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2005

Nevada Test Site Environmental Report

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Executive Summary

The *Nevada Test Site Environmental Report 2005* (NTSER) was prepared to meet the information needs of the public and the requirements and guidelines of the U.S. Department of Energy (DOE) for annual site environmental reports. It was prepared by Bechtel Nevada (BN) and finalized by its successor contractor, National Security Technologies. This Executive Summary presents the purpose of the document, the major programs conducted at the Nevada Test Site (NTS), NTS key environmental initiatives, radiological releases and potential doses to the public resulting from site operations, a summary of non-radiological releases, implementation status of the NTS Environmental Management System, a summary of compliance with environmental regulations, pollution prevention and waste minimization accomplishments, and significant environmental accomplishments. Much of the content of this Executive Summary is also presented in a separate stand-alone pamphlet titled *Nevada Test Site Environmental Report Summary 2005* produced to provide a more cost-effective and wider distribution of information contained in the NTSER to interested DOE stakeholders.

Purpose of the NTS Environmental Report

This NTSER was prepared to satisfy DOE Order 231.1A, *Environment, Safety and Health Reporting.* Its purpose is to (1) report compliance status with environmental standards and requirements, (2) present results of environmental monitoring of radiological and nonradiological effluents, (3) report estimated radiological doses to the public from releases of radioactive material, (4) summarize environmental incidents of noncompliance and actions taken in response to them, (5) describe the NTS Environmental Management System and characterize its performance, and (6) highlight significant environmental programs and efforts. This report meets these objectives for the NTS and its three Nevada satellite sites mentioned below.

Major Site Programs and Facilities

The U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) directs the management and operation of the NTS and seven satellite sites across the nation. The NTS is located about 105 kilometers (km) (65 miles [mi]) northwest of Las Vegas. The seven satellite sites include three sites in Nevada (North Las Vegas Facility, Cheyenne Las Vegas Facility, and the Remote Sensing Laboratory – Nellis) and four sites in other states (Remote Sensing Laboratory – Andrews in Maryland, Livermore Operations in California, Los Alamos Operations in New Mexico, and Special Technologies Laboratory in California). Los Alamos, Lawrence Livermore, and Sandia National Laboratories are the principal organizations that sponsor and implement the nuclear weapons programs at the NTS. In 2005, BN was the Management and Operations contractor accountable for the successful execution of work and ensuring that work was performed in compliance with environmental regulations. The NTS and its seven satellite sites all provide support to enhance the NTS as a site for weapons experimentation and nuclear test readiness. The three major NTS missions include National Security, Environmental Management, and Stewardship of the NTS.

Facilities that support the National Security mission of keeping the U.S. stockpile of nuclear weapons safe and reliable include the U1a Facility, Big Explosives Experimental Facility, Device Assembly Facility, and Joint Actinide Shock Physics Experimental Research (JASPER) Facility. Facilities that support the Homeland Security program include the new Radiological/Nuclear Countermeasures Test and Evaluation Complex which is expected to be operational in October 2006.

Other Key Initiatives

Apart from the major site programs, other NTS activities include demilitarization activities, controlled spills of hazardous material at the Non-Proliferation Test and Evaluation Complex (NPTEC) for research purposes, processing of waste destined for the Waste Isolation Pilot Plant in Carlsbad, New Mexico, or the Idaho National Laboratory in Idaho Falls, Idaho; and environmental research.

Environmental Performance Measure Programs

During the conduct of the major programs and other key initiatives mentioned above, NNSA/NSO complies with applicable environmental and public health protection regulations and strives to manage the land and facilities at the NTS as a unique and valuable national resource. For the identification of NTS environmental initiatives, BN relied upon BN's Integrated Safety Management System (ISMS), contractual Work Smart Standards (WSS), and the Environmental Management System (EMS). The ISMS is designed to ensure the systematic integration of environment, safety, and health concerns into management and work practices so that NTS missions are accomplished safely and in a manner which protects the environment. Implementation of an ISMS at the NTS was verified by NNSA/NSO in July 2001. NNSA/NSO oversees ISMS implementation through the Integrated Safety Management Council. Each Council member performed a self-assessment in September 2005 and verified that ISMS continues to be effectively implemented at the NTS.

WSS are an integral part of the ISMS whereby hazards and environmental aspects of work are identified and standards of operation are established that are specific to the work environment, its associated hazards, and its threats to the environment. WSS are developed at the management level with the most expertise in the work. NNSA/NSO approved the initial complete set of BN WSS in September 1996. The approved WSS identify within each BN program, the contractual commitment to meet applicable laws, regulations, and policies which protect the public and the environment. Compliance with WSS is tracked through management assessments.

In 2000, Executive Order (EO) 13148, *Greening of the Government Through Leadership in Environmental Management* was issued. This EO requires all federal agencies to adopt an environmental management system (EMS). EMSs are designed to incorporate concern for environmental performance throughout an organization, with the ultimate goal being continual reduction of the organization's impact on the environment. DOE requires contractors who operate DOE sites to develop an EMS and expects full integration of EMS into their ISMS by December 2005. Full implementation of the NTS EMS was completed, and NNSA/NSO made the Self Declaration to NNSA Headquarters on December 15, 2005.

Performance Measures

Performance measures are used to evaluate the achievement of organization or process goals and to identify the need to institute changes in an organization or process. The NTS performance measures, defined from the WSS, relate to protection of the environment and the public from effects of NTS operations. These performance measures apply to several programs and processes. They include: (1) the potential radiological dose received by the public; (2) the identification, notification, and mitigation of spills and releases to the environment; (3) the reduction in the generation of wastes; and (4) compliance with applicable environmental protection regulations. The performance measures tracked by each process or program (e.g., air quality protection) are consolidated and presented in this report in Section 2.0, Compliance Summary. As part of implementing EMS, BN identified Objectives and Targets which were reviewed and approved by the Executive Safety Committee. These additional Targets (Table 17-1) will be tracked and reported beginning in 2006 in addition to those measures presented in Section 2.0.

Offsite Monitoring for Radiological Releases into Air

An oversight radiological air monitoring program is run by the Community Environmental Monitoring Program (CEMP) and is coordinated by the Desert Research Institute (DRI) of the Nevada System of Higher Education under contract with NNSA/NSO (Section 6.0). Its purpose is to provide monitoring for radionuclides that might be released from the NTS. A network of 27 CEMP stations, located in selected towns and communities within 386 km (240 mi) from the NTS, was operated during 2005. The CEMP stations monitored gross alpha and beta radioactivity in airborne particulates using low-volume particulate air samplers, penetrating gamma radiation using thermoluminescent dosimeters (TLDs), gamma radiation exposure rates using pressurized ion chamber (PIC) detectors, and meteorological parameters using automated weather instrumentation. One new station was added at Mesquite, Nevada in the fall of 2005 and supplied about two months' data for this report concerning background gamma radiation; however, data related to low-volume particulate air sampling will not be available until 2006.

No airborne radioactivity related to historic or current NTS operations was detected in any of the samples from the CEMP particulate air samplers during 2005. Gross alpha and gross beta radioactivity was detected at all CEMP stations at levels which were consistent with previous years and which reflect radioactivity from naturally-occurring radioactive materials (Section 6.1.1). The mean annual gross alpha activity across all sample locations was $1.80 \pm 0.54 \times 10^{-15}$ microcuries per milliliter (μCi/mL). The mean annual gross beta activity across all sample locations was $2.08 \pm 0.17 \times 10^{-14}$ μCi/mL. No man-made gamma-emitting radionuclides were detected.

TLD and PIC detectors measure gamma radiation from all sources: natural background radiation from cosmic and terrestrial sources and man-made sources. The offsite TLD and PIC results remained consistent with previous years' background levels and are well within background levels observed in other parts of the United States. The highest total annual gamma exposure measured offsite, based on PIC data, was 183.96 milliroentgen per year (mR/yr) at Milford, Utah. The lowest offsite gamma exposure rate measured was 74.55 mR/yr at Pahrump, Nevada (Section 6.1.3).

Onsite Monitoring and Estimating of Radiological Releases into Air

Estimates of radionuclide emissions from the following sources were used to compute total air emissions from source locations on the NTS. Those emissions and locations identified for 2005 included: (1) tritium gas released at Building 650 in Area 23 during equipment calibration (0.000014 curies per year [Ci/yr]), (2) the evaporation of tritiated water discharged from E Tunnel in Area 12 (17 Ci/yr) and a post-shot well (U-20n PS #1DD-H) in Area 20 (3.5 Ci/yr), (3) the evaporation of tritiated water removed from the basement of Building A-1 at the North Las Vegas Facility (NLVF) and transported to the NTS for disposal in the Area 5 Sewage Lagoon (0.00037 Ci/yr), (4) the evaporation and transpiration of tritiated water from soil and vegetation, respectively, at sites of past nuclear tests and from the Area 3 Radioactive Waste Management Site (RWMS) (57 Ci/yr) and the Area 5 RWMS (8.9 Ci/yr), and (5) the re-suspension of surface soil containing americium-241 (^{241}Am) and plutonium-239+240 ($^{239+240}$Pu) from past nuclear testing over numerous areas of the NTS. Total tritium emissions from all sources was estimated to be 170 Ci in 2005, and those for plutonium and americium were 0.29 and 0.047 Ci, respectively. The methods used to estimate these quantities each year include the use of annual field air and water monitoring data, historical soil inventory data, and accepted soil re-suspension and air transport models.

Total NTS Radiological Atmospheric Releases for 2005 (Ci/yr)

^{3}H	^{85}Kr	Noble Gases ($T_{1/2}$<40 days)	Short-Lived Fission and Activation Products ($T_{1/2}$<3 hr)	Fission and Activation Products ($T_{1/2}$>3 hr)	Total Radio-iodine	Total Radio-strontium	Total Uranium	Plutonium	Other Actinides	Other
170	0	0	0	0	0	0	0	0.29 ($^{239+240}$Pu)	0.047 (^{241}Am)	0

A network of 19 air sampling stations (3 having low-volume particulate air samplers, 1 having a tritium water vapor sampler, and 15 having both) and a network of 109 TLDs were used to monitor diffuse onsite radioactive emissions in 2005. Several human-made radionuclides from legacy contamination were measured in air samples at levels above their minimum detectable concentrations (MDCs) in 2005: ^{241}Am; tritium (^{3}H); and plutonium-238 (^{238}Pu) and $^{239+240}$Pu (Section 3.1.4). These were attributed to the resuspension of contamination in surface soils from legacy sites and to the evaporation and transpiration of tritium from the soil, plants, and containment ponds at legacy sites. The highest mean level of ^{241}Am (229. 6 $\pm$ 273.8 x 10^{-18} μCi/mL] was detected at Bunker 9-300 in Area 9, a vacant building located within an area of known soil contamination from past nuclear tests. The highest mean level of tritium (330.5 $\pm$ 7.4 x 10^{-6} picocuries [pCi]/mL) was detected at Schooner, site of the second-highest yield Plowshare cratering experiment on the NTS where tritium-infused ejecta surrounds the crater. The highest mean levels of plutonium isotopes in air were at Bunker 9-300 (19.7 $\pm$ 26.3 x 10^{-18} and 1526 $\pm$ 1277 x 10^{-18} μCi/mL for ^{238}Pu and $^{239+240}$Pu, respectively). The relatively high plutonium values occur most often at the Bunker 9-300 air sampling station due to historical nuclear testing in Area 9 and surrounding Areas 3, 4, and 7. Uranium isotopes are also measured in air samples collected in areas where depleted uranium ordnance have been used or tested. However, the samples' isotopic ratios were close to what one would expect from naturally-occurring uranium in soil with possibly a slight contribution of enriched depleted uranium; the ratios did not resemble those expected from depleted uranium (Section 3.1.4.4).

Gross alpha and gross beta radioactivity was detected at all stations on the NTS (Section 3.1.4.6). The average gross alpha activities ranged from 15.29 ± 2.24 to 54.68 ± 8.54 x 10^{-16}; the highest seen at Bunker 9-300. The average gross beta activities ranged from 17.29 ± 1.45 to 22.51 ± 0.47 x 10^{-15} µCi/mL; the highest seen at Sugar Bunker, an unoccupied structure used during past nuclear testing, located about 1 km (0.6 mi) south-southwest of the Area 5 Radioactive Waste Management Complex.

Both $^{239+240}$Pu and tritium continue their overall declining trends at the air sampling locations (Sections 3.1.4.3 and 3.1.4.5). Tritium in air concentrations have decreased since the cessation of testing in 1992. The average trend line varies from NTS Area to Area; it shows an average decrease ranging from 52 percent since 1992 in Area 1 to 99.7 percent in Areas 23 and 25. The only exception to this trend has been Schooner in Area 20 (Section 3.1.4.3), at which sampling began relatively recently. $^{239+240}$Pu concentrations have likewise decreased; the average decline since 1992 ranges from 38 percent in Areas 1 and 3 to 91 percent in areas 18, 19, and 20. The downward trends in plutonium concentrations are attributed to its dispersal by the wind and weathering in the soil, where it becomes bound to less mobile particles.

The highest estimated mean annual gamma exposure measured at a TLD station on the NTS was 834 ± 26 mR/yr at Schooner, one of the legacy Plowshare sites on Pahute Mesa. The lowest was 60 ± 2 mR/yr in Mercury at the fitness track (Section 5.3). The mean annual gamma exposure at 17 TLD locations near the Area 3 and Area 5 RWMSs was 147 ± 1 mR. At the 35 TLD locations near known legacy sites (including Schooner), it was 277 ± 2 mR. At the 10 TLD locations in uncontaminated sites away from all current operations, it was 119 ± 1 mR.

Offsite Radiological Monitoring of Water

Offsite water monitoring conducted by BN and DRI through the CEMP verifies that there has been no offsite migration of man-made radionuclides from NTS underground contamination areas.

In 2005, BN conducted radiological monitoring of 27 offsite wells and 3 offsite springs. The wells included 9 private domestic wells, 6 local community wells, and 12 NNSA/NSO wells drilled for hydrogeologic investigations including groundwater flow modeling. All of the BN-sampled wells and springs are in Nevada within 19 mi from the western and southern borders of the NTS. The DRI, through the CEMP, sampled 25 offsite water locations in 2005. They included 4 springs, 18 wells, and 3 surface water bodies located in selected towns and communities within 240 mi from the NTS. One site, the Beatty Water and Sewer well, is sampled by both BN and DRI.

CEMP and BN water samples are both analyzed for tritium. To be able to detect the smallest possible amounts of tritium in offsite water supplies, enriched tritium analyses were run on all samples. The MDC for tritium using this enrichment process was approximately 23 picocuries per liter (pCi/L) for both the BN and the CEMP samples. Without enrichment, the MDC for tritium typically ranges from 200-400 pCi/L. To put these values in perspective, the U.S. Environmental Protection Agency's (EPA's) drinking water maximum contaminant level (MCL) for tritium is 20,000 pCi/L.

BN offsite water samples are also analyzed for man-made gamma-emitting radionuclides that would signify contamination from nuclear testing and for gross alpha and gross beta radioactivity to determine if alpha or beta radioactivity at any well or spring is increasing over time.

CEMP results in 2005, as in past years, continue to verify that no contaminated groundwater has migrated beyond the NTS boundaries into surrounding water supplies used by the public (Section 6.2). Measured tritium concentrations from the wells ranged from -7 to 8 pCi/L. For the springs and surface waters, they ranged from -2 to 24 pCi/L. As in previous years, samples from Boulder City and Henderson municipal water supplies contained tritium at levels barely above detection. These two municipal water systems obtain water from Lake Mead, which has documented levels of residual tritium persisting in the environment that originated from global atmospheric nuclear testing.

Similarly, the results of BN offsite water monitoring verified that there has been no offsite migration of man-made radionuclides from NTS underground contamination areas. None of the offsite springs or the offsite public or domestic water supply wells had levels of tritium above their detection limits. Measured tritium levels in the sampled drinking water wells ranged from -8.4 to 7.6 pCi/L (Section 4.1.4). For the three offsite springs they ranged from -1.4 to 11 pCi/L (Section 4.1.5). BN measured tritium above detection limits in only 2 of the 12 offsite NNSA/NSO monitoring wells: ER-OV-03A and ER-OV-03C2. Tritium levels in both of these was 24 ± 12 pCi/L (Section 4.1.4). This level is within the range of concentrations indicative of analytical background levels for tritium (20 to 39 pCi/L) (Section 4.1.3). No offsite wells or springs contained any man-made gamma-emitting radionuclides.

All offsite well and spring samples contained detectable gross alpha and gross beta activity (Sections 4.1.4 and 4.1.5). The levels of activity in offsite drinking supply wells and springs were all less that the EPA limits set for drinking water. One NNSA/NSO offsite monitoring well (ER-OV-02) had gross alpha levels of 16 to 24 pCi/L which were above the EPA drinking water limits of 15 pCi/L, but this well does not supply drinking water. The detectable gross alpha and gross beta radioactivity in all of the offsite spring and well samples is most likely from natural sources.

Onsite Radiological Monitoring of Water

In 2005, the onsite water monitoring network was comprised of 10 potable water supply wells, 18 monitoring wells, 3 natural springs, 1 tritiated water containment pond system, and 2 sewage lagoons. The 2005 data continue to indicate that underground nuclear testing has not impacted the NTS potable water supply network. All of the water samples from the ten supply wells had non-detectable concentrations of tritium and man-made gamma-emitting radionuclides (Section 4.1.6). The gross alpha and gross beta radioactivity detected in potable water supply wells represent the presence of naturally-occurring radionuclides.

Five of the 18 monitoring wells sampled had detectable levels of tritium ranging from 21 ± 13 to 492 ± 31 pCi/L, all well below the MCL of 20,000 pCi/L (Section 4.1.7). Three of these wells (U-19BH, WW A, and Well PM-1) are each within 1 km (0.6 mi) of an historical underground nuclear test; all have consistently had detectable levels of tritium in past years. Their tritium levels are still less than 3 percent of the EPA MCL for drinking water of 20,000 pCi/L, and no trend of rising tritium concentrations in these wells have been observed since 2000. The other two monitoring wells with detectable tritium (ER-19-1 and UE-25P #1) had levels just above their MDCs.

Most groundwater and spring samples on the NTS had gross alpha and gross beta levels above detection limits but below the EPA limits for drinking water. Three onsite monitoring wells (U-19BH, UE-25 WT #6, and ER-19-1) showed either gross alpha and/or gross beta levels above the EPA drinking water limits, but none of these wells supply drinking water. The gross alpha and gross beta radioactivity is most likely from natural sources.

Three onsite springs were sampled in 2005 (Section 4.1.8). None of them are discharge points from a regional aquifer but are perched water tables from surface infiltration of precipitation. Tritium was detected at very low concentrations at White Rock Spring (46 ± 14 pCi/L) and is believed to come from known surface contamination from previous nuclear testing. Gamma spectroscopy detected the man-made fission product cerium-144 (^{144}Ce) in the water sample collected from Tub Spring although no other man-made radionuclides were detected in the sample.

Five constructed basins collect and hold water discharged from E Tunnel in Area 12 where nuclear testing was conducted in the past. Tunnel effluent water and sediment samples are analyzed for tritium, gross alpha, gross beta, and other radionuclides. Most samples had detectable radionuclide concentrations in 2005 (Section 4.1.9). The average tritium concentration in tunnel effluent water was 600,000 pCi/L, lower than the limit allowed under a discharge permit (1,000,000 pCi/L). Gross alpha and gross beta values in 2005 were also less than their permitted limits: 13 pCi/L with a permissible limit of 35 pCi/L for gross alpha and 77 pCi/L with a permissible limit of 100 pCi/L for gross beta.

Neither of the two onsite sewage lagoons had detectable levels of tritium (Section 4.1.10).

Tritiated water is pumped into lined sumps during studies conducted by the Underground Test Area Project. Suitable wells are being drilled and existing wells re-completed in the vicinity of certain underground tests and at other locations on the NTS designated by hydrologists. During these drilling operations, if the tritium level exceeds 200,000 pCi/L, contaminated water is pumped from the wells and diverted to lined containment ponds (sumps), as required by the state. During 2005, water containing tritium was pumped from Well U-20n PS #1DD-H into a lined sump; preliminary analysis measured appoximately 37,000,000 pCi/L of tritium (Section 4.1.11).

Radiation Dose to the Public from the NTS

Background Gamma Radiation - Background gamma radiation exposure rates on the NTS were measured at ten TLD stations located away from radiologically contaminated sites; these ranged from 65 to 161 milliroentgen per year (mR/yr) during 2005 (Section 5.3). This equates to an annual estimated background external dose of 65 to 161 millirem per year (mrem/yr) to a hypothetical person residing at those locations all year. In comparison, DRI measured background radiation at offsite locations which ranged from 59 mR/yr at Pahrump, Nevada, to 184 mR/yr at Milford, Utah.

Drinking Water - Man-made radionuclides from past nuclear testing have not been detected in offsite groundwater in the past or during 2005 (Section 4.1). The only pathways, therefore, by which the offsite public could receive a radiation dose from NTS operations are from inhalation, ingestion, and direct external exposure to gamma radiation

Inhalation - The radiation dose limit to the general public via just the air transport pathway is established by the National Emission Standards for Hazardous Air Pollutants (NESHAP) under the Clean Air Act to be 10 mrem/yr. The EPA, Region IX, has approved the use of six air sampling stations on the NTS (called "critical receptor" stations) to verify compliance with the NESHAP dose limit. These six stations are part of the 19 stations in the NTS air sampling network and they are located near legacy sites of contamination and along the NTS boundaries. The following human-produced radionuclides were detected at three or more of the critical receptor samplers in 2005: ^{241}Am, ^{238}Pu, $^{239+240}$Pu, and ^{3}H (tritium). Concentrations of these radionuclides at each of the stations indicated that the NESHAP dose limit to the public was not exceeded. The Schooner critical receptor station in the far northwest corner of the NTS experienced the highest concentrations of radioactive air emissions (Section 3.1.5), yet an individual residing at this station would experience a dose from air emissions of only 2.3 mrem/yr, 23 percent of the admissible does limit. No one resides at this location, and the dose at offsite populated locations 20-80 km (12-50 mi) from the Schooner station would be much lower due to wind dispersion.

Ingestion of Radionuclides in Game Animals - Game animals from different contaminated NTS 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 NTS. NTS game animals include pronghorn antelope, mule deer, chukar, Gambel's quail, mourning doves, cottontail rabbits, and jackrabbits. In 2005, both mourning doves and jackrabbits were sampled at the Sedan crater, and mourning doves were sampled at a sump in which tritium-contaminated water from well U-19ad was pumped and stored. Based on these samples, the highest annual dose to a member of the public was estimated to be 0.32 mrem (0.0032 millisieverts), assuming that this person eats 20 jackrabbits from the Sedan site. This hypothetical dose is only 0.32 percent of the annual dose limit for members of the public. To put this dose into perspective, it is 1.5 times lower than the dose from cosmic radiation received by an individual while on a one-hour airplane flight at 39,000 feet (0.5 mrem).

Direct Radiation - Direct gamma radiation exposure to the public from NTS operations in 2005 was negligible. Areas accessible to the public had exposure rates comparable to natural background rates, with one exception. The TLD location on the west side of the parking area at Gate 100, the NTS entrance gate, had an estimated annual exposure of 220 mR. It is likely that low-level radioactive waste shipments parked there prior to entering the NTS were responsible for this elevated exposure. That exposure would be 155 mR above the estimated exposure at the nearest background location, or 59 mR above the highest estimated background exposure. These exceedence values straddle the allowable dose of 100 mrem during the year, established by DOE Order 5400.5; however, nobody resides or remains full-time in the truck parking area.

The great majority of the NTS is bounded by the Nevada Test and Training Range (NTTR). Military or other personnel on the NTTR who are not classified as radiation workers would also be subject to the 100 mrem annual dose limit for members of the public. Military personnel could be exposed to direct radiation from legacy sites in Frenchman Lake playa. A TLD location near the NTS boundary with NTTR in the Frenchman Lake playa had an estimated annual exposure during 2005 of 391 mR (down from 411 mR in 2004). The resulting dose of approximately 230 to 326 mrem, depending on which background radiation value is used, would exceed the 100 mrem dose limit to a hypothetical person residing year-round at this location; again, however, there are no living quarters or full-time personnel in this vicinity.

2005 Changes in Reporting Radiation Dose to the Public

DOE Order 5400.5 requires all DOE and NNSA sites to estimate each year the radiation dose to the public from all possible exposure pathways. Those dose estimates are presented each year in this report. Dose is to be presented as: (1) the effective does equivalent (EDE) to the maximally-exposed individual (MEI) residing within an 80-km (50-mi) radius of the site, and (2) the population dose, or the collective EDE for all individuals combined who reside within the 80-km radius (expressed as person-rem/yr). DOE Order 5400.5 specifies that dose calculations be performed using standard EPA or DOE dose conversion factors or analytical models prescribed in regulations applicable to site operations. The use of several EPA-approved air transport models are prescribed for use in evaluating compliance with the NESHAP limits for radiological air emissions. In previous years, the EPA-approved air transport model called Clean Air Package 1988 (CAP88-PC) has been used to calculate the EDE to the MEI and the collective population dose (person-rem/yr, product of dose times population at location of dose estimate) attributed to NTS air emissions. Previously, these two dose calculations were combined with dose estimates from other potential pathways (e.g., consumption of game animals) to report public dose from all pathways and to assess compliance with the DOE dose limit of 100 mrem/yr from all pathways (over and above background).

Region IX of the EPA approved the use of six "critical receptor" air sampling stations on the NTS to evaluate NESHAP compliance instead of using the estimated public dose calculated by the CAP88-PC model. The reasoning for this change was that the doses to the MEI offsite reported in the past were consistently very low (<0.2 mrem/yr) and were from diffuse sources, primarily from the resuspension of radioactively-contaminated soil from legacy sites containing ^{241}Am, ^{238}Pu, and $^{239+240}$Pu. Also, current NTS projects having the potential for airborne emissions are required to use high efficiency particulate air filters and stack monitoring and have not produced any emissions. Since the cessation of nuclear testing in 1992, no emissions other than those from diffuse legacy deposits have occurred. Because of this, the EPA concurred that a more accurate measure of offsite public exposure to emissions from legacy sites would be the continuous data collected from the critical receptor stations and not the dose estimate generated from the CAP88-PC model that relies on indirect data such as measures of soil contamination at legacy sites collected in the 1980s.

Beginning with this report, data from the six critical receptor stations will be used in lieu of computing an EDE to the MEI from diffuse legacy contamination using the CAP88-PC air transport model. This change was approved by DOE (DOE, 2004e). Furthermore, DOE also approved the discontinuance of reporting collective population dose to those residing within 80 km (50 mi) of the NTS. Existing 2005 radiological monitoring data from air sampling stations, TLD stations, groundwater monitoring wells, and game animals indicate that the dose to the public living in communities surrounding the NTS are not expected to be higher than the previous 10 years and are expected to be less than 1 percent of the 100 mrem/yr dose limit.

Onsite Non-Radiological Releases into Air

There were no discharges of non-radiological hazardous materials to offsite areas in 2005. Therefore, only onsite non-radiological environmental monitoring of NTS operations was conducted. Air quality was monitored on the NTS throughout the year as required by state of Nevada permits for those operations that release criteria air pollutants, hazardous air pollutants (HAPs), or toxic and hazardous chemicals. The NTS has been issued a Class II air permit from the state of Nevada. Class II permits are issued to facilities which emit small quantities of air pollutants within a year (less than 100 tons of each criteria air pollutant, or 10 tons of any one HAP, or 25 tons of any combination of HAPs).

An estimated 3.66 tons of criteria air pollutants were released on the NTS in 2005. They included particulate matter equal to or less than 10 microns in diameter, carbon monoxide, nitrous oxides, sulfur dioxide, and volatile organic compounds (VOCs) (Section 3.2.1). The majority of these emissions (1.94 tons) was VOCs. Total air emissions of lead, also a criteria pollutant, were 14.55 pounds (Section 10.3). The quantity of HAPS released in 2005 was 0.05 tons. No emission limits for any criteria air pollutants or HAPS were exceeded. On June 8, the state of Nevada conducted an inspection of the following facilities regulated by the NTS air quality permit: the Area 1 Aggregate Plant and the Area 23 Incinerator. During the inspection, the incinerator failed its performance emission testing and was immediately shut down. No other exceedances were observed during the state inspection.

Asbestos is a HAP of regulatory concern on the NTS. In 2005, all materials containing regulated asbestos that were removed from NTS facilities were disposed of in the Mercury landfill. Large quantities of asbestos were removed during renovation of the A-1 Building at the NLVF and during demolition of the Test Cell A Facility in Area 25 of the NTS. EPA was notified of both of these projects (Section 3.2.8). The Mercury landfill documented receipt of 2 tons of such material in 2005.

A combined total of 3 tests consisting of 19 releases of hazardous chemicals were conducted at the Area 5 and the Area 25 Test Cell C NPTEC facilities in 2005 (Section 3.2.5). An annual report of the types and amounts of chemicals released and the test plans and final analysis reports for each chemical release were submitted to the state of Nevada. No ecological monitoring was performed since each test posed a very low level of risk to the environment and biota.

Onsite Non-Radiological Releases into Water

There are no liquid discharges to navigable waters, offsite surface water drainage systems, or publicly owned treatment works resulting from operations on the NTS. Therefore, no Clean Water Act National Pollution Discharge Elimination System (NPDES) permits are required for NTS operations.

In 2005, industrial discharges on the NTS were limited to two operating sewage lagoon systems, the Area 6 Yucca Lake and Area 23 Mercury systems. Under the conditions of state of Nevada operating permits, liquid discharges to these sewage lagoons are tested quarterly for biochemical oxygen demand, pH, and total suspended solids. Annually, sewage lagoon pond waters are sampled for a suite of toxic chemicals. In 2005, quarterly and annual analyses of sewage influent and pond waters, respectively, both showed that all water measurements were within permit limits (often below detection levels) with one exception. One measure of 5-day Biological Oxygen Demand, Mean Daily Load was exceeded at the Area 6 Yucca Lake Sewage lagoons in the first quarter. Subsequent samples in the second quarter showed that the lagoons were once again in compliance (Section 4.2.3).

Onsite Non-Radiological Drinking Water Quality

NNSA/NSO operates a network of nine permitted wells that comprise three permitted public water systems on the NTS; these supply the potable water needs of NTS workers and visitors. In addition, three private water systems are maintained but are not regulated under state permit. NNSA/NSO hauls potable water for use in decontamination and sanitation for work locations at the NTS that are not part of a public water system. Monitoring results indicate that water samples from the three public water systems and from the potable water hauling trucks met the National Primary and Secondary Drinking Water Standards in 2005 with one exception. The Area 12 water system (PWS NV0004099) exceeded the action level for lead (0.046 milligrams per liter [mg/L]; with action level of 0.015 mg/L) (Section 4.2.1). The state was notified and more frequent monitoring of this system was initiated to more closely monitor the system's lead levels. The Area 12 buildings were last occupied in March 2005, and there are no immediate plans to use this camp in 2006.

Non-Radiological Releases into Air and Water at the NLVF

Like the NTS, the NLVF is regulated for the emission of criteria air pollutants and HAPs. An air quality operating permit is maintained for a variety of equipment at the NLVF. There are no monitoring requirements associated with the permit. The Clark County Department of Air Quality and Environmental Management (DAQEM), formerly the Clark County Health District (CCHD), requires submittal of an annual emissions inventory. The combined quantity of criteria air pollutants and HAPs emitted at the NLVF in 2005 was 1.391 tons; they ranged from 0.001 tons for HAPS to 0.916 tons for nitrous oxides (Appendix A, Section A.1.3).

Water discharges at the NLVF are regulated by a permit with the City of North Las Vegas (CNLV) for sewer discharges and by temporary NPDES discharge permits with the state for discharging pumped groundwater onsite for irrigation and dust suppression. The NPDES permits were obtained for a groundwater characterization and dewatering project at the facility. Self-monitoring and reporting of the levels of non-radiological contaminants in sewage and industrial outfalls is conducted. In 2005, contaminant measurements were below established permit limits in all water samples from NLVF outfalls and all sludge and liquid samples from sand/oil interceptors except in water samples from two outfalls where total dissolved solids (TDS) exceeded permit limits (Appendix A, Section A.1.1). In response to these exceedances, a Salinity Control Plan discussing steps taken to reduce the TDS levels was written and submitted to CNLV. CNLV conducted an annual inspection in September 2005 that resulted in no findings or corrective actions.

Pollution Prevention/Waste Minimization (P2/WM) Activities

P2/WM activities result in reductions to the volume and/or toxicity of waste actually generated onsite. In 2005, a lead-shielded room in Building 23-600, used in the past to store radioactive sources, was converted into office space. Through segregation, approximately 13,800 metric tons (mtons) (15,180 tons) of potential hazardous waste (concrete with lead shielding) was eliminated. The lead shielding was segregated from the concrete and sent to the BN scrap metal salvage group for recycle. The Material Exchange Program reused 2.2 mtons (2.4 tons) of non-hazardous chemicals, equipment, and supplies. The NTS Calibration Lab eliminated a small hazardous waste stream by replacing a hazardous freon cleaning solvent used to clean pressure gauges with a non-hazardous solvent. Other significant waste reduction efforts continued in 2005, such as sending bulk used oil to an offsite vendor for recycling (166.3 mtons [182.9 tons]) and offsite recycling of mixed paper and cardboard (509.8 mtons [560.8 tons]). Overall, a reduction of 13,992 mtons (15,391.2 tons) of hazardous wastes and 1,194.4 mtons (1,313.9 tons) of solid wastes was realized in 2005. No reductions in radioactive wastes occurred in 2005 (Section 11.0).

Accidental or Unplanned Environmental Releases or Occurrences

In 2005, there were no reportable accidental or unplanned environmental releases or occurrence on the NTS or at any of the NTS satellite facilities.

Compliance with Environmental Laws, Regulations, and Policies

A summary of NNSA/NSO's compliance with over 100 applicable environmental laws, regulations, and policies are presented in Section 2.0 of this NTSER. The major categories of these drivers are listed below. Where compliance for a category was not 100 percent, all of the non-compliance incidents are noted.

Environmental Compliance Summary for the NTS in 2005

Category	Non-Compliance Incidents
Air Quality	Three pieces of equipment failed their performance emissions test and were shut down (Section 3.2.2).
Water Quality and Protection	Limits for lead were exceeded in Area 12 public water system (Section 4.2.1.1). Limits for total dissolved solids were exceeded in sewage outfalls at NLVF (Section A.1.1.1).
Radiation Dose Protection	None
Radioactive and Non-Radioactive Waste Management and Environmental Restoration	None
Hazardous Materials Control and Management	None
Pollution Prevention and Waste Minimization	One Executive Order 13101 goal (Section 11.1) and four Secretary of Energy's P2 Leadership goals (Section 11.4) were not met.
Historic Preservation and Cultural Resource Protection	None
Conservation and Protection of Biota and Wildlife Habitat	11 accidental bird deaths attributable to NTS activities (e.g., roadkill); represented 9 species protected as migratory birds (Section 13.3.5.1).

Significant Environmental Accomplishments

Environmental Restoration - The cleanup of sites contaminated by past DOE operations and the hydrogeological investigations supporting characterization of underground nuclear contamination areas are the most significant environmental work performed by NNSA/NSO each year. The DOE, U.S. Department of Defense, and the State of Nevada Division of Environmental Protection identify a work scope and milestone schedule for the cleanup and safe closure of the contaminated above-ground sites and for the field investigations and model development necessary to characterize the underground sites. A total of 49 contaminated above-ground sites was closed safely in 2005. Extensive progress was made towards the development of hydrologic models describing groundwater flow and possible radionuclide transport from the primary underground sites into the groundwater underlying public lands outside the boundaries of the NTS. This involved well development, aquifer testing, groundwater characterization sampling, and the completion of several technical data documentation packages and modeling approach/strategy documents.

Pollution Prevention - BN received three NNSA Pollution Prevention Awards for P2 activities in 2005. BN's Pollution Prevention Team was awarded an Environmental Stewardship Award for developing a Material Exchange Program that utilizes an interactive web site where employees from different organizations can "shop" for used items and add items they no longer need to the list of available items. This reduces the amount of waste that would be slated for the NTS landfill. Two NNSA Best-In-Class Awards for 2005 went to recognize the efforts of the JASPER team to eliminate the generation of low-level, mixed transuranic waste, and to the Fleet Fuel Efficiency Team's proposal to use B-20 Bio-diesel, E-85 Ethanol/Gasoline mixtures and "Micro" vehicles resulting in reductions in the amount of petroleum usage at the NTS.

Waste Management - In 2005, the primary sewage lagoon in Area 23 was lined, thus preventing any infiltration from that basin. This is one of the first lagoons in Nevada to be lined with geosynthetic clay and high density polyethylene liners.

Ecological Monitoring - A total of 25.5 acres of habitat within the range of the federally threatened desert tortoise (*Gopherus agassizii*) was disturbed on the NTS in 2005; however, no desert tortoises were accidentally injured or killed from project activities. Two projects to restore native vegetation to disturbed tortoise habitat were implemented.

Five major wildland fires occurred on the NTS in 2005 which burned a total of 13,000 acres. BN biologists prepared written assessments for soil stabilization and revegetation for these NTS fires. BN biologists also participated in two emergency stabilization planning meetings with the Bureau of Land Management, U.S. Fish and Wildlife Service, Nevada Division of Wildlife, and the U.S. Geological Survey to assess the impacts of the large wildfires in southern Nevada and to develop emergency stabilization plans for controlling erosion. BN biologists provided a presentation on revegetation in the Mojave Desert including techniques, species selection, timing, and irrigation.

A West Nile Virus Sampling Program on the NTS continued in 2005 with guidance from the CCHD. BN biologists conducted 16 trapping sessions at 10 sites on the NTS. A total of 77 mosquitoes of three different species was collected. None of the mosquitoes tested positive for the West Nile virus.

Acknowledgements

Environmental Technical Services (ETS) of Bechtel Nevada (BN) is responsible for production of this document for the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO). Environmental monitoring and compliance data were gathered through the combined efforts of several BN organizations in addition to ETS: Environmental Services, Radioactive Waste Operations, Solid Waste Operations, Environmental Restoration, Ecological Services, Radiological Control, Occupational Safety & Health, and Contractor Assurance & Compliance. The Water Resources and Cultural Resources divisions of the Desert Research Institute (DRI) contributed data for offsite water and air monitoring and cultural resource protection. Stoller-Navarro Joint Venture (SNJV) provided schedule and progress data for environmental restoration projects. Lawrence Livermore National Laboratory (LLNL) provided tritium data for certain onsite wells. The Air Resources Laboratory, Special Operations and Research Division (ARL/SORD) provided summary descriptions of NTS climate, and the U.S. Geological Survey (USGS) provided water level and usage data for selected wells. My thanks go to each of the authors and contributors who are listed below from these organizations. Your help during the writing and review phases were greatly appreciated.

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Appendix B: Glossary
Modified from *Lawrence Livermore National Laboratory 2003 Environmental Report*

ETS Support Staff

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Table of Contents

List of Figures

List of Tables

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1.0 Introduction and Helpful Information

1.1 Site Location

The U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) directs the management and operation of the Nevada Test Site (NTS) which is located in Nye County in south-central Nevada (Figure 1-1). The southeast corner of the NTS is about 88 kilometers (km) (55 miles [mi]) northwest of the center of Las Vegas in Clark County. By highway, it is about 105 km (65 mi) from the center of Las Vegas to Mercury. Mercury, located at the southern end of the NTS, is the main base camp for worker housing and administrative operations for the NTS.

The NTS encompasses about 3,561 square kilometers (km^2) (1,375 square miles [mi^2]). It varies from 46 to 56 km (28 to 35 mi) in width from west to east and from 64 to 88 km (40 to 55 mi) from north to south. The NTS is surrounded on all sides by federal lands (Figure 1-1). It is bordered on the southwest corner by the Yucca Mountain Project Area, on the west and north by the Nevada Test and Training Range (NTTR), on the east by an area used by both the NTTR and the Desert National Wildlife Range, and on the south by Bureau of Land Management (BLM) lands. The combination of the NTTR and the NTS represents one of the larger unpopulated land areas in the United States, comprising some 14,200 km^2 (5,470 mi^2).

1.2 Environmental Setting

The NTS is located in the southern part of the Great Basin, the northern-most sub-province of the Basin and Range Physiographic Province. The NTS terrain is typical of much of the Basin and Range Physiographic Province, characterized by generally north-south trending mountain ranges and intervening valleys. These mountain ranges and valleys, however, are modified on the NTS by very large volcanic calderas (Figure 1-2).

