated NSTec's Fleet, Fuel, and Equipment Service operation fourth among the 100 best government "green" fleets in the nation. More than 38,000 public fleets competed for recognition. The NSTec fleet was recognized as one of the cleanest, most fuel-efficient government fleets. The fleet comprises 960 vehicles ranging from sedans to large trucks. More than 40 of these vehicles are alternative-fueled or plug-in electric vehicles.

To earn this top rating, NSTec's fleet management demonstrated a commitment to the use of alternative fuel vehicles, outstanding operations, strategic planning, and a "green" approach toward protecting the environment.

E85 85% Ethanol

2014 Federal Energy and Water Management Award

NNSA/NFO's Alternative Fuel Vehicle (AFV) Management Program increased the use of renewable fuels on the NNSS by 164% in FY 2014 and by 224% in FY 2015 when compared to the FY 2005 baseline. This was achieved through the construction of two ethanol (E-85) alternative fuel-capable service stations and implementing an innovative fuel lock-out program. The program identifies vehicles that can run on E-85 and prevents them from getting non-renewable fuel from the site's fueling stations. This significant increase in renewable fuel use on the NNSS supports the national objective to reduce dependence on foreign oil.

2014 NNSA Environmental Stewardship Award in the Green Buildings Category

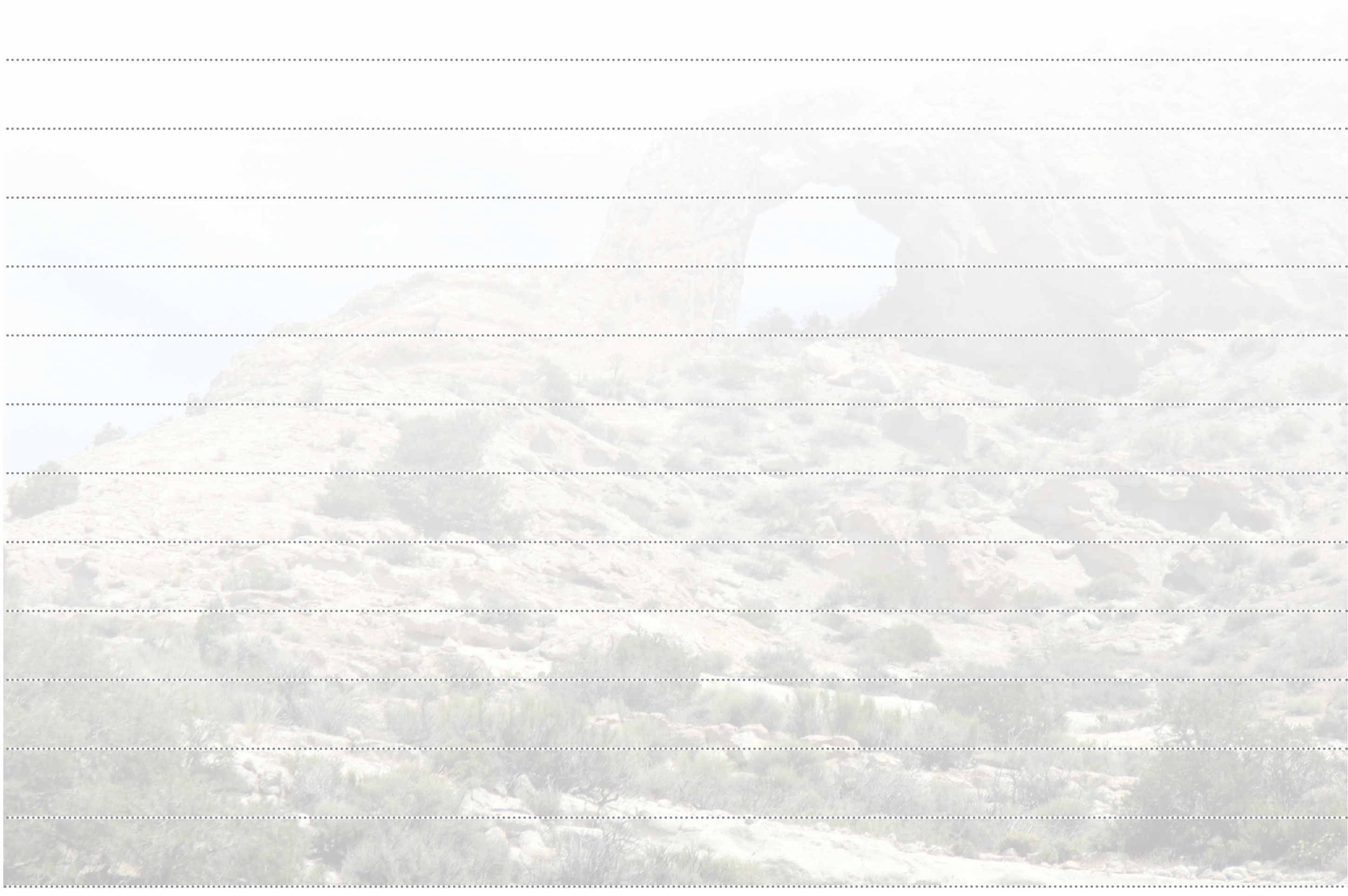
This award was received for increasing the energy and water use efficiency at Warehouse 23-160, the main warehouse in Mercury, through multiple efforts over several years. From 2009 through 2014, the improvements made to the warehouse included new lighting and heating controls, new Clean Burn furnaces which use recycled oil, the replacement of lights with energy efficient LED bulbs, new energy efficient fans, a reduced volume water heater, weather stripping, air strip curtains, and a filtered and metered water fountain to replace bottled water.