The principal valleys within the NTS are Frenchman Flat, Yucca Flat, and Jackass Flats (Figure 1-2). Both Yucca and Frenchman Flat are topographically closed and contain dry lake beds, or playas, at their lowest elevations. Jackass Flats is topographically open, and surface water from this basin flows off the NTS via the Fortymile Wash. The dominant highlands of the NTS are Pahute Mesa and Rainier Mesa (high volcanic plateaus), Timber Mountain (a resurgent dome of the Timber Mountain caldera complex), and Shoshone Mountain. In general, the slopes of the highland areas are steep and dissected, and the slopes in the lowland areas are gentle and less eroded. The lowest elevation on the NTS is 823 meters (m) (2,700 feet [ft]) in Jackass Flats in the southeast, and the highest elevation is 2,341 m (7,680 ft) on Rainier Mesa in the north-central region.

The topography of the NTS has been altered by historic U.S. Department of Energy (DOE) actions, particularly underground nuclear testing. The principal effect of testing has been the creation of numerous collapse sinks ("craters") in Yucca Flat basin and a lesser number of "craters" on Pahute and Rainier Mesas. Shallow detonations were also performed during Project Plowshare to determine the potential uses of nuclear devices for large-scale excavation.

The reader is directed to Appendix A of the *Nevada Test Site Environmental Report 2004* (DOE, 2005a) where the geology, hydrology, climatology, ecology, and cultural resources of the NTS are described. That appendix has also been included as a separate file on the compact disc of this 2005 report.

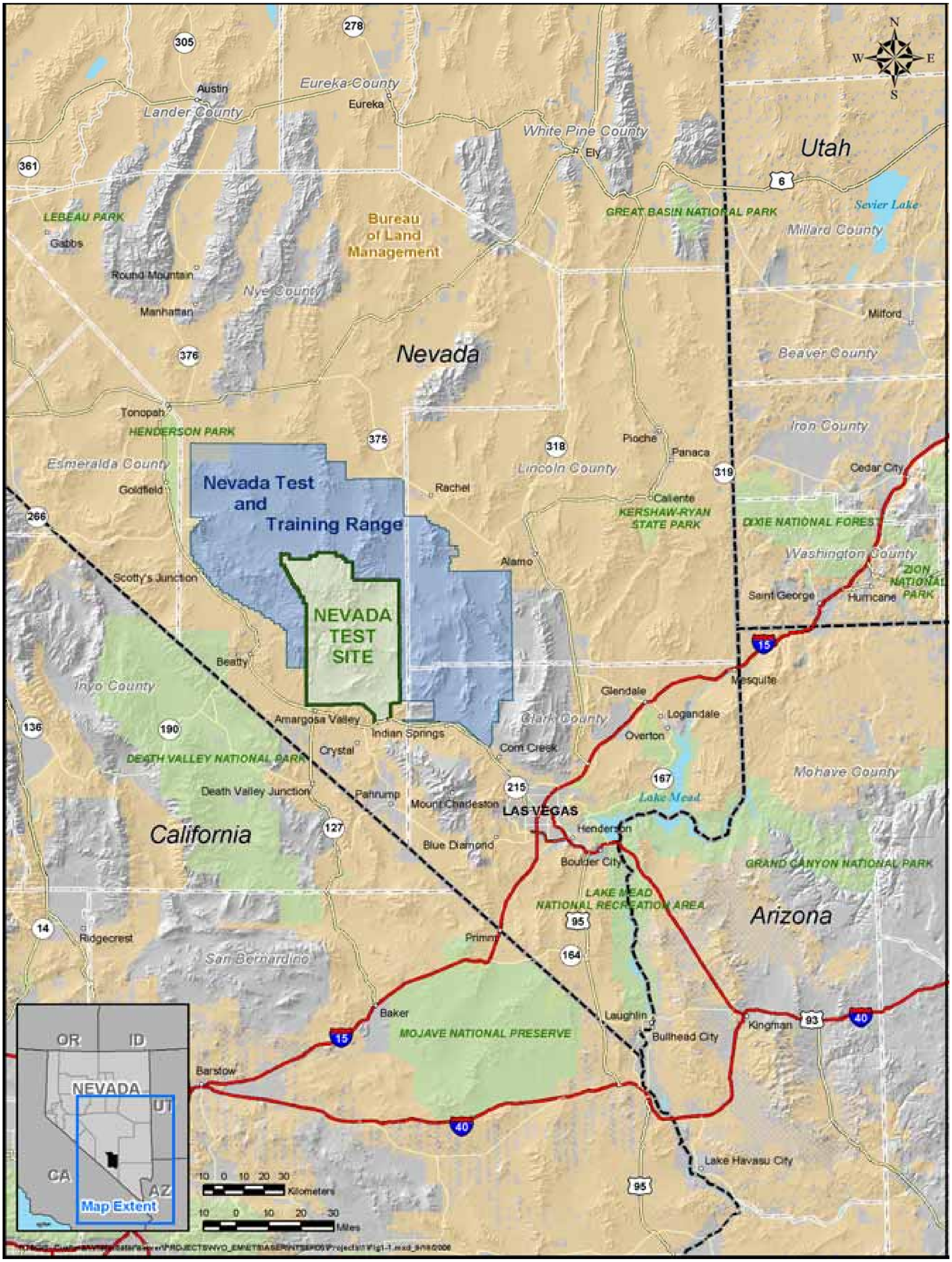


Figure 1-1. NTS vicinity map

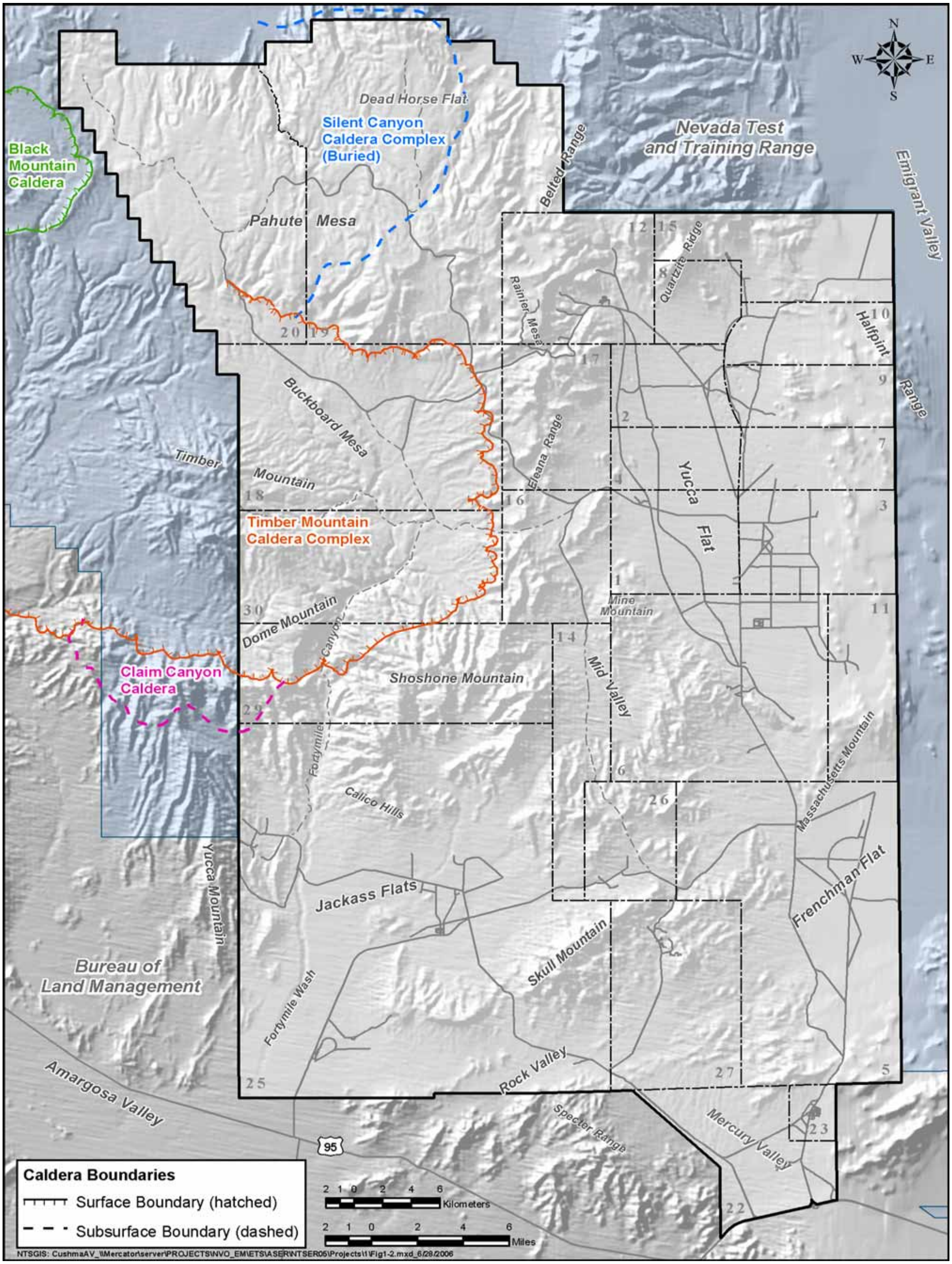


Figure 1-2. Major topographic features of the NTS

1.3 Site History

The history of the NTS, as well as its current missions, directs the focus and design of the environmental monitoring and surveillance activities on and near the site. Between 1940 and 1950, the area now known as the NTS was under the jurisdiction of Nellis Air Force Base and was part of the Nellis Bombing and Gunnery Range. The NTS was established in 1950 to be the primary location for testing the nation's nuclear explosive devices and supported nuclear testing from 1951 to 1992. The NTS currently conducts only subcritical nuclear experiments. Fact sheets on many of the historical tests and projects mentioned below can be found at http://www.nv.doe.gov/library/factsheets.aspx.

Atmospheric Tests - Tests conducted through the 1950s were predominantly atmospheric tests. These tests involved a nuclear explosive device detonated while 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 the dispersion of plutonium in the test vicinity. One of these test areas lies just north of the NTS boundary at the south end of the NTTR, and four others involving storage-transportation are at the north end of the NTTR. These test areas have been monitored for radionuclides in the past (1996 – 2000) in support of remediation projects, two of which were completed. The three remaining sites will be monitored again once restoration of these sites begins. All nuclear device tests are listed in *United States Nuclear Tests, July 1945 through September 1992* (DOE, 2000a).

Underground Tests - The first underground test, a cratering test, was conducted in 1951. The first totally-contained underground test was 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. Since late 1962, nearly all tests have been 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 NTS. Approximately one third of these tests were detonated near or below the water table; this has resulted in the contamination of groundwater in some areas. In 1996, DOE, U.S. Department of Defense (DoD), and the state of Nevada entered into a Federal Facilities Agreement and Consent Order which established Corrective Action Units (CAUs) on the NTS that delineated and defined areas of concern for groundwater contamination.

Cratering Tests - Five earth-cratering (shallow-burial) tests were conducted over the period of 1962 through 1968 as part of the Plowshare Program that explored peaceful uses of nuclear explosives. The first and highest yield Plowshare crater test, Sedan (U.S. Public Health Service, 1963) was detonated at the northern end of Yucca Flat on the NTS. The second highest yield crater test was Schooner, located in the northwest corner of the NTS. From these tests, mixed fission products, tritium, and plutonium were entrained in the soil ejected from the craters and deposited on the ground surrounding the craters.

Other Tests - Other nuclear-related experiments at the NTS have included the BREN series (Bare Reactor Experiment - Nevada series) in the early 1960s conducted in Area 4. These tests were performed with a 14-million electron volt neutron generator mounted on a 465-m (1,527-ft) steel tower to produce neutron and gamma radiation for the purpose of estimating the radiation doses received by survivors of Hiroshima and Nagasaki. The tower was moved in 1966 to Area 25 and used for conducting Operation HENRE (High Energy Neutron Reactions Experiment), jointly funded by the DoD and the Atomic Energy Commission (AEC) to provide information for the AEC's Division of Biology and Medicine. From 1959 through 1973, a series of open-air nuclear reactor, nuclear engine, and nuclear furnace tests were conducted in Area 25, and a series of tests with a nuclear ramjet engine were conducted in Area 26. Erosion of metal cladding on the reactor fuel released some fuel particles that caused negligible deposition of radionuclides on the ground. Most of the radiation released from these tests was gaseous in the form of radio-iodines, radio-xenons, and radio-kryptons.

1.4 Site Mission

NNSA/NSO directs the management and operation of the NTS and seven satellite sites across the nation. Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and Sandia National Laboratory are the principal organizations that sponsor and implement the nuclear weapons programs at the NTS. In 2005, Bechtel

Nevada (BN) was is the Management and Operations contractor who was accountable for the successful execution of work and ensuring that work was performed in compliance with environmental regulations. The seven satellite sites of the NTS include the North Las Vegas Facility (NLVF), Cheyenne Las Vegas Facility (CLVF), Remote Sensing Laboratory (RSL)–Nellis, RSL–Andrews, Livermore Operations, Los Alamos Operations, and Special Technologies Laboratory. These sites all provide support to enhance the NTS as a site for weapons experimentation and nuclear test readiness. This report addresses environmental monitoring and compliance only at the NTS and its three Nevada satellite sites: NLVF, CLVF, and RSL-Nellis (see Appendix A). The three major NTS missions include National Security, Environmental Management, and Stewardship of the NTS. The programs which support these missions include Stockpile Stewardship, Homeland Security, Test Readiness, Environmental Restoration, Waste Management, and Facilities and Infrastructure.

NTS Missions and Programs

National Security

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

Homeland Security Program – Provides support facilities, training facilities, and capabilities for government agencies involved in counterterrorism activities, emergency response, first responders, national security technology development, and nonproliferation technology development.

Test Readiness Program – Maintains the capability to resume underground nuclear weapons testing, if directed.

Environmental Management

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

Waste Management – Manages and safely disposes of low-level waste received from DOE- and DoD-approved facilities throughout the U.S. and mixed low-level waste generated in Nevada by NNSA/NSO, and safely manages and characterizes hazardous and transuranic wastes for offsite disposal.

Stewardship of the NTS

Facilities and Infrastructure – Maintains the buildings, roads, utilities, and facilities required to support all NTS programs and to provide a safe environment for NTS workers.

1.5 Primary Operations and Activities

NTS activities in 2005 continued to be diverse, with the primary role being to help ensure that the existing U.S. stockpile of nuclear weapons remains safe and reliable. Facilities that support this national security mission include the U1a Facility, Big Explosives Experimental Facility, Device Assembly Facility, and Joint Actinide Shock Physics Experimental Research (JASPER) Facility (Figure 1-3). Facilities that support the Homeland Security program include the new Radiological/Nuclear Countermeasures Test and Evaluation Complex (Rad/NucCTEC) (Figure 1-3) which is expected to be operational in October 2006. Facilities that support the Waste Management Program include the Area 5 Radioactive Waste Management Complex (RWMC) and the Area 3 Radioactive Waste Management Site (RWMS) (Figure 1-3). Other NTS activities include demilitarization activities; controlled spills of hazardous material at the Non-Proliferation Test and Evaluation Complex (NPTEC) (Figure 1-3); remediation of industrial sites; processing of waste destined for the Waste Isolation Pilot Plant in Carlsbad, New Mexico or the Idaho National Laboratory in Idaho Falls, Idaho; disposal of radioactive and mixed waste; and environmental research.

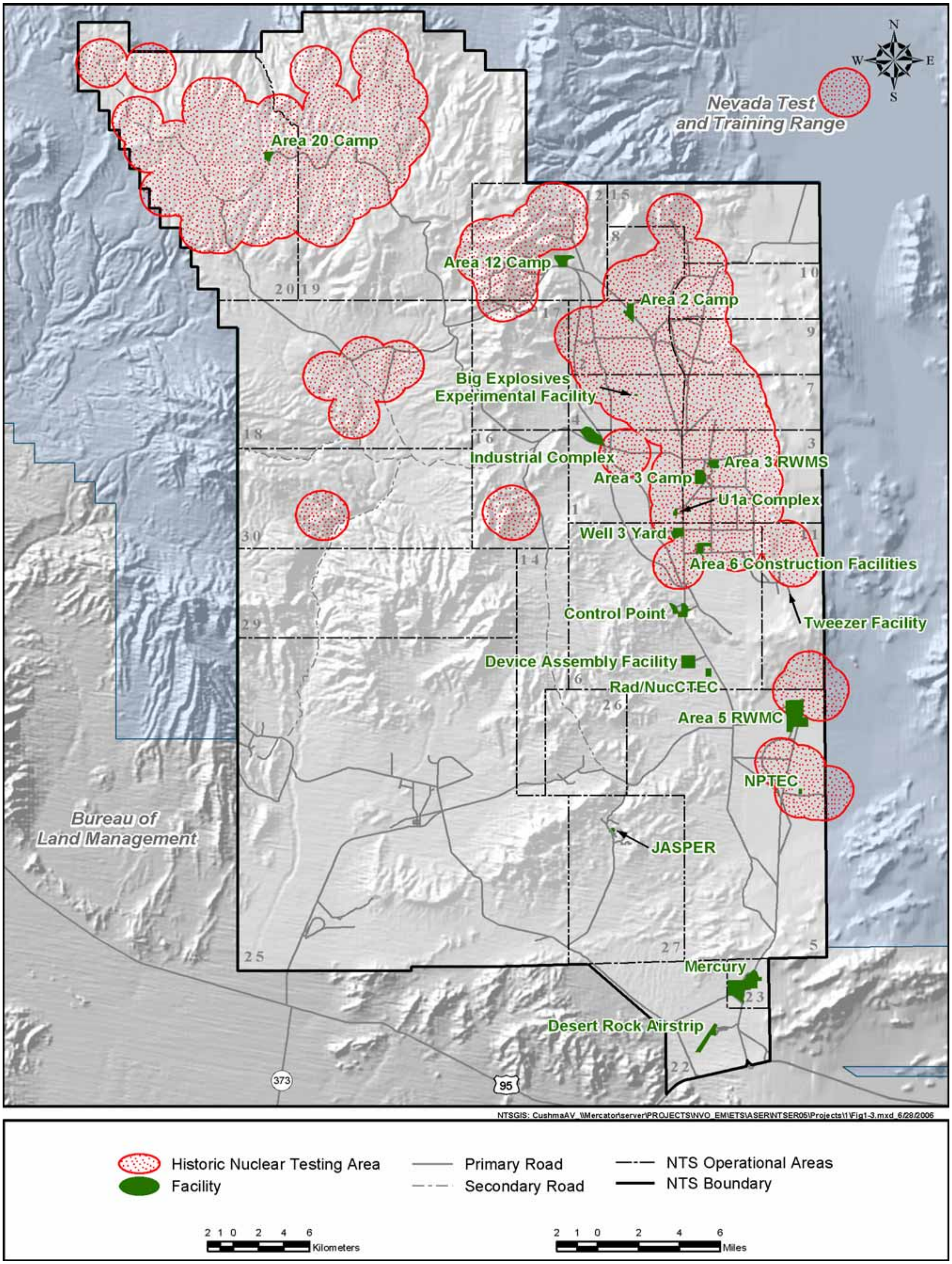


Figure 1-3. NTS operational areas, principal facilities, and past nuclear testing areas

1.6 Populations Near the NTS

The population of the area surrounding the NTS (see Figure 1-1) is predominantly rural. The population estimates for Nevada communities has been estimated by the Nevada State Demographer Office up through July 1, 2005 (Hardcastle, 2006). The annual population estimate for Nevada counties, cities, and unincorporated towns is 2,518,869, with all but 722,489 residing in Clark County. The total population estimate for Nye County is 41,302 and includes the communities of Amargosa Valley (1,383), Beatty (1,032), Gabbs (312), Manhattan (124), Pahrump (33,241), Round Mountain (744), and Tonopah (2,607). The largest of the Nye County communities is Pahrump Valley, which is approximately 50 mi (80 km) south of the NTS Control Point facility located near the center of the NTS. Neighboring Lincoln County to the east of the NTS includes a few small communities including Alamo (428), Caliente (1,015), Panaca (562), and Pioche (698). Neighboring Clark County is the major population center of Nevada and has an estimated total population of 1,796,380. Mesquite, on the northwest border of Arizona, has a population of over 16,400.

The Mojave Desert of California, which includes Death Valley National Park, lies along the southwestern border of Nevada. This area is still predominantly rural; however, tourism at Death Valley National Park swells the population to more than 5,000 on any particular day during holiday periods when the weather is mild.

The extreme southwestern region of Utah is more developed than the adjacent portion of Nevada. The population estimates for Utah communities are based on projections by Utah's Associations of Government and Governor's Office of Planning and Budget, Demographic and Economic Analysis (2000). The largest community is St. George, located 220 km (137 mi) east of the NTS, with a population of 56,497. The next largest town, Cedar City, is located 280 km (174 mi) east-northeast of the NTS and has a population of 24,410.

The extreme northwestern region of Arizona is mostly rangeland, except for that portion in the Lake Mead recreation area. In addition, several small communities lie along the Colorado River. The largest towns in the area are Bullhead City, 165 km (103 mi) south-southeast of the NTS, with an estimated population of 38,210, and Kingman, located 280 km (174 mi) southeast of the NTS, with an estimated population of 25,860 (July 1, 2005 population estimates, Arizona Department of Economic Security, 2006).

The offsite population density within an 80-km radius of all emission sources of radioactivity on the NTS is about 1.0 persons/km^2 (2.6 persons/mi^2). In comparison, the 48 contiguous states have a population density of about 36 persons/km^2 (94 persons/mi^2) (U.S. Census Bureau, 2005).

1.7 Understanding Data in this Report

1.7.1 Scientific Notation

Scientific notation is used in this report to express very large or very small numbers. A very small number is expressed with a negative exponent, for example 2.0 x 10^{-5}. To convert this number from scientific notation to a more traditional number, the decimal point must be moved left by the number of places equal to the exponent (5 in this case). The number thus becomes 0.00002.

Very large numbers are expressed in scientific notation with a positive exponent. The decimal point should be moved to the right by the number of places equal to the exponent. The number 1,000,000,000 could be presented in scientific notation as 1.0 x 10^9.

1.7.2 Unit Prefixes

Units for very small and very large numbers are commonly expressed with a prefix. The prefix signifies the amount of the given unit. For example, the prefix k, or kilo-, means 1,000 of a given unit. Thus 1 kg (kilogram) is 1,000 g (grams). Other prefixes used in this report are listed in Table 1-1.

Table 1-1. Unit prefixes

Prefix	Abbreviation	Meaning
mega-	M	1,000,000 (1 x 10^6)
kilo-	k	1,000 (1 x 10^3)
centi-	c	0.01 (1 x 10^{-2})
milli-	m	0.001 (1 x 10^{-3})
micro-	µ	0.000001 (1 x 10^{-6})
nano-	n	0.000,000,1 (1 x 10^{-9})
pico-	p	0.000,000,000,0001 (1 x 10^{-12})

1.7.3 Units of Radioactivity

Much of this report deals with levels of radioactivity in various environmental media. The basic unit of radioactivity used in this report is the curie (Ci) (Table 1-2). The curie describes the amount of radioactivity present, and amounts are usually expressed in terms of fractions of curies in a given mass or volume (e.g., picocuries per liter). The curie is historically defined as the rate of nuclear disintegrations that occur in 1 g of the radionuclide radium-226, which is 37 billion nuclear disintegrations per second. For any other radionuclide, 1 Ci is the quantity of the radionuclide that decays at this same rate. Nuclear disintegrations produce spontaneous emissions of alpha or beta particles, gamma radiation, or combinations of these.

Table 1-2. Units of radioactivity

Symbol	Name
Ci	curie
cpm	counts per minute
mCi	millicurie (1 x 10^{-3} Ci)
μCi	microcurie (1 x 10^{-6} Ci)
nCi	nanocurie (1 x 10^{-9} Ci)
pCi	picocurie (1 x 10^{-12} Ci)
aCi	attocurie (1 x 10^{-18} Ci)

1.7.4 Radiological Dose Units

The amount of ionizing radiation energy absorbed by a living organism is expressed in terms of radiological dose. Radiological dose in this report is usually written in terms of effective dose equivalent and reported numerically in units of millirem (mrem) (Table 1-3). Millirem is a term that relates ionizing radiation to biological effect or risk to humans. A dose of 1 mrem has a biological effect similar to the dose received from an approximate 1-day exposure to natural background radiation. An acute (short-term) dose of 100,000 to 400,000 mrem can cause radiation sickness in humans. An acute dose of 400,000 to 500,000 mrem, if left untreated, results in death approximately 50 percent of the time. Exposure to lower amounts of radiation (1,000 mrem or less) produces no immediate observable effects, but long-term (delayed) effects are possible. The average person in the United States receives an annual dose of approximately 300 mrem from exposure to naturally produced radiation. Medical and dental x-rays, air travel, and tobacco smoking add to this total.

Table 1-3. Units of radiological dose

Symbol	Name
mrad	millirad (1 x 10^{-3} rad)
mrem	millirem (1 x 10^{-3} rem)
R	roentgen
mR	milliroentgen (1 x 10^{-3} R)
μR	microroentgen (1 x 10^{-6} R)

The unit "rad," for radiation absorbed dose, is also used in this report. The rad is a measure of the energy absorbed by any material, whereas a rem relates to both the amount of radiation energy absorbed by humans and its consequence. A roentgen (R) is a measure of radiation exposure. Generally speaking, one roentgen of exposure will result in an effective dose equivalent of 1 rem. Additional information on radiation and dose terminology can be found in the Glossary (Appendix B).

1.7.5 International System of Units for Radioactivity and Dose

In some instances in this report, radioactivity and radiological dose values are expressed in other units in addition to Ci and mrem. These units are the becquerel (Bq) and the millisievert (mSv), respectively. The Bq and Sv belong to the International System of Units (SI), and their inclusion in this report is mandated by DOE. SI units are the internationally accepted units and may eventually be the standard for reporting both radioactivity and radiation dose in the United States. One Bq is equivalent to one nuclear disintegration per second.

The unit of radiation absorbed dose (rad) has a corresponding SI unit called the gray (Gy). The roentgen measure of radiation exposure has no SI equivalent. Table 1-4 provides the multiplication factors for converting to and from SI units.

Table 1-4. Conversion table for SI units

To Convert From	To	Multiply By
becquerel (Bq)	picocurie (pCi)	27
curie (Ci)	becquerel (Bq)	3.7 x 10^{10}
gray (Gy)	rad	100
mrem	msievert (mSv)	0.01
msievert (mSv)	mrem	100
picocurie (pCi)	becquerel (Bq)	0.03704
rad	gray (Gy)	0.01
sievert (Sv)	rem	100

1.7.6 Radionuclide Nomenclature

Radionuclides are frequently expressed with the one- or two-letter chemical symbol for the element. Radionuclides may have many different isotopes, which are shown by a superscript to the left of the symbol. This number is the atomic weight of the isotope (the number of protons and neutrons in the nucleus of the atom). Radionuclide symbols, many of which are used in this report, are shown in Table 1-5 along with the half-life of each radionuclide. The half-life is the time required for one-half the radioactive atoms in a given amount of material to decay. For example, after one half-life, half of the original atoms will have decayed; after two half-lives, three-fourths of the original atoms will have decayed; and after three half-lives, seven-eighths of the original atoms will have decayed, and so on. The notation $^{236+238}$Ra and similar notations in this report (e.g., $^{239+240}$Pu) are used when the analytical method does not distinguish between the isotopes, but reports the total amount of both.

Table 1-5. Radionuclides and their half-lives

Symbol	Radionuclide	Half-Life [(a)]
^{241}Am	americium-241	432.2 yr
^{7}Be	beryllium-7	53.44 d
^{14}C	carbon-14	5,730 yr
^{134}Cs	cesium-134	2.1 yr
^{137}Cs	cesium-137	30 yr
^{51}Cr	chromium-51	27.7 d
^{60}Co	cobalt-60	5.3 yr
^{152}Eu	europium-152	13.3 yr
^{154}Eu	europium-154	8.8 yr
^{155}Eu	europium-155	5 yr
^{3}H	tritium	12.35 yr
^{129}I	iodine-129	1.6×10^7 yr
^{131}I	iodine-131	8 d
^{40}K	potassium-40	1.3×10^8yr
^{85}Kr	krypton-85	10^7 yr
^{212}Pb	lead-212	10.6 h
^{238}Pu	plutonium-238	87.7 hr
^{239}Pu	plutonium-239	2.4×10^4 yr
^{240}Pu	plutonium-240	6.5×10^3 yr
^{241}Pu	plutonium-241	14.4 yr
^{226}Ra	radium-226	1.62×10^3 yr
^{228}Ra	radium-228	5.75 yr
^{220}Rn	radon-220	56 s
^{222}Rn	radon-222	3.8 d
^{103}Ru	ruthenum-103	39.3 d
^{106}Ru	ruthenum-106	368.2 d
^{125}Sb	antimony-125	2.8 yr
^{113}Sn	tin-113	115 d
^{90}Sr	strontium-90	29.1 yr
^{99}Tc	technetium-99	2.1×10^5 yr
^{232}Th	thorium-232	1.4×10^{10} yr
U [(b)]	uranium total	- - - [(c)]
^{234}U	uranium-234	2.4×10^5 yr
^{235}U	uranium-235	7×10^8 hr
^{238}U	uranium-238	4.5×10^9 yr
^{65}Zn	zinc-65	243.9 d
^{95}Zr	zirconium-95	63.98 d

(a) From Shleien, 1992
(b) Total uranium may also be indicated by U- natural (U-nat) or U-mass
(c) Natural uranium is a mixture dominated by ^{238}U, thus the half-life is approximately 4.5×10^9 years

1.7.7 Units of Measurement

Both metric and non-metric units of measurement are used in this report. Metric system and U.S. customary units and their respective equivalents are shown in Table 1-6 on the following page.

1.7.8 Measurement Variability

There is always uncertainty associated with the measurement of environmental contaminants. For radioactivity, a major source of uncertainty is the inherent randomness of radioactive decay events.

Uncertainty in analytical measurements is also the consequence of variability related to collecting and analyzing the samples. This variability is associated with reading or recording the result, handling or processing the sample, calibrating the counting instrument, and numerical rounding.

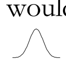
The uncertainty of a measurement is denoted by following the result with an uncertainty value which is preceded by the plus-or-minus symbol, ±. This uncertainty value gives information on what the measurement might be if the same sample were analyzed again under identical conditions. The uncertainty value implies that approximately 95 percent of the time the average of many measurements would give a value somewhere between the reported value minus the uncertainty value and the reported value plus the uncertainty value.

If the reported concentration of a given constituent is smaller than its associated uncertainty (e.g., 40 ± 200), the sample may not contain that constituent. Such low concentration values are considered to be below detection, meaning the concentration of the constituent in the sample is so low that it is undetected by the method and/or instrument.

Table 1-6. Metric and U.S. customary unit equivalents

Metric Unit	U.S. Customary Equivalent Unit	U.S. Customary Unit	Metric Equivalent Unit
Length			
1 centimeter (cm)	0.39 inches (in.)	1 inch (in.)	2.54 centimeters (cm)
1 millimeter (mm)	0.039 inches (in.)		25.4 millimeters (mm)
1 meter (m)	3.28 feet (ft)	1 foot (ft)	0.3048 meters (m)
	1.09 yards (yd)	1 yard (yd)	0.9144 meters (m)
1 kilometer (km)	0.62 miles (mi)	1 mile (mi)	1.6093 kilometers (km)
Volume			
1 liter (L)	0.26 gallons (gal)	1 gallon (gal)	3.7853 liters (L)
1 cubic meter (m^3)	35.32 cubic feet (ft^3)	1 cubic foot (ft^3)	0.028 cubic meters (m^3)
	1.35 cubic yards (yd^3)	1 cubic yard (yd^3)	0.765 cubic meters (m^3)
Weight			
1 gram (g)	0.035 ounces (oz)	1 ounce (oz)	28.6 gram (g)
1 kilogram (kg)	2.21 pounds (lb)	1 pound (lb)	0.373 kilograms (kg)
1 metric ton (mton)	1.10 short ton (2,000 lb)	1 short ton (2,000 lb)	0.90718 metric ton (mton)
Geographic area			
1 hectare	2.47 acres	1 acre	0.40 hectares
Radioactivity			
1 becquerel (Bq)	2.7×10^{-11} curie (Ci)	1 curie (Ci)	3.7×10^{-10} becquerel (Bq)
Radiation dose			
1 rem	0.01 sievert (Sv)	1 sievert (Sv)	100 rem
Temperature			
°C = (°F – 32)/1.8		°F = (°C x 1.8) + 32	

1.7.9 Mean and Standard Deviation

The mean of a set of data is the usual average of those data. The standard deviation (SD) of sample data relates to the variation around the mean of a set of individual sample results; it is defined as the square root of the average squared difference of individual data values from the mean. This variation includes both measurement variability and actual variation between monitoring periods (weeks, months, or quarters, depending on the particular analysis). The sample mean and standard deviation are estimates of the average and the variability that would be seen in a large number of repeated measurements. If the distribution shape were "normal" (i.e., shaped as ), about 67 percent of the measurements would be within the mean ± SD and 95 percent would be within the mean ± 2 SD.

1.7.10 Standard Error of the Mean

Just as individual values are accompanied by counting uncertainties, mean values (averages) are accompanied by uncertainty. The standard deviation of the distribution of sample mean values is known as the standard error of the mean (SE). The SE conveys how accurate of an estimate the mean value is based on the samples that were collected and analyzed. The ± value presented to the right of a mean value is equal to 2 x SE (2 multiplied by the SE). The ± value implies that approximately 95 percent of the time the average of many calculated means will fall somewhere between the reported value minus the 2 x SE value and the reported value plus the 2 x SE value.

1.7.11 Median, Maximum, and Minimum Values

Median, maximum, and minimum values are reported in some sections of this report. A median value is the middle value when all the values are arranged in order of increasing or decreasing magnitude. For example, the median value in the series of numbers, 1 2 3 3 4 5 5 5 6, is 4. The maximum value would be 6 and the minimum value would be 1.

1.7.12 Less Than (<) Symbol

The less than (<) symbol is used to indicate that the actual measured value may be smaller than the number given. For example, <0.09 would indicate that the actual value is less than 0.09. In this report, < is often used in reporting the amounts of non-radiological contaminants in a sample when the amounts are less than the analytical laboratory's reporting limit for that contaminant in that sample. For example, the measurement of benzene in sewage lagoon pond water is reported as <0.005 milligrams per liter (mg/L), which implies that the actual amount of benzene present, if any, was unable to be determined below this level given the sample and analysis methods used. For some constituents the notation "ND" is also used to indicate that the constituent in question was not detected. The measurements of radionuclide concentrations are reported whether or not they are below the usual reporting limit (the minimum detectable concentration or MDC [see Glossary, Appendix B]).

1.7.13 Negative Radionuclide Concentrations

There is always a small amount of natural radiation in the environment. The instruments used in the laboratory to measure radioactivity in environmental media are sensitive enough to measure the natural, or background, radiation along with any contaminant radiation in a sample. To obtain a true measure of the contaminant level in a sample, the natural, or background, radiation level must be subtracted from the total amount of radioactivity measured by an instrument. Because of the randomness of radioactive emissions and the very low concentrations of some contaminants, it is possible to obtain a background measurement that is larger than the actual contaminant measurement. When the larger background measurement is subtracted from the smaller contaminant measurement, a negative result is generated. The negative results are reported because they are useful when conducting statistical evaluations of the data.

1.7.14 Understanding Graphic Information

Some of the data graphed in this report are plotted using logarithmic, or compressed, scales. Logarithmic (log) scales are used in plots where the values are of widely different magnitudes at different locations and/or different times. Log scales use equal distances to represent equal <u>ratios</u> of values, whereas in linear scales equal distances represent equal <u>differences</u> in values. For example, a log scale would use the same distance to represent a change from 2 to 4 as a change from 10 to 20 or a change from 700 to 1,400.

For example, compare Figure 1-4 and Figure 1-5. Figure 1-4 shows long-term trends in mean ^{3}H concentrations. The use of the log scale for the concentration (vertical) axis allows the variation in measurements in all areas of the NTS to be seen for the entire time history. Figure 1-5 contains the same data, but uses a linear scale for the concentrations. In Figure 1-5 only the variation in the highest values (pre-1987 values from Area 23) can be seen clearly; nearly all of the rest of the values are smudges along the bottom of the graph.

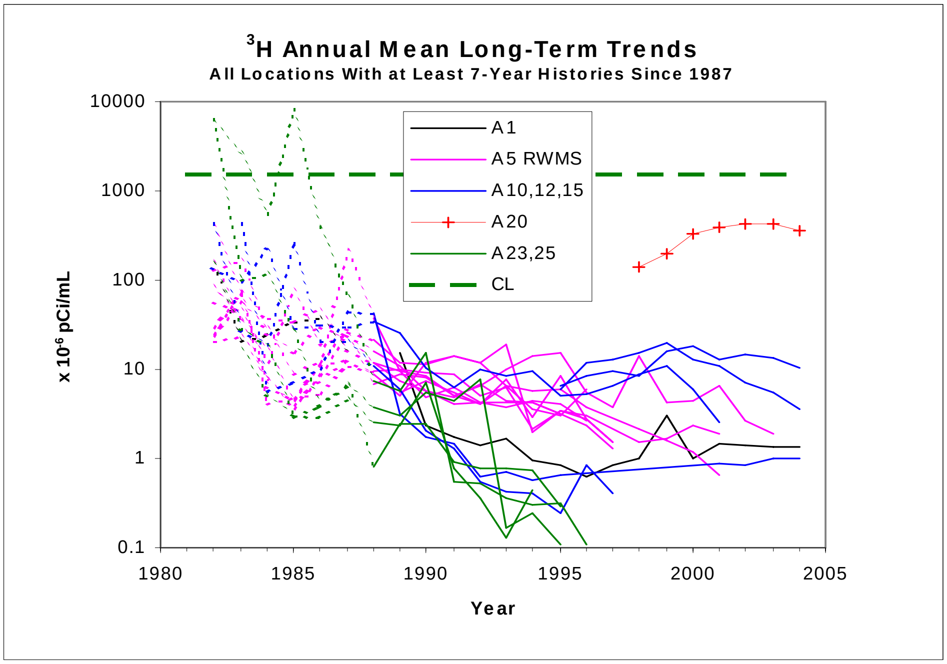


Figure 1-4. Data plotted using a log scale

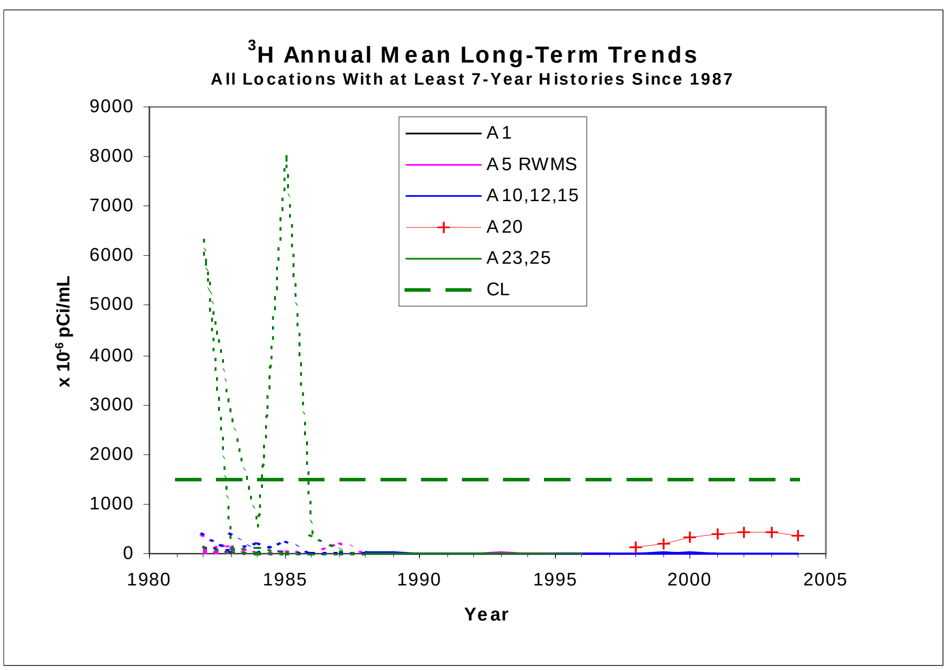


Figure 1-5. Data plotted using a linear scale

2.0 Compliance Summary

Environmental regulations pertinent to operations on the Nevada Test Site (NTS) and its Nevada satellite facilities (North Las Vegas Facility [NLVF], Cheyenne Las Vegas Facility, and Remote Sensing Laboratory [RSL]-Nellis) are listed in this Compliance Summary. They include federal and state laws, state permit requirements, Executive Orders (EOs), U.S. Department of Energy (DOE) Orders, and state agreements. They dictate how the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) conducts operations on and off the NTS to ensure the protection of the environment and the public. The regulations are grouped by topic. A compliance status table is presented for each topical group of regulations. Each table lists those measures or actions which are tracked or performed annually to ensure compliance with a regulation. A description of the field monitoring efforts, actions, and results which support the data in each table can be found in subsequent sections of this document, as noted in the "Reference Section" column of each table. Non-compliance incidents or compliance issues, if any, are included in the topical subsections along with a listing of compliance reports generated during or for the reporting year. The last table presented in this section is a list of all environmental permits for the NTS and its satellite facilities for 2005.

2.1 Air Quality

Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAP) – Under Title III of the CAA, NESHAP was established to control those pollutants that might reasonably be anticipated to result in either an increase in mortality or an increase in serious irreversible or incapacitating but reversible illness. Industry-wide national emissions standards were developed for 22 of the 189 designated hazardous air pollutants (HAPs). Radionuclides and asbestos were among the 22 HAPs for which standards were established. NESHAP compliance activities at the NTS and satellite facilities are limited to radionuclide monitoring and reporting and notification of asbestos abatement.

CAA, National Ambient Air Quality Standards (NAAQS) – Title I of the CAA established the NAAQS to limit levels of pollutants in the air for six "criteria" pollutants: sulfur dioxide, nitrogen oxides, carbon monoxide, ozone, lead, and particulate matter. Title V of the CAA authorizes the states to implement permit programs in order to regulate emissions of the criteria pollutants. At the NTS there is one main permit that regulates operations and emissions from aggregate-producing facilities, fuel-burning equipment, fuel storage, project-specific activities associated with the Non-Proliferation Test and Evaluation Complex (NPTEC), Test Cell C Facility, and the Tactical Demilitarization Development Project (TaDD). Detonations conducted at the Big Explosives Experimental Facility (BEEF) and the Explosives Ordnance Disposal Unit (EODU) are also included in the permit. Nevada air quality permits specify emission limits for criteria pollutants (except ozone and lead) that are based on published emissions values for other similar industries and on operational data specific to the NTS. Lead is considered a HAP as well as a criteria pollutant. Emissions from lead are reported, if they occur, as part of the total HAPs emissions rather than as a separate criteria pollutant. Quantities of NAAQS and HAPS emissions from operations at the NTS are calculated and submitted each year to the state of Nevada. The NTS air permit also specifies recordkeeping and reporting requirements, performance testing requirements, visible emissions (opacity) limits for equipment or facilities, opacity field monitoring requirements, and certification requirements for personnel conducting opacity monitoring.

State of Nevada regulations prohibit the open burning of combustible refuse and other materials unless specifically exempted by an authorized variance (Nevada Administrative Code [NAC] 445B.22067). At the NTS, Open Burn Variances are routinely obtained for fire extinguisher training and various emergency management exercises.

The NTS satellite facilities discussed in Appendix A operate under air quality permits that require the annual reporting of hours of operation, emissions quantities of criteria pollutants and HAPs, and summaries of significant malfunctions and repairs.

CAA, New Source Performance Standards (NSPS) – The NSPS were established by Title I of the CAA to set minimum nationwide emission limitations of regulated air pollutants (HAPs and criteria pollutants mentioned above) and for various industrial categories of facilities. The state of Nevada has adopted the NSPS and regulates emissions from subject facilities through state law (NRS 445B as codified in NAC 445B). At the NTS, some of the screens and conveyor belts that were manufactured after August 1981 are subject to NSPS under the category of Nonmetallic Mineral Processing Plants. Some of the bulk fuel storage tanks constructed after July 1984 must also comply with NSPS requirements. The NSPS imposes more stringent standards, including a reduced allowance of visible emissions (opacity) than under NAAQS. NSPS compliance activities on the NTS are reported to the state of Nevada. No NTS satellite facilities are subject to the NSPS regulations.

CAA, Stratospheric Ozone Protection – Title VI (Section 608) of the CAA establishes production limits and a schedule for the phase-out of ozone-depleting substances (ODS). ODS are defined as those substances that are known or could reasonably be anticipated to cause or contribute to stratospheric ozone depletion. Under Section 608, the U.S. Environmental Protection Agency (EPA) has established regulations through 40 Code of Federal Regulations (CFR) Part 82 that include: (1) maximizing recycling of ozone-depleting compounds during servicing and disposal of air conditioning and refrigeration equipment; (2) establishing requirements for recycling and recovery equipment, technicians, and reclaimers; (3) requiring the repair of substantial leaks in certain air conditioning and refrigeration equipment; and (4) establishing safe disposal requirements. While there are no reporting requirements for ODS, recordkeeping to document the usage of ODS and technician certification is required. Under Section 608, the EPA may conduct random inspections to determine compliance.

At the NTS, refrigerants containing ODS are mainly used in air conditioning units in vehicles, buildings, refrigerators, water fountains, vending machines, and laboratory equipment. Halon 1211 and 1301, now classified as ODS, have been used in the past in fire extinguishers. Self-assessments are conducted periodically to document adherence to Title VI of the CAA.

Other NTS Air Quality Permit Requirements – Under Title V, Part 70 of the CAA amendments, all owners or operators of Part 70 sources must pay annual fees to the state of Nevada. Any source which has the potential to emit 45.4 metric tons (mtons) (50 tons) or more of any regulated air pollutant, except carbon monoxide, must pay an annual fee of $3,000. Any source that has the potential to emit less than 22.7 mtons (25 tons) per year of any regulated air pollutant, except carbon monoxide, must pay an annual fee of $250. NTS operations are subject to these fees for the emission of criteria pollutants. In addition to permit fees, NNSA/NSO must allow the state of Nevada Bureau of Air Pollution Control to conduct inspections of NTS facilities and operations that are regulated by state air quality permits.

Section VII of the NTS Class II Air Quality Operating Permit, No. AP9711-0549.01 *Surface Area Disturbance Conditions* requires implementation of an ongoing program to control fugitive dust using the best practicable methods.

2.1.1 Compliance Issues

Three pieces of equipment permitted under the NTS air permit failed their performance emission tests: the Area 23 Incinerator, a Device Assembly Facility (DAF) generator, and an Area 6 dual-stack generator. The state's Bureau of Air Pollution Control was notified of all the equipment failures and the equipment was shut down. Corrective actions were taken to either replace, repair, or retest the equipment (see Section 3.2.2). Any environmental effects of excess emissions from the failed equipment prior to their shutdown is expected to have been negligible because the equipment are used so infrequently.

2.1.2 Compliance Reports

The following reports were generated for NTS operations in 2005 in compliance with air quality regulations:

- *National Emissions Standards for Hazardous Air Pollutants, Calendar Year 2005* (submitted to EPA Region IX)

- Annual Asbestos Abatement Notification Form, submitted to EPA Region IX
- *Calendar Year 2005 Actual Production/Emissions Reporting Form*, submitted to the Nevada Division of Environmental Protection
- *Quarterly Class II Air Quality Report*, submitted to the Nevada Division of Environmental Protection
- NPTEC Pre-test and Post-test Reports, submitted to the Nevada Division of Environmental Protection

The following reports were generated for operations at NTS satellite facilities in 2005 in compliance with air quality regulations:

- *Clark County Air Emission Inventory for North Las Vegas Facility*, submitted to the Clark County Department of Air Quality and Environmental Management
- *Clark County Air Emissions Inventory for Remote Sensing Laboratory*, submitted to the Clark County Department of Air Quality and Environmental Management

2.1.3 Compliance Status

See Table 2-1 for a summary of how NNSA/NSO complied with air quality and protection regulations at the NTS and its satellite facilities in 2005.

Table 2-1. NTS compliance status with applicable air quality regulations

Compliance Measure/Actions	Compliance Limit	Compliance Status - 2005	Section Reference [a]
Clean Air Act – NESHAP			
Annual dose equivalent from all radioactive air emissions	10 mrem/yr [b] (0.1 mSv/yr)	Compliant - <10 mrem/yr [b] based on sample data from 6 critical receptor air sampling stations	3.1.5
Notify EPA Region IX if the number of linear feet (ft) or square feet (ft^2) of asbestos to be removed from a facility exceeds limit	260 linear ft or 160 ft^2 [c]	Compliant - EPA notified for 1 NTS and 1 NLVF project where limits would be exceeded	3.2.8
Maintain asbestos abatement plans, data records, and activity/ maintenance records	For up to 25 or 75 years	Compliant	3.2.8
Clean Air Act – NAAQS			
Submit quarterly reports of calculated emissions at the NTS to the state of Nevada	Due 30 days after end of quarter	Compliant	3.2.1
Submit annual report of calculated emissions at the NTS to the state of Nevada	Due March 1	Submitted March 7, 2006	3.2.1
Number of gallons of fuel used, hours of operation, and rate of aggregate/concrete production by permitted equipment/facility at the NTS	Limit varies [d]	Compliant	3.2.3
Tons of emissions of each criteria pollutant produced by permitted equipment/facility at the NTS based on calculations	PTE [e] varies	Compliant	3.2.1; Table 3-12
Conduct performance emission tests on permitted equipment	Once during the life of the permit (once every 5 years)	Compliant - 3 pieces of equipment failed tests and shut down	3.2.2
Conduct opacity readings from permitted equipment/facility at the NTS	Quarterly	Compliant	3.2.4
Percent opacity of emissions from permitted equipment/facility at the NTS	20%	Compliant - 0 to 15% for 8 facilities	3.2.4
Submit test plans/final analysis reports for tests at NPTEC facilities and annual report of all chemicals released during the year to the state	Annual report due March 1	Compliant 3 tests conducted	3.2.5; Table 3-17; Table 3-18
Submit annual report of calculated emissions at the NLVF and the RSL-Nellis to Clark County	Due March 31	Submitted March 22, 2006	A.1.3; A.3.2
Tons of emissions of each criteria pollutant produced by permitted equipment/facility at the NTS based on calculations	PTE [e] varies	Compliant	Table A-4; Table A-8

Table 2-1. NTS compliance status with applicable air quality regulations **(continued)**

Compliance Measure/Actions	Compliance Limit	Compliance Status - 2005	Section Reference[a]
Clean Air Act - NSPS			
Conduct opacity readings from permitted equipment/facility	Quarterly	Compliant	3.2.4
Percent opacity of emissions from permitted equipment/facility	10%	Compliant < 10% for 1 facility	3.2.4
Clean Air Act - Stratospheric Ozone Protection			
Maintain ODS technician certification records, approvals for ODS-containing equipment recycling/recovery, and applicable equipment servicing records	NA[f]	Compliant	3.2.7
Other Nevada Air Quality Permit Regulations			
Control fugitive dust for land disturbing activities	NA	Compliant	3.2.9
Allow Nevada Bureau of Air Pollution Control access to conduct inspections of facilities and operations regulated by state air permits	NA	Compliant Inspection conducted in June	3.2.2

(a) The section(s) within this document that describe how compliance summary data were collected

(b) mrem/yr = millirem per year; mSv/yr = millisievert per year

(c) 260 linear ft or 160 ft^2 = 79.3 linear meters (m) or 14.9 m^2

(d) Compliance limit is specific for each piece of permitted equipment/facility

(e) Potential to emit (PTE) = the quantities of criteria pollutants that each facility/piece of equipment would emit annually if it were operated for the maximum number of hours specified in the state air permit

(f) Not applicable

2.2 Water Quality and Protection

Clean Water Act (CWA) –Prohibits the discharge of pollutants from point sources to waters of the U.S. without a National Pollutant Discharge Elimination System (NPDES) permit. The CWA also gives the EPA, or the approved state environmental control agency, the authority to implement pollution control programs. The CWA sets water quality standards for all contaminants in surface waters. At the NTS, CWA regulations are followed through compliance with permits issued by the Nevada Division of Environmental Protection (NDEP) and the Nevada State Health Division, Bureau of Health Protection Services (BHPS) for wastewater discharges and disposal of wastewater from facilities. NTS operations do not require any NPDES permits. Three NPDES permits have been issued to NNSA/NSO for the discharge of pumped groundwater at the NLVF (see Appendix A).

Safe Drinking Water Act (SDWA) – Protects the quality of drinking water in the U.S. It authorizes the EPA to establish safe standards of purity and requires all owners or operators of public water systems to comply with National Primary Drinking Water Standards (health-related standards). State governments, which assume this power from the EPA, also set Secondary Standards which are related to taste, odor, and visual aspects of drinking water. Nevada state law pertaining to public water systems (NAC 445A) ensures that such water systems meet the EPA water quality standards specified under the SDWA.

NAC 445A - Water Controls (Public Water Systems) – Enforces the SDWA requirements and sets standards for permitting, design, construction, operation, maintenance, certification of operators, and water quality of public water systems (PWSs). The NTS has three PWSs and two potable water hauler trucks which BHPS regulates through the issuance of permits. Although the SDWA sets drinking water standards for radionuclides, the state of Nevada does not require radionuclide monitoring of drinking water on the NTS because the NTS does not have a "community water system" (i.e., a PWS having at least 15 service connections and used by year-round residents). However, all potable water supply wells are monitored on the NTS for radionuclides in compliance with DOE Order 5400.5 *Radiation Protection of the Public and the Environment* (see Section 2.3).

NAC 444 and 445A - Water Controls (Water Pollution Control) – Regulates the collection, treatment, and disposal of wastewater and sewage at the NTS. The requirements of this state regulation are issued in permits for E Tunnel effluent waters, sewage lagoons, septic tanks, and septic hauler contractors and pumpers. Perched groundwater which seeps out of E Tunnel in Area 12 is contained and monitored annually for radiological contaminants and quarterly for non-radiological contaminants as required under an NDEP permit issued to the Defense Threat Reduction Agency (DTRA). NNSA/NSO holds a general permit issued by NDEP covering two active and nine inactive sewage lagoon systems. Water quality and toxicity of the active sewage lagoons are monitored quarterly and annually, respectively, to meet permit requirements. The 21 septic systems on the NTS each process less than 5,000 gallons per day (gal/d) (18,927 liters/day), therefore they are not regulated by NDEP. The BHPS regulates the NTS septic systems as commercial individual systems which treat domestic sewage only in quantities less than 5,000 gal/d. The BHPS does not require collection or analysis of sewage samples from these septic systems. The BHPS also regulates the permits that NNSA/NSO holds for four septic tank pumpers and one septic tank pumping contractor.

Discharges of sewage and industrial wastewater from the NLVF are required to meet permit limits set by the City of North Las Vegas. Discharges of wastewater from RSL-Nellis are required to meet permit limits set by the Clark County Water Reclamation District.

NAC 534 - Nevada Division of Water Resources Regulations for Water Well and Related Drilling – Regulates the drilling and construction of new wells and the reworking of existing wells in order to prevent the wasting of underground waters and their pollution or contamination. Two site operations that are affected by this state regulation are the Underground Test Area (UGTA) Project and the Borehole Management Project. New water wells are drilled for ongoing UGTA investigations of site-specific hydrogeologic characteristics, underground source terms, and contaminant movement through groundwater. Over 1,100 existing boreholes on the NTS are being plugged according to these regulations, under the Borehole Management Project.

2.2.1 Compliance Issues

All drinking water and wastewater samples in 2005 met regulatory water quality standards with two exceptions: (1) the Area 12 PWS exceeded the drinking water standard for lead (see Section 4.2.1.1), (2) and the levels of total dissolved solids (TDS) in two of the three sewage outfalls at NLVF exceeded the permit limits (see Appendix A, Section A.1.1.1).

2.2.2 Compliance Reports

The following reports were generated for NTS operations in 2005 in compliance with water quality regulations:

- *Quarterly Monitoring Report for Nevada Test Site Sewage Lagoons* submitted to NDEP (in compliance with permit GNEV93001)
- Results of water quality analyses for PWSs were sent to the state throughout the year as they were obtained from the laboratory.
- *Water Pollution Control Permit NEV 96021, Quarterly Monitoring Report* (for E Tunnel effluent monitoring) submitted to NDEP
- *Water Pollution Control Permit NEV 96021 Quarterly Monitoring Report and Annual Summary Report for E Tunnel Waste Water Disposal System* (DTRA, 2005)

The following reports were generated for operations at the NTS satellite facilities in 2005 in compliance with water quality regulations:

- *Self-Monitoring Report for the National Nuclear Security Administration's North Las Vegas Facility: Permit VEH-112* submitted to the City of North Las Vegas
- Quarterly reports titled *Remote Sensing Laboratory Self Monitoring Report- Permit No. CCWRD-080* submitted to the Clark County Water Reclamation District
- Two additional monitoring reports titled *Remote Sensing Laboratory Additional Monitoring Reports - Permit No. CCWRD-080* submitted to Clark County Water Reclamation District
- Reports of groundwater discharge volumes for NLVF temporary NPDES permits TNEV2004364, TNEV2005437, and TNEV2006369 submitted each month to NDEP

2.2.3 Compliance Status

See Table 2-2 for a summary of how NNSA/NSO complied with air quality and protection regulations at the NTS and its satellite facilities in 2005.

Table 2-2. NTS compliance status with applicable water quality and protection regulations

Compliance Measure/Action	Compliance Limit	Compliance Status - 2005	Section Reference[a]
Safe Drinking Water Act and Nevada Water Controls (NAC 445A - Water Controls - Public Water Systems)			
Number of water samples containing coliform bacteria	3 per month	0	4.2.1.1; Table 4-10
Concentration of synthetic organic Phase II and V contaminants in all PWSs	Limit varies[c]	Compliant	4.2.1.1; Table 4-10
Concentration of disinfection byproducts in all PWSs	0.06-0.08 mg/L	<0.002 – 0.0151	4.2.1.1; Table 4-10
Concentration of inorganic Phase II and V contaminants in all PWSs	Limit varies	Compliant	4.2.1.1; Table 4-10
Concentration of secondary standards in all PWSs	Limit varies	Compliant for all standards except for lead in the Area 12 PWS	4.2.1.1; Table 4-10
Adhere to design, construction, maintenance, and operation regulations specified by permits	NA[d]	Compliant	- -
Allow BHPS access to conduct inspections of PWS and water hauling trucks	NA	Compliant	4.2.1.2
Clean Water Act – NPDES/State Pollutant Discharge Elimination System Permits			
Measure and report volume of pumped groundwater discharged at the NLVF	NA	Compliant	Appendix A, A.1.1.2; Table A-3
Clean Water Act and Nevada Water Pollution Controls - Sewage Disposal (NAC 444 – Sewage Disposal)			
Adhere to all design/construction/operation requirements for new systems and those specified in 23 septic system permits, 5 septic tank pumper permits, and 1 septic tank pumping contractor permit	NA	Compliant	4.2.3
Clean Water Act and Nevada Water Pollution Controls (NAC 445A - Water Pollution Controls)			
Value of 5-day Biological Oxygen Demand (BOD_5), total suspended solids (TSS), and pH in one sewage lagoon water sample sampled quarterly	BOD_5: varies TSS: no limit pH: 6.0 - 9.0 S.U.	Compliant – Samples collected in Jan., Apr., Jul, and Oct.	4.2.3.1; Table 4-11
Concentration of 36 contaminants in the filtrate from one sewage lagoon sample collected annually from each of two permitted facilities	Limit varies	Compliant - concentrations within limits	4.2.3.2; Table 4-12
Inspection by operator of active sewage lagoon systems	Weekly	Compliant	4.2.3.3
Inspection by operator of inactive sewage lagoon systems	Quarterly	Compliant	4.2.3.3

Table 2-2. NTS compliance status with applicable water quality and protection regulations (continued)

Compliance Measure/Action	Compliance Limit	Compliance Status - 2005	Section Reference[a]
Clean Water Act and Nevada Water Pollution Controls (NAC 445A - Water Pollution Controls) (continued)			
Submit quarterly monitoring reports for 2 active sewage lagoons (for Areas 6 and 23)	Due end of Jan., Apr., Jul., Oct.	Compliant	- -
Allow NDEP access to conduct inspections of active sewage lagoon systems	NA	Compliant - Inspection conducted June 2005	4.2.3.3
Concentrations of tritium (^3H), gross alpha (α), and gross beta (β), (in picocuries per liter [pCi/L]), and 16 non-radiological contaminants/water quality parameters in E Tunnel effluent water samples collected quarterly	^3H: 1,000,000 pCi/L α: 35 pCi/L β: 100 pCi/L Non-rad: Limit varies	^3H: 600,000 pCi/L α: 13 pCi/L β: 77 pCi/L Non-rad: Compliant	4.1.6: Table 4-6
Concentrations of 19 contaminants in water samples from three NLVF sewage outfalls and all sludge and liquid samples from the NLVF sand/oil interceptor	Limit varies	All samples compliant except for TDS at Outfall B and Outfall C2	A.1.1.1; Table A-2
Concentrations of 12 contaminants in water samples from sewage outfall at the RSL-Nellis	Limit varies	Compliant	A.3.1; Table A-7
NAC 534 - Nevada Division of Water Resources Regulations for Water Well and Related Drilling			
Maintain state well-drilling license for personnel supervising well construction/reconditioning	NA	Compliant - 5 licensed personnel supervised well activities	- -
File notices of intent and affidavits of responsibility for plugging	NA	Compliant - 3 notices of intent with 0 affidavits were filed	- -
Adhere to well construction requirements/waivers	NA	Compliant - 3 new wells constructed for UGTA Project; 78 boreholes plugged for Borehole Management Program	- -
Maintain required records and submit required reports	NA	Compliant	- -

(a) The section(s) within this document that describe how compliance summary data were collected
(b) Not detectable
(c) Compliance limit is specific for each contaminant; see referenced tables for specific limits
(d) Not applicable

2.3 Radiation Dose Protection

Clean Air Act (CAA), National Emission Standards for Hazardous Air Pollutants (NESHAP) – NESHAP (40 CFR 61 Subpart H) establishes a radiation dose limit of 10 millirem per year (mrem/yr) (0.1 millisievert per year [mSv/yr]) to individuals in the general public from the air pathway. Sources of radioactive air emissions on the NTS include: (1) evaporation of tritiated water (HTO) from containment ponds; (2) diffusion of HTO vapor from the soil at Area 5 Radioactive Waste Management Complex, Sedan crater, and Schooner crater; (3) release of tritium gas during calibration of analytical equipment at Building 650 in Area 23; and (4) re-suspension of plutonium and americium from contaminated soil at nuclear device safety test and atmospheric test locations. NESHAP also specifies "Concentration Levels for Environmental Compliance" (abbreviated as CLs) for radionuclides. A CL is the annual average concentration of a radionuclide that could deliver a dose of 10 mrem/yr. The CLs are provided for facilities which use air sampling at offsite receptor locations to demonstrate compliance.

Safe Drinking Water Act (SDWA) – The National Primary Drinking Water Regulations (40 CFR 141), promulgated by the SDWA, requires that the maximum contaminate level goal for any radionuclide be zero. But, when this is not possible (e.g., in groundwater containing naturally-occurring radionuclides), the SDWA specifies that the concentration of one or more radionuclides should not result in a whole body or organ dose greater than 4 mrem/yr (0.04 mSv/yr). Sources of radionuclide contamination in groundwater at the NTS are the underground nuclear tests detonated near or below the water table.

DOE Order 450.1, *Environmental Protection Program* – Requires federal facilities to: (1) conduct environmental monitoring to detect, characterize, and respond to releases from DOE activities, (2) assess impacts, (3) estimate dispersal patterns in the environment, (4) characterize the pathways of exposure to members of the public, (5) characterize the exposures and doses to individuals and to the population, and (6) evaluate the potential impacts to the biota in the vicinity of a DOE activity. Such releases, exposures, and doses apply to radiological contaminants.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment* – This Order and its flow-down procedural standards establishes requirements for: (1) measuring radioactivity in the environment, (2) applying the ALARA (As Low As Reasonably Achievable) process to all operations, (3) using mathematical models for estimating radiation doses, (4) releasing property having residual radioactive material, and (5) maintaining records demonstrating compliance with the requirements. This Order sets a radiation dose limit of 100 mrem/yr (1 mSv/yr) above background levels to individuals in the general public from all pathways of exposure combined. It also provides the derived concentration guides (DCGs) for all radionuclides. The DCGs are the annual average concentrations of a radionuclide that could deliver a dose of 100 mrem/yr. The DCGs are provided as reference values to use in radiological protection programs at DOE facilities. The NESHAP CLs mentioned above are more conservative than one-tenth of the DCGs because they are computed with different dose models.

DOE Standard DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* – Provides methods, computer models, and guidance in implementing a graded approach to evaluating the radiation doses to populations of aquatic animals, terrestrial plants, and terrestrial animals residing on DOE facilities (DOE, 2002a), A dose limit of 1 rad per day (rad/d) (10 milligray [mGy]/d) for terrestrial plants and aquatic animals, and of 0.1 rad/d (1 mGy/d) for terrestrial animals is specified by this DOE standard. Dose rates below these levels are believed to cause no measurable adverse effects to populations of plants and animals.

DOE Order 435.1, *Radioactive Waste Management* – Ensures that all DOE radioactive waste is managed in a manner that is protective of the worker, public health and safety, and the environment. It directs how radioactive waste management operations are conducted on the NTS. These requirements are summarized in Section 2.4. The manual for this Order (DOE M435.1-1) specifies that operations at the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs) must not contribute a dose to the general public in excess of 25 mrem/yr.

2.3.1 Compliance Reports

In compliance with NESHAP under the CAA, the report *National Emission Standards for Hazardous Air Pollutants, Calendar Year 2005*, was submitted to EPA Region IX in June 2006. This *Nevada Test Site Environmental Report 2005* was generated to report 2005 compliance with DOE Order 5400.5 and DOE-STD-1153-2002.

2.3.2 Compliance Status

Table 2-3 presents a summary of how NNSA/NSO complied with radiation protection regulations at the NTS and its satellite facilities in 2005.

Table 2-3. NTS compliance status with regulations for radiation protection of the public and the environment

Compliance Measure	Compliance Limit	Compliance Status - 2005	Section Reference[(a)]
Clean Air Act - NESHAP			
Annual dose to the general public from all radioactive air emissions	10 mrem/yr (0.1 mSv/yr)	<10 mrem/yr[(b)] based on sample data from 6 critical receptor air sampling stations	3.1.5
Safe Drinking Water Act			
Annual dose to the general public from drinking water	4 mrem/yr (0.04 mSv/yr)	0 mrem/yr[(b)] (0 mSv/yr)	4.1.4; Table 4-1
DOE Order 5400.5, *Radiation Protection of the Public and the Environment*			
Annual dose above background levels to the general public from all pathways	100 mrem/yr (1 mSv/yr)	0.52 mrem/yr (0.0052 mSv/yr)	8.1.7; Table 8-4; A.1.5; Table A-5
Total residual surface contamination of property released offsite (in disintegrations per minute per 100 square centimeters [dpm/100 cm^2])	300–15,000 dpm/100 cm^2 depending on radionuclide	Compliant No detectable releases	8.1.5
DOE STD 1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*			
Absorbed radiation dose to terrestrial plants	1 rad/d (0.01 Gy/d)	<1 rad/d (<0.01 Gy/d)	8.2
Absorbed radiation dose to aquatic animals	1 rad/d	<1 rad/d	8.2
Absorbed radiation dose to terrestrial animals	0.1 rad/d (1 mGy/d)	<0.1 rad/d (<1 mGy/d)	8.2
DOE Order 435.1, *Radioactive Waste Management*			
Annual dose to the general public due to RWMS operations	25 mrem/yr (0.25 mSv/yr)	Compliant[(c)]	5.3.2
DOE Order 450.1, *Environmental Protection Program*			
Conduct radiological environmental monitoring	NA[(d)]	Compliant	3.1; 4.1; 5.0; 6.0; 7.0
Detect and characterize radiological releases	NA	Compliant	3.1; 4.1; 5.0; 6.0; Table 3-12
Characterize pathways of exposure to the public	NA	Compliant	8.1.1
Characterize exposures and doses to individuals, the population, and biota	NA	Compliant	8.1.6; 8.1.7; 8.2

(a) The section(s) within this document that describe how compliance summary data were collected.
(b) Migration of radioactivity in groundwater to offsite wells has never been detected.
(c) Nearest populations to the Area 3 and 5 RWMSs are Amargosa Valley (55 km away) and Cactus Springs (36 km away), respectively. They are too distant to receive any radiation exposure from operations at the sites.
(d) Not applicable.

2.4 Radioactive and Non-Radioactive Waste Management and Environmental Restoration

10 CFR 830: Nuclear Safety Management – Establishes requirements for the safe management of work at DOE's nuclear facilities. It governs the possession and use of special nuclear and byproduct materials. Part 830 also covers activities at facilities where no nuclear material is present such as facilities that prepare the non-nuclear components of nuclear weapons, but which could cause radiological damage at a later time. It governs the conduct of the "management and operating contractor and other persons at DOE nuclear facilities" (including visitors to the facility). When coupled with the Price-Anderson Amendments Act (PAAA) of 1988 (Section 234A to the Atomic Energy Act), it provides DOE with authority to assess civil penalties for violation of rules, regulations, or orders relating to nuclear safety by contractors, subcontractors, and suppliers who are indemnified under PAAA.

DOE Order 435.1, *Radioactive Waste Management* – Ensures that all DOE radioactive waste is managed in a manner that is protective of the worker, public health and safety, and the environment. Activities conducted on the NTS subject to this Order include: (1) characterization of low level radioactive waste (LLW) and low level mixed radioactive waste (LLMW) generated by DOE within the state of Nevada; (2) disposal of LLW and LLMW at the Area 3 and Area 5 RWMSs; (3) characterization, visual examination, and repackaging of transuranic (TRU) waste at the Waste Examination Facility south of the Area 5 RWMS; and (4) loading of TRU waste at the Area 5 RWMS for shipment to Idaho National Environmental Engineering Laboratory.

Atomic Energy Act (AEA) of 1954 (42 U.S.C. Sect. 2011 et seq.) – Ensures the proper management of source, special nuclear, and byproduct material. At the NTS, AEA regulations are followed through compliance with DOE Order 435.1 and 10 CFR 830.

Resource Conservation and Recovery Act (RCRA) – Ensures the safe and environmentally responsible management of hazardous (see Glossary, Appendix B) and non-hazardous solid waste. RCRA and the Hazardous and Solid Waste Amendments of 1984 constitute the statutory basis for the regulation of hazardous waste and underground storage tanks (USTs). Under Section 3006, the EPA authorizes Nevada to administer and enforce hazardous waste permits for many NNSA/NSO facilities. In November, Nevada renewed the RCRA Part B Permit (NEV HW 0021) regulating hazardous waste management activities at the NTS. The permit regulates the operation of the Hazardous Waste Storage Unit (HWSU) in Area 5, the Explosive Ordnance Disposal Unit (EODU) in Area 11, and authorizes the disposal of LLMW in the Pit 3 Mixed Waste Disposal Unit (P03U) at the Area 5 RWMS. The permit also prescribes post-closure monitoring for five closed waste sites that were closed under RCRA as Corrective Action Units (CAUs) (see Section 9.4.2).

The NTS has five USTs which are either (1) fully regulated under RCRA and registered with the state (1 tank); (2) regulated under RCRA and registered with the state of Nevada, but deferred from leak detection requirements (1 tank); or (3) excluded from federal and state regulation (3 tanks). The NTS UST program reports, upgrades, and removes USTs in accordance with regulatory compliance schedules.

RCRA also requires generators of hazardous waste to have a program in place to reduce the volume or quantity and toxicity of such waste. These requirements and NTS compliance with them are addressed under the Pollution Prevention and Waste Minimization sections of this report (Section 2.7, Section 11.0).

The specific Nevada laws which govern hazardous waste management operations under Permit NEV HW009 are Disposal of Hazardous Waste (NRS 459-400–459.600), Facilities for Management of Hazardous Waste (NAC 44.842–444.8482), Disposal of Hazardous Waste (NAC 444.850–444.8746), and Limitations on Issuance of Permits (NAC 444.960).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA) – Provides a framework for the cleanup of waste sites containing hazardous substances and an emergency response program in the event of a release of a hazardous substance to the environment. No hazardous waste cleanup operations on the NTS are regulated under CERCLA; they are regulated under RCRA instead. The only requirements of CERCLA applicable to NTS operations pertain to an emergency response program for hazardous substance releases to the environment (see Emergency Planning and Community Right-to-Know Act in Section 2.5).

Federal Facility Compliance Act (FFCA) – Extends the full range of enforcement authorities in federal, state, and local laws for management of hazardous wastes to federal facilities, including the NTS. The FFCA of 1992, signed by NNSA/NSO and the state of Nevada, requires the identification of existing quantities for mixed waste, the proposal of methods and/or technologies of mixed waste treatment and management, the creation of enforceable timetables, and the tracking and completion of deadlines.

Federal Facilities Agreement and Consent Order (FFACO) – Pursuant to Section 120(a)(4) of CERCLA and to Sections 6001 and 3004(u) of RCRA, the U.S. Department of Energy, U.S. Department of Defense, and the state of Nevada entered into a FFACO in May 1996. The FFACO addresses the environmental restoration of historically contaminated sites at the NTS, parts of Tonopah Test Range (TTR), parts of the Nevada Test and Training Range (NTTR), the Central Nevada Test Area, and the Project SHOAL Area. Under the FFACO, hundreds of sites on and off the NTS have been identified for cleanup and closure. Individual sites are called Corrective Action Sites (CASs). Multiple CASs are often grouped into CAUs.

40 CFR Subchapter I, Parts 239-299: Solid Wastes – At the NTS, these federal solid waste management regulations are followed through compliance with permits issued by the NDEP.

NAC 444.570-7499 – Solid Waste Disposal Controls – Enforces the federal regulations pertaining to solid wastes (40 CFR Subchapter I, Parts 239-299). This Nevada regulation sets standards for solid waste management systems, including the storage, collection, transportation, processing, recycling, and disposal of solid waste. The NTS has four active and one inactive permitted landfills. The Area 5 Asbestiform Low-Level Solid Waste Disposal Unit (P07U) is inactive. Active units include the Area 6 Hydrocarbon Disposal Site, Area 9 U10c Solid Waste Disposal Site, and Area 23 Solid Waste Disposal Site. These landfills are designed, constructed, operated, maintained, and monitored in adherence to the requirements of their state-issued permits.

2.4.1 Compliance Reports

The following reports were prepared in 2005 or 2006 to comply with environmental regulations for waste management and environmental restoration operations conducted on the NTS in 2005. All CAU or CAS reports prepared in 2005 as per the FFACO schedule are presented in Table 9-4 of Section 9.4.1.

- *Annual Asbestos Disposal Report* (for the Area 5 Asbestiform Low-Level Solid Waste Disposal Site P06U)
- *Quarterly LLW/MLLW Disposal Reports* (for all active LLW and mixed waste disposal cells)
- *Biannual Neutron Monitoring Report for the Nevada Test Site Area 9 10c and Area 6 Hydrocarbon Landfills*
- *Nevada Test Site 2005 Data Report: Groundwater Monitoring Program Area 5 Radioactive Waste Management Site* (Bechtel Nevada [BN], 2006a)
- Post-closure monitoring reports for the five RCRA Part B-identified CAUs
- *January-June 2005 Biannual Solid Waste Disposal Site Report for the Nevada Test Site Area 23 Sanitary Landfill*
- *July-December 2005 Biannual Solid Waste Disposal Site Report for the Nevada Test Site Area 23 Sanitary Landfill*
- *2005 Annual Solid Waste Disposal Site Report for the Nevada Test Site Area 6 Hydrocarbon Landfill and Area 9 U10c Landfills*
- *Nevada Test Site 2005 Waste Management Monitoring Report Area 3 and Area 5 Radioactive Waste Management Sites* (BN, 2006b)

2.4.2 Compliance Status

See Table 2-4 for a summary of how NNSA/NSO complied with waste management and environmental restoration regulations at the NTS in 2005.

Table 2-4. NTS compliance status with applicable waste management and environmental restoration regulations

Compliance Measure/Action	Compliance Limit	Compliance Status - 2005	Section Reference[a]
10 CFR 830: Nuclear Facilities			
Completion and maintenance of proper conduct of operations documents required for Class II Nuclear Facility for disposal/characterization/storage of radioactive waste	Six types of guiding documents required	Compliant	9.1.1; Table 9-1
DOE Order 435.1 *Radioactive Waste Management*			
Establishment of Waste Acceptance Criteria for radioactive wastes received for disposal/storage at Area 3 and 5 RWMSs	NA[b]	Compliant	9.1.1; Table 9-1
Vadose zone monitoring at Area 3 and Area 5 RWMSs	Not required by Order - Performed to validate performance assessment criteria of RWMSs	Conducted	9.1.6
Volume of disposed LLW at Area 3 and Area 5 RWMSs (in cubic meters [m^3])	No limit	Area 3: 9,615 m^3 Area 5: 36,828 m^3	9.1.3
Resource Conservation and Recovery Act (as enforced through permits issued by the state of Nevada)			
pH, specific conductance (SC), total organic carbon (TOC), total organic halides (TOX), and tritium (H^3) and 11 general water chemistry parameters in groundwater sampled semi-annually from wells UE5 PW-1, UE5 PW-2, and UE5 PW-3 to verify performance of the Pit 3 Mixed Waste Disposal Unit (P03U)	pH: 7.6 to 9.2 SC: 0.440 mmhos/cm[c] TOC: 1 mg/L TOX: 50 µg/L[d] H^3: 2,000 pCi/L	Compliant	9.1.6; Table 9-2; 4.1.7; Table 4-4;
Volume of stored non-radioactive hazardous waste stored at the HWSU	61,600 liters (16,280 gallons)	Compliant	9.2; Table 9-3
Submit quarterly reports of volume of wastes received at the HWSU to the state of Nevada	Due April, July, October, January	Compliant	9.2
Weight of approved explosive ordnance wastes detonated at the EODU (in kilograms [kg] or pounds [lbs])	45.4 kg (100 lbs) at a time, not to exceed 1 detonation event/hour	0 kg	9.2; Table 9-3
Volume of disposed LLMW at Pit 3 Mixed Waste Disposal Unit (P03U) (in cubic meters [m^3] or cubic yards [yd^3])	20,000 m^3 (260,159 yd^3)	0 m^3	9.2; Table 9-3

Table 2-4. NTS compliance status with applicable waste management and environmental restoration regulations (continued)

Compliance Measure/Action	Compliance Limit	Compliance Status - 2005	Section Reference[a]
Resource Conservation and Recovery Act (as enforced through permits issued by the state of Nevada) (continued)			
Conduct vadose zone monitoring for RCRA closure sites: Area 23 Hazardous Waste Trenches and U3ax/bl Subsidence Crater	A23: semi-annually using NL[e] U3ax/bl: continuous using TDR[f]	Compliant	9.4.2
Periodic post-closure inspection of Area 2 Bitcutter Containment and Area 6 Decon Pond	NA	Compliant	9.4.2
Upgrade, remove, and report on USTs	NA	Compliant	9.3
Federal Facilities Agreement and Consent Order			
Adherence to calendar year work scope for site characterization, remediation, and closures	42 CAUs identified for some phase of action; 56 CASs were closed	Compliant All milestones were met	9.4.1; Table 9-4
Post-closure monitoring and inspections of closed sites	28 sites required monitoring/ inspecting	Compliant	9.4.2
NAC 444.750-8396 - Solid Waste Disposal Controls			
Track weight and volume of waste disposed each calendar year	Area 5 P06U - No limit Area 6 - No limit Area 9 - No limit Area 23 - 20 tons/d	Compliant	9.5; Table 9-5
Monitor vadose zone for the Area 6 Hydrocarbon and Area 9 U10c Solid Waste disposal sites	Annually using NL[e]	Compliant	9.5.1

(a) The section(s) within this document that describe how compliance summary data were collected
(b) Not applicable
(c) mmhos/cm = milli-mhos per centimeter
(d) µg/L = micrograms per liter
(e) Neutron logging through access tubes
(f) Time domain reflectometry sensors

2.5 Hazardous Materials Control and Management

Toxic Substances Control Act (TSCA) – Requires testing and regulation of chemical substances that enter the consumer market. Since the NTS does not produce chemicals, compliance with TSCA is primarily directed toward management of polychlorinated biphenyls (PCBs). The regulations implementing TSCA for the state of Nevada contain record keeping requirements for PCB activities (NAC 444.9452). At the NTS, remediation activities and maintenance of fluorescent lights can result in the disposal of PCB-contaminated waste and light ballasts. Disposal of these items on the NTS is regulated.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) – Sets forth procedures and requirements for pesticide registration, labeling, classification, devices for use, and certification of applicators. The use of certain pesticides (called "restricted-use pesticides") are regulated. The use of non-restricted-use pesticides (as available in consumer products) is not regulated. On the NTS, only non-restricted-use pesticides are applied under the direction of a state of Nevada certified applicator. Pesticide applications in food service facilities are subcontracted to state-certified vendors who provide these services.