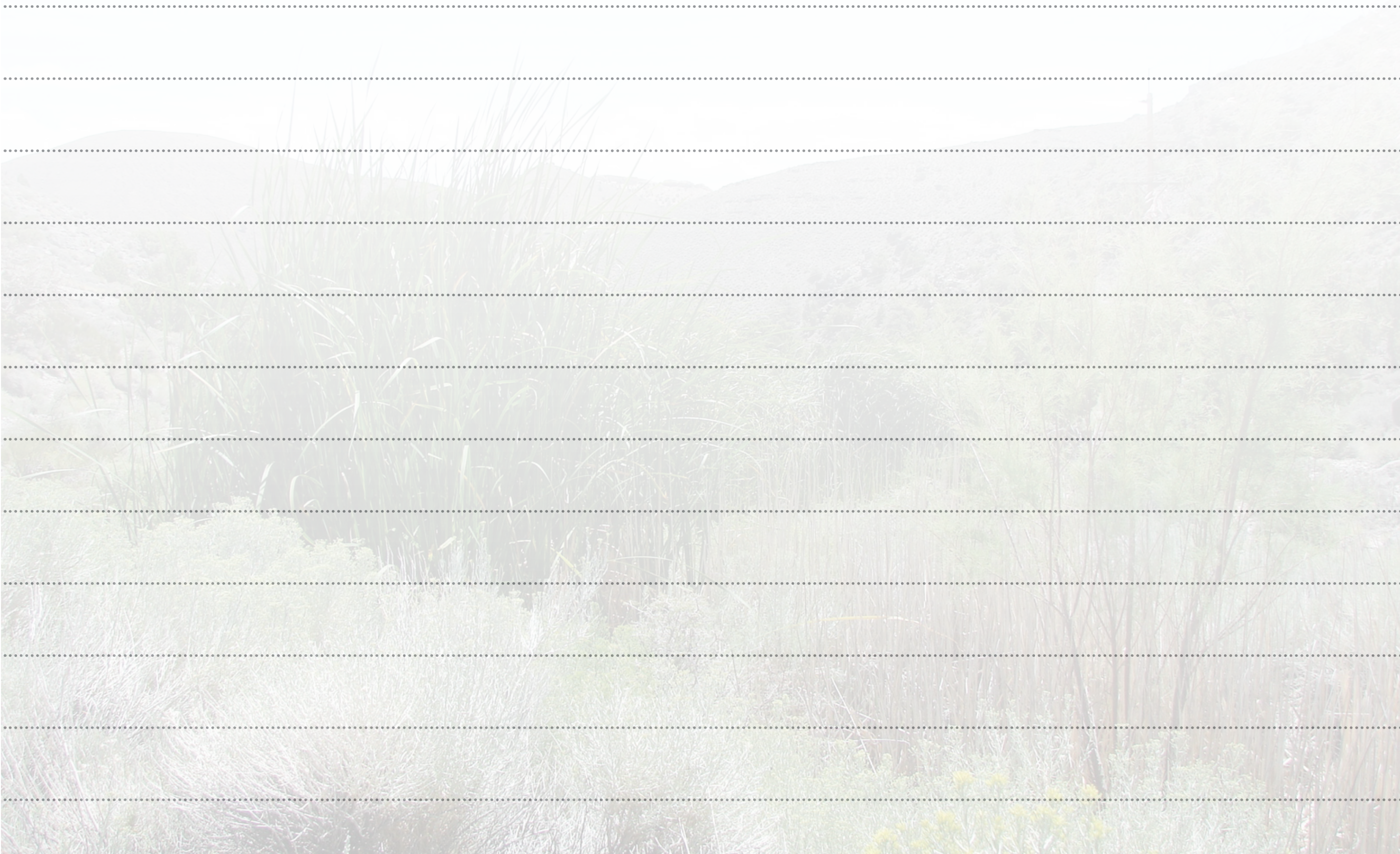
Our Energy Hero

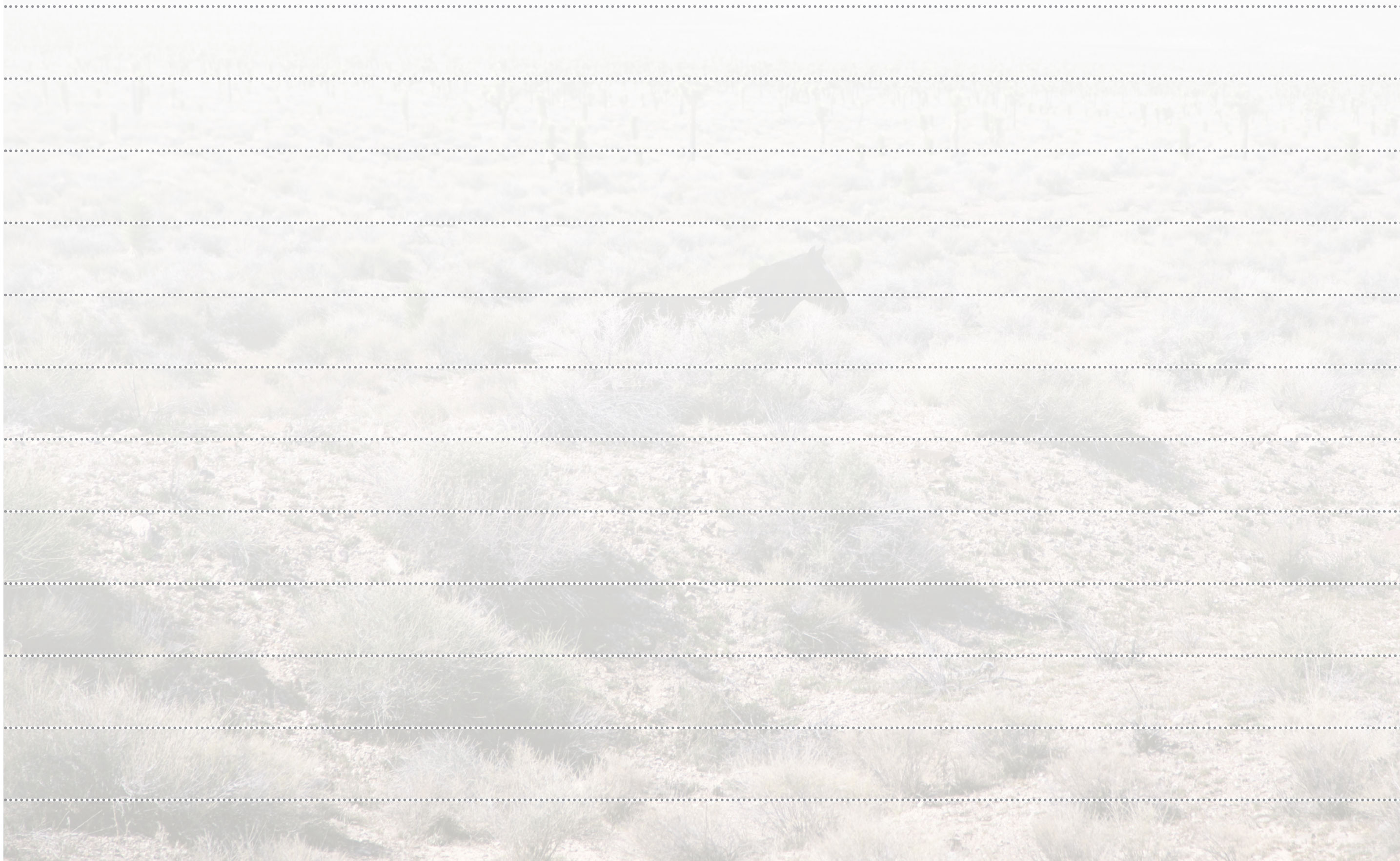
The **Green Reaper** cartoon character and costumed "live" character represent the Energy Program and are used in NNSS literature, employee activities, and in community outreach presentations to local elementary schools. In 2014, the costumed Green Reaper character visited six elementary schools, the Las Vegas Science and Technology Festival, and eight employee activities promoting energy awareness, recycling, water conservation, and site sustainability.

2014 DOE Sustainability Award

In February 2015, it was announced that NNSS was selected to receive a 2014 DOE Sustainability Award. This award is one of several new awards specifically selected by DOE's Sustainability Project Office staff to recognize outstanding sustainability commitment. It was awarded to recognize NNSS's noteworthy progress in effective energy, water, and vehicle fleet management, resulting in meeting many sustainability goals ahead of schedule *(see pages 23 and 24)*.







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The information presented in this document is explained in greater detail in the ***Nevada National Security Site Environmental Report 2015*** (DOE/NV/25946--2950). A compact disc of this document is included on the back inside cover. This document can also be downloaded from the U.S. Department of Energy, National Nuclear Security Administration Nevada Field Office at **http://www.nv.energy.gov/library/publications/aser.aspx**.

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Front cover photo: Historical tower structure in Area 6 used for electromagnetic pulse experiments during atmospheric nuclear testing in the 1950s *(photo taken in June 2014).*

Back cover photo: Wild burros in Area 25 *(photo taken in October 2015).*

NNSA
National Nuclear Security Administration

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