Emergency Planning and Community Right-to-Know Act (EPCRA) – This act is a free-standing provision under Title III of the 1986 Superfund Amendments and Reauthorization Act (SARA Title III) amendments to CERCLA. It requires that federal, state, and local emergency planning authorities be provided information regarding the presence and storage of hazardous substances and their planned and unplanned environmental releases, including provisions and plans for responding to emergency situations involving hazardous materials. EO 12856, *Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements*, requires all federal facilities to comply with the provisions of EPCRA. Under EPCRA, NNSA/NSO is required to submit reports pursuant to Sections 302, 304, 311, 312, and 313 of SARA Title III described below.

> **Section 302-303, Planning Notification** – Requires that the state emergency response commission and the local emergency planning committee be notified when an extremely hazardous substance (EHS) is present at a facility in excess of the threshold planning quantity. An inventory of the location and amounts of all hazardous substances stored on the NTS and its satellite facilities is maintained. Inventory data are included in an annual report called the Nevada Combined Agency (NCA) Report. Also, NNSA/NSO monitors hazardous materials while they are in transit on the NTS through a hazardous materials notification system called HAZTRAK®.
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> **Section 304, Extremely Hazardous Substances Release Notification** – Requires that the local emergency planning committee and state emergency response agencies be notified immediately of accidental or unplanned releases of an EHS to the environment. Also, the national response center is notified if the release exceeds the CERCLA reportable quantity for the particular hazardous substance.
>
> **Section 311-312, Material Safety Data Sheet (MSDS)/Chemical Inventory** – Requires facilities to provide applicable emergency response agencies with MSDSs, or a list of MSDSs for each hazardous chemical stored on site. This is essentially a one-time reporting unless chemicals or products change. Any new MSDSs are provided annually in the NCA Report. Section 312 requires facilities to report maximum amounts of chemicals onsite at any one time. This report is submitted to the State Emergency Response Commission, the Local Emergency Planning Committee, and the local fire departments.
>
> **Section 313, Toxic Release Inventory (TRI) Reporting** – Requires facilities to submit an annual report entitled "Toxic Chemical Release Inventory, Form R" to the EPA and to the state of Nevada if annual usage quantities of listed toxic chemicals exceed specified thresholds. Lead releases on the NTS above threshold limits are reported to the EPA and the State Emergency Response Commission in the TRI, Form R report.

NAC 555 – Control of Insects, Pests, and Noxious Weeds – Provides regulatory framework for certification of several classifications of registered pesticide and herbicide applicators in the state of Nevada. The Nevada Department of Agriculture (NDOA) administers this program and has the primary role to enforce FIFRA in Nevada.

Inspections of pesticide/herbicide applicator programs are carried out by NDOA. Restricted-use pesticides are not used by BN at the NTS.

NAC 444 – Polychlorinated Biphenyls – This code incorporates by reference the federal requirements for the handling, storage, and disposal of PCBs at the NTS.

State of Nevada Chemical Catastrophe Prevention Act – This state act directed the NDEP to develop and implement an accident prevention program which was named the Chemical Accident Prevention Program. The act requires registration of facilities storing EHSs above listed thresholds. A report is submitted to the NDEP if any storage quantity thresholds are exceeded.

2.5.1 Compliance Reports

The following reports were generated for 2005 NNSA/NSO operations on the NTS and its satellite facilities in compliance with hazardous materials control and management regulations:

- *Nevada Combined Agency Report - Calendar Year 2005,* submitted to state and local agencies
- *Toxic Release Inventory Report, Form R for CY2005 Operations,* submitted to the EPA and to the state of Nevada
- *Calendar Year (CY) 2005 Polychlorinated Biphenyls (PCBs) Report for the Nevada Test Site (NTS)*, submitted to NNSA/NSO (no longer required to be submitted to the EPA)

2.5.2 Compliance Status

See Table 2-5 for a summary of how NNSO/NSA complied with regulations for hazardous materials control and management at the NTS and its satellite facilities in 2005.

Table 2-5. NTS compliance status with applicable regulations for hazardous substance control and management

Compliance Measure/Action	Compliance Limit	Compliance Status - 2005	Section Reference[a]
Toxic Substances Control Act (TSCA) and NAC 444 - Polychlorinated Biphenyls			
Storage and offsite disposal of PCB materials	Required if >50 ppm[b] PCBs	Compliant – disposed of 16 55 gallon drums offsite	10.1
Storage and onsite disposal of PCB materials	Allowed if <50 ppm PCBs	Compliant – no onsite storage or disposal	10.1
Disposal of bulk product waste containing PCBs generated by remediation and site operations	Case-by-case approval by NDEP	Compliant - No BPW disposal	10.1
Generate report of quantities of PCB liquids and materials disposed offsite during previous calendar year	Due July 1 of following year	Compliant - submitted 2005 report in April 2006	10.1
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and NAC 555 - Control of Insects, Pests, and Noxious Weeds			
Application of restricted-use pesticides are conducted under the direct supervision of a state-certified applicator	NA[c]	Compliant - no restricted-use pesticides were applied	10.2
Maintain state certification of onsite pesticide and herbicide applicator	NA	Compliant	10.2
Emergency Planning and Community Right-to-Know Act (EPCRA)			
Section 302-303 Planning Notification	NCA Report due in March for previous calendar year	Compliant - submitted 2005 report February 23, 2006; no EHS thresholds exceeded	10.3; A.1.4; A.3.3
Section 304 – EHS Release Notification	Notification Report due immediately after a release	Compliant - no releases occurred	10.3; A.1.4; A.3.3
Section 311-312 – MSDS/Chemical Inventory	NCA Report due in March for previous calendar year	Compliant - submitted 2005 report February 23, 2006	10.3; A.1.4; A.3.3
Section 313 – TRI Reporting	TRI Report, Form R due July 1 for previous calendar year	Compliant - submitted June 22, 2006 - lead was the only reportable substance	10.3; A.1.4; A.3.3
State of Nevada Chemical Catastrophe Prevention Act			
Registration of NTS with the state if EHSs are stored above listed threshold quantities	NDEP-CAPP[d] Report due June 21, 2006	Compliant – no threshold quantities exceeded, no report submitted	10.4

(a) The section(s) within this document that describe how compliance summary data were collected
(b) ppm = parts per million
(c) Not applicable
(d) Chemical Accident Prevention Program

2.6 National Environmental Policy Act

Before any project or activity is initiated at the NTS, it must be evaluated for possible impacts to the environment. Under the National Environmental Policy Act (NEPA), federal agencies are required to consider environmental effects and values and reasonable alternatives before making a decision to implement any major federal action that may have a significant impact on the human environment. NNSA/NSO uses four levels of documentation to demonstrate compliance with NEPA:

- Environmental Impact Statement (EIS) – a full disclosure of the potential environmental effects of proposed actions and the reasonable alternatives to those actions
- Environmental Assessment (EA) – a concise discussion of proposed actions and alternatives and the potential environmental effects to determine if an EIS is necessary
- Supplement Analysis (SA) – a collection and analysis of information for an action already addressed in an existing EIS or EA used to determine whether a supplemental EIS or EA should be prepared, a new EIS or EA should be prepared, or no further NEPA documentation is required
- Categorical Exclusion (CX) – a category of actions which do not have a significant adverse environment impact based on similar previous activities, and for which, therefore, neither an EA nor an EIS is required

A NEPA Environmental Evaluation Checklist (Checklist) is completed for all proposed projects or activities on the NTS, as required under the NNSA/NV Work Acceptance Process Procedural Instructions (Carlson, 2000). The Checklist is reviewed by the NNSA/NSO NEPA Compliance Officer to determine whether the activity's environmental impacts have been addressed in existing NEPA documents. If a proposed project has not been covered under any previous NEPA analysis and it does not qualify as a CX, then a new NEPA analysis is performed. The NEPA analysis may result in preparation of a new EA or a new SA to the existing programmatic NTS EIS (DOE, 1996a). The NEPA Compliance Officer must approve each Checklist before a project proceeds. Table 2-6 presents a summary of how NNSA/NSO complied with NEPA in 2005 for 83 projects.

Table 2-6. NTS NEPA compliance activities conducted in 2005

Results of NEPA Checklist Reviews / NEPA Compliance Activities
30 projects were exempted from further NEPA analysis because they were of CX status.
42 projects were exempted from further NEPA analysis due to their inclusion under previous analysis in the NTS EIS (DOE, 1996a) and its Record of Decision.
3 projects were exempted from further NEPA analysis due to their inclusion under previous analysis in an SA to the NTS EIS to address the increase in activities associated with the National Center for Combating Terrorism & Counterterrorism Training and related activities (DOE, 2003a).
1 project was reviewed which was not adequately addressed in existing NEPA analysis and resulted in the preparation of an EA: *Environmental Assessment for Large-Scale, Open-Air Explosive Detonation DIVINE STRAKE at the Nevada Test Site* (DOE, 2005b). The Record of Decision will be made in early 2006.
2 projects were exempted from further NEPA analysis due to their inclusion under previous analysis in the *Final Environmental Assessment for Activities Using Biological Simulants and Releases of Chemicals at the Nevada Test Site* (DOE, 2004a).
3 projects were exempted from further NEPA analysis due to their inclusion under previous analysis in the *Environmental Assessment for Hazardous Materials Testing at the Hazardous Materials Spill Center, Nevada Test Site* (DOE, 2002b).
1 project was exempted from further NEPA analysis due to its inclusion under previous analysis in the *Environmental Assessment for Aerial Operations Facility Modifications* (DOE, 2004b).
1 project was exempted from further NEPA analysis due to its inclusion under previous analysis in the *Environmental Assessment for the Radiological/Nuclear Countermeasures Test and Evaluation Complex* (DOE, 2004c).

2.7 Pollution Prevention and Waste Minimization

Resource Conservation and Recovery Act of 1976 (RCRA) – Through 42 USC 6922 (b)(1) of RCRA, generators of hazardous waste are required to have a program in place to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to be economically practicable. The EPA was required to develop a list of types of commercially-available products (e.g., copy machine paper, plastic desk top items) and then specify that a certain minimum percentage of the product type's content be comprised of recycled materials if they are to be purchased by a federal agency (e.g., all federally-purchased copy machine paper must be comprised of a minimum of 30 percent recycled paper). It then requires federal facilities to have a procurement process in place to ensure that they purchase product types which satisfy the EPA-designated minimum percentages of recycled material.

EO 13101, *Greening the Government through Waste Prevention, Recycling and Federal Acquisition* – Requires federal facilities to incorporate waste prevention and recycling into daily operations. It requires federal facilities to maintain an affirmative procurement process that ensures that 100 percent of products purchased which are found on the EPA-designated product list contain recycled material at the EPA-specified minimum content. The Secretary of Energy's goal is for DOE sites to become 100 percent compliant with this EO by the end of 2005.

DOE Order 450.1, *Environmental Protection Program* – Requires federal facilities to implement an Environmental Management System (EMS) that includes pollution prevention. The EMS must be fully integrated into the site Integrated Safety Management System (ISMS).

NDEP Hazardous Waste Permit Number NEV HW0021 – This state permit requires NNSA/NSO to maintain an Annual Waste Minimization Summary Report in the Facility Operating Records. This report should include a description of the efforts taken during the year to reduce the volume and toxicity of waste generated as per RCRA, 42 USC 6922 (b) (1), as well as a description of the changes in volume and toxicity of waste actually achieved during the year in comparison to previous years to the extent such information is available for the years prior to 1984.

Secretary of Energy's Pollution Prevention and Energy Efficiency Leadership Goals – On November 12, 1999, the Secretary of Energy set numerous pollution prevention and energy efficiency goals that each DOE site was required to meet by the end of 2005. They included goals for: (1) reducing wastes, (2) increasing recycling and purchases of recycled materials, and (3) reducing ODS and greenhouse gasses. Table 2-7b presents the status of site compliance with the first two groups of goals. DOE has developed new pollution prevention (P2 goals) for 2006 and beyond.

2.7.1 Compliance Issues

One EO 13101 goal and four of the six Secretary of Energy's Pollution Prevention and Energy Efficiency Leadership Goals were not met at the NTS in 2005. They are shown in Tables 2-7a and 2-7b and are discussed in Section 11.

2.7.2 Compliance Reports

The compliance reports generated in 2005 to comply with pollution prevention and waste minimization (P2/WM) directives are presented in Table 2-7a.

2.7.3 Compliance Status

See Tables 2-7a and 2-7b for a summary of how NNSA/NSO complied with P2/WM regulations in 2005.

Table 2-7a. NTS compliance status with applicable pollution prevention/waste minimization regulations

Compliance Measure/Action	Compliance Limit/Goal	Compliance Status 2005	Section Reference [(a)]
Resource Conservation and Recovery Act of 1976 (RCRA)			
Have a program in place to reduce the volume or quantity and toxicity of generated hazardous waste to the degree it is economically practicable	NA[(b)]	Compliant	11.1
Have a process in place to ensure that EPA-designated-list products are purchased containing the minimum content of recycled materials	NA	Compliant	11.1
EO 13101, *Greening the Government through Waste Prevention, Recycling and Federal Acquisition*			
Incorporate waste prevention and recycling into daily operations	NA	Compliant	11.1
Percent of all purchased items which contain the minimum content of recycled material as specified on the EPA-designated product list	100%	90%	11.1
Submit a calendar year RCRA/EO 13101 Report to DOE/Headquarters (HQ) by entering the site's data into the DOE/HQ electronic database	Due December 31, 2005	Submitted December 15, 2005	- -
DOE Order 450.1, *Environmental Protection Program*			
Implement an EMS that includes pollution prevention	Implement by December 31, 2005	Compliant December 15, 2005	17.0
Submit a fiscal year Waste Generation and Pollution Prevention Progress Report to DOE/HQ that includes annual recycling totals and waste minimization accomplishments by entering the site's data into the DOE/HQ electronic database	Due December 3, 2005	Submitted November 15, 2005	11.3
Submit a calendar year Waste Minimization Summary Report to NDEP	Due by March 1, 2006	Submitted February 23, 2006	11.3
Secretary of Energy's P2 Leadership Goals			
See Table 2-7b	See Table 2-7b	Non-compliant with Goals 2, 3, 4, and 6	11.4

(a) The section(s) within this document that describe how compliance summary data were collected
(b) Not applicable

Table 2-7b. NTS compliance status with the Secretary of Energy's pollution prevention and energy efficiency leadership goals

Leadership Goal	1993 Baseline	CY 2005 Goal	CY 2005 Status	CY 2005 Reduction
Goal 1. Reduce waste from routine operations by the following percentages for each waste type by 2005, using a 1993 baseline:				
Hazardous by 90%	3,724 mtons[a]	372 mtons	23.2 mtons	99.2%
Low Level Radioactive by 80%	0 m^3 [b]	0 m^3	0 m^3	N/A
Low Level Mixed Radioactive by 80%	0 m^3	0 m^3	0 m^3	N/A
Transuranic (TRU) by 80%	0 m^3	0 m^3	0 m^3	N/A
Goal 2. Reduce solid waste from routine operations by 75% by 2005, using a 1993 baseline	13,735 mtons	3,434 mtons	5,380 mtons	61%
Goal 3. Reduce releases of toxic chemicals subject to Toxic Release Inventory (TRI) reporting by 90% by 2005, using a 1993 baseline	0 pounds (lbs) reported	No reduction possible[c]	5,485.7 lbs reported	No reduction possible
		Waste Generated	**Waste Recycled**	**CY 2005 Reduction**
Goal 4. Recycle 45% of solid waste from all operations by 2005 and 50% by 2010		17,767 mtons	1,194 mtons	6.7%
		Waste Disposed	**Waste Reduced**	**CY 2005 Reduction**
Goal 5. Reduce waste resulting from cleanup, stabilization, and decommissioning activities by 10% on an annual basis		11,800 mtons	14,308 mtons	55%
			CY 2005 Goal	**CY 2005 Status**
Goal 6. Increase purchases of EPA-designated items with recycled content to 100%, except when not available competitively at a reasonable price or when items do not meet performance standards			100%	90%

(a) metric tons, 1 mton = 1.10 ton
(b) cubic meters, 1 m^3 = 1.35 yd^3
(c) No measurable reduction can be reported because no waste of this type was reported on the NTS in 1993

2.8 Historic Preservation and Cultural Resource Protection

National Historic Preservation Act of 1966, as amended – This Act presents the goals of federal participation in historic preservation and delineates the framework for federal activities. Section 106 requires federal agencies to take into account the effects of their undertakings on properties included in, or eligible for inclusion in, the National Register of Historic Places (NRHP) and to consult with interested parties. The Section 106 process involves the agency reviewing background information, identifying eligible properties for the NRHP within the area of potential effect through consultation with the Nevada Historic Preservation Officer (SHPO), making a determination of effect (when applicable), and developing a mitigation plan when an adverse effect is unavoidable. Determinations of eligibility, effect, and mitigation are conducted in consultation with the SHPO and, in some cases, the federal Advisory Council on Historic Preservation. Section 110 sets out the broad historic preservation responsibilities of federal agencies and is intended to ensure that historic preservation is fully integrated into the ongoing programs of all federal agencies. It requires federal agencies to develop and implement a Cultural Resources Management Plan, to identify and evaluate the eligibility of historic properties for long-term management as well as for future project-specific planning; and to maintain archaeological collections and their associated records at professional standards. At the NTS, a long-term management strategy includes: (1) monitoring NRHP-listed and eligible properties to determine if environmental or other actions are negatively affecting the integrity or other aspects of eligibility and (2) taking corrective actions if necessary.

EO 11593, *Protection and Enhancement of the Cultural Environment* – Reinforces the obligation of federal agencies to conduct adequate surveys to locate any and all sites of historic value under their jurisdiction.

Archeological Resources and Protection Act of 1979 – The purpose of this act is to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public and Indian lands, and addresses the irreplaceable heritage of archaeological sites and materials. It requires the issuance of a federal archaeology permit to qualified archaeologists for any work that involves excavation or removal of archaeological resources on federal and Indian lands and notification to Indian tribes of these activities. Unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources is prohibited, as is the sale, purchase, exchange, transport, receipt of, or offer for sale of, such resources. Criminal and civil penalties apply to such actions. Information concerning the nature and location of any archaeological resource may not be made available to the public unless the federal land manager determines that the disclosure would not create a risk of harm to the resources or site. The Secretary of Interior is required to submit an annual report at the end of each fiscal year to Congress which reports the scope and effectiveness of all federal agencies' efforts on the protection of archaeological resources, specific projects surveyed, resources excavated or removed, damage or alterations to sites, criminal and civil violations, the results of permitted archaeological activities, and the costs incurred by the federal government to conduct this work. All archaeologists working at the NTS must have qualifications that meet federal standards and must work under a permit issued by NNSA/NSO. In the event of vandalism, NNSA/NSO would need to investigate the actions.

American Indian Religious Freedom Act of 1978 – This law established the government policy to protect and preserve for American Indians their inherent right of freedom to believe, express, and exercise the traditional religions, including but not limited to access to sites, use and possession of sacred objects, and the freedom to worship through ceremonials and traditional rites. Locations exist on the NTS that have religious significance to Western Shoshone and Southern Paiute; visits to these places involve prayer and other activities. Access is provided by NNSA/NSO as long as there are no safety or health hazards.

Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 – This act requires federal agencies to identify Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony in their possession. Agencies are required to prepare an inventory of human remains and associated funerary objects, as well as a summary with a general description of sacred objects, objects of cultural patrimony, and unassociated funerary objects. Through consultation with Native American tribes, the affiliation of the remains and objects are determined and the tribes can request repatriation of their cultural items. The agency is required to publish a notice of inventory completion in the Federal Register. The law also protects the physical location where human remains are placed during a death rite or ceremony. The NTS artifact collection is subject to NAGPRA and the locations of American Indian human remains at the NTS must to be protected from NTS activities.

2.8.1 Reporting Requirements

NNSA/NSO submits Section 106 cultural resources survey reports and historical evaluations to the Nevada SHPO for review and concurrence. Mitigation plans and mitigation documents also are submitted to the Nevada SHPO and some types of documents go to the Advisory Council on Historic Preservation and the National Park Service. Reports containing restricted data on site locations are not available to the public. Some technical reports, however, are available to the public upon request and can be obtained from the National Technical Information Service. The 2005 reports submitted to agencies are discussed in Chapter 12.

2.8.2 Compliance Status

See Table 2-8 for a summary of how NNSA/NSO complied with historic preservation and cultural resource protection regulations on the NTS in 2005.

Table 2-8. NTS compliance status with historic preservation regulations

Compliance Action	Compliance Status - 2005	Section Reference[(a)]
National Historic Preservation Act of 1966 and EO 11593, *Protection and Enhancement of the Cultural Environment*		
Maintain and implement NTS Cultural Resources Management Plan	Compliant	- -
Conduct cultural resources pre-activity surveys, inventories and evaluations of historic structures	Conducted for 7 projects	12.1; Table 12-1
Make determinations of eligibility to the National Register	3 determinations were made	12.1.3; Table 12-1
Make assessments of impact to eligible properties	All eligible sites are avoided by NTS activities	12.1.3
Manage artifact collection as per required professional standards	Compliant	12.2
Archaeological Resources and Protection Act of 1979		
Conduct archaeological work by qualified permittees	Compliant	- -
Determine if archaeological sites have been damaged	None damaged	12.1.4.1
Complete and submit Secretary of the Interior Archaeology Questionnaire	Completed	12.1.4.3
American Indian Religious Freedom Act of 1978		
Allow American Indians access to NTS locations for ceremonies and traditional use	Access provided	12.3
Native American Graves Protection and Repatriation Act		
Consult with affiliated Native American Indian tribes regarding repatriation of cultural items	Completed	12.2
Protect Native American Indian burial locations on NTS	Compliant	12.2
Overall Requirement		
Consult with tribes regarding various cultural resources issues	Compliant	12.3

(a) The section(s) within this document that describe how compliance summary data were collected

2.9 Conservation and Protection of Biota and Wildlife Habitat

Endangered Species Act – Section 7 of this act requires federal agencies to ensure that their actions do not jeopardize the continued existence of federally listed endangered or threatened species or their critical habitat. The threatened desert tortoise is the only animal protected under the ESA which may be impacted by NTS operations. NTS activities within tortoise habitat are conducted so as to comply with the terms and conditions of Biological Opinions issued by the U.S. Fish and Wildlife Service (FWS) to NNSA/NSO.

Migratory Bird Treaty Act (MBTA) – Prohibits the harming of any migratory bird, their nest, or eggs without authorization by the Secretary of the Interior. All but five of the 239 bird species observed on the NTS (Wills and Ostler, 2001) are protected under this act. Biological surveys are conducted for projects to prevent direct harm to protected birds, nests, and eggs.

Bald Eagle Protection Act – Prohibits the capture or harming of bald and golden eagles without special authorization. Both bald and golden eagles occur on the NTS. Biological surveys are conducted for projects to prevent direct harm to eagles and their nests and eggs.

Clean Water Act (CWA), Section 404, Wetlands Regulations – Regulates land development affecting wetlands by requiring a permit obtained from the U.S. Army Corps of Engineers (USACE) to discharge dredged or fill material into waters of the United States, which includes most wetlands on public and private land. NTS projects are evaluated for their potential to disturb wetlands and their need for a Section 404 permit application. Based on recent rulings, no natural NTS wetland may meet the criteria of a "jurisdictional" wetland subject to Section 404 regulations. However, final determination from the USACE regarding the status of NTS wetlands has yet to be received.

National Wildlife Refuge Administration Act – Forbids a person to knowingly disturb or injure vegetation or kill vertebrate or invertebrate animals or their nests or eggs on any National Wildlife Refuge lands unless permitted by the Secretary of the Interior. The boundary of the Desert National Wildlife Refuge (DNWR), land administered within this System, is approximately 5 km (3.1 mi) downwind of the NPTEC in Area 5. Biological monitoring is conducted to verify that approved tests conducted at the NPTEC do not disperse toxic chemicals that could harm biota on the DNWR.

EO 11990, *Protection of Wetlands* – Requires governmental agencies to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities, including managing federal lands and facilities. Projects are evaluated for their potential to disturb the more than 20 natural water sources on the NTS. NTS wetlands are monitored to document their status and use by wildlife, even though they may not meet the criteria for "jurisdictional" status under the CWA.

EO 11988, *Floodplain Management* – Ensures protection of property and human wellbeing within a floodplain and protection of floodplains themselves. The Federal Emergency Management Agency (FEMA) publishes guidelines and specifications for assessing alluvial fan flooding. NNSA/NSO generally satisfies EO 11988 through DOE Order 420.1, *Facility Safety*, and invoked standards. DOE Order 420.1 and the associated implementation guide for mitigation of natural phenomena hazards call for a graded approach to assessing risk to all facilities (structures, systems, and components [SSC]) from potential natural hazards. Chapter 4 of DOE Standard 1020 (DOE-STD-1020-2002) provides flood design and evaluation criteria for SSC. Evaluations of flood hazards at the NTS are generally conducted to ensure protection of property and human wellbeing.

EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds* – Directs federal agencies to take certain actions to further implement the MBTA if agencies have, or are likely to have, a measurable negative effect on migratory bird populations. It also directs federal agencies to support the conservation intent of the MBTA and conduct actions, as practicable, to benefit the health of migratory bird populations. NTS projects are evaluated for their potential to impact such bird populations.

EO 13112, *Invasive Species* – Directs federal agencies to act to prevent the introduction of, or to monitor and control, invasive (non-native) species, to provide for restoration of native species, and to exercise care in taking actions that could promote the introduction or spread of invasive species. Land-disturbing activities on the NTS have resulted in the spread of numerous invasive plant species. Habitat reclamation and other controls are evaluated and conducted when feasible to control such species and meet the purposes of this EO.

Wild Free-Roaming Horse and Burro Act – Requires the protection, management, and control of wild horses and burros on public lands and calls for the management and protection of these animals in a manner that is designed to achieve and maintain a thriving natural ecological balance. Wild horses on the NTS may wander off the NTS onto public lands and therefore are protected under this act. This act makes it unlawful to harm wild horses and burros.

Five-Party Cooperative Agreement – Agreement between NNSA/NSO, NTTR, FWS, Bureau of Land Management (BLM), and the state of Nevada Clearinghouse that calls for cooperation in conducting resource inventories and developing resource management plans for wild horses and burros and to maintain favorable habitat on federally withdrawn lands for these animals. BLM considers NTS a zero herd-size management area. NNSA/NSO consults with BLM regarding any issue of NTS horse management.

NAC 503.010-503.104 - Protection of Wildlife – Identifies Nevada animal species, both protected and un-protected, and prohibits the harm of protected species without special permit. Over 200 bird species and 1 bat species on the NTS are State-protected. Biological surveys are conducted for projects to prevent direct harm to protected birds, nests, eggs, and protected bats.

NAC 527.270 - Protection of Flora – Requires that the State Forester Firewarden determine the protective status of Nevada plants and prohibits removal or destruction of protected plants without special permit. Currently, no State-protected plant species are known to occur on the NTS. Annual reviews of the protection status of NTS plants are conducted.

2.9.1 Compliance Issues

Eleven of 12 deaths among migratory birds recorded in 2005 were related to NTS activities (see Table 13-6). They included nine species of migratory birds. The major cause of mortality was being hit by vehicles on roads (eight road kills). No feasible mitigation actions were identified or taken to reduce future bird mortality from these causes.

2.9.2 Compliance Reports

The following reports were prepared in 2005 to meet requirements of the regulations or to document compliance activities:

- *Annual Report of Actions Taken Under Authorization of the Biological Opinion on Nevada Test Site Activities* (File No. 1-5-96-F-33) – *January 1, 2005 Through December 31, 2005,* submitted to the FWS Southern Nevada Field Office in January 2006
- *Annual Report of Actions Taken Under Authorization of the Biological Opinion on Chemical Release Tests at the Nevada Test Site* (File No. 1-5-05-F-455) – July 20, 2005 through August 31, 2005, submitted to the FWS Southern Nevada Field Office in October 2005
- *Annual Report for Handling Permit S26952 for 2005*, submitted via email to Nevada Division of Wildlife (Maureen Hullinger) on January 31, 2006
- *Annual Report for Federal Migratory Bird Scientific Collecting Permit MB008695-0*, submitted via FAX to FWS Portland Office in January 2006
- *Annual Report for Federal Migratory Bird Special Purpose Possession Permit (Dead Permit) MB037277-0,* submitted via FAX to FWS Portland Office in January 2006

2.9.3 Compliance Status

See Table 2-9 for a summary of how NNSA/NSO complied with regulations related to the conservation and protection of biota and wildlife habitat on the NTS in 2005.

Table 2-9. NTS compliance status with applicable biota and wildlife habitat regulations

Compliance Measure/Action	Compliance Limit	Compliance Status - 2005	Section Reference[a]
Endangered Species Act – 1996 Opinion for NTS Programmatic Activities			
Number of tortoises accidentally injured or killed due to NTS activities, per year	3	0	13.1
Number of tortoises captured and displaced from project sites, per year	10	0	13.1
Number of tortoises taken since 1992 by way of injury or mortality on NTS paved roads by vehicles other than those in use during a project	Unlimited	1	13.1
Number of total acres (ac) of desert tortoise habitat disturbed during NTS project construction since 1992	3,015 ac	265.70 ac	13.1
Follow the 23 terms and conditions of the Biological Opinion during construction and operation of NTS projects	NA[b]	Compliant	13.1
Conduct biological surveys at proposed project sites to assess presence of protected species	NA	Compliant 88 surveys conducted for 36 projects	13.2
Endangered Species Act - 2005 Opinion for NPTEC Test Cell C Activities			
Number of desert tortoises that may be captured and moved as a result of project activities	1	0	13.1
Number of tortoises taken in the form of indirect mortality through predation by ravens	0	0	13.1
Number of tortoises taken indirectly in the form of harm as a result of release of potentially harmful chemicals	<5	0	13.1
Migratory Bird Treaty Act; Bald Eagle Protection Act; and EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*			
Number of birds/nests/eggs harmed by NTS project activities	0	15 bird nests removed from buildings, 11 bird deaths	13.2; Table 13-4; 13.3.5.1; Table 13-6
National Wildlife Refuge System Administration Act			
Number of animals, their nests, or eggs killed and amount of vegetation disturbed or injured on System lands (the Desert National Wildlife Range) as a result of NTS activities	0	0	13.6
Wild Free-Roaming Horse and Burro Act and Five-Party Cooperative Agreement			
Number of horses harassed or killed due to NTS activities	0	0	13.3.4
Cooperation in conducting resource inventories and developing resource management plans for horses on NTS, NTTR, and the Desert National Wildlife Range	NA	NTS annual horse inventory conducted	13.3.4; Figure 13-6

Table 2-9. NTS compliance status with applicable biota and wildlife habitat regulations (continued)

Compliance Measure/Action	Compliance Limit	Compliance Status - 2005	Section Reference[(a)]
EO 11988, *Floodplain Management*			
Conduct flood hazard evaluations	NA	Evaluations were conducted for: (1) Corrective Action Unit 383, E Tunnel and vicinity (2) Area 12 Camp (3) Proposed fire station in Area 6 (4) Proposed fire station in Area 23	--
Clean Water Act, Section 404-Wetlands Regulations and EO 11990, *Protection of Wetlands*			
Number of wetlands disturbed by NTS activity	NA	12 natural wetlands surveyed – none disturbed by NTS activity	13.3.6
EO 13112, *Invasive Species*			
Disturbed habitat is revegetated with native plant species on occasion to mitigate for loss of tortoise habitat (in lieu of payment), to stabilize soil, and to prevent invasion of non-native plants	NA	No revegetation conducted, previously revegetated Egg Point Fire area and closure cover for U-3ax/bl disposal unit were monitored	13.4
NAC 503.010-503.104 and NAC 527.270 - Nevada Protective Measures for Wildlife and Flora			
Number of state-protected animals harmed or killed and number of state-protected plants collected or harmed due to NTS activities	0	11 bird deaths recorded	13.3; Table 13-6

(a) The sections within this document that describe how compliance summary data were collected

(b) Not applicable

2.10 Environmental Management System

EO 13148, *Greening the Government through Leadership in Environmental Management* – Requires federal facilities to have an EMS that considers potential environmental impacts in all aspects of its work. This is especially important in the work planning and budgeting stages. Pollution prevention, eliminating potential wastes, and recycling materials must always be addressed when planning work. The EO requires that the EMS be in place by December 31, 2005.

DOE Order 450.1, *Environmental Protection Program* – Requires each DOE facility to implement an EMS which is a continuing cycle of planning, implementing, evaluating, and improving processes and actions undertaken to achieve environmental goals. The objectives are to implement sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by DOE operations, by which DOE cost-effectively meets or exceeds compliance with applicable environmental, public health, and resource protection laws, regulations, and DOE requirements. The EMS must be fully integrated into each DOE site's ISMS by December 31, 2005.

2.10.1 Compliance Reports

NNSA/NSO submitted quarterly reports to DOE/HQ in 2005 regarding progress towards meeting interim goals that were established to help facilities meet the December 31, 2005 deadline. NNSA/NSO made the Self Declaration to NNSA/HQ on December 15, 2006 that the requirements of DOE Order 450.1 had been implemented.

2.10.2 Compliance Status

See Table 2-10 for a summary of how NNSA/NSO complied with EMS regulations.

Table 2-10. NTS compliance status with Environmental Management System regulations

Compliance Measure/Action	Compliance Limit	Compliance Status - 2005	Section Reference[(a)]
EO 13148, *Greening the Government through Leadership in Environmental Management*			
Have an EMS in place	December 31, 2005	Compliant	17.0
DOE Order 450.1, *Environmental Protection Program*			
Incorporate the EMS into the site's ISMS	December 31, 2005	Compliant	17.0

(a) The section(s) within this document that describe compliance summary data

2.11 Occurrences, Unplanned Releases, and Continuous Releases

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) – Continuous release reporting under Section 103 requires that a non-permitted hazardous substance release that is equal to or greater than its reportable quantity be reported to the National Response Center. The EPA requires all facilities that release a hazardous substance meeting the Section 103(f) requirements to report annually to EPA and perform an annual evaluation of releases. CERCLA requirements applicable to NTS operations also pertain to an emergency response program for hazardous substance releases to the environment (see discussion of Emergency Planning and Community Right-to-Know Act in Section 2.5).

Emergency Planning and Community Right-to-Know Act (EPCRA) – This act is described in Section 2.5. See Table 2-5 for summary of compliance to EPCRA pertaining to unplanned environmental releases of hazardous substances.

40 CFR 302.1 – 302.8: Designation, Reportable Quantities, and Notification – Requires facilities to notify federal authorities of spills or releases of certain hazardous substances designated under CERCLA and the CWA. It specifies what quantities of hazardous substance spills/releases must be reported to authorities and delineates the notification procedures for a release that equals or exceeds the reportable quantities.

DOE Order 231.1A, *Environment, Safety, and Health Reporting* – This Order includes the requirement for reporting environmental occurrences. Along with DOE M 231.1-2, *Occurrence Reporting and Processing of Operations Information*, it requires the establishment and maintenance of a system for reporting operations information related to DOE-owned and leased facilities, for processing that information to identify the root causes of environmental occurrences, and for providing appropriate corrective action for such occurrences.

NAC 445A.345–445.348 - Notification of Release of Pollutant – Requires state notification for the unplanned or accidental releases of specified quantities of pollutants, hazardous wastes, and contaminants.

Water Pollution Control General Permit GNEV93001 – This general wastewater discharge permit issued by the state to the NTS specifies that no petroleum products will be discharged into treatment works without first being processed through an oil/water separator or other approved methods. It also specifies how NNSA/NSO shall report each bypass, spill, upset, overflow, or release of treated or untreated sewage.

Other NTS Permits/Agreements – As with General Permit GNEV93001, there are other state permits and agreements cited in previous subsections of this chapter (e.g., FFACO) that specify that accidents or events of non-compliance must be reported. These include events that may create an environmental hazard.

2.11.1 Compliance Status

There are no continuous releases on the NTS or at its satellite facilities.

In 2005, no reportable environmental occurrence happened at the NTS or at its satellite facilities.

2.12 Summary of Permits

Table 2-11 presents the complete list of all federal and state permits active in 2005 that have been issued to NNSA/NSO and to BN for NTS, NLVF, and RSL-Nellis operations and which have been referenced in previous subsections of this chapter. The table includes those pertaining to air quality monitoring, operation of drinking water and sewage systems, hazardous materials and hazardous waste management and disposal, and endangered species protection. Reports associated with these permits are submitted to the appropriate designated state or federal office. Copies of reports may be obtained upon request.

Table 2-11. Environmental permits required for NTS and NTS site facility operations

Permit Number	Description	Expiration Date	Reporting
Air Quality	**NTS**		
AP9711-0549.01	NTS Class II Air Quality Operating Permit	June 25, 2009	Annually
05-15	NTS Burn Variance (Training Fires)	March 12, 2006	None
	NLVF		
Facility 657, Mod. 2	Clark County Authority to Construct/Operating Permit for a Testing Laboratory	None	March
	RSL-Nellis		
Facility 348, Mod. 1	Clark County Authority to Construct/Operating Permit for a Testing Laboratory	None	March
NTS Drinking Water			
NY-0360-12NTNC	Areas 6 and 23	September 30, 2006	None
NY-4098-12NTNC	Area 25	September 30, 2006	None
NY-4099-12NTNC	Area 12	September 30, 2006	None
NY-0835-12NP	NTS Water Hauler #84846	September 30, 2006	None
NY-0836-12NP	NTS Water Hauler #84847	September 30, 2006	None
NTS Septic Systems and Pumpers			
NY-1076	Septic System, Area 6 (Airborne Response Team Hangar)	None	None
NY-1077	Septic System, Area 27 (Baker Compound)	None	None
NY-1106	Septic System, Area 5 (Building 05-08)	None	None
NY-1079	Septic System, Area 12 (U12g Tunnel)	None	None
NY-1080	Septic System, Area 23 (Building 1103)	None	None
NY-1081	Septic System, Area 6 (CP-170)	None	None
NY-1082	Septic System, Area 22 (Building 22-01)	None	None
NY-1083	Septic System, Area 5 (Radioactive Material Management Site)	None	None
NY-1084	Septic System, Area 6 (Device Assembly Facility)	None	None
NY-1085	Septic System, Area 25 (Central Support Area)	None	None
NY-1086	Septic System, Area 25 (Reactor Control Point)	None	None
NY-1087	Septic System, Area 27 (Able Compound)	None	None
NY-1089	Septic System, Area 12 (Camp)	None	None
NY-1090	Septic System, Area 6 (LANL Construction Camp Site)	None	None
NY-1091	Septic System, Area 23 (Gate 100)	None	None
NY-1103	Septic System, Area 22 (Desert Rock Airport)	None	None
NY-1110-HAA-A	Individual Sewage Disposal System, A-12, Bldg. 12-910	None	None
NY-1112	Commercial Sewage Disposal System, U1a, Area 1	None	None
NY-1113	Commercial Sewage Disposal System, Area 1, Building 121	None	None

Table 2-11. Environmental permits required for NTS and NTS site facility operations (continued)

Permit Number	Description	Expiration Date	Reporting
NTS Septic Systems and Pumpers (cont.)			
NY-1124	Commercial Individual Sewage Disposal System, NTS, Area 6, Permit to Operate	None	None
NY-1128	Commercial Individual Sewage Disposal System, NTS, Area 6, Yucca Lake Project, Permit to construct	None	None
NY-17-03313	Septic Tank Pumper E 106785	November 30, 2006	None
NY-17-03315	Septic Tank Pumper E 107105	November 30, 2006	None
NY-17-03317	Septic Tank Pumper E-105918	November 30, 2006	None
NY-17-03318	Septic Tank Pumping Contractor (one unit)	November 30, 2006	None
NY-17-06838	Septic Tank Pumper E-105919	November 30, 2006	None
NY-17-06839	Septic Tank Pumper E-107103	November 30, 2006	None
Wastewater Discharge	**NTS**		
GNEV93001	Water Pollution Control General Permit	August 5, 2010	Quarterly
NEV96021	Water Pollution Control for E-Tunnel Waste Water Disposal System and Monitoring Well ER-12-1	September 25, 2007	Quarterly
	NLVF		
VEH-112	NLVF Wastewater Contribution Permit	December 31, 2006	Annually
TNEV2004364	NLVF Temporary Well Test/Discharge Permit	May 21, 2005	Monthly
TNEV2005437	NLVF Temporary Well Test/Discharge Permit	December 6, 2005	Monthly
TNEV2006369	NLVF Temporary Authorization to Discharge	June 6, 2006	Monthly
	RSL-Nellis		
CCWRD-080	Industrial Wastewater Discharge Permit	June 30, 2006	Quarterly
Hazardous Materials	**NTS**		
2287-5146	NTS Hazardous Materials	February 28, 2006	Annually
2287-5147	Non-Proliferation Test and Evaluation Complex	February 28, 2006	Annually
	NLVF		
2287-5144	NLVF Hazardous Materials Permit	February 28, 2006	Annually
	RSL-Nellis		
2287-5145	RSL Hazardous Materials Permit	February 28, 2006	Annually
NTS Hazardous Waste			
NEV-HW0021	NTS Hazardous Waste Management Permit (RCRA)	November 17, 2005	Biennially
NTS Disposal Sites			
SW 13 000 01	Area 5 Asbestiform Low-Level Solid Waste Disposal Site	Post-closure[(a)]	Annually
SW 13 097 02	Area 6 Hydrocarbon Disposal Site	Post-closure	Annually
SW 13 097 03	Area 9 U10c Solid Waste Disposal Site	Post-closure	Annually
SW 13 097 04	Area 23 Solid Waste Disposal Site	Post-closure	Annually

Table 2-11. Environmental permits required for NTS and NTS site facility operations (continued)

Permit Number	Description	Expiration Date	Reporting
Endangered Species/Wildlife/Special Use			
File No. 1-5-96-F-33	U.S. Fish and Wildlife Service - Desert Tortoise Incidental Take Authorization (Biological Opinion for Programmatic NTS Activities)	December 31, 2006	Annually
File No. 1-5-05-F-455	U.S. Fish and Wildlife Service - Desert Tortoise Incidental Take Authorization (Biological Opinion for Chemical Release Tests at the NPTEC Area 25 Test Cell C Facility)	None specified	Annually
MB008695-0	U.S. Fish and Wildlife Service – Migratory Bird Scientific Collecting Permit	December 31, 2005	Annually
MB037277-0	U.S. Fish and Wildlife Service – Migratory Bird Special Purpose Possession – Dead Permit	December 31, 2005	Annually
S26952	Nevada Division of Wildlife - Scientific Collection of Wildlife Samples	December 31, 2005	Annually
SUP LAME 25AO 1324	U.S. Department of the Interior, National Park Service Special Use Permit – issued for fly-over missions by RSL-Nellis over Lake Mead National Recreation Area to establish a natural environmental background radiation reference standard test line for equipment calibration.	December 31, 2007	None Required

(a) Permit expires 30 years after closure of the landfill

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3.0 Radiological and Non-Radiological Air Monitoring

Section 3.1 of this chapter presents the results of radiological air monitoring conducted on and off the Nevada Test Site (NTS) to ensure compliance with radioactive air emission standards (see Section 2.1). Sources of radioactive air emissions from the NTS include evaporation of tritiated water from containment ponds; diffusion of tritiated water vapor from the soil at Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs), Sedan crater, and Schooner crater; release of tritium gas during equipment calibrations at Building 650 in Area 23; and resuspension of plutonium and americium from contaminated soil at historical nuclear device safety test locations and atmospheric test locations. In 2005, radiological monitoring was conducted by Bechtel Nevada (BN) Environmental Technical Services. The concentrations of radioactivity in air samples are used to assess radiological dose to the general public in the vicinity of the NTS. The assessed dose to the public from all pathways of exposure (i.e., air, water, direct radiation exposure, and consumption of game animals) is presented in Section 8.0 (Radiological Dose Assessment).

An oversight monitoring program has been established by the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) to monitor radionuclide contamination of air within communities adjacent to the NTS. This independent oversight program is managed by the University of Nevada's Desert Research Institute (DRI) of the Nevada System of Higher Education. DRI's 2005 air monitoring results are presented in Section 6.0.

Section 3.2 of this chapter presents the results of non-radiological air quality assessments conducted on the NTS to ensure compliance with current air quality permits (see Section 2.1). NTS operations which are potential sources of non-radiological air pollution include aggregate production, surface disturbance (e.g., construction), release of fugitive dust from driving on unpaved roads, use of fuel-burning equipment, open burning, venting from bulk fuel storage facilities, and releases of various chemicals during testing at the Non-Proliferation Test and Evaluation Complex (NPTEC). Air quality assessments were conducted by BN Environmental Services (ES).

3.1 Radiological Air Monitoring

U.S. Department of Energy (DOE) Order 5400.5, *Radiation Protection of the Public and the Environment*, and the Clean Air Act (CAA) National Emission Standards for Hazardous Air Pollutants (NESHAP) require air monitoring for radiological emissions at the NTS. Radiological air monitoring is conducted to ensure that no significant emission source that contributes to calculable offsite exposures is ignored and that the NTS is in full compliance with the requirements of DOE Order 5400.5 and the CAA. To accomplish this, an air surveillance network comprised of air particulate samplers and samplers for tritium in atmospheric moisture has been established. The objectives and design of the network are described in detail in the *Routine Radiological Environmental Monitoring Plan* (RREMP) (DOE, 2003b). The network monitors airborne radioactivity near NTS sites at which radioactivity from past nuclear testing was deposited on and in the soil, at NTS operating facilities that may produce radioactive air emissions, and along the boundaries of the NTS. Data from all sampling stations are analyzed to meet the specific goals listed below.

Also listed below are the monitored analytes that comprise the base data needed to perform dose assessments. They are concentrations of the radionuclides or radioactivity which are most likely to be present in the air as a result of past or current NTS operations. These analytes were selected based on the results of NTS inventories of radionuclides in surface soil (McArthur, 1991), and upon their volatility and availability for resuspension. Uranium is included on this list because depleted uranium (see Glossary, Appendix B) ordinances are used during exercises in Areas 20 and 25. It is analyzed for in air samples only from selected sampling locations in the vicinity of these areas. Gross alpha and gross beta readings are also used in air monitoring as a rapid screening measure and for looking at trends in gross radioactivity concentrations.

Radiological Air Monitoring Goals	***Analytes Monitored***	
Measure radionuclide concentrations in air at or near historic or current operation sites which have the potential to release airborne radioactivity to (1) detect and identify local and site-wide trends, (2) identify radionuclides emitted to air, and (3) detect accidental and unplanned releases.	Americium-241 (^{241}Am)	Uranium-233+234 ($^{233+234}U$)
Determine if radioactive air emissions from past or present NTS activities result in a radiation dose to any member of the public that exceeds the NESHAP standard of 10 millirem per year (mrem/yr) (0.1 millisievert per year [mSv/yr]).	Cesium-137 (^{137}Cs)	Uranium-235+236 ($^{235+236}U$)
	Tritium (^{3}H)	Uranium-238 (^{238}U)
Provide point source operational monitoring as required under NESHAP for any facility that has the potential to emit radionuclides into the air which could cause a dose greater than 0.1 mrem/yr (0.001 mSv/yr) to any member of the public.	Plutonium-238 (^{238}Pu)	Gross alpha radioactivity
Provide data to determine if radioactive air emissions from past or present NTS activities result in a radiation dose to any member of the public from all pathways (air, water, food) that exceeds the DOE Order 5400.5 standard of 100 mrem/yr (1 mSv/yr).	Plutonium- 239+240 ($^{239+240}Pu$)	Gross beta radioactivity
	$^{239+240}Pu$, $^{233+234}U$, and $^{235+236}U$ are reported as the sum of isotope concentrations since the analytical method cannot readily distinguish the individual isotopes.	

3.1.1 Monitoring System Design

Environmental Samplers – There are 19 sampling stations referred to as environmental samplers. They include 3 stations which have only low-volume air particulate samplers, 1 which has only a tritium sampler, and 15 which have both air particulate and tritium samplers (Figure 3-1). They are located throughout the NTS in or near diffuse radiation sources. The sources include areas with (1) radioactivity in surface soil that can be resuspended by the wind, (2) tritium that transpires or evaporates from plants and soil at the sites of past nuclear cratering tests, and (3) tritium that evaporates from ponds receiving tritiated water either pumped from contaminated wells or directed from tunnels that cannot be sealed shut. Sampling and analysis of air particulates and tritium were performed at these stations as described in Section 3.1.2. Radionuclide concentrations measured at these stations are used for trending, determining ambient background concentrations in the environment, and monitoring for unplanned releases of radioactivity. Air concentrations approaching 10 percent of the NESHAP Concentration Levels for Environmental Compliance (CLs) (second column of Table 3-1) are investigated for causes so that they may be mitigated to avoid exceeding regulatory dose limits.

Critical Receptor Samplers – Six of the 15 samplers which have combined air particulate and tritium sampling stations are located near the boundaries and the center of the NTS and are approved by the U.S. Environmental Protection Agency (EPA) Region IX as critical receptor samplers (Figure 3-1). Radionuclide concentrations measured at these six stations are used to assess compliance with the NESHAP dose limit to the public of 10 mrem/yr (0.1 mSv/yr). Analysis of air particulate and tritium data obtained at these six stations was performed as described in Section 3.1.2 below. The annual average concentrations from each station were then compared with the concentration limits listed in Table 3-1. To be in compliance with NESHAP, the annual average concentrations must be less than the concentration limits in Table 3-1. If multiple radionuclides are detected at a station, then compliance with NESHAP is demonstrated when the sum of the fractions, determined by dividing each radionuclide's concentration by its concentration limit and then adding the fractions together, is less than 1.0.

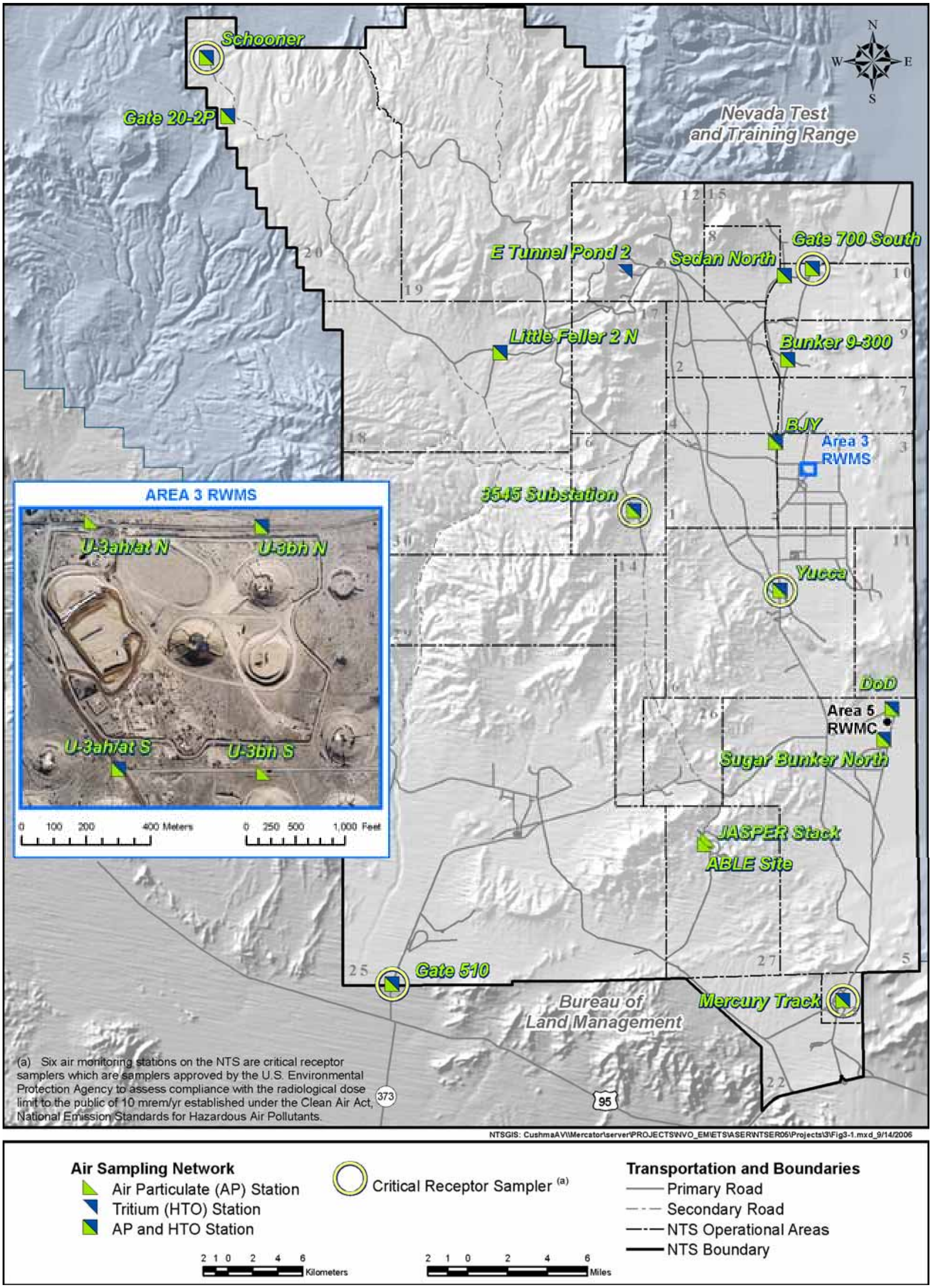

Figure 3-1. Radiological air sampling network on the NTS in 2005

Table 3-1. Regulatory concentration limits for radionuclides in air

	Concentration (x 10^{-15} microcuries/milliliter [µCi/mL])	
Radionuclide	NESHAP Concentration Level for Environmental Compliance (CL)[(a)]	Derived Concentration Guide (DCG)[(b)]
^{241}Am	1.9	2
^{137}Cs	19	40,000
^{3}H	1,500,000	10,000,000
^{238}Pu	2.1	3
^{239}Pu	2	2
^{233}U	7.1	9
^{234}U	7.7	9
^{235}U	7.1	10
^{236}U	7.7	10
^{238}U	8.3	10

Note: Both the CL and DCG values represent the annual average concentration which would result in a committed effective dose equivalent (CEDE) of 10 mrem/yr which is the federal dose limit to the public from all radioactive air emissions. When they differ, the CLs are more conservative than the DCGs. They are computed using different dose models.

(a) From Table 2, Appendix E of 40 CFR 61, NESHAP, 1999

(b) From Chapter 3 of DOE Order 5400.5, 1990, see Glossary, Appendix B for definition

Point–Source (Stack) Sampler – Only one facility on the NTS, the Joint Actinide Shock Physics Experimental Research (JASPER) facility in Area 27 (Figure 3-1), requires stack monitoring because it has the potential to emit airborne radionuclides that could result in an offsite radiation dose ≥ 0.1 mrem/yr. Air emissions from the facility are filtered through a high efficiency particulate air (HEPA) filter, and Lawrence Livermore National Laboratory (LLNL) performs stack monitoring down-stream of the filter. Environmental sampling of air particulates adjacent to the facility is performed as stated in Section 3.1.2. If air concentrations of any man-made radionuclide were found above the minimum detectable concentration (MDC), (see Glossary, Appendix B) then an assessment of offsite dose to the public would be performed to determine NESHAP compliance and LLNL would investigate the cause of the emission and implement corrective actions.

3.1.2 Air Particulate and Tritium Sampling Methods

A weekly sample of airborne particulates was collected from each air sampling station by drawing air through a 10-centimeter (cm) (4-inch [in.]) diameter glass-fiber filter at a constant flow rate of 85 liters per minute (L/min) (3 cubic feet per minute). The particulate filter is mounted in a filter holder that faces downward at a height of 1.5 meters (m) (5 feet [ft]) above ground. A run-time clock measures the operating time. The run time, multiplied by 85 L/min yields the volume of air sampled, which is about 860 cubic m (m^3) (30,000 cubic ft [ft^3]) during a typical seven-day sampling period. The air sampling rates were measured at the start and end of each sampling period with a mass-flow meter.

The 10-cm diameter filters were analyzed for gross alpha and gross beta radioactivity after a five-day holding time to allow for the decay of the progeny of naturally-occurring radon and thoron. The filters from four weeks of sampling were composited, analyzed by gamma spectroscopy, and then analyzed for $^{239+240}$Pu and ^{241}Am by alpha spectroscopy after radiochemical separation. To monitor for any potential emissions from tests using depleted uranium, the filter composites from Yucca (Area 6), Substation 3545 (Area 16), Gate 20-2p (Area 20), Gate 510 (Area 25), and Able Site (Area 27) were also analyzed for uranium isotopes by alpha spectroscopy.

Tritiated water vapor in the form of $^{3}H^{3}HO$ or ^{3}HHO (collectively referred to as HTO) was sampled continuously over two-week periods at each tritium sampling station. Tritium samplers were operated with elapsed time meters at a constant flow rate of 566 cubic centimeters per minute (1.2 ft^3 per hour). The total volume sampled is determined from the product of the sampling period and the flow rate (about 11 m^3 [14.4 cubic yards] over a two-week sampling period). The HTO was removed from the air stream by two molecular sieve columns connected in series (one for routine collection and a second one to indicate if breakthrough occurred during collection). These columns were exchanged biweekly. An aliquot of the total moisture collected was extracted from the first column and analyzed for tritium by liquid scintillation counting. In all cases measured activity in units per sample are converted to units per volume of air prior to analysis and reporting in the following sections.

Routine quality control air samples (e.g., duplicates, blanks, and spikes) are also incorporated into the analytical suites on a frequent basis. The reader is directed to Section 18.0 for a discussion of quality assurance/quality control protocols and procedures utilized for radiological air monitoring.

3.1.3 Presentation of Air Sampling Data

The annual average concentration for each radionuclide at each sampling location is presented in data tables in the following results sections. The annual average concentration for each radionuclide was calculated from uncensored analytical results for individual samples; i.e., values less than the sample-specific MDC were included in the calculation. A column is included in each table indicating the percentage of the analytical results that were greater than their analysis-specific MDCs.

Annual average concentrations are also expressed in the tables as percentages of the CL (the second column of Table 3-1). In graphs of concentration data, the CL or some percentage of the CL is included as a green horizontal line. The CL for each radionuclide was used instead of the DCG, as it was always the lesser of the two for those radionuclides for which these limits differed. The CL (or fraction thereof) is shown in graphs for reference only and not to demonstrate compliance with NESHAP dose limits; assessment of compliance is based upon annual average concentrations, not upon the single measurement results shown in the graphs.

For convenience in reporting, values shown in the tables in the following result sections are frequently formatted to a greater number of significant digits than can be justified by the accuracy of the measurements, which is typically two significant figures (e.g., 2500, 25, 2.5, or 0.025).

3.1.4 Air Sampling Results from Environmental Samplers

With the exception of tritium concentrations at two air sampling stations near the Area 5 Radioactive Waste Management Complex (RWMC) during one two-week sampling period (see Section 3.1.4.5), all elevated radionuclide concentrations in the 2005 air samples shown in the tables and graphs are attributed to the resuspension of legacy contamination in surface soils and to the evaporation and transpiration of tritium from the soil and plants at sites of past nuclear tests and of low-level radioactive waste burial.

3.1.4.1 Americium-241

During 2005, 35 percent of ^{241}Am measurements exceeded their MDCs (see Table 3-2). This is slightly lower than for 2004 (41 percent) and slightly higher than for 2003 (29 percent). The mean concentration over all locations was 23 x 10^{-18} μCi/mL, which is somewhat higher than in recent years. This increase comes from elevated concentrations in the late summer at a few locations in Areas 1, 3, and 9, most notably Bunker 9-300; see Figure 3-2. The annual mean concentration at Bunker 9-300 was 230 x 10^{-18} μCi/mL, which is 12 percent of the compliance limit. Bunker 9-300 measurements in 2004 were in turn elevated compared with those in 2003. These increased measurements (as well as those of ^{238}Pu, $^{239+240}$Pu, and gross alpha) are attributed to increased field activity resulting in resuspension of soils containing legacy plutonium contamination.

Table 3-2. Concentrations of ^{241}Am in air samples collected in 2005

NTS Area	Location	Number of Samples	^{241}Am ($\times 10^{-18}$ µCi/mL) Mean	% of CL [(a)]	Median	SD [(b)]	Min [(c)]	Max [(d)]	Mean MDC	% > MDC
1	BJY	12	32.58	1.7	13.97	57.29	-2.98	205.74	9.20	50.0
3	U-3ah/at N	12	37.08	2.0	18.95	42.69	1.62	154.00	9.47	75.0
3	U-3ah/at S	12	38.34	2.0	31.29	30.10	1.25	106.00	9.03	83.3
3	U-3bh N	12	11.77	0.6	9.78	10.16	-3.23	33.60	9.98	50.0
3	U-3bh S	12	10.38	0.5	11.47	9.49	-3.49	25.67	9.23	58.3
5	DoD	12	2.19	0.1	1.77	3.33	-1.10	11.50	8.64	16.7
5	Sugar Bunker N	12	3.58	0.2	3.29	5.52	-7.26	17.60	10.94	16.7
6	Yucca	12	4.43	0.2	2.29	4.91	-0.25	13.32	9.41	25.0
9	Bunker 9-300	12	229.56	12.1	97.07	254.13	7.74	709.00	11.21	91.7
10	Gate 700 S	12	3.18	0.2	3.94	2.60	-1.84	7.12	8.84	16.7
10	Sedan N	12	19.75	1.0	10.78	22.40	-4.21	65.40	10.21	41.7
16	3545 Substation	12	1.50	0.1	1.68	2.50	-4.19	4.88	8.44	16.7
18	Little Feller 2 N	12	3.72	0.2	2.55	4.17	-0.71	11.02	8.92	25.0
20	Gate 20-2P	12	1.45	0.1	1.40	2.99	-3.11	7.89	7.33	8.3
20	Schooner	12	4.76	0.3	2.89	6.39	-0.17	24.30	9.95	16.7
23	Mercury Track	12	1.64	0.1	1.61	1.96	-2.38	5.05	8.69	12.5
25	Gate 510	12	4.01	0.2	2.29	4.44	-1.20	11.56	7.49	16.7
27	ABLE Site	12	1.69	0.1	-0.09	6.20	-6.27	18.34	10.03	8.3
All Environmental Samplers		**216**	**22.87**	**1.2**	**3.66**	**79.58**	**-7.26**	**709.00**	**9.28**	**35.0**
27	JASPER Stack	12	4.46	0.2	6.96	18.23	-20.85	33.12	104.51	0.0

Blue-shaded locations are EPA-approved critical receptor sampler stations.

The orange-shaded location is a point-source sampler station.

Non-shaded locations are environmental sampler stations.

Green shading indicates that some percentage of samples had concentrations above the sample-specific MDC.

(a) CL is the NESHAP Concentration Level for Environmental Compliance (see Table 3-1).

(b) Standard deviation (c) Minimum (d) Maximum

Note: The CL for ^{241}Am is 1,900 x 10^{-18} µCi/mL.

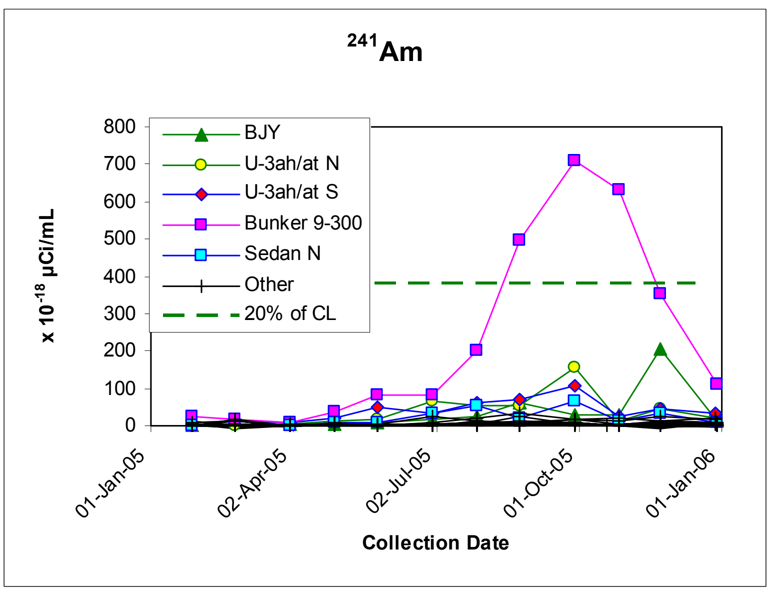

Figure 3-2. Concentrations of ^{241}Am in air samples collected in 2005

3.1.4.2 Cesium-137

During 2005, no ^{137}Cs measurements exceeded their MDCs. Mean values for all environmental locations were near or slightly below zero. No plot is provided because of the low measurement levels (Table 3-3).

Table 3-3. Concentrations of ^{137}Cs in air samples collected in 2005

NTS Area	Location	Number of Samples	^{137}Cs (x 10^{-16} µCi/mL) Mean	% of CL (a)	Median	SD (b)	Min (c)	Max (d)	Mean MDC	% > MDC
1	BJY	12	0.67	0.4	-0.56	3.92	-2.44	12.30	7.38	0.0
3	U-3ah/at N	12	-0.22	-0.1	0.24	2.18	-4.27	3.67	7.41	0.0
3	U-3ah/at Ss	12	-0.58	-0.3	-0.55	2.54	-5.88	2.49	7.63	0.0
3	U-3bh N	12	-0.59	-0.3	-0.18	3.55	-8.07	5.90	7.88	0.0
3	U-3bh S	12	0.28	0.1	-0.78	2.46	-2.62	4.82	7.48	0.0
5	DoD	12	-0.54	-0.3	-0.63	2.41	-5.05	5.39	7.09	0.0
5	Sugar Bunker N	12	-0.52	-0.3	-0.68	3.16	-6.15	5.77	8.51	0.0
6	Yucca	12	-1.69	-0.9	-1.45	2.61	-8.22	2.33	7.25	0.0
9	Bunker 9-300	12	0.71	0.4	0.44	2.74	-2.99	6.51	7.26	0.0
10	Gate 700 S	12	-0.27	-0.1	0.80	2.80	-6.14	3.19	7.49	0.0
10	Sedan N	12	0.64	0.3	0.99	1.94	-2.66	3.37	7.12	0.0
16	3545 Substation	12	0.79	0.4	-0.47	3.61	-4.33	8.21	7.36	0.0
18	Little Feller 2 N	11	-0.90	-0.5	-0.20	2.68	-5.35	3.97	6.73	0.0
20	Gate 20-2P	12	0.23	0.1	0.02	1.98	-2.25	4.83	7.48	0.0
20	Schooner	12	0.03	0.0	-0.10	2.80	-4.33	3.96	7.24	0.0
23	Mercury Track	10	-0.79	-0.4	-0.04	2.72	-6.89	2.78	8.09	0.0
25	Gate 510	11	-0.51	-0.3	-1.17	2.15	-2.90	4.94	7.84	0.0
27	ABLE Site	11	0.06	0.0	-0.24	2.68	-5.45	4.82	7.12	0.0
All Environmental Samplers		**211**	**-0.17**	**-0.1**	**-0.35**	**2.74**	**-8.22**	**12.30**	**7.46**	**0.0**
27	JASPER Stack	12	-10.04	-5.3	-9.72	25.41	-61.75	27.66	98.29	0.0

Blue-shaded locations are EPA-approved critical receptor sampler stations.
The orange-shaded location is a point-source sampler station.
Non-shaded locations are environmental sampler stations.
Green shading indicates that some percentage of samples had concentrations above the sample-specific MDC.
(a) CL is the NESHAP Concentration Level for Environmental Compliance (see Table 3-1).
(b) Standard deviation (c) Minimum (d) Maximum
Note: The CL for ^{137}Cs is 190 x 10^{-16} µCi/mL.

3.1.4.3 Plutonium Isotopes

During 2005, 14.4 percent of ^{238}Pu measurements exceeded their MDCs, a slightly higher proportion than in 2004. The overall mean concentration (2.9 x 10^{-18} µCi/mL) is modestly higher than in 2004 as well. This increase is due to the increased concentrations measured at Bunker 9-300 in Area 9; the annual mean at that location increased from 5.6 to 19.8 x 10^{-18} µCi/mL; the means for ^{241}Am, $^{239+240}Pu$, and gross alpha also increased at that location. The Bunker 9-300 mean is still only 0.9 percent of the CL (see Table 3-4 and Figure 3-3).

Table 3-4. Concentrations of ^{238}Pu in air samples collected in 2005

NTS Area	Location	Number of Samples	^{238}Pu (x 10^{-18} μCi/mL) Mean	% of CL [(a)]	Median	SD [(b)]	Min [(c)]	Max [(d)]	Mean MDC	% > MDC
1	BJY	12	3.71	0.2	2.48	8.45	-4.86	28.65	14.24	4.2
3	U-3ah/at N	12	3.63	0.2	3.38	4.57	-1.96	12.90	9.78	33.3
3	U-3ah/at S	12	5.97	0.3	6.16	4.95	-0.53	13.80	9.82	25.0
3	U-3bh N	12	1.67	0.1	1.95	3.38	-3.97	7.61	11.38	16.7
3	U-3bh S	12	1.67	0.1	1.29	2.83	-2.96	7.04	13.39	8.3
5	DoD	12	2.21	0.1	0.29	4.99	-1.85	16.85	12.88	12.5
5	Sugar Bunker N	12	1.08	0.1	0.90	4.09	-4.65	9.53	18.25	8.3
6	Yucca	12	1.54	0.1	0.88	3.25	-2.78	8.55	9.51	12.5
9	Bunker 9-300	12	19.70	0.9	10.27	21.55	0.00	59.90	10.08	58.3
10	Gate 700 S	12	0.99	0.0	-0.22	5.76	-4.68	17.10	15.92	4.2
10	Sedan N	12	3.11	0.1	3.02	9.61	-23.06	14.20	17.39	25.0
16	3545 Substation	12	2.87	0.1	1.31	5.01	-6.25	10.66	13.23	8.3
18	Little Feller 2 N	12	1.05	0.0	0.41	7.67	-14.35	20.49	11.05	8.3
20	Gate 20-2P	12	-0.68	0.0	-0.48	1.60	-3.86	1.12	9.99	0.0
20	Schooner	12	2.79	0.1	1.39	6.05	-4.50	18.80	12.80	25.0
23	Mercury Track	12	-1.28	-0.1	-0.20	8.16	-25.59	6.61	15.37	8.3
25	Gate 510	12	1.08	0.1	0.00	3.72	-4.17	9.42	9.88	0.0
27	ABLE Site	12	-0.13	0.0	0.00	3.04	-6.71	5.21	11.23	0.0
All Environmental Samplers		**216**	**2.83**	**0.1**	**0.92**	**8.39**	**-25.59**	**59.90**	**12.57**	**14.4**
27	JASPER Stack	12	-8.99	-0.4	-4.74	11.28	-31.71	3.40	116.80	0.0

Blue-shaded locations are EPA-approved critical receptor sampler stations.
The orange-shaded location is a point-source sampler station.
Non-shaded locations are environmental sampler stations.
Green shading indicates that some percentage of samples had concentrations above the sample-specific MDC.
(a) CL is the NESHAP Concentration Level for Environmental Compliance (see Table 3-1).
(b) Standard deviation (c) Minimum (d) Maximum
Note: The CL for ^{238}Pu is 2,100 x 10^{-18} μCi/mL.

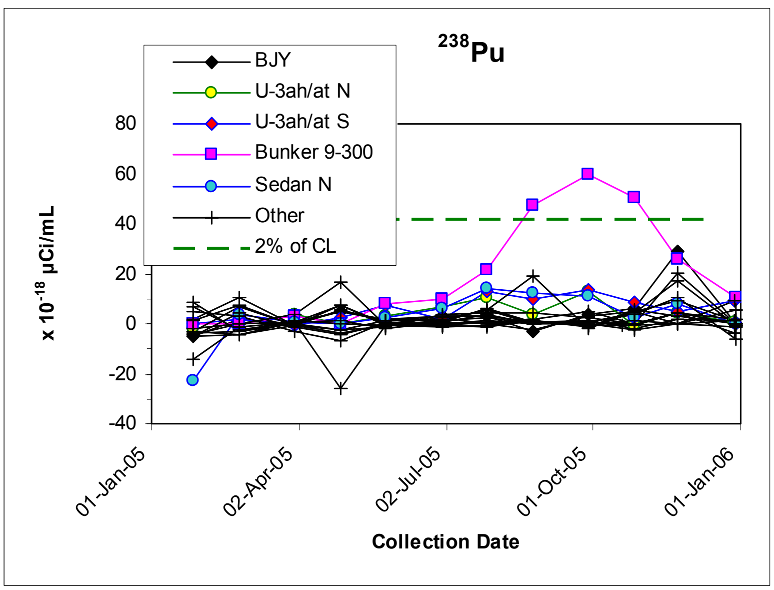

Figure 3-3. Concentrations of ^{238}Pu in air samples collected in 2005

The isotopes $^{239+240}Pu$ (analytical methods cannot readily distinguish between these two) are of greater abundance and hence greater interest. Overall, 51.5 percent of measurements exceeded their MDCs, similar to the proportions in the past few years. The overall mean (148 x 10^{-18} μCi/mL) is considerably higher than in 2004 (48 x 10^{-18} μCi/mL), which is in turn slightly higher than 2003 but about the same as 2002. As with ^{241}Am and ^{238}Pu, this increase is attributed to resuspension of soil in Areas 1, 3, and 9. The annual mean at Bunker 9-300, the highest location, was 1524 x 10^{-18} μCi/mL; this is 76 percent of the CL (see Table 3-5 and Figure 3-4 for $^{239+240}Pu$).

Table 3-5. Concentrations of $^{239+240}Pu$ in air samples collected in 2005

			$^{239+240}Pu$ (x 10^{-18} μCi/mL)							
NTS Area	Location	Number of Samples	Mean	% of CL [(a)]	Median	SD [(b)]	Min [(c)]	Max [(d)]	Mean MDC	% > MDC
1	BJY	12	266.79	13.3	103.50	533.49	7.01	1926.48	13.19	91.7
3	U-3ah/at N	12	225.61	11.3	120.41	254.11	5.84	897.00	10.70	91.7
3	U-3ah/at S	12	280.75	14.0	211.54	248.71	2.97	843.00	11.18	83.3
3	U-3bh N	12	71.47	3.6	45.64	60.02	7.02	179.00	13.06	91.7
3	U-3bh S	12	78.00	3.9	86.89	63.05	3.80	195.50	12.94	75.0
5	DoD	12	5.59	0.3	3.27	14.99	-6.83	50.80	14.48	16.7
5	Sugar Bunker N	12	26.15	1.3	13.14	42.60	0.46	153.00	11.76	50.0
6	Yucca	12	16.08	0.8	7.50	25.01	-4.46	88.90	9.91	37.5
9	Bunker 9-300	12	1525.80	76.3	767.68	1585.42	57.13	4130.00	10.87	100.0
10	Gate 700 S	12	21.00	1.1	11.62	31.10	-0.88	114.20	13.42	45.8
10	Sedan N	12	121.87	6.1	42.40	166.31	-6.58	456.00	18.07	75.0
16	3545 Substation	12	3.23	0.2	3.30	2.69	0.00	7.99	13.57	0.0
18	Little Feller 2 N	12	15.16	0.8	9.92	16.04	-1.37	47.63	11.16	66.7
20	Gate 20-2P	12	1.88	0.1	2.16	3.69	-6.20	6.67	9.55	20.8
20	Schooner	12	2.56	0.1	2.47	8.95	-18.57	22.60	13.01	16.7
23	Mercury Track	12	0.30	0.0	0.35	5.98	-12.77	8.78	15.17	16.7
25	Gate 510	12	2.99	0.1	2.24	4.44	-3.14	14.23	6.99	25.0
27	ABLE Site	12	2.48	0.1	3.00	3.11	-4.40	6.60	10.06	16.7
All Environmental Samplers		**216**	**148.21**	**7.4**	**7.83**	**521.80**	**-18.57**	**4130.00**	**12.17**	**51.2**
27	JASPER Stack	12	14.02	0.7	6.02	54.33	-96.35	142.26	107.06	0.0

Blue-shaded locations are EPA-approved critical receptor sampler stations.
The orange-shaded location is a point-source sampler station.
Non-shaded locations are environmental sampler stations.
Green shading indicates that some percentage of samples had concentrations above the sample-specific MDC.
(a) CL is the NESHAP Concentration Level for Environmental Compliance (see Table 3-1).
(b) Standard deviation
(c) Minimum
(d) Maximum
Note: The CL for $^{239+240}Pu$ is 2,000 x 10^{-18} μCi/mL.

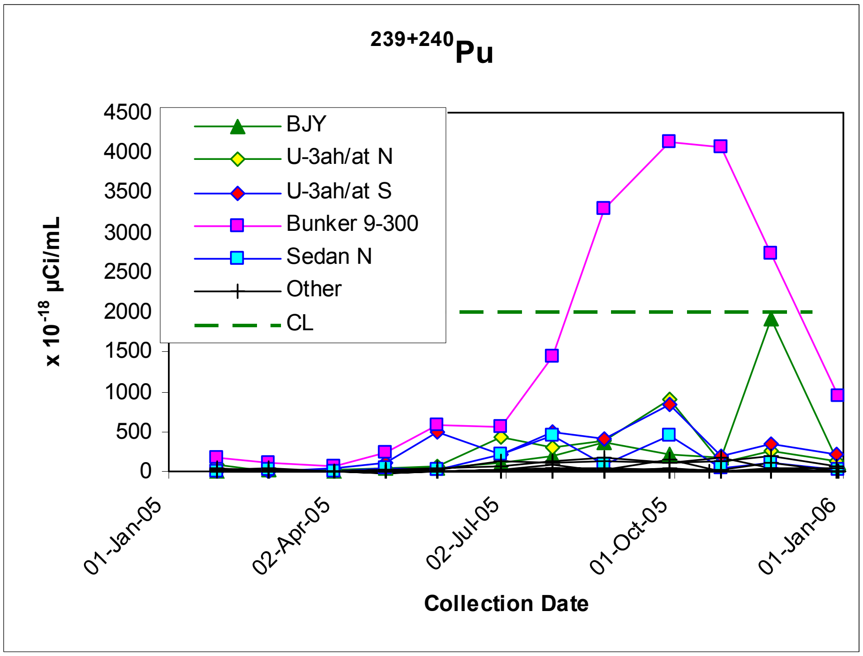

Figure 3-4. Concentrations of $^{239+240}$Pu in air samples collected in 2005

The time series plots for ^{241}Am, ^{238}Pu, and $^{239+240}$Pu at Bunker 9-300 in Figures 3-2, 3-3, and 3-4 are highly correlated. This is because ^{241}Am is the long-lived daughter product obtained when ^{241}Pu (a short-lived isotope created along with the more common Pu isotopes) decays by beta emission. Hence both $^{239+240}$Pu and ^{241}Am (and also ^{238}Pu) tend to be found together in particles of Pu remaining from past nuclear tests. The half-life of ^{241}Pu is 14.4 years, whereas that of ^{241}Am is 433 years; consequently the concentrations of ^{241}Am in NTS soils will gradually increase for about 80 years and then decrease. These isotopes are made airborne by soil disturbances.

Figure 3-5 shows long-term trends in $^{239+240}$Pu annual mean concentrations at locations with at least 14-year data histories since 1971. Estimated average annual rates of decline for the groups of NTS areas shown in that figure range from 3.6 percent for Areas 1 and 3 to 17.2 percent for Areas 18, 19, and 20. The slowest rates of decline of locations currently monitored are 1.5 percent per year at U-3ah/at N and 1.6 percent per year at Bunker 9-300. Rates at other locations range up to 9.8 percent per year. These rates are all considerably faster than can be attributed to radioactive decay, as the half-lives of ^{239}Pu and ^{240}Pu are 24,110 and 6537 years, respectively. The decreases are therefore attributed to immobilization of Pu particles in soil and/or decrease in activities that result from soil resuspension. (The half life of the relatively less abundant ^{238}Pu is 88 years.)

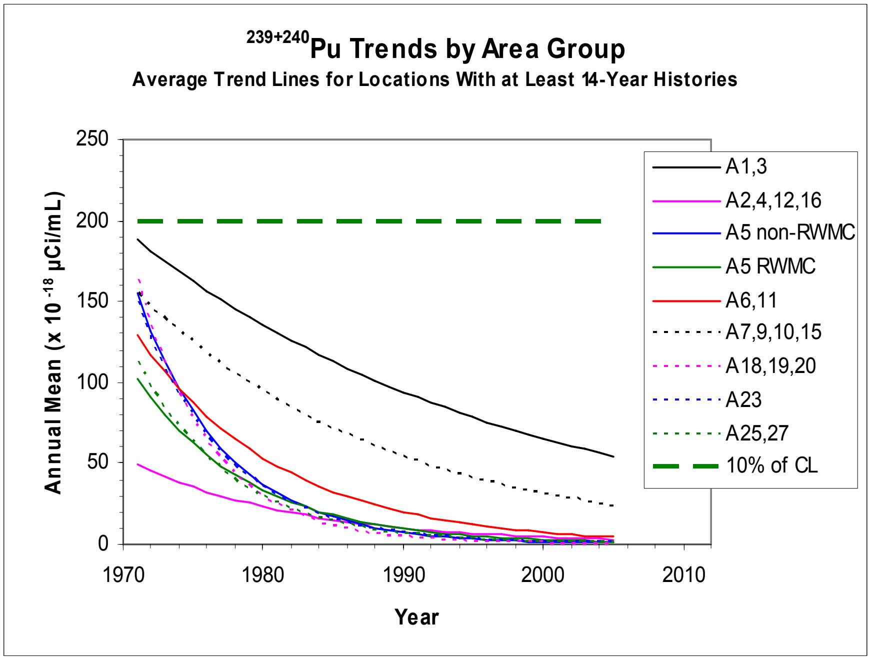

Figure 3-5. Long-term trends in average annual mean $^{239+240}$Pu for NTS area groups

3.1.4.4 Uranium Isotopes

Uranium analyses were performed for samples from only those locations in Areas 20 and 25 where depleted uranium ordinances have been used during exercises. The annual mean concentrations for uranium isotopes, measured in air samples collected at these locations and analyzed by radiochemistry, are shown in Table 3-6. Note that the scale factor in Table 3-6 is the same for $^{233+234}$U and ^{238}U, but an order of magnitude lower for $^{235+236}$U. Ninety-eight and 100 percent of the $^{233+234}$U and ^{238}U measurements exceeded their MDCs, respectively; that proportion is 53 percent for $^{235+236}$U. These are very close to the 2004 proportions. Mean concentrations of these isotopes are likewise very similar to those for 2004, but higher than the mean values for the preceding three years. The mean concentrations remain less than 3 percent of the CLs for $^{233+234}$U and ^{238}U, and at most 0.3 percent of the CL for $^{235+236}$U.

Table 3-6. Concentrations of uranium isotopes in air samples collected in 2005

			$^{233+234}$U (x 10^{-17} µCi/mL)							
NTS Area	Location	Number of Samples	Mean	% of CL [(a)]	Median	SD [(b)]	Min [(c)]	Max [(d)]	Mean MDC	% > MDC
6	Yucca	12	17.75	2.5	18.28	4.13	11.60	26.59	3.60	91.7
16	3545 Substation	12	18.77	2.6	17.55	3.35	14.65	24.30	2.36	100.0
20	Gate 20-2P	12	18.55	2.6	18.71	4.69	12.05	25.30	1.86	100.0
25	Gate 510	12	19.54	2.8	18.51	5.08	15.81	34.41	2.43	100.0
27	ABLE Site	12	18.28	2.6	18.25	2.71	13.21	21.95	1.96	100.0
	All Locations	**60**	**18.58**	**2.6**	**18.19**	**3.99**	**11.60**	**34.41**	**2.44**	**98.3**

Table 3-6. Concentrations of uranium isotopes in air samples collected in 2005 (continued)

NTS Area	Location	Number of Samples	$^{235+236}U$ (x 10^{-18} μCi/mL) Mean	% of CL [(a)]	Median	Std [(b)]	Min [(c)]	Max [(d)]	Mean MDC	% > MDC
6	Yucca	12	18.38	0.3	12.10	17.45	3.85	70.43	27.82	45.8
16	3545 Substation	12	18.51	0.3	17.78	8.62	7.56	37.97	19.64	58.3
20	Gate 20-2P	12	15.47	0.2	15.15	9.33	1.53	30.47	17.98	54.2
25	Gate 510	12	20.64	0.3	15.93	15.89	8.82	62.36	21.28	62.5
27	ABLE Site	12	13.00	0.2	11.63	8.53	-3.66	29.07	16.66	45.8
	All Locations	**60**	**17.20**	**0.2**	**14.50**	**12.44**	**-3.66**	**70.43**	**20.68**	**53.3**
			^{238}U (x 10^{-17} μCi/mL)							
6	Yucca	11	18.57	2.2	18.80	2.34	13.67	21.55	2.43	100.0
16	3545 Substation	12	17.99	2.2	18.26	1.94	14.86	22.30	2.09	100.0
20	Gate 20-2P	12	15.86	1.9	17.25	2.99	10.30	19.40	2.15	100.0
25	Gate 510	12	18.17	2.2	18.30	3.55	11.58	23.69	2.45	100.0
27	ABLE Site	12	17.89	2.2	18.28	2.27	14.63	21.15	1.52	100.0
	All Locations	**59**	**17.68**	**2.1**	**18.00**	**2.76**	**10.30**	**23.69**	**2.12**	**100.0**

Blue-shaded locations are EPA-approved critical receptor sampler stations.
Non-shaded locations are environmental sampler stations.
Green shading indicates that some percentage of samples had concentrations above the sample specific MDC.
(a) CL is the NESHAP Concentration Level for Environmental Compliance (see Table 3-1).
(b) Standard deviation
(c) Minimum
(d) Maximum
Note: The CL for $^{233+234}U$ is about 710 x 10^{-17} μCi/mL.
Note: The CL for $^{235+236}U$ is about 7,100 x 10^{-18} μCi/mL.
Note: The CL for ^{238}U is 830 x 10^{-17} μCi/mL.

The ratios of the isotope concentrations are given in Table 3-7, and Table 3-8 presents the expected values of those ratios for uranium from different sources. Means of both the $^{238}U/^{233+234}U$ and $^{238}U/^{235+236}U$ ratios are below the expected value for natural uranium in the direction of enriched uranium, the former slightly and the latter considerably. Because of the larger degree of uncertainty associated with measurements of the very low concentrations of $^{235+236}U$, the former mean ratio is taken to be a more reliable indication of the source of the uranium, which appears to be largely natural with perhaps a small proportion of enriched uranium present.

Table 3-7. Mean uranium isotope ratios from air samples collected in 2005

NTS Area	Location	Estimated Mean Isotope Ratios ^{238}U / $^{233+234}U$	^{238}U / $^{235+236}U$
6	Yucca	1.046	16.29
16	3545 Substation	0.972	11.69
20	Gate 20-2P	0.889	20.83
25	Gate 510	0.962	12.30
27	ABLE Site	0.984	15.02
	All Locations	**0.969**	15.37

Table 3-8. Expected ratios of uranium isotopes by type of source

Source	Expected Isotope Ratios ^{238}U / $^{233+234}U$	^{238}U / $^{235+236}U$
Natural	~1	~21
Enriched	~0.1	~5
Depleted	~1	~62

3.1.4.5 Tritium

Measurements of tritium in air vary widely across the NTS. Overall 46 percent of ^{3}H measurements are above their MDCs; this proportion ranges from 100 percent at Schooner, 92 percent at E Tunnel Pond, and over 60 percent at U-3ah/at S, DoD, and Sedan N to less than 10 percent at Little Feller 2 N and Gate 510. The spatial patterns are very similar to those observed in 2004 with two exceptions to be discussed below. See Table 3-9 for summary statistics.

The highest mean concentration was found at Schooner (331 x 10^{-6} pCi/mL). The next highest is 9.2 x 10^{-6} pCi/mL at Sedan N, considerably lower. These data are shown in Figure 3-6. Note that the Schooner values are plotted at one-tenth their actual values in order to allow the variation at other locations to be visible. The Schooner annual mean is 22 percent of the CL. The mean concentrations at other locations are at most 0.6 percent of the CL.

Table 3-9. Concentrations of tritium in air samples collected in 2005

NTS Area	Location	Number of Samples	^{3}H Concentration (x 10^{-6} pCi/mL) Mean	% of CL (a)	Median	SD (b)	Min (c)	Max (d)	Mean MDC	% > MDC
1	BJY	25	1.23	0.1	0.94	0.96	-0.13	2.90	1.03	56.0
3	U-3ah/at S	24	1.59	0.1	1.32	1.28	-0.35	3.91	1.08	66.7
3	U-3bh N	26	1.12	0.1	1.05	0.93	-0.36	3.14	1.08	38.5
5	DoD	25	3.25	0.2	1.48	9.25	-0.27	47.40	1.21	70.0
5	Sugar Bunker N	26	2.70	0.2	1.67	5.70	-0.29	30.10	1.17	61.5
6	Yucca	26	0.49	0.0	0.57	0.49	-0.44	1.51	1.08	19.2
9	Bunker 9-300	26	2.84	0.2	2.37	2.49	-0.62	7.17	1.03	69.2
10	Gate 700 S	25	0.72	0.0	0.55	0.58	-0.25	1.84	1.02	36.0
10	Sedan N	26	9.20	0.6	7.01	8.76	0.00	28.41	1.02	76.9
12	E Tunnel Pond 2	24	2.94	0.2	3.11	1.57	0.11	5.65	0.97	91.7
16	3545 Substation	26	0.29	0.0	0.20	0.50	-0.59	1.37	0.99	19.2
18	Little Feller 2 N	26	0.26	0.0	0.36	0.46	-0.61	1.20	0.97	7.7
20	Gate 20-2P	26	0.37	0.0	0.30	0.44	-0.28	1.32	0.95	19.2
20	Schooner	26	330.54	22.0	155.50	360.38	11.13	1049.90	0.96	100.0
23	Mercury Track	26	0.42	0.0	0.50	0.53	-0.68	1.56	1.07	15.4
25	Gate 510	26	0.28	0.0	0.34	0.45	-0.62	1.17	1.16	3.8
All Environmental Samplers		**409**	**22.74**	**1.5**	**0.85**	**120.09**	**-0.68**	**1049.90**	**1.05**	**46.6**

Blue-shaded locations are EPA-approved critical receptor sampler stations.
Non-shaded locations are environmental sampler stations.
Green shading indicates that some percentage of samples had concentrations above the sample-specific MDC.
(a) CL is the NESHAP Concentration Level for Environmental Compliance (see Table 3-1).
(b) Standard deviation
(c) Minimum
(d) Maximum
Note: The CL for ^{3}H is 1,500 x 10^{6} pCi/mL .

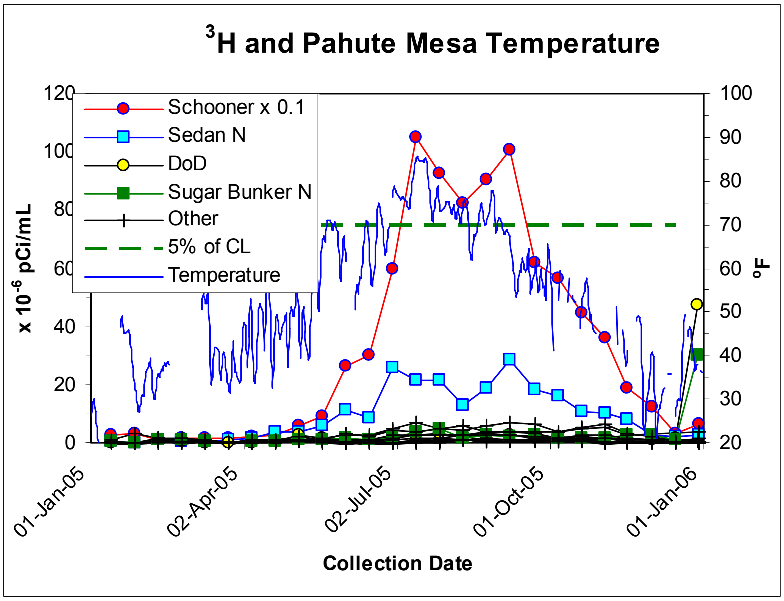

Figure 3-6. Concentrations of tritium in air samples collected in 2005 and Pahute Mesa air temperature

The tritium found at Schooner, Sedan N, and E Tunnel Pond comes primarily from tritium used in past nuclear tests. During detonations, the ^{3}H is oxidized into tritiated water, which remains in the ejecta from the craters and the rubble in tunnel shafts until it evaporates. The rate of evaporation increases as the temperature increases during the summer months, with some lag to allow for heating of the soil; conversely, rainfall can temporarily suppress the evaporation by saturating the soil and diluting the surface moisture with rain water. Figure 3-6 shows the relationship between ^{3}H measurements and the average daily temperature at Pahute Mesa, where Schooner is located; Figure 3-7 shows the time and amount of precipitation events in that area.

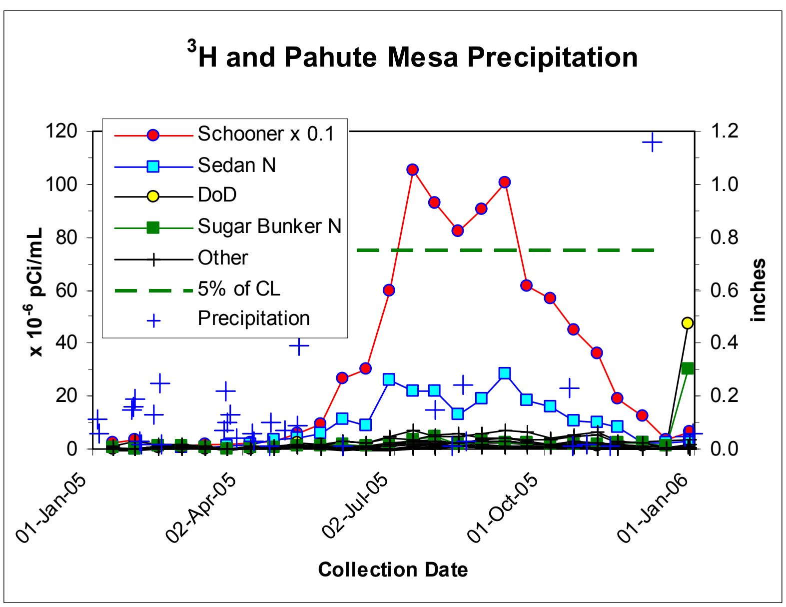

Figure 3-7. Concentrations of tritium in air samples collected in 2005 and Pahute Mesa precipitation

During the final two-week period of 2005, elevated measurements of 3H occurred at Sugar Bunker N and DoD (Figures 3-6 and 3-7). These corresponded in time with the discovery of a low-level waste container with a 3/8- x 8-in. hole in its side at the Area 5 RWMS. Radiological contamination was discovered around the container. No personnel contamination occurred and all standard procedures were followed to prevent the further release of radioactivity from the breached container. The event did not meet the reporting criteria for environmental occurrences according to DOE M 231.1-2, *Occurrence Reporting and Processing of Operations Information*. It is anticipated that the environmental tritium levels will return promptly to their ambient values. However, these elevated values did boost the yearly mean values for those locations somewhat over their 2004 values, but not substantially above the mean values obtained at Bunker 9-300 and E Tunnel Pond, and well below the mean values obtained at Sedan N and Schooner.

Figure 3-8 shows long-term trends for the annual means of all locations with at least seven-year histories since 1987, color-coded by NTS area. The early observations between 1982 and 1987 were obtained from previous annual reports, in which a number of values were reported as "<*xx*", where *xx* was an average of actual values (when measurements were above their sample-specific MDCs) and of sample MDC values (when measurements were below their MDCs). Beginning with 1988, the current practice of using all measured values whether above the MDC or not was adopted. The air sampler at Schooner was added in 1998; it first appeared in these long-term trend plots in the 2004 NTS environmental report (DOE, 2005a).

At most locations, the ^3H measurements have been decreasing fairly rapidly from year to year; the average decline rate is 16.4 percent per year across all locations. This varies from 5.5 percent per year at BJY in Area 1 to an average of 36 percent per year in Areas 23 and 25. The exception is Schooner, where on average it has been increasing at an average rate of 12 percent per year.

During 1998 a more efficient sampling system (molecular sieve) was incorporated. The trend plots and decline rates presented here are not adjusted for the impact of this more efficient system. If they were, the decline rates would average around 19 percent per year, ranging from 12 percent at BJY to 36 percent in Areas 23 and 25 (data from these areas pre-date this change). The rate of increase at Schooner would fall to around 8 percent per year.

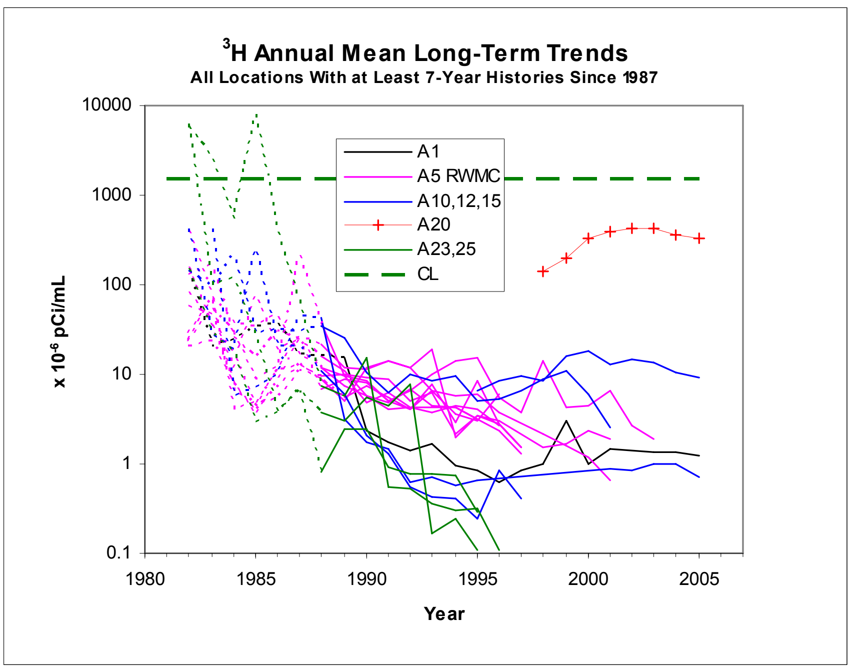

Figure 3-8. Average long-term trends in tritium at locations on the NTS having at least 7 years of data

3.1.4.6 Gross Alpha and Gross Beta

The concentrations of gross alpha and gross beta radioactivity in air samples collected from all environmental samplers in 2005 are shown in Tables 3-10 and 3-11 and Figures 3-9 and 3-10. Since these radioactivities include naturally-occurring ^{40}K, ^{7}Be, uranium, thorium, and the daughter isotopes of uranium and thorium in unknown proportions, a meaningful CL can not be constructed. These analyses are useful in that they can be performed by field personnel at NTS five days after collection to identify any increases requiring investigation.

Overall, 37 percent of gross alpha measurements exceeded their MDCs, somewhat higher than in 2004. The overall mean measurements are about the same as in 2004, however. The biggest increase in measurements over 2004 is found at Bunker 9-300; this corresponds to the increased concentrations of ^{241}Am, ^{238}Pu, and $^{239+240}$Pu present during the summer. This increase reverses the generally decreasing trend since 2001 at this location.

With the exception of the specific peaks associated with locations identified in color in Figure 3-9, the dominant feature of the gross alpha data is the way in which the measurements for all locations tend to rise and fall in parallel. This phenomenon has become rather less pronounced in recent years than it was previously. Also, the proportions of values exceeding their MDCs and the mean values have generally both declined since 2001, with the exception of the anomalies occurring in 2005 at the stations identified in color in Figure 3-9.

Nearly all of the gross beta measurements exceeded their MDCs in 2005, as in 2004. The mean value is near the same, and there are few outstanding values to highlight in Figure 3-10. The week-to-week parallel variation is much more pronounced with gross beta than with gross alpha, continuing the pattern of prior years.

Table 3-10. Gross alpha radioactivity in air samples collected in 2005

			Gross Alpha (x 10^{-16} µCi/mL)						
NTS Area	**Location**	**Number of Samples**	**Mean**	**Median**	**SD [(a)]**	**Min [(b)]**	**Max [(c)]**	**Mean MDC**	**% > MDC**
1	BJY	52	26.29	25.02	21.99	-3.33	147.61	25.91	49.0
3	U-3ah/at N	52	28.88	29.62	18.72	-4.44	107.49	25.43	55.8
3	U-3ah/at S	52	34.50	31.16	21.77	-2.29	96.72	25.59	63.5
3	U-3bh N	52	20.02	20.31	12.37	-3.94	47.91	25.39	32.7
3	U-3bh S	52	20.66	18.88	12.61	-3.33	46.65	25.40	36.5
5	DoD	52	19.83	19.27	10.92	-2.26	40.26	25.49	36.5
5	Sugar Bunker N	48	40.20	43.43	21.57	-1.10	82.70	27.97	66.7
6	Yucca	52	20.94	21.04	10.48	-4.45	49.02	25.31	34.6
9	Bunker 9-300	52	54.68	31.28	59.67	0.00	281.55	25.33	61.5
10	Gate 700 S	51	16.08	15.83	9.46	-2.22	36.82	26.27	18.6
10	Sedan N	52	20.76	20.79	14.11	-1.12	69.83	25.39	32.7
16	3545 Substation	52	16.49	16.64	11.63	-13.41	39.73	25.31	23.1
18	Little Feller 2 N	50	17.04	16.93	9.65	-4.54	37.85	25.47	28.0
20	Gate 20-2P	51	15.29	15.06	9.15	-3.38	37.58	25.90	19.6
20	Schooner	51	17.33	15.56	10.31	1.14	40.16	25.42	31.4
23	Mercury Track	51	15.42	14.67	9.78	-3.48	39.78	25.94	19.6
25	Gate 510	50	16.80	16.70	10.73	-3.31	40.61	25.14	28.0
27	ABLE Site	52	16.32	17.60	10.54	-4.54	41.74	26.16	23.1
All Environmental Samplers		**924**	**23.18**	**19.81**	**21.96**	**-13.41**	**281.55**	**25.70**	**36.7**
27	JASPER Stack	47	76.08	12.67	252.44	-214.25	1410.79	425.18	6.4

Blue-shaded locations are EPA-approved critical receptor sampler stations.
The orange-shaded location is a point-source sampler station.
Non-shaded locations are environmental sampler stations.
Green shading indicates that some percentage of samples had concentrations above the sample-specific MDC.
(a) Standard deviation (b) Minimum (c) Maximum

Table 3-11. Gross beta radioactivity in air samples collected in 2005

			Gross Beta (x 10^{-15} μCi/mL)						
NTS Area	Location	Number of Samples	Mean	Median	SD [(a)]	Min [(b)]	Max [(c)]	Mean MDC	% > MDC
1	BJY	52	18.30	18.81	6.36	5.45	36.10	4.14	100.0
3	U-3ah/at N	52	18.80	18.71	6.44	6.17	35.64	4.04	100.0
3	U-3ah/at S	52	19.05	18.51	6.65	5.72	35.73	4.07	100.0
3	U-3bh N	52	18.35	17.83	6.34	4.76	35.32	4.03	100.0
3	U-3bh S	52	18.63	18.47	6.55	5.94	34.86	4.04	100.0
5	DoD	52	19.79	19.55	7.05	6.83	42.19	4.05	100.0
5	Sugar Bunker N	48	22.51	20.95	8.08	7.23	46.63	4.46	100.0
6	Yucca	52	19.15	18.73	6.62	6.66	36.48	4.03	100.0
9	Bunker 9-300	52	18.04	17.77	6.35	3.86	35.30	4.03	98.1
10	Gate 700 S	51	18.25	18.20	6.33	5.79	36.46	4.20	100.0
10	Sedan N	52	17.92	17.85	5.95	4.95	33.37	4.04	100.0
16	3545 Substation	52	17.29	17.33	5.73	6.56	31.02	4.03	100.0
18	Little Feller 2 N	50	17.47	17.16	5.76	5.13	31.95	3.99	100.0
20	Gate 20-2P	51	17.76	17.34	6.15	5.12	33.10	4.06	98.0
20	Schooner	51	18.22	17.31	7.02	4.38	38.57	3.99	100.0
23	Mercury Track	51	18.65	18.48	6.73	6.40	42.48	4.13	100.0
25	Gate 510	51	18.51	18.54	6.46	3.65	40.61	4.18	98.0
27	ABLE Site	52	17.98	18.52	6.73	5.75	38.63	4.15	100.0
All Environmental Samplers		**925**	**18.58**	**18.38**	**6.56**	**3.65**	**46.63**	**4.09**	**99.7**
27	JASPER Stack	47	-13.14	-6.03	65.15	-295.23	147.20	68.36	4.3

Blue-shaded locations are EPA-approved critical receptor sampler stations.
The orange-shaded location is a point-source sampler station.
Non-shaded locations are environmental sampler stations.
Green shading indicates that some percentage of samples had concentrations above the sample-specific MDC.
(a) Standard deviation (b) Minimum (c) Maximum

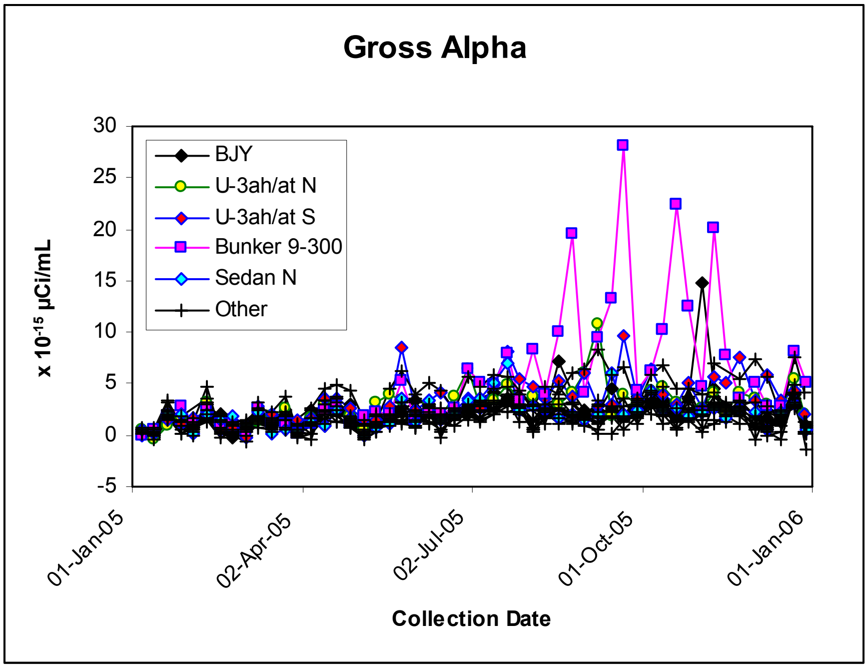

Figure 3-9. Gross alpha radioactivity in air samples collected in 2005

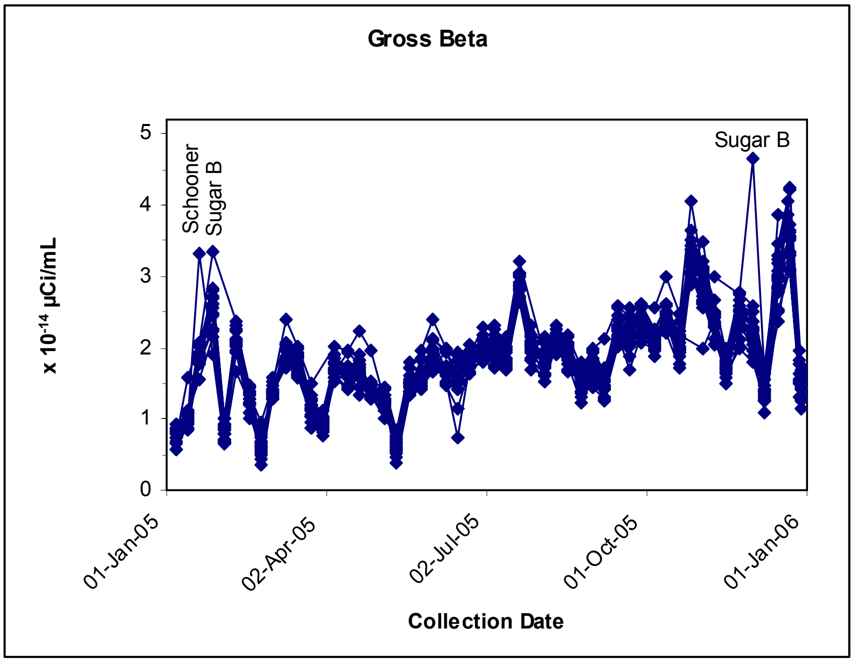

Figure 3-10. Gross beta radioactivity in air samples collected in 2005

3.1.5 *Air Sampling Results from Critical Receptor Samplers*

The following radionuclides were detected at three or more of the critical receptor samplers: ^{241}Am, ^{238}Pu, $^{239+240}$Pu, $^{233+234}$U, $^{235+236}$U, ^{238}U, and ^{3}H (tritium) (see Tables 3-2, 3-4, 3-5, 3-6, and 3-9, respectively). All concentrations of these radionuclides were well below their CLs. The uranium isotopes are attributed to naturally-occurring uranium (see Section 3.1.4.4). The concentration of each measured radionuclide (excluding uranium, since it has been determined to be of natural origin) at each of the six critical receptor samplers was divided by its respective CL (see Table 3-1) to obtain a "fraction of CL." These fractions were then summed for each location. The sum of these fractions at each critical receptor sampler is less than 1.0 (Table 3-12). The NESHAP dose limit to the public of 10 mrem/yr was not exceeded. A hypothetical individual residing at Schooner would receive a CEDE of 2.3 mrem/yr.

Table 3-12. Sum of percents of compliance levels for radionuclides detected at critical receptor samplers

Radionuclides Included in Sum of Percents[(a)]	NTS Area	Location	Sum of Fractions of Compliance Levels (CLs)
^{241}Am, ^{238}Pu, $^{239+240}$Pu, ^{3}H	6	Yucca	0.012
	10	Gate 700 S	0.013
	16	3545 Substation	0.004
	20	Schooner	0.23[(b)]
	23	Mercury	0.002
	25	Gate 510	0.004

(a) $^{233+234}$U, $^{235+236}$U, and ^{238}U are not included in sum of percents. All or nearly all uranium detected in air particulate samples was determined to be naturally-occurring, based on the isotopic ratios.
(b) This equates to a hypothetical receptor at this location receiving a CEDE of 2.3 mrem/yr.

3.1.6 Air Sampling Results from Point-Source (Stack) Sampler

The 2005 air samples from the stack sampler at the JASPER facility contained no man-made radionuclides above their MDCs (see Tables 3-2 through 3-5). The HEPA filters at the facility appeared to function as intended; therefore, no radionuclide emission rate or offsite dose was calculated for this potential NTS radiation source (see Section 8.0).

3.1.7 Emission Evaluations for Planned Projects

In 2005, several planned projects were evaluated to determine if they have the potential to release airborne radionuclides which would expose the public to a dose greater than 0.1 mrem/yr (0.001 mSv/yr). For any project or facility with this potential, the EPA requires point-source operational monitoring like that conducted at the JASPER facility. These projects are listed below. Evaluations were performed using the EPA-approved atmospheric diffusion model called the Clean Air Package 1988, Versions 2.0 or 3.0 (CAP88-PC). CAP88-PC computes the CEDE (see Glossary, Appendix B) for an offsite maximally exposed individual (MEI) from air emissions, in mrem/yr. The CEDE to the MEI for all these projects were well below the limit of 0.1 mrem/yr. The detailed air emission dose evaluations for each project are presented in Grossman (2006).

- Use of special nuclear materials at the Radiological/Nuclear Countermeasures Test and Evaluation Complex under construction in Area 6
- Removal of approximately 12,600 m^3 of soil from the CLEAN SLATE II site at the Tonopah Test Range
- Demolition of a radiation shield wall at the Area 25 Test Cell A facility
- Release of radioactive material at the Area 25 MX Race Track (project is now scheduled for 2006 in Area 14)
- Removal and burial at the NTS of several cubic meters of soil near the Engine Maintenance, Assembly, and Disassembly facility in Area 25 which contains ^{90}Sr, ^{137}Cs, ^{234}U, and ^{235}U
- Series of experiments by the Dense Plasma Focus project in Area 11, Building 11-103
- Installation and use of a down-draft table in Building 6-353 at the Area 6 Device Assembly Facility (DAF) for the assembly of diagnostic packages containing $^{239+240}$Pu

3.1.8 Unplanned Releases

During June 2005, 31 wild fires were started by lightning strikes on the NTS in portions of Areas 14, 25, 27, 29, and 30 (BN, 2006c). High-volume air samplers were deployed at appropriate areas to supplement the routine air sampling network. No man-made radionuclides were detected in any of the air samples above concentrations normally observed. These fires did not occur in areas with the highest concentrations of legacy radioactivity in soil. An evaluation was performed to estimate the onsite and offsite radiation doses that could occur if the fires spread into an area of high surface contamination, such as the SMOKY site in Area 8. The estimated radiation dose 4 kilometers (km) (2.5 miles [mi]) downwind of the SMOKY site would be 1 mrem, and the highest offsite dose would only be about 0.1 mrem at 40 km (24.8 mi) from the SMOKY site. This finding helps alleviate apprehensions that radioactivity released from wild fires on the NTS would result in hazards offsite.

3.1.9 Total NTS Radiological Atmospheric Releases

Each year, all existing operations and new construction projects and modifications to existing facilities involving the use of radioactive materials are reviewed to identify those operations that can result in airborne emissions of radioactivity. The following are measured or calculated to obtain the total annual quantity of radiological atmospheric releases from the NTS:

- The quantity of tritium gas released during the calibration of laboratory equipment
- The quantity of tritium released through evaporation from containment ponds or open tanks, estimated from the measured tritium concentrations in water discharged into them and assuming that all water is completely evaporated during the year

- The quantity of tritium released from the Area 3 and Area 5 RWMSs and from Schooner and Sedan crater sites, estimated using: (1) the EPA-approved atmospheric diffusion model called CAP88-PC, and (2) the annual mean concentration of tritium in air measured by environmental air samplers at locations near these sources
- The quantity of other radionuclides resuspended in air from areas of known soil contamination, calculated from an inventory of radionuclides in surface soil determined by the Radionuclide Inventory and Distribution Program (McArthur, 1991), a re-suspension model (Nuclear Regulatory Commission [NRC], 1983), and equation parameters derived at the NTS (DOE, 1992)

Emission sources identified in 2005 were:

- The release of tritium during the calibration of equipment at Building 650, Area 23
- The evaporation of tritiated water discharged from E Tunnel and a post-shot well (U-20n PS #1DD-H)
- The evaporation of tritiated water removed from the basement of Building A-1 at the North Las Vegas Facility and transported to the NTS for disposal in the Area 5 Sewage Lagoon
- The evaporation and transpiration of tritiated water from soil and vegetation, respectively, at sites of past nuclear tests and from the Area 3 and Area 5 RWMSs
- The re-suspension of surface soil contaminated by past nuclear testing at NTS

Table 3-13 presents the radionuclide emission rates (in Ci/yr) at these identified source locations. Brief descriptions of the methods used for estimating these quantities are given in the table footnotes. More detailed descriptions are reported in Grossman (2006). In the last row of the table, the total amounts of ^{241}Am and $^{239+240}$Pu emissions from soil re-suspension are presented. They are the sum of emission rates computed for each area of the NTS with surface contamination (Areas 1-11, 12, 13, 15, 16, 17, 18, 19, 20, and 30). Other radionuclides (^{60}Cs, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{155}Eu, and ^{238}Pu), although found in surface soils during past radiation surveys, were not included since combined, they contributed only ten percent or less to the total MEI dose.

Table 3-13. Radiological atmospheric releases from NTS for 2005

Source	Radionuclide	Emission Rate (Ci/yr)
Area 23 Building 650	^{3}H	0.000014[(a)]
Area 12 E Tunnel Ponds	^{3}H	17[(b)]
Well U-20n PS #1DD-H	^{3}H	3.5[(b)]
Area 5 Sewage Lagoon	^{3}H	0.00037[(b)]
Area 3 RWMS	^{3}H	57[(c)]
Area 5 RWMS	^{3}H	8.9[(c)]
Area 10 Sedan	^{3}H	45[(c)]
Area 20 Schooner	^{3}H	40[(c)]
All Sources Total	**^{3}H**	**170**
Grouped NTS Areas Total	**^{241}Am**	**0.047[(d)]**
Grouped NTS Areas Total	**$^{239+240}$Pu**	**0.29[(d)]**

(a) Quantity of tritium gas released during the calibration of laboratory equipment.
(b) Estimated from ^{3}H concentration in water discharged into containment ponds or open tanks, assuming all water completely evaporated.
(c) Estimated from calculations with CAP88-PC and annual mean concentration of ^{3}H in air measured by air sampling at a location near the emission source.
(d) Calculated from inventory of radionuclides in surface soil determined by Radionuclide Inventory and Distribution Program (McArthur, 1991), a re-suspension model (NRC, 1983), and equation parameters derived at the NTS (DOE, 1992).

3.1.10 Environmental Impact

The concentrations of man-made radionuclides in air on the NTS were all less than the regulatory concentration limits specified by federal regulations. Long-term trends of $^{239+240}$Pu and tritium in air continue to show a decline with time. Nearly all radionuclides detected by environmental air samplers in 2005 appear to be from legacy deposits of radioactivity on and in the soil from past nuclear tests. There was no significant contribution to radioactive air emissions from NTS operational facilities in 2005.

3.2 Non-Radiological Air Quality Assessment

Non-radiological air quality assessments[1] are conducted to document compliance with current state of Nevada air quality permits that regulate specific operations or facilities on the NTS. The state of Nevada has adopted the CAA standards which include NESHAP, National Ambient Air Quality Standards (NAAQS), and New Source Performance Standards (NSPS) (see Section 2.1). Therefore, requirements set forth in the NTS air permit issued by the state are also in compliance with these national standards. Specifically omitted from this section is NESHAP compliance for radionuclide emissions, which is presented in Section 3.1. In 2005, assessments, facility/equipment monitoring, record-keeping, and reporting activities related to air quality on the NTS were conducted by BN ES personnel to meet the program goals shown in the table below. BN ES personnel collected and tracked the compliance measures shown in the table below.

Air Quality Assessment Program Goals	Compliance Measures
Ensure that NTS operations comply with all the requirements of current air quality permits issued by the state of Nevada for NTS operations. Ensure that air emissions of criteria pollutants (sulfur dioxide [SO_2]), nitrogen oxides[NO_x], carbon monoxide [CO], volatile organic compounds ([VOCs], and particulate matter do not exceed limits established under NAAQS. Ensure that NTS operations comply with the asbestos abatement reporting requirements under NESHAP. Document usage of ozone-depleting substances (ODS) to comply with Title VI of the CAA.	Tons of emissions of criteria pollutants produced annually Gallons of fuel burned annually Hours of operation of equipment per year Rate at which aggregate and concrete is produced Quarterly opacity readings Pounds of chemicals released from Non-Proliferation Test and Evaluation Complex (NPTEC) facilities Amount of asbestos in existing structures removed or scheduled for removal

There is one current NTS air quality permit, which is listed below along with the NTS facilities it regulates.

NTS Class II Air Quality Operating Permit AP9711-0549.01

- Over 30 facilities/pieces of equipment in Areas 1, 3, 5, 6, 12, and 23
- NPTEC in Area 5
- Test Cell C Facility in Area 25
- Big Explosives Experimental Facility
- Explosives Ordnance Disposal Unit

In June 2004, a Class II/Temporary General Air Quality Operating Permit was issued for the placement of a screening and crushing plant in Area 6 at the NTS. In August 2005, the screening and crushing plant was added to the NTS Class II Air Quality Operating Permit. The Class II/Temporary General Air Quality Operating Permit was then cancelled.

[1]The word "assessment" versus "monitoring" is used in this section. Adherence to most non-radiological air quality standards on the NTS does not require field collection and analysis of air samples (activities called "monitoring" in this report). Instead, adherence to NTS air quality permits for non-radiological emissions usually involves the review of records, gathering of operational information, visible emissions evaluations, and calculation of emissions.

Facilities regulated by the NTS Class II Air Quality Operating Permit must adhere to the recordkeeping and operational requirements specified in the permit. Compliance is verified by conducting periodic site walk-downs, observations of equipment while in operation, and a review of the records associated with each permitted facility. A description of the various activities performed or measures tracked in order to meet permit requirements and the results of 2005 air quality activities are described below.

3.2.1 Emissions of Criteria Air Pollutants and Hazardous Air Pollutants

Along with each air quality permit issued, there is an *Air Emissions Inventory* which lists all permitted facilities and equipment and the quantities of criteria pollutants (see Glossary, Appendix B) as well as Hazardous Air Pollutants (HAPs) that each facility/piece of equipment would emit annually if it were operated for the maximum number of hours specified in the air permit. These quantities are known as the "Potential to Emit" (PTE). Lead is considered a HAP as well as a criteria pollutant. Emissions from lead are reported as part of the total HAPs emissions rather than as a separate criteria pollutant. Compliance with permits involves documenting that the PTE for all facilities or equipment is not exceeded. Quantities of emissions of criteria pollutants and non-radiological HAPs produced by each permitted facility are determined through calculations that take into account the number of operating hours, emissions controls, number of gallons of fuel burned, number of tons of material that were produced, and emission factors. Emission factors are representative values that relate the quantity of a pollutant released to the atmosphere to an activity associated with the release of that pollutant. These factors are generally expressed as the weight of the pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant; e.g., pounds of particulates emitted per ton of aggregate material produced. Emission factors have been developed for many different types of industries and activities and are published by the EPA in a document titled *Compilation of Air Pollutant Emission Factors* (EPA, 1995). The emission factors that were used in the NTS air quality operating permits are derived from this source and from the state's listing of "default emission factors."

Each year, the state issues to NNSA/NSO *Actual Production/Emissions Reporting Forms* for the NTS air permit to NNSA/NSO. These forms are used to report the actual hours of operation, gallons of fuel burned, etc. for each permitted facility/piece of equipment. Using these data and emission factors furnished by the state, emissions of the criteria pollutants and HAPs are calculated and reported along with the other required information mentioned above. The forms wee completed by BN ES personnel and returned to NNSA/NSO for submittal to the state. The state uses the submitted information to determine annual maintenance and emissions fees and to document compliance with emission limits.

Unless specifically exempted, the open burning of any combustible refuse, waste, garbage, or oil; or for salvage operations, is prohibited. Open burning for other purposes, including personnel training, is allowed if approved in advance by the state (Nevada Administrative Code 445B.22067). Approval is denoted by the issuance of an Open Burn Variance prior to each burn. An exception to this is the Open Burn Variance issued to NNSA/NSO for fire extinguisher training at the NTS. This Open Burn Variance is renewed annually and requires 24-hour advance notification to the state prior to each burn. There are approximately 60 fire extinguisher training sessions conducted throughout the year. Quantities of criteria pollutants produced by open burns are not required to be calculated.

In 2005, examination of records for permitted facilities and equipment indicated that all operational parameters were being properly tracked. Table 3-14 presents the calculated tons of emissions of criteria pollutants from NTS facilities that were operational during 2005. The PTEs for each facility are shown in Table 3-14 and were derived from the limits set forth in the NTS air quality permits. Approximately 3.66 tons (3.32 metric tons [mtons]) of criteria pollutants were emitted from NTS facilities and equipment during 2005. The majority of these emissions were VOCs from the NPTEC facilities.

Table 3-14. Tons of criteria air pollutant emissions released on the NTS in 2005

	Calculated Tons[(a)] of Emissions									
	Particulate Matter (PM10)[(b)]		Carbon Monoxide (CO)		Nitrogen Oxides (NOx)		Sulfur Dioxide (SO_2)		Volatile Organic Compounds (VOC)	
Facility	**Actual**	**PTE[(c)]**	**Actual**	**PTE**	**Actual**	**PTE**	**Actual**	**PTE**	**Actual**	**PTE**
Wet Aggregate Plant	0.37	6.14	NA[(d)]	NA	NA	NA	NA	NA	NA	NA
Area 1 Concrete Batch Plant	0.14	2.04	NA	NA	NA	NA	NA	NA	NA	NA
Cementing Equipment	0.28	18.54	NA	NA	NA	NA	NA	NA	NA	NA
Portable Cement Bins	0	3.06	NA	NA	NA	NA	NA	NA	NA	NA
Portable Screening/Crushing Plant	0.01	0.16	NA	NA	NA	NA	NA	NA	NA	NA
Incinerator (propane fired)	0	0.03	0	0	0	0.02	0	0	0	0
Diesel Fired Compressors	0	0.54	0	1.66	0	7.72	0	0.51	0	0.61
Diesel Fired Generators	0.04	3.34	0.15	10.24	0.69	17.87	0.04	3.13	0.05	2.16
Laboratory Hoods	NA	NA	NA	NA	NA	NA	NA	NA	0	2.0
Bulk Gasoline Storage Tank	NA	NA	NA	NA	NA	NA	NA	NA	1.68	3.92
Bulk Diesel Fuel Storage Tank	NA	NA	NA	NA	NA	NA	NA	NA	0.02	0.02
NPTEC Facilities	0	3.00	0	3.26	0	3.02	0	3.00	0.19	10
Area 1 Miscellaneous Conveyors	0	0.21	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total by Pollutant	**0.84**	**36.90**	**0.15**	**15.16**	**0.69**	**28.63**	**0.04**	**6.64**	**1.94**	**18.71**
Total Emissions	**3.66 Actual, 106.04 PTE**									

(a) For mtons, multiply tons by 0.9072

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

(c) Potential to Emit - the quantity of criteria pollutant that each facility/piece of equipment would emit annually if it were operated for the maximum number of hours at the maximum production rate specified in the air permit

(d) Not applicable because the permit does not regulate the emissions of this pollutant for this facility

Table 3-15 and Figure 3-11 show the tons of air pollutants released on the NTS since 1996. These numbers were derived from the Actual Production/Emissions Reporting Forms that are required to be submitted to the state annually. Prior to calendar year (CY) 2000, HAPS were not included in the Reporting Forms. HAPs are now reported for chemical releases and detonations; although HAPs are emitted from some other facilities and equipment, the quantities are negligible. Specific HAPs are not identified in the Reporting Forms. The quantity of HAPs released in 2005, as calculated in the Reporting Forms, was 0.05 tons (Table 3-15).

The *Calendar Year 2005 Actual Production/Emissions Reporting Form,* containing the calculated emission totals for 2005 was submitted to the Nevada Division of Environmental Protection (NDEP) on March 7, 2006.

Table 3-15. Criteria air pollutants and HAPS released on the NTS since 1996

	Total Emissions (tons/yr)[(a)]									
Pollutant	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Particulate Matter (PM10)[(b)]	2.89	1.67	1.11	1.7	1.46	2.05	3.61	2.39	0.94	0.84
Carbon Monoxide (CO)	0.04	5.28	1.85	1.87	2.76	4.84	4.6	1.79	0.24	0.15
Nitrogen Oxides (NO_x)	0.16	19.79	7.57	8.07	12.75	22.23	21.09	8.11	1.01	0.69
Sulfur Dioxide (SO_2)	0.3	0.85	0.37	0.42	0.98	1.68	1.62	0.76	0.12	0.04
Volatile Organic Compounds (VOC)	2.82	0.94	11.76	1.99	1.89	2.01	2.1	1.21	4.60	1.94
Hazardous Air Pollutants (HAPs)	NR	NR	NR	NR	0.01	0.03	0.01	0	0.41	0.05

(a) For mtons, multiply tons by 0.9072
(b) Particulate matter equal to or less than 10 microns in diameter
(c) Not reported

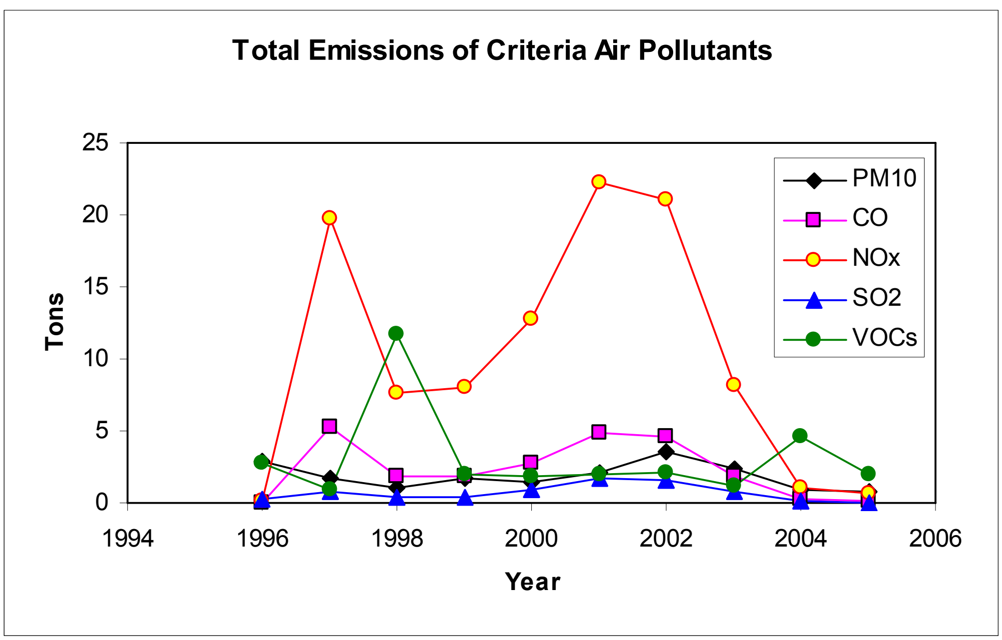

Figure 3-11. Criteria air pollutants released on the NTS since 1996

3.2.2 Performance Emission Testing and State Inspection

The NTS air permit requires performance emission testing of equipment that vents emissions through stacks (called "point sources"). The testing was a new requirement of the June 2004 renewed NTS air permit, and testing was initiated in June 2005. The tests must be conducted once during the five-year life of the NTS air permit for each specified source. Testing is conducted by inserting a probe into the stack while the equipment is operating to determine if the emissions are in compliance with the air permit limits. Visible emissions readings must also be conducted by a certified evaluator during the tests (see Section 3.2.4 for additional information). Three point source pieces of equipment failed the tests conducted in 2005 (Table 3-16). The Nevada Bureau of Air Pollution Control was notified of all equipment failures. The equipment was shut down and cannot be used again until it is repaired and retested.

On June 8, the state of Nevada conducted an inspection of the Area 1 Aggregate Plant and the Area 23 Incinerator, in part, to observe the performance emission testing of these point sources. During the inspection, the incinerator, which failed the testing, was immediately shut down. A feasibility study was conducted and it was determined that it was not cost efficient to have the incinerator repaired and retested. The existing incinerator will be taken off the NTS air permit. No other exceedances were observed during the state inspection.

Table 3-16. Emission performance testing in 2005

Month and Point Sources Tested	Results	Corrective Action
June 2005:		
Area 1 Aggregate Plant Baghouse	Passed	None required
Area 3 Portable Stemming Baghouse	Passed	None required
Area 23 Incinerator	Failed	Shut down, to be removed from air permit, may be replaced
Device Assembly Facility (DAF) generator (emission unit S2.107)	Passed	None required
DAF generator (emission unit S2.108)	Failed	Shut down, repaired, retested in March 2006, passed test
Area 6 dual-stack generator (emission unit S2.105)	Failed	Shut down, to be repaired, scheduled for retesting in April 2006
September 2005:		
Area 6 Cementing Services Baghouses	Passed	None required
Area 1 Batch Plant Baghouse	Passed	None required

3.2.3 Production Rates/Hours of Operation

Compliance with operational parameters such as production rates and hours of operation is verified through an examination of the data generated by each facility owner for the annual report to the state. The number of hours that equipment operates throughout a year is determined either by reading meters that are located on each piece of equipment or by recording the operating hours in a logbook each time the equipment is operated. Permit requirements specific to each piece of equipment dictate the frequency in which readings are obtained. Production rates for construction facilities such as the aggregate-producing plant are calculated using the hours of operation and amount of material produced. Logbooks are maintained to record this information. Gallons of fuel used are calculated preferably by recording tank levels each time that the tank is filled. If this is not possible, then calculations are performed by using industry standards and the hours of operation.

Production rates and hours of operation were computed for all permitted facilities in order to calculate the tons of air pollutants emitted in 2005, as shown in Table 3-15 above. The records examined for all permitted equipment and facilities indicated that the production rates, hours of operation, and gallons of fuel used by each were within the specified permit limits.

3.2.4 Opacity Readings

Under Title 40 CFR Part 60, personnel that conduct visible emissions evaluations to satisfy the opacity requirements for a facility or piece of equipment must be certified semi-annually by a qualified organization. A form similar to one appearing in Title 40 CFR Part 60 for conducting visible emissions evaluations is used to record and document the readings. The form requires that weather conditions, wind speeds, and other factors that could affect the readings be recorded. Visual readings are taken every 15 seconds. A minimum of 24 consecutive readings is required for a valid reading. The average of the 24 readings must not exceed the permit-specified limit (20 percent for NAAQS, 10 percent for NSPS) to remain in compliance. The NTS air quality operating permit requires that readings be obtained once each quarter that the equipment is used. This applies to construction equipment only. No readings are required to be recorded for other permitted equipment such as the generators, compressors, and boilers. However, in order to determine compliance with either the 10 or 20 percent opacity limit, which is imposed on all equipment except operations pertaining to detonations or chemical releases, visual readings are taken on occasion but not recorded.

During 2005, five BN personnel were certified by Carl Koontz Associates to conduct visible emissions evaluations (opacity readings). Opacity readings were obtained for the following NTS permitted facilities regulated under the NAAQS opacity limit of 20 percent: Area 23 Incinerator, Area 1 Concrete Batch Plant, Area 1 Wet Aggregate Plant, Area 6 Storage Silos, and the Portable Field Bins. Readings for these facilities ranged from 0 to 10 percent, all below the air quality permit limits of 20 percent. Readings were also obtained during performance emissions testing as a requirement of the NTS air quality operating permit for the facilities listed above as well as for the two Area 6 DAF diesel generators and an Area 6 dual-stack diesel generator. Readings for these facilities were below the 20 percent limit and ranged from 0 to 15 percent opacity.

Equipment on the NTS that is regulated by the stricter 10 percent opacity limit includes miscellaneous conveyor belts, screens and hoppers, and also the Area 1 pugmill. None of this equipment was operated during 2005, so no opacity readings were required.

3.2.5 NPTEC Reporting

The NTS air quality operating permit for both the Area 5 NPTEC and the Area 25 Test Cell C facility requires, in addition to annual reporting, the submittal of test plans and final analysis reports to the state for each chemical release. Test plans provide detailed information regarding the types and quantities of chemicals to be released, a description of how they will be released, and environmental and chemical hazards. The Area 5 NPTEC and Area 25 Test Cell C facilities, by their nature as research facilities, provide no air quality controls. The impact of the chemical releases at both facilities is minimized by controlling the amount and duration of each release. When chemical release tests are conducted, plumes pass through an instrument array and impacts are confined to a defined area. Predictions of impacts for each test are reliable because of extensive meteorological data that are available on wind direction, wind speed, standard deviation of wind direction, vertical turbulence, temperature, humidity, and barometric pressure. In turn, post-release monitoring is used to document the degree of actual impact. Following each release, a completion report is submitted that documents the test dates, chemicals, and quantities that were actually released.

In 2005, 3 chemical tests consisting of 19 releases were conducted at the Area 5 NPTEC and the Area 25 Test Cell C facility. They included:

- Side Car Project (3 releases at Area 5 NPTEC)
- Scorpion Project/Roadrunner IIIC (5 releases at Area 5 NPTEC, 2 releases at Area 25 Test Cell C facility)
- Shrike Project (9 releases at Area 5 NPTEC)

A completion report was submitted to NNSA/NSO for transmittal to NDEP's Bureau of Air Pollution Control at the conclusion of each test. Tables 3-17 and 3-18 summarize the total quantities of all chemicals released during tests in 2005.

Table 3-17. Chemicals released during tests conducted at the Area 5 NPTEC in 2005

Chemical	Total Amount Released (lbs)[a]
Dimethyl methylphosphonate	8.8
Ammonia	7
Carbon tetrachloride	75
Diethyl ethylphosphonate	15
Dimethyl methylphosphonate	6
Ethyl acetate	16.52
Freon 134A	6
Isobutene	5
Isopropanol	8
Isopropyl alcohol	29
Malathion	4.4
Methanol	26
Methyl acetate	8
Methyl salicylate	8
n-Butanol	5
Nitric oxide	28.54
Propylene	36
Sodium cyanide	40
Sulfur hexafluoride	71
Thionyl chloride	43.04
Triethyl phosphate	152

(a) 1 pound (lb) = 0.456 kilograms (kg)

Table 3-18. Chemicals released during tests conducted at the Area 25 Test Cell C facility in 2005

Chemical	Total Amount Released (lbs)[a]
Ammonia	3.2
Calcium hypochlorite	73.5

(a) 1lb = 0.456 kg

3.2.6 Tactical Demilitarization Development Project (TaDD) Reporting

The TaDD is located in Area 11 at the NTS. This facility was developed as a prototype of a portable burn facility to dispose of unneeded Shillelagh tactical military rocket motors. As such, TaDD was added to the NTS air quality operating permit because of the emissions generated during each burn. Emissions are controlled by a baghouse, HEPA, and ultra high-efficiency filters. Permit requirements include annual reporting of hours of operation and emissions and an opacity limit of 20 percent.

The TaDD facility has not been used due to lack of funding. It is listed in the renewed air permit with zero allowable operating hours and is expected to be removed from the air permit in 2006.

3.2.7 ODS Recordkeeping

ODS recordkeeping requirements applicable to NTS operations include maintaining, for a minimum of three years, evidence of technician certification, recycling/recovery equipment approval, and servicing records for appliances containing 22.7 kg (50 lbs) or more of refrigerant. Compliance with recordkeeping and certification requirements for the use and disposition of ODS is verified through periodic assessments. The assessments include a records review and interviews with managers and technicians associated with the use, disposition, and purchase of refrigerants. Under Section 608 of the CAA, EPA may conduct random inspections to determine compliance.

From an assessment conducted in CY 2002, it was determined that the regulatory requirements of Title VI (Section 608) of the CAA for the protection of stratospheric ozone were generally being met. No assessment was conducted in 2005. An ODS Management Plan was scheduled to be written in 2005 to develop and implement a program and procedures to maximize the use of safe alternatives to ODS due to their required phase-out. This plan has been rescheduled to be written in 2006.

3.2.8 Asbestos Abatement

A NESHAP notification is submitted annually to the EPA for the next calendar year. This notification provides an estimate of the quantities of asbestos-containing materials that are expected to be removed from small projects: removal of less than 79.2 linear meters [260 linear feet] or less than 14.9 square meters (m^2) (160 square feet [ft^2]). These projections are submitted to EPA in an Annual Asbestos Abatement Notification Form. A Notification of Demolition and Renovation Form is also submitted to EPA at least 10 working days prior to the start of each project if either (1) no asbestos is present in a facility scheduled for demolition, or (2) if quantities of asbestos-containing materials to be removed are estimated to exceed 79.2 linear meters or 14.9 m^2. The recordkeeping requirements for asbestos abatement activities on the NTS include maintaining the following records for the following number of years:

- Asbestos air and bulk sampling data records (collected during asbestos removal projects) up to 75 years
- Asbestos abatement plans up to 25 years
- Operations and Maintenance activity records up to 75 years
- Location-specific records of asbestos-containing materials for a minimum of 75 years

Compliance with recordkeeping requirements is verified through periodic internal assessments. The assessments include a records review and interviews with managers and technicians associated with asbestos abatement. NNSA/DOE informal reviews are performed periodically.

An Annual Asbestos Abatement Notification Form was submitted to the EPA on November 30, 2004 which projected that 45.7 linear meters (150 linear feet) and 23.2 m^2 (250 ft^2) of asbestos-containing material would be removed from small projects from NTS facilities in 2005. However, there were two big asbestos abatement projects that arose: the A-1 Building renovation in Area 24 (North Las Vegas Complex) for which 2,600 ft^2 of asbestos-containing materials were removed, and Building 3113 (Test Cell A Facility) in Area 25 for which 5,000 linear feet of asbestos-containing materials were removed prior to demolition of that building. A Notification of Demolition and Renovation Form was submitted to EPA within 10 working days prior to the start of each project. The rest of the asbestos abatement activities throughout the NTS complex were minor in scope, involving the removal of amounts below the reporting threshold. Asbestos abatement records continued to be maintained as required.

3.2.9 Fugitive Dust Control

Section VII of the NTS Class II Air Quality Operating Permit, No. AP9711-0549.01, *Surface Area Disturbance Conditions* states that "Permittee may not cause or permit the construction, repair, demolition, or use of unpaved or untreated areas without first putting into effect an ongoing program using the best practical methods to prevent particulate matter from becoming airborne." Methods that are typically used to control fugitive dust include presoaking, using water sprays, using dust palliatives, gravelling or paving haul routes, revegetating, reducing vehicle speeds, and either covering stockpiles or watering them. At the NTS, the main method of dust control is the use of water sprays.

During 2005, BN personnel conducted several fugitive dust readings of operations throughout the NTS that included that U10c landfill, the Radiological/Nuclear Countermeasures Test and Evaluation Complex and the Area 5 RWMS. No excessive fugitive dust was noted.

3.2.10 Environmental Impact

In order to be considered a Class II or "minor" source of pollutants for air permitting purposes, a facility's annual emissions must not exceed 100 tons of any one criteria pollutant, or 10 tons of any one HAP, or 25 tons of any combination of HAPS. During 2005, NTS activities produced a total of only 3.66 tons of criteria pollutants and 0.05 tons of hazardous air pollutants (see Table 3-15). These small quantities had little, if any, impact to air quality on the NTS and at offsite locations. Emissions of pollutants for 2005 were significantly less than those generated during the heightened activity that occurred in the years prior to the nuclear weapons testing moratorium.

Impacts of the chemical releases during tests at the NPTEC are minimized by controlling the amount and duration of each release. Biological monitoring at the NPTEC is performed whenever there is a risk of significant exposure to downwind plants and animals from the planned tests (see Section 13.5). BN biologists review all chemical release test plans to determine the level of field monitoring needed for each test. To date, chemical releases at the NPTEC have used such small quantities (when dispersed into the air) that downwind test-specific monitoring has not been necessary. No measurable impacts to downwind plants or animals have been observed.

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4.0 Radiological and Non-Radiological Water Monitoring

This chapter presents radiological and non-radiological monitoring results for surface water and groundwater from on and off the Nevada Test Site (NTS). Surface water and groundwater includes natural springs, drinking water, non-potable groundwater, and water discharged into domestic and wastewater systems on the NTS. In 2005, several programs or projects were involved in water monitoring. These included: (1) routine radiological monitoring conducted by Bechtel Nevada (BN) Environmental Technical Services (ETS) under the *Routine Radiological Environmental Monitoring Plan* (RREMP) (U.S. Department of Energy [DOE], 2003b), (2) water quality assessments of permitted water systems conducted by BN Environmental Services (ES), and (3) water sampling and analysis conducted by the Underground Test Area (UGTA) Project. Water monitoring is conducted to comply with applicable state and federal regulations (see Section 2.2) as well as to address the concerns of stakeholders who reside within the vicinity of the NTS.

Section 4.1 presents the concentrations of radioactivity in water samples. These data are used to calculate radiological dose to the general public residing near the NTS via drinking water; these results are provided in Section 8.0 (Radiological Dose Assessment).

The Community Environmental Monitoring Program was established by the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) to independently monitor radionuclide contamination of offsite springs and water supply systems. This independent oversight program is managed by the Desert Research Institute (DRI). DRI's 2005 monitoring results for surface and groundwater are presented in Section 6.2.

Section 4.2 of this chapter presents the results of non-radiological monitoring of drinking water and domestic and industrial wastewaters on the NTS.

4.1 Radiological Surface Water and Groundwater Monitoring

There have been 828 underground nuclear tests conducted at the NTS. Approximately one third of these tests were detonated near or below the water table (DOE, 1996; DOE, 2000a). This legacy of nuclear testing has resulted in the contamination of groundwater in some areas. The Federal Facilities Agreement and Consent Order established Corrective Action Units (CAUs) that delineated and defined areas of concern for groundwater contamination on the NTS (DOE, 1996a). Figure 4-1 shows the locations of underground nuclear tests and areas of potential groundwater contamination. To safeguard the public's health and safety and comply with applicable federal, state, and local environmental protection regulations as well as DOE directives, groundwater on and near the NTS is monitored for radioactivity. Monitoring in the past was conducted by the U.S. Public Health Service, U.S. Geological Survey, the U.S. Environmental Protection Agency (EPA), and others. In 1998, BN was tasked by NNSA/NSO to establish and manage an NTS integrated and comprehensive radiological environmental monitoring program. The RREMP (DOE, 2003b) describes groundwater monitoring objectives, regulatory drivers, and quality assurance protocols.

The purpose of radiological water monitoring is to determine whether concentrations of radionuclides in groundwater and surface water bodies at the NTS and its vicinity pose a threat to public health or the environment. Toward this end, the monitoring program collects and analyses water samples to meet the goals shown below.

In addition to RREMP-driven monitoring, the UGTA Project (see Section 14.0) collects data from wells to define groundwater flow rates and directions to determine the nature and location of aquifers. Data from these studies are used to determine whether radionuclides from nuclear testing have moved appreciable distances from original test locations. Groundwater sampling and radiological analysis results for 2005 from UGTA wells are presented in Section 4.1.11 of this chapter.

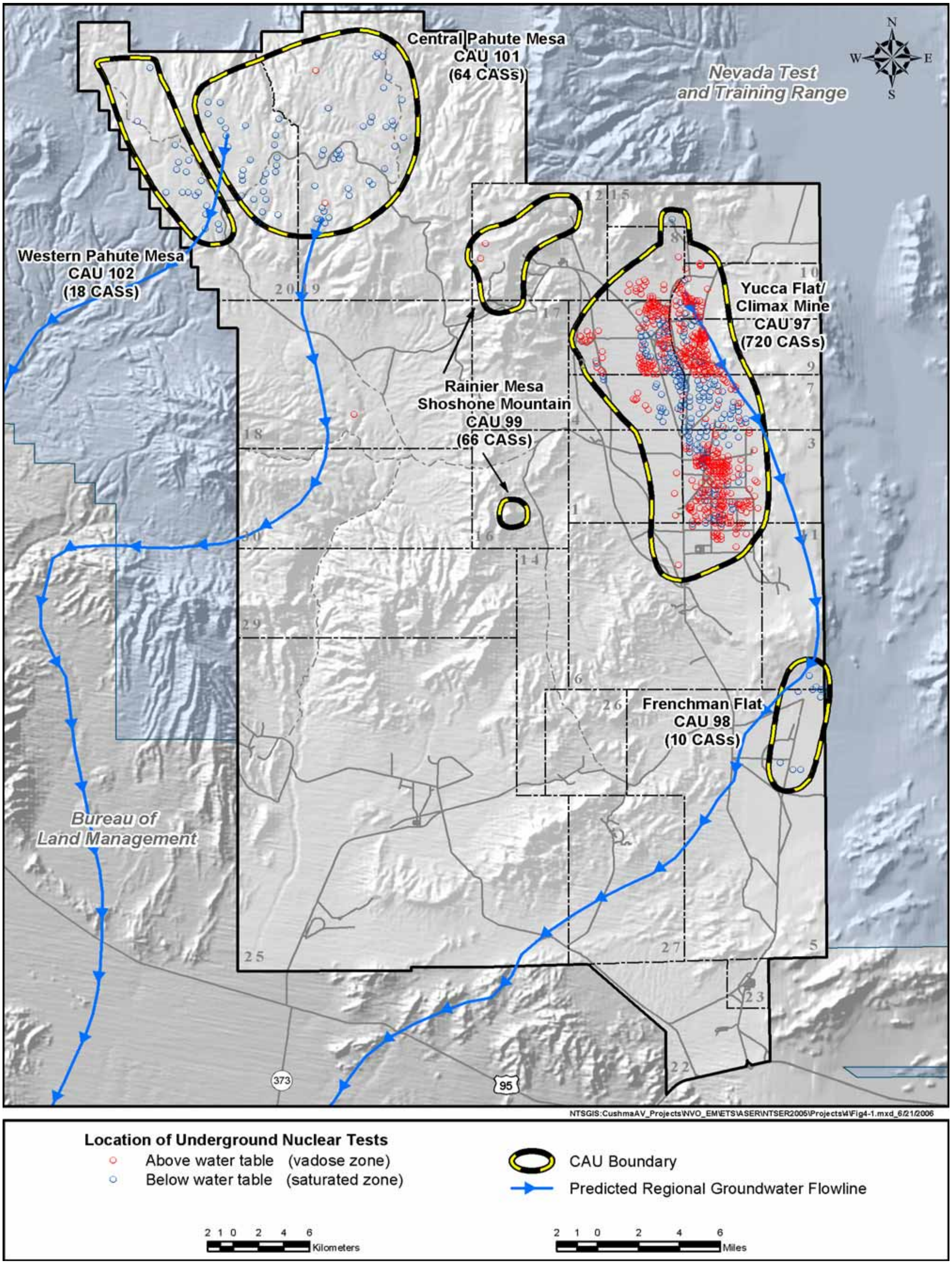

Figure 4-1. Areas of potential groundwater contamination on the NTS

Radiological Surface Water and Groundwater Monitoring Program Goals	Analytes Monitored
Determine if radionuclide concentrations of offsite and onsite water supply wells exceed the safe drinking water standards established by the EPA under the Safe Drinking Water Act or the dose limits to the general public set by DOE Order 5400.5.	Tritium (^{3}H) Gross alpha radioactivity
Determine if radionuclide concentrations in surface waters on the NTS expose terrestrial and aquatic animals to doses which exceed those set by DOE (DOE-STD-1153-2002) to protect wildlife populations.	Gross beta radioactivity Gamma-emitting radionuclides
Determine if permitted facilities on the NTS are in compliance with permit discharge limits for radionuclides.	Plutonium-238 (^{238}Pu) Plutonium-239+240 ($^{239+240}Pu$)
Determine if radionuclide concentrations in onsite and offsite natural springs and non-potable water wells (monitoring wells), including those within CAUs, indicate that NNSA/NSO activities have had an impact on the environment. Strict drinking water standards are often used as a monitoring action level for this determination.	Carbon-14 (^{14}C) Strontium-90 (^{90}Sr) Technetium-99 (^{99}Tc)

The selection of analytes for groundwater monitoring under the RREMP (DOE, 2003b) is based on the radiological source term from historical nuclear testing, regulatory/permit requirements, and characterization needs. The isotopic inventory remaining from nuclear testing is presented in the most recent environmental impact statement for NTS activities (DOE, 1996a) and in a recent Lawrence Livermore National Laboratory (LLNL) document (Smith, 2001). Many of the radioactive species generated from subsurface testing have very short half-lives, sorb strongly onto the solid phase, or are bound into what is termed "melt glass" and are not available for groundwater transport in the near term (Smith, 1993; Smith et al., 1995). Tritium (^{3}H) is the radioactive species created in the greatest quantities and is widely believed to be the most mobile. Tritium is therefore the primary target analyte; it represents the greatest concern to users of groundwater on and around the NTS for at least the next 100 years due to its high mobility and concentration (DOE, 1996a; International Technology Corporation, 1997).

Tritium analyses are done on all water samples. Analyses for gross alpha and gross beta radioactivity and gamma-emitting radionuclides are also conducted on all water samples as rapid screening measures. Gross alpha and gross beta radioactivity can include activity from both natural and man-made radionuclides, if any are present. Naturally-occurring deposits of certain minerals in water can contribute to both alpha radiation (e.g., isotopes of uranium and radium-226 [^{226}Ra]) and beta radiation (e.g., radium-228 [^{228}Ra] and potassium-40 [^{40}K]). The analyses for gamma-emitting radionuclides by gamma spectroscopy can identify the presence of specific man-made radionuclides (e.g., americium-241 [^{241}Am], cesium-137 [^{137}Cs], cobalt-60 [^{60}Co], and europium-152 and -154 [^{152}Eu and ^{154}Eu]) as well as natural radionuclides (e.g., actinium-228 [^{228}Ac], lead-212 [^{212}Pb], ^{40}K, uranium-235 [^{235}U], and thorium-234 [^{234}Th]). Specific analyses for ^{238}Pu, $^{239+240}Pu$, ^{14}C, ^{90}Sr, ^{99}Tc, ^{241}Am, and uranium isotopes are performed on selected water samples to help characterize sampled locations. Radium analyses were discontinued in 2005 because previous analyses indicate ^{226}Ra is not a major source of measured gross alpha activity and ^{228}Ra is not a major source of measured gross beta activity. Water analyses also include chemical parameters to characterize the groundwater chemistry and hydrology, but these measures are not presented in this report.

4.1.1 Water Monitoring Locations

The NTS groundwater and surface water monitoring network consists of a variety of locations that include onsite supply wells, domestic offsite wells, wells specifically designed to monitor groundwater, onsite and offsite natural springs, onsite containment ponds, and point-of-opportunity locations. The monitoring network is located in a complex hydrogeologic setting (see Attachment A, Site Description, included on the compact disc version of this report). The RREMP (DOE, 2003b) identifies a groundwater monitoring network of 78 wells to be sampled at frequencies ranging from once every three months to once every three years. Two of the wells, ASH-B Piezometer #1 and ASH-B Piezometer #2, are actually separate pieziometers within the same borehole. There are also nine additional wells (six offsite and three onsite) not identified in the RREMP which have been added to the network and which are sampled opportunistically or under the suggestion of NNSA/NSO. One additional offsite well, called Fuller, was sampled for the first time in 2005. Of all these 87 wells, 71 have been sampled at least once since 1999. These 71 include 32 offsite wells, 10 onsite potable water supply wells, and 29 onsite monitoring wells (Figure 4-2). Those wells not sampled since 1999, but identified in the RREMP, include 14 onsite monitoring wells and 1 offsite well that have not been sampled because they are either not accessible, are used for other purposes, are blocked, provide water samples that are of poor quality or are contaminated (disqualifying them from monitoring), or contain waters with known high levels of radiological contamination which are not expected to change.

In 2005, a network of 55 groundwater locations was sampled (Figure 4-2) and included:

- 27 offsite wells
- 10 onsite potable water supply wells (9 of which are permitted)
- 18 onsite monitoring wells (3 are compliance wells for the Area 5 Radioactive Waste Management Site and 1 was a compliance well for the Area 23 sewage lagoon)

The RREMP identifies seven offsite springs that have been sampled over the years at intervals which range from once a year to once every three years (Figure 4-3). Three onsite springs were opportunistically sampled in 2005. The RREMP also identifies one containment pond system and three sewage lagoons that are sampled at intervals of once every three months to once a year. Only two of the three sewage lagoons are currently active (Yucca and A23).

The surface water monitoring locations sampled in 2005 (Figure 4-3) included:

- 3 offsite springs
- 3 onsite springs
- 1 NTS operations-related containment pond system (E Tunnel ponds)
- 2 onsite sewage lagoons

Four UGTA Project wells were sampled and analyzed for radionuclides in 2005 and are briefly discussed in Section 4.1.11 below.

4.1.2 Water Sampling/Analysis Methods

Water sampling methods are based, in part, on the characteristics and configurations of the sample locations. For example, wells with dedicated pumps may be sampled from the associated plumbing (e.g., spigots) at the wellhead, while wells without pumps may be sampled via a wireline bailer or a portable pumping system. Grab samples are typically obtained from the springs.

Some of the monitoring program wells are constructed with multiple strings of casing/tubing or multiple completion zones comprised of discrete intervals of slotted casing which access different horizons of the penetrated hydrostratigraphic units. Multiple-depth samples were obtained from three wells with such configurations in 2005:

- 590, 622, 649, and 701 meters (m) (1,935, 2,040, 2,130, and 2,300 feet [ft]) below ground surface (bgs) in HTH #1
- 518 and 649 m (1,700 and 2,130 ft) bgs in UE-18r
- 475 and 608 m (1,560 and 1,994 ft) bgs in PM-3
- 826 and 1000 m (2,710 and 3,280 ft) bgs in ER-19-1
- 114 and 312 m (375 and 1025 ft) bgs in ASH-B (ASH-B Piezometer #2 and ASH-B Piezometer #1)

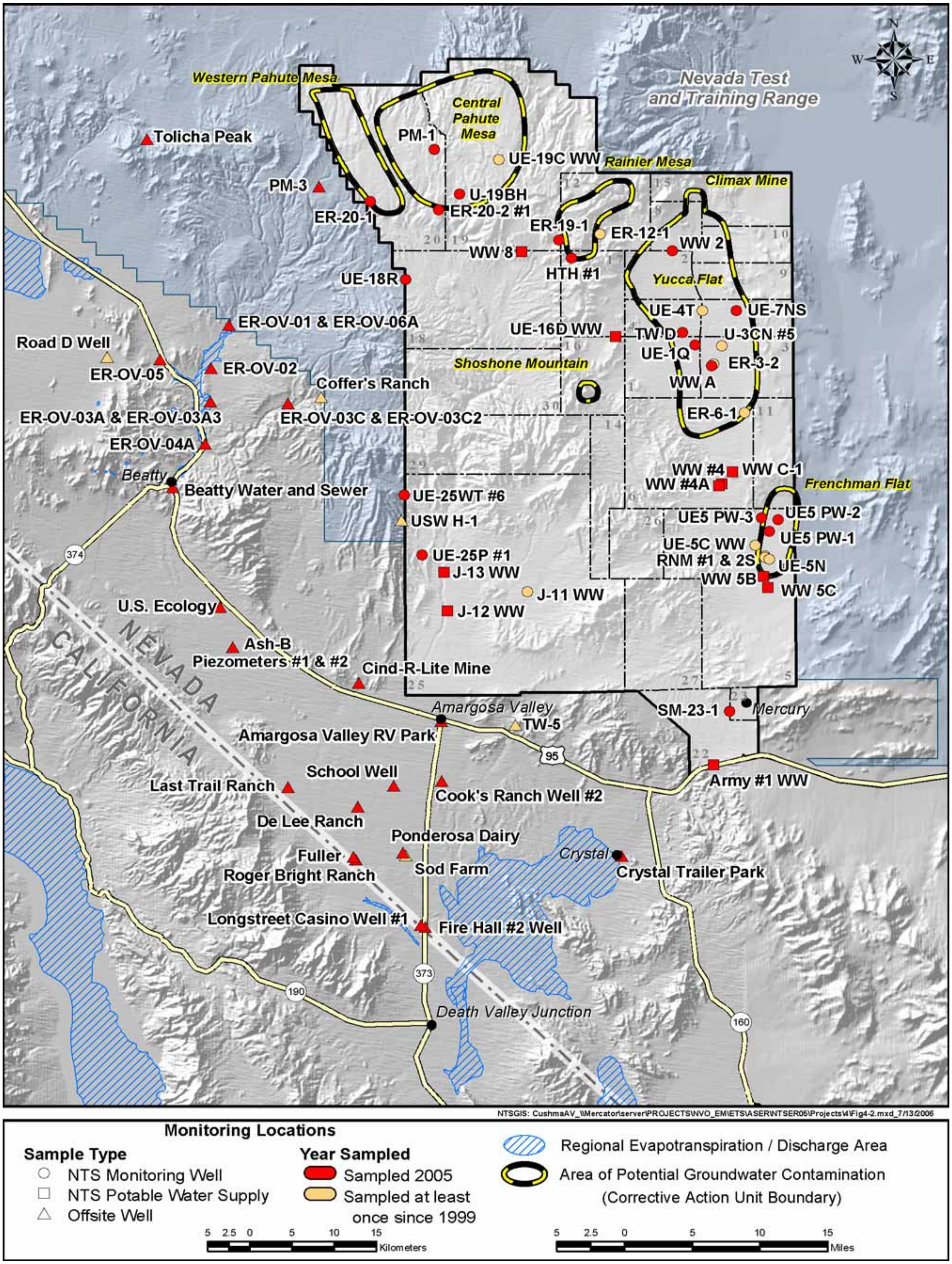

Figure 4-2. RREMP well monitoring locations sampled on and off the NTS in 2005

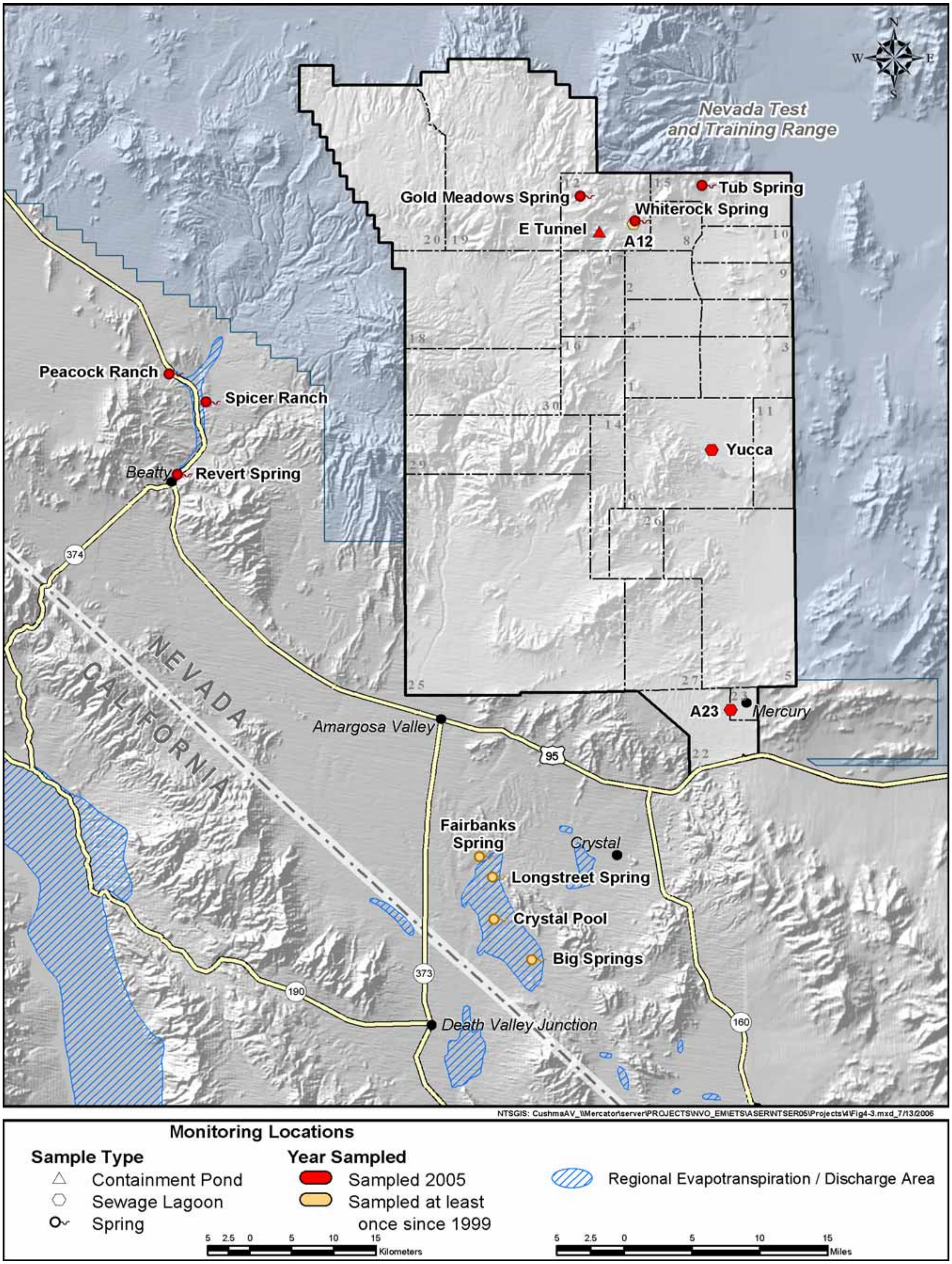

Figure 4-3. RREMP spring and surface water monitoring locations sampled on and off the NTS in 2005

Sampling frequencies and requisite analyses for routine radiological water monitoring are based on the location and type of the sampling point as defined in the RREMP (DOE, 2003b). During each monitoring year, not every water sample is analyzed for every analyte, per the design criteria of the RREMP. In 2005, tritium analyses were performed on all samples. Analyses for the other analytes listed were performed only on specific samples based on the probability of their detection at the sampled location or on whether they had been screened for previously at that location.

To achieve a sufficiently low detection limit, most tritium analyses were conducted after the samples underwent an enrichment process. The enrichment process concentrates tritium in a sample to provide an effective minimum detectable concentration (MDC) (see Glossary, Appendix B) for the sample-specific laboratory analysis. Sample-specific MDCs for laboratory analysis, reported in each results table, ranged from 13 to 35 picocuries per liter (pCi/L) with an average of 22.3 pCi/L. The MDC for standard (non-enriched) tritium analyses typically ranges from 200-400 pCi/L.

Routine quality control samples (e.g., duplicates, blanks, and spikes) are also incorporated into the analytical streams on a frequent basis. The reader is directed to Section 18.0 for a thorough discussion of quality assurance/quality control protocols and procedures utilized for radiological water monitoring.

4.1.3 Presentation of Water Sampling Data

The following sections present only concentrations that were above the MDC for gamma-emitting radionuclides, plutonium, ^{14}C, ^{90}Sr, and ^{99}Tc. Concentration values of gross alpha, gross beta, and tritium, whether they are below or above the sample-specific MDCs, are presented for all water samples in the data tables.

The uncertainty values presented in the data tables of this chapter represent the counting uncertainty ("error") of the analytical method. This does not include the uncertainty associated with sample collection or the preparation and concentration of tritium during the enrichment process. A statistical analysis of all background samples analyzed between 1999 and 2005 was conducted to obtain an estimate of the tritium decision level (L_C) (see Glossary, Appendix B). The background samples included those from wells with no known tritium. The analysis suggests an L_C for tritium of approximately 20 pCi/L. When measured tritium data from sample blanks analyzed during that period were added to the background well samples, the Lc increases curiously to 25 pCi/L. When only the sample blanks are retained in the analysis, the L_C increases to around 39 pCi/L. These analyses indicate that measured tritium levels in the blanks are higher than tritium levels in the well samples. In computing these L_C values, ETS requires there be 99 percent confidence that the sample contains tritium above background. Moreover, about 1 percent of the background data values were found to be atypical and were deleted from the computation; this suggests that sporadic anomalies may be an inherent feature of the tritium sampling, enrichment, and analysis process.

All values shown in the tables in the following results sections are formatted to two significant figures based on the accuracy of the measurements (e.g., 2500, 25, 2.5, or 0.025).

4.1.4 Results from Offsite Wells

The 27 offsite locations sampled in 2005 included 9 private domestic wells, 6 community wells, and 12 NNSA/NSO wells related to NTS activities. The 2005 data indicate that groundwater at the offsite locations has not been impacted by NTS nuclear testing operations.

All but two of the tritium levels in samples from offsite wells were less than the MDC. One duplicate sample from well ER-OV-03C2 was slightly above the sample-specific MDC, but its other duplicate sample collected on the same date was below its MDC (Table 4-1). A sample from well ER-OV-03A was also slightly above its sample-specific MDC for tritium (Table 4-1). Both of the results are between the background-sample-based L_C of 20 pCi/L and the L_C based on the background and the blank samples of 25 pCi/L.

Table 4-1. Gross alpha, gross beta, and tritium analysis results for offsite wells in 2005

Monitoring Location	Date Sampled	Gross α ± Uncertainty (MDC)[a] (pCi/L)[b]	Gross β ± Uncertainty (MDC) (pCi/L)[c]	^{3}H ± Uncertainty (MDC) (pCi/L)[d]
Amargosa Valley RV Park	9/27/2005	6.0 ± 2.9 (3.0)	13 ± 3.8 (6.9)	1.3 ± 14 (23)
Ash-B Piezometer #1	9/20/2005	0.30 ± 0.72 (1.6)	4.1 ± 1.4 (2.5)	17 ± 13 (20)
Ash-B Piezometer #2	9/20/2005	1.6 ± 1.2 (2.1)	5.5 ± 1.5 (2.5)	-1.1 ± 12 (20)
Ash-B Piezometer #2 FD[e]	9/20/2005	NA[f]	NA	16 ± 12 (20)
Ponderosa Dairy	9/27/2005	1.9 ± 1.2 (1.9)	8.2 ± 2.1 (3.6)	3.5 ± 14 (24)
Beatty Water And Sewer	9/27/2005	14 ± 4.4 (3.6)	10 ± 3.4 (6.1)	7.2 ± 14 (24)
Beatty Water And Sewer FD	9/27/2005	NA	NA	2.8 ± 15 (24)
Cind-R-Lite Mine	9/27/2005	5.9 ± 2.4 (2.1)	5.2 ± 2.5 (4.8)	2.5 ± 14 (24)
Cind-R-Lite Mine FD	9/27/2005	NA	NA	-2.3 ± 14 (24)
Cook'S Ranch Well #2	9/27/2005	5.1 ± 2.3 (3.6)	10 ± 2.5 (4.2)	6.5 ± 15 (24)
Crystal Trailer Park	9/27/2005	2.7 ± 1.6 (2.1)	7.3 ± 2.5 (4.4)	-8.4 ± 14 (24)
De Lee Ranch	9/27/2005	1.9 ± 1.1 (1.6)	5.8 ± 2.1 (3.6)	3.3 ± 14 (24)
De Lee Ranch FD	9/27/2005	1.6 ± 1.2 (2.2)	7.7 ± 2.2 (3.6)	
ER-OV-01	10/25/2005	9.2 ± 2.3 (1.9)	9.3 ± 1.7 (2.4)	5.4 ± 10 (17)
ER-OV-01 FD	10/25/2005	NA	NA	5.1 ± 12 (20)
ER-OV-02	3/29/2005	16 ± 2.9 (0.96)	6.0 ± 1.5 (1.7)	0.00 ± 15 (26)
ER-OV-02	9/19/2005	23 ± 2.9 (1.6)	13 ± 2.0 (2.7)	11 ± 12 (20)
ER-OV-02 FD	9/19/2005	24 ± 3.7 (1.5)	14 ± 2.6 (4.0)	NA
ER-OV-03A	9/19/2005	14 ± 2.2 (1.5)	8.3 ± 1.8 (2.6)	24 ± 12 (19)
ER-OV-03A3	9/19/2005	NA	NA	16 ± 13 (20)
ER-OV-03C	9/19/2005	9.0 ± 1.4 (0.89)	2.1 ± 0.91 (1.5)	9.9 ± 12 (20)
ER-OV-03C2	9/18/2005	7.9 ± 1.7 (2.0)	-0.37 ± 1.0 (1.9)	4.0 ± 12 (20)
ER-OV-03C2 FD	9/18/2005	NA	NA	24 ± 14 (21)
ER-OV-04A	3/29/2005	3.3 ± 1.3 (1.7)	7.2 ± 1.9 (2.7)	2.7 ± 15 (26)
ER-OV-04A	10/26/2005	5.2 ± 1.6 (2.1)	8.3 ± 1.6 (2.4)	4.1 ± 11 (18)
ER-OV-04A FD	10/26/2005	NA	NA	3.6 ± 11 (18)
ER-OV-05	10/26/2005	3.0 ± 1.2 (1.5)	10 ± 1.6 (2.1)	9.0 ± 11 (18)
ER-OV-05 FD	10/26/2005	2.7 ± 0.99 (0.85)	8.6 ± 1.4 (1.7)	NA
ER-OV-06A	10/25/2005	10 ± 2.1 (1.9)	7.3 ± 1.4 (2.2)	8.7 ± 11 (18)
ER-OV-06A FD	10/25/2005	8.9 ± 1.9 (1.4)	10 ± 1.6 (2.0)	NA
Fire Hall #2 Well	9/27/2005	1.0 ± 0.99 (1.8)	10 ± 1.8 (2.9)	-2.7 ± 14 (24)
Fire Hall #2 Well FD	9/27/2005	2.2 ± 1.4 (1.8)	13 ± 2.5 (3.7)	NA
Last Trail Ranch	9/27/2005	6.7 ± 3.0 (3.8)	14 ± 3.4 (5.5)	2.1 ± 14 (24)
Longstreet Casino Well #1	9/27/2005	2.2 ± 1.3 (1.5)	9.1 ± 1.9 (2.7)	0.38 ± 14 (23)
Fuller	9/27/2005	7.0 ± 3.3 (4.0)	15 ± 3.8 (6.1)	-5.4 ± 14 (24)
PM-3 (1560 ft bgs)	7/19/2005	6.0 ± 1.3 (0.90)	19 ± 3.4 (1.9)	9.3 ± 12 (20)
PM-3 (1560 ft bgs) FD	7/19/2005	4.0 ± 1.0 (0.84)	9.6 ± 2.1 (2.0)	NA
PM-3 (1994 ft bgs)	7/19/2005	2.9 ± 0.88 (0.90)	16 ± 2.8 (1.6)	10 ± 12 (21)
Roger Bright Ranch	9/27/2005	4.6 ± 2.1 (3.4)	17 ± 2.7 (4.1)	-7.9 ± 14 (24)
School Well	9/27/2005	2.6 ± 1.4 (1.9)	13 ± 2.5 (3.8)	4.5 ± 14 (24)
Tolicha Peak	12/12/2005	NA	NA	2.5 ± 15 (25)
Tolicha Peak FD	12/12/2005	NA	NA	-4.4 ± 10 (17)
U.S. Ecology	9/27/2005	7.3 ± 2.7 (3.3)	12 ± 2.6 (4.4)	7.6 ± 14 (24)
U.S. Ecology FD	9/27/2005	NA	NA	1.6 ± 14 (24)

Green-shaded results are considered detected (result is greater than the sample-specific MDC)

Yellow-shaded results are any which are equal to or greater than the EPA-designated levels shown below for each analyte:

(a) ±2 standard deviations

(b) The EPA-established MCL in drinking water for gross alpha (α) is 15 pCi/L

(c) The EPA "Level of Concern" in drinking water for gross beta (β) is 50 pCi/L

(d) The EPA-established MCL in drinking water for tritium (^{3}H) is 20,000 pCi/L

(e) FD = field duplicate sample

(f) NA = Specific analysis was not run on the sample

Gross alpha and gross beta radioactivity were detected in most offsite well samples in 2005 (Table 4-1). Well ER-OV-02 had gross alpha levels above 15 pCi/L, the EPA maximum contaminant level (MCL) in drinking water. Similar gross alpha levels have been measured previously in this well although the 2005 levels are approximately half the levels measured in 2004. This offsite monitoring well does not supply drinking water. It produces water from a volcanic aquifer that may have relatively higher quantities of natural alpha-yielding elements in the host rock. The gross alpha levels are attributed to the decay of naturally-occurring uranium and local variation in mineralogy due to hydrothermal alteration in the volcanic host rock. No man-made radionuclides were detected by gamma spectroscopy in any of the water samples from this well or from any other offsite wells.

Among the 27 offsite wells which have been sampled at least once since 1999, there are no detectable trends in gross alpha or gross beta activity (Figure 4-4) or in tritium concentrations (Figure 4-5) from 2000 to 2005. Most measured gross alpha and gross beta levels have been below the EPA MCL for drinking water, and most measured tritium concentrations have been below their MDCs.

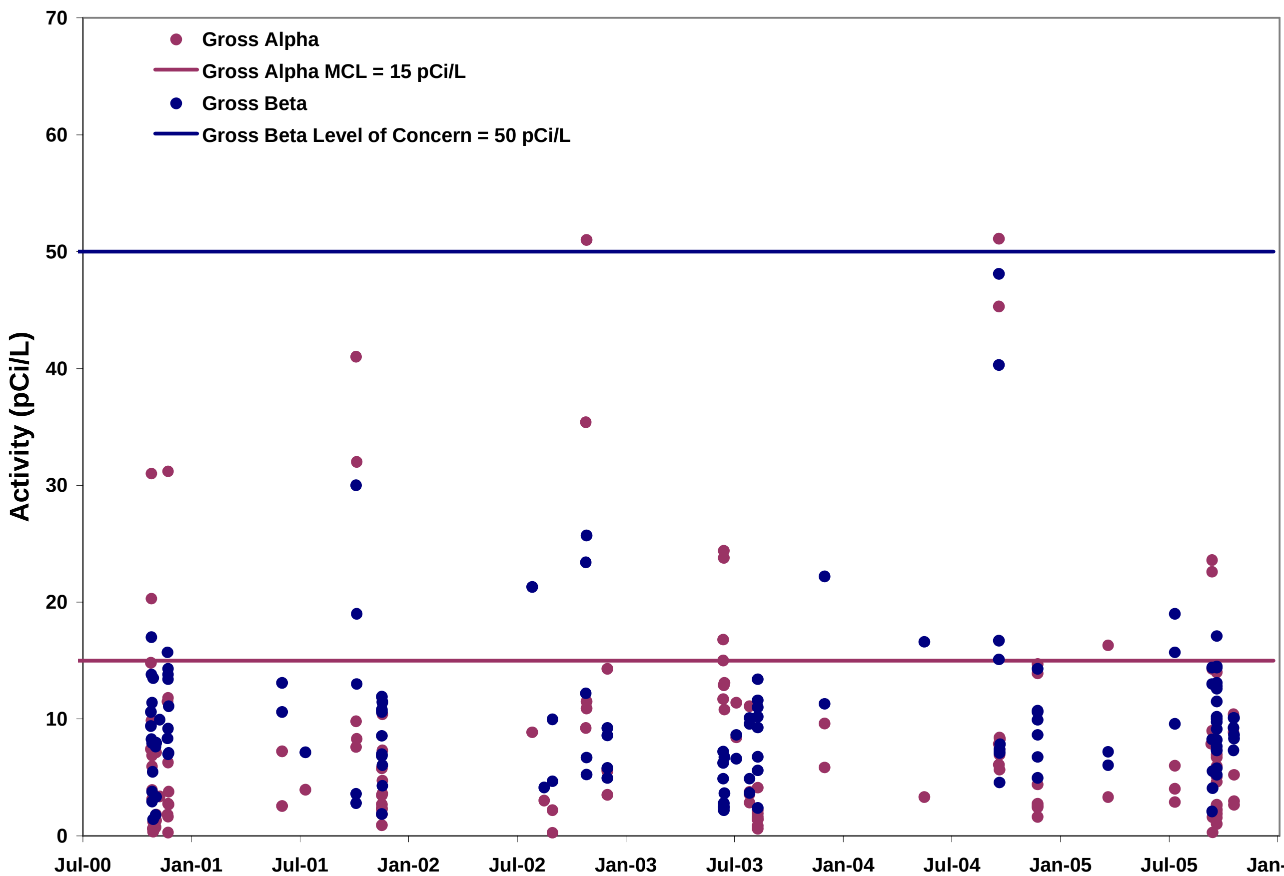

Figure 4-4. Gross alpha and gross beta levels in offsite wells from 2000 to 2005

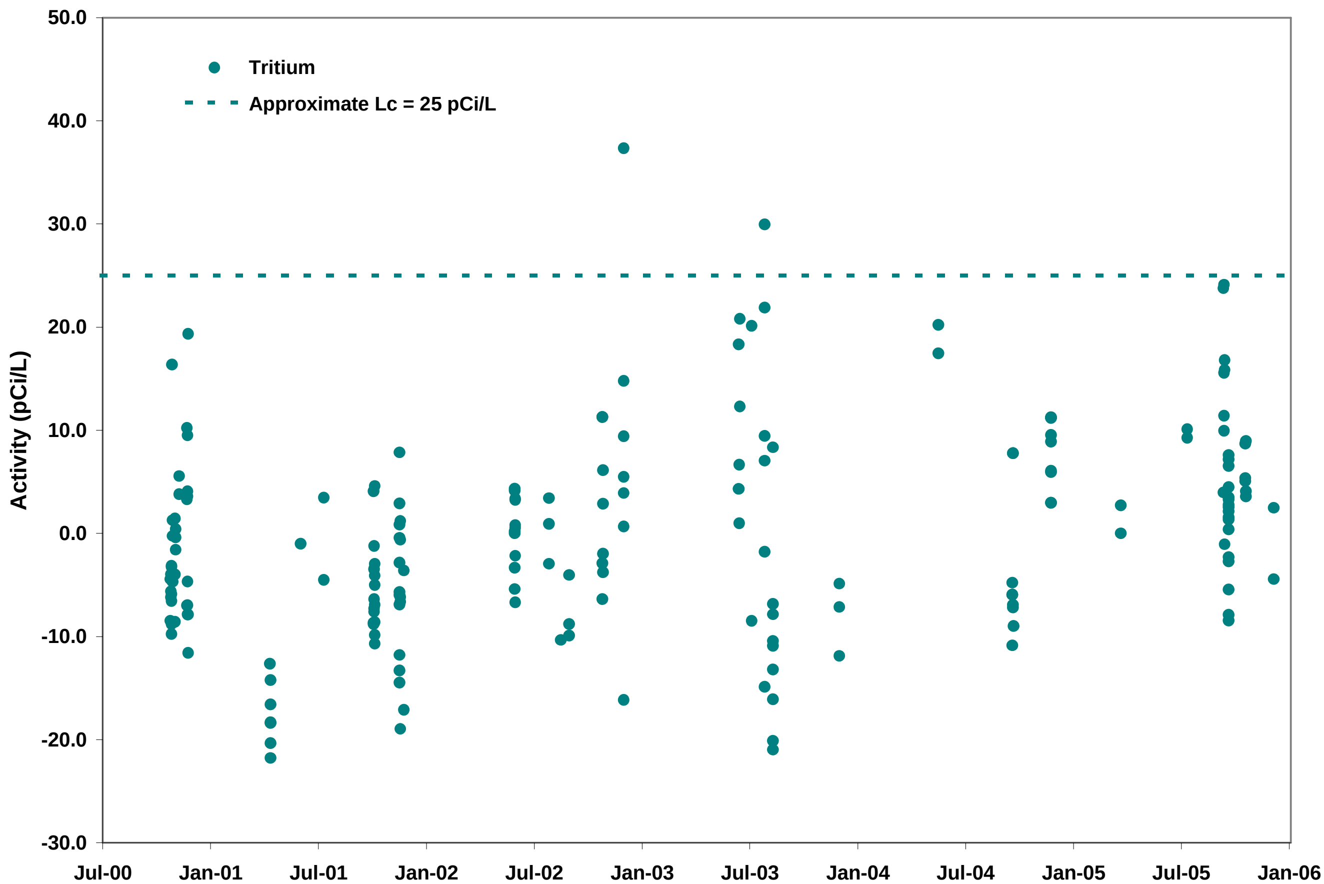

Figure 4-5. Tritium concentrations in offsite wells from 2000 to 2005

4.1.5 Results from Offsite Springs

Peacock Ranch Spring, Spicer Ranch Spring, and Revert Spring were sampled in 2005. All three springs are near Beatty, Nevada. Detectable concentrations of gross alpha and gross beta were present in water collected from the springs, although all concentrations are below the EPA MCL for drinking water (Table 4-2). The measurable gross alpha and gross beta radioactivity is likely from natural sources.

No detectable concentrations of tritium were found in any of the samples (Table 4-2). No analysis for man-made gamma-emitting radionuclides were performed in 2005.

Among the seven offsite springs that have been sampled at least once since 1999, there are no detectable trends in gross alpha or gross beta activity (Figure 4-6) or in tritium concentrations (Figure 4-7) from 2000 to 2005. Alpha and beta levels have all been below the EPA MCL for drinking water, and tritium concentrations have all been below the MDCs.

Table 4-2. Gross alpha, gross beta, and tritium analysis results for offsite springs in 2005

Monitoring Location	Date Sampled	Gross α ± Uncertainty (MDC)[a] (pCi/L)[b]	Gross β ± Uncertainty (MDC) (pCi/L)[c]	^{3}H ± Uncertainty (MDC) (pCi/L)[d]
Peacock Ranch	9/27/2005	5.2 ± 1.6 (2.3)	13 ± 1.9 (3.0)	-1.4 ± 14 (23)
Peacock Ranch FD [e]	9/27/2005	NA[f]	NA	-0.81 ± 14 (23)
Revert Spring	9/27/2005	10 ± 2.8 (2.3)	5.4 ± 2.5 (4.8)	0.61 ± 14 (23)
Spicer Ranch	9/27/2005	14 ± 3.0 (3.1)	7.6 ± 2.4 (4.4)	11 ± 14 (24)
Spicer Ranch FD	9/27/2005	11 ± 3.1 (2.9)	12 ± 2.9 (4.5)	NA

Green-shaded results are considered detected (result is greater than the sample-specific MDC)

(a) ±2 standard deviations

(b) The EPA-established MCL in drinking water for gross alpha (α) is 15 pCi/L

(c) The EPA "Level of Concern" in drinking water for gross beta (β) is 50 pCi/L

(d) The EPA-established MCL in drinking water for tritium (^{3}H) is 20,000 pCi/L

(e) FD = field duplicate sample

(f) NA = Specific analysis was not run on the sample

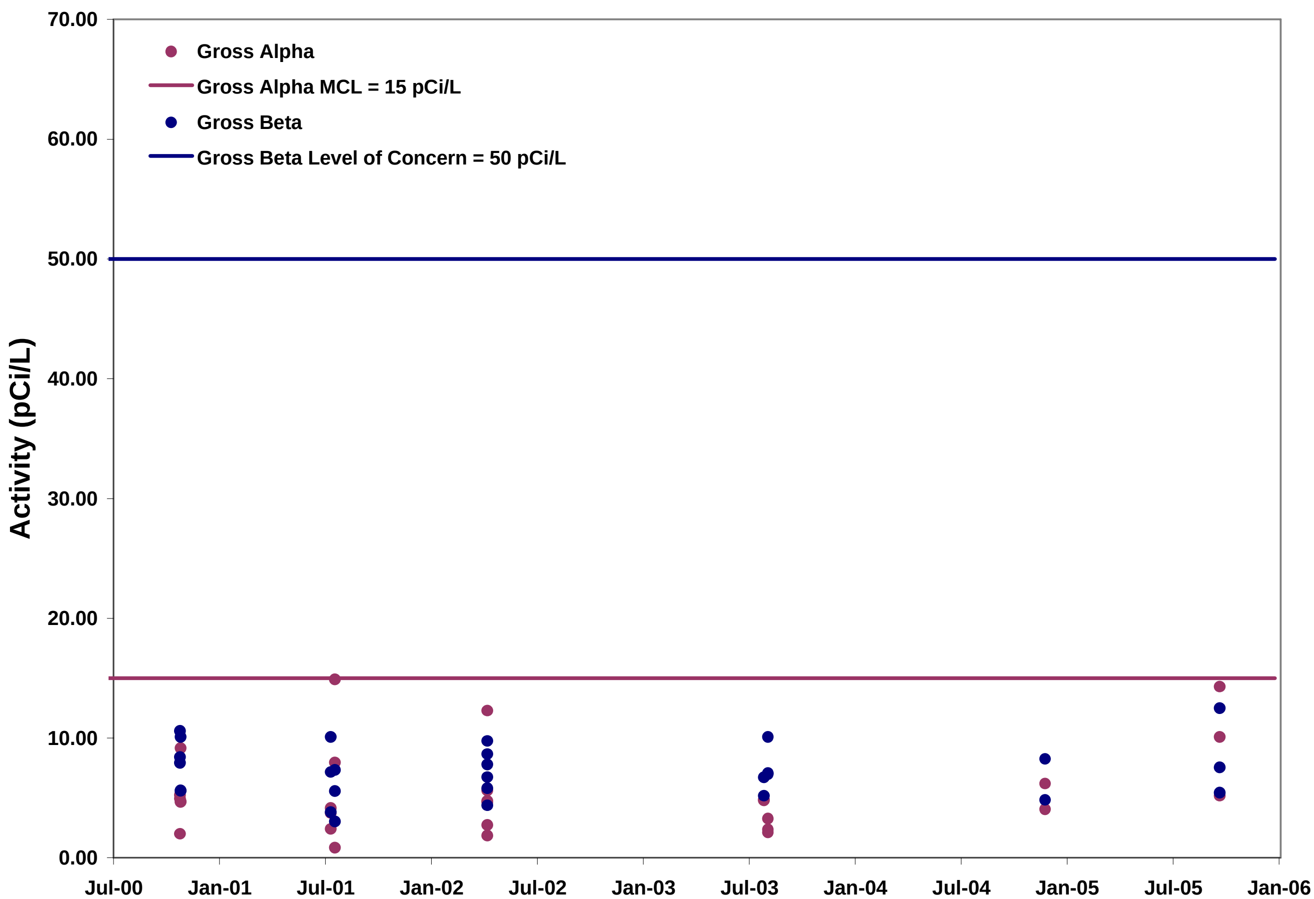

Figure 4-6. Gross alpha and gross beta levels in offsite springs from 2000 to 2005

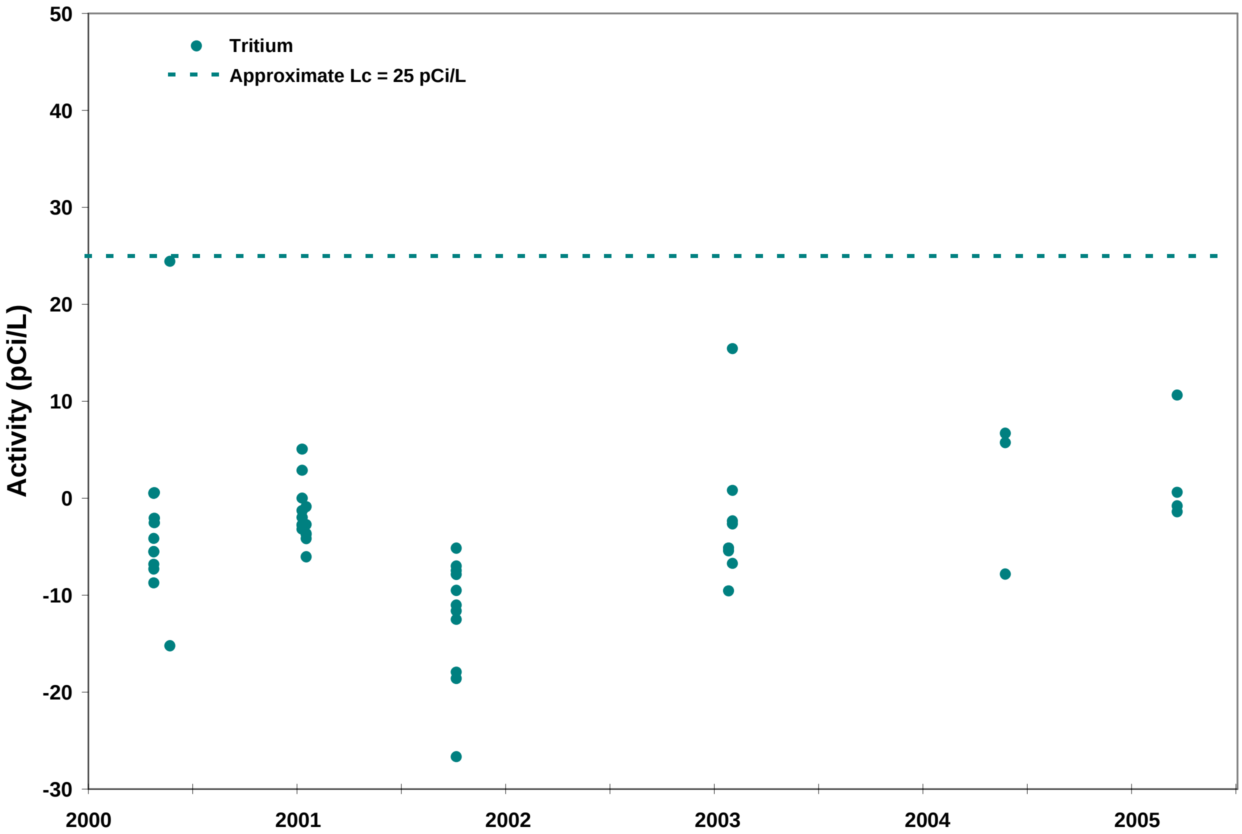

Figure 4-7. Tritium concentrations in offsite springs from 2000 to 2005

4.1.6 Results from NTS Potable Water Supply Wells

Results from the ten potable NTS water wells sampled in 2005 continue to indicate that nuclear testing has not impacted the NTS potable water supply network. All 2005 water samples from the supply wells had non-detectable concentrations of tritium.

Prior to 1994, WW C-1 (also known as Water Well C-1) had a history of validated tritium detections because this well was injected with approximately 0.1 to 0.2 curies of tritium in 1962 by a researcher conducting a tracer test (Lyles, 1990). Since 1995, tritium concentrations in WW C-1 have remained below their MDCs.

The radiological analytes that were principally detectable in 2005 in the potable water supply wells are gross alpha and gross beta radioactivity. This activity likely represents the presence of naturally-occurring radionuclides, since there was a general lack of corresponding detectable man-made radionuclides in the samples (Table 4-3). None of these detectable radiological analytes exceeded EPA-established Levels of Concern or the established MCLs for drinking water (Table 4-3).

No man-made gamma-emitting radionuclides were detected in the potable water supply well samples.

These ten NTS potable water supply wells have all been sampled routinely since 1999. No detectable trends in gross alpha or gross beta activity (Figure 4-8) or in tritium concentrations (Figure 4-9) have been found from 2000 to 2005.

The Nevada State Health Division, Bureau of Health Protection Services (BHPS) independently sampled all of the NTS potable water supply wells at least once during 2005 at the same time as BN ETS personnel collected samples. The state of Nevada sample results also indicate that man-made radionuclides are at or below MDC and that naturally-occurring radioactive materials, such as thorium and uranium decay chain radionuclides, are within normal ranges (BHPS, 2006a; 2006b; 2006c).

Table 4-3. Gross alpha, gross beta, and tritium analysis results for NTS potable water supply wells in 2005

Monitoring Location	Date Sampled	Gross α ± Uncertainty (MDC)[a] (pCi/L)[b]	Gross β ± Uncertainty (MDC) (pCi/L)[c]	^{3}H ± Uncertainty (MDC) (pCi/L)[d]
Army #1 WW	1/19/2005	2.1 ± 0.95 (1.2)	5.9 ± 1.6 (2.3)	-6.5 ± 12 (22)
	4/13/2005	4.8 ± 4.5 (6.8)	2.4 ± 1.6 (2.2)	5.3 ± 15 (26)
	7/13/2005	2.8 ± 0.89 (1.0)	6.0 ± 1.6 (2.1)	3.3 ± 12 (21)
	10/19/2005	0.3 ± 1.4 (2.5)	2.9 ± 0.76 (1.1)	-2.8 ± 7.5 (13)
	10/19/2005 FD[e]	NA[f]	NA	5.3 ± 10 (17)
J-12 WW	1/19/2005	0.57 ± 0.67 (1.3)	3.5 ± 1.4 (2.3)	-1.1 ± 12 (21)
	4/13/2005	-0.046 ± 1.7 (3.3)	3.9 ± 1.1 (1.2)	4.8 ± 14 (23)
	4/13/2005 FD	-2.9 ± 2.5 (3.7)	2.0 ± 0.91 (1.2)	5.0 ± 14 (24)
	7/13/2005	1.4 ± 0.43 (0.47)	5.0 ± 1.1 (1.1)	7.8 ± 11 (19)
	10/19/2005	1.1 ± 1.2 (2.0)	2.5 ± 0.67 (0.77)	1.6 ± 16 (27)
J-13 WW	1/19/2005	0.55 ± 0.67 (1.3)	3.4 ± 1.4 (2.4)	-0.88 ± 12 (22)
	1/19/2005 FD	0.54 ± 0.67 (1.4)	4.2 ± 1.5 (2.4)	-3.3 ± 12 (22)
	4/13/2005	2.8 ± 2.4 (3.5)	3.4 ± 1.1 (1.1)	4.5 ± 13 (22)
	7/13/2005	0.57 ± 0.32 (0.47)	4.1 ± 0.94 (1.1)	3.3 ± 11 (19)
	10/19/2005	0.98 ± 1.2 (1.9)	2.3 ± 0.43 (0.52)	-0.83 ± 10 (17)
UE-16D WW	1/18/2005	3.8 ± 0.89 (0.74)	7.0 ± 1.4 (1.2)	-1.9 ± 12 (20)
	4/12/2005	5.0 ± 4.5 (6.4)	7.0 ± 2.5 (2.9)	-5.7 ± 16 (28)
	7/12/2005	3.7 ± 1.1 1.2	6.6 ± 1.9 (2.5)	7.5 ± 14 (24)
	10/18/2005	3.9 ± 1.5 2.1	3.7 ± 0.71 (0.91)	2.4 ± 10 (17)
WW #4	1/18/2005	5.9 ± 1.6 1.2	4.9 ± 1.5 (2.3)	-7.8 ± 13 (24)
	1/18/2005 FD	5.6 ± 1.6 1.3	5.7 ± 1.7 (2.4)	1.9 ± 13 (24)
	4/12/2005	3.6 ± 4.1 (6.5)	4.3 ± 1.7 (2.1)	19 ± 16 (26)
	7/12/2005	3.4 ± 0.79 (0.62)	5.5 ± 1.2 (1.3)	7.7 ± 14 (24)
	10/18/2005	10 ± 1.9 1.7	4.5 ± 0.7 (0.67)	6.4 ± 10 (17)
WW #4A	1/18/2005	7.0 ± 1.9 1.2	5.2 ± 1.6 (2.4)	1.0 ± 12 (20)
	4/12/2005	2.9 ± 4.6 (7.7)	3.8 ± 1.4 (1.6)	11 ± 15 (26)
	7/12/2005	4.6 ± 0.93 (0.45)	4.0 ± 0.98 (1.2)	12 ± 14 (24)
	10/18/2005	2.5 ± 1.2 1.9	3.5 ± 0.49 (0.60)	-1.7 ± 10 (17)
WW 5B	1/18/2005	3.3 ± 1.3 1.3	12 ± 2.6 (2.7)	-6.3 ± 13 (24)
	4/12/2005	4.8 ± 3.8 (5.5)	5.9 ± 2.0 (2.3)	-8.0 ± 15 (26)
	4/12/2005 FD	6.7 ± 4.5 6.2	7.9 ± 1.8 (1.7)	0.00 ± 13 (23)
	7/12/2005	3.9 ± 0.91 (0.69)	12 ± 2.3 (1.5)	3.3 ± 12 (21)
	10/18/2005	-0.44 ± 1.5 (2.6)	6.0 ± 0.50 (0.51)	2.2 ± 10 (17)
WW 5C	1/18/2005	6.7 ± 1.3 (0.73)	5.8 ± 1.4 (1.5)	-7.5 ± 11 (20)
	4/12/2005	5.1 ± 5.5 (8.7)	5.2 ± 1.8 (2.0)	4.6 ± 13 (22)
	7/12/2005	6.3 ± 1.4 (0.95)	7.2 ± 1.7 (1.9)	6.5 ± 12 (21)
	7/12/2005 FD	NA	NA	6.7 ± 12 (21)
	10/18/2005	7.6 ± 1.8 2.2	3.7 ± 0.83 (1.1)	3.3 ± 10 (17)
WW 8	2/23/2005	0.27 ± 0.61 (1.3)	2.6 ± 1.3 (2.3)	-28 ± 19 (35)
	4/12/2005	0.35 ± 1.3 (2.5)	2.1 ± 0.94 (1.2)	-6.0 ± 17 (29)
	7/12/2005	0.82 ± 0.32 (0.41)	3.6 ± 0.88 (1.0)	0.00 ± 14 (24)
	7/12/2005 FD	NA	NA	-3.7 ± 13 (23)
	10/18/2005	-0.09 ± 0.95 (1.8)	2.2 ± 0.66 (0.82)	6.7 ± 10 (17)
WW C-1	1/18/2005	9.3 ± 1.9 (0.99)	13 ± 2.5 (2.1)	1.6 ± 12 (20)
	4/12/2005	6.7 ± 7.1 (11)	13 ± 3.7 (3.9)	-2.7 ± 15 (26)
	7/12/2005	10 ± 2.2 1.5	15 ± 3.2 (3.2)	0.00 ± 13 (24)

Green-shaded results are considered detected (result is greater than the sample-specific MDC)

(a) ±2 standard deviations

(b) The EPA-established MCL in drinking water for gross alpha (α) is 15 pCi/L

(c) The EPA "Level of Concern" in drinking water for gross beta (β) is 50 pCi/L

(d) The EPA-established MCL in drinking water for tritium (^{3}H) is 20,000 pCi/L

(e) FD = field duplicate sample

(f) NA = Specific analysis was not run on the sample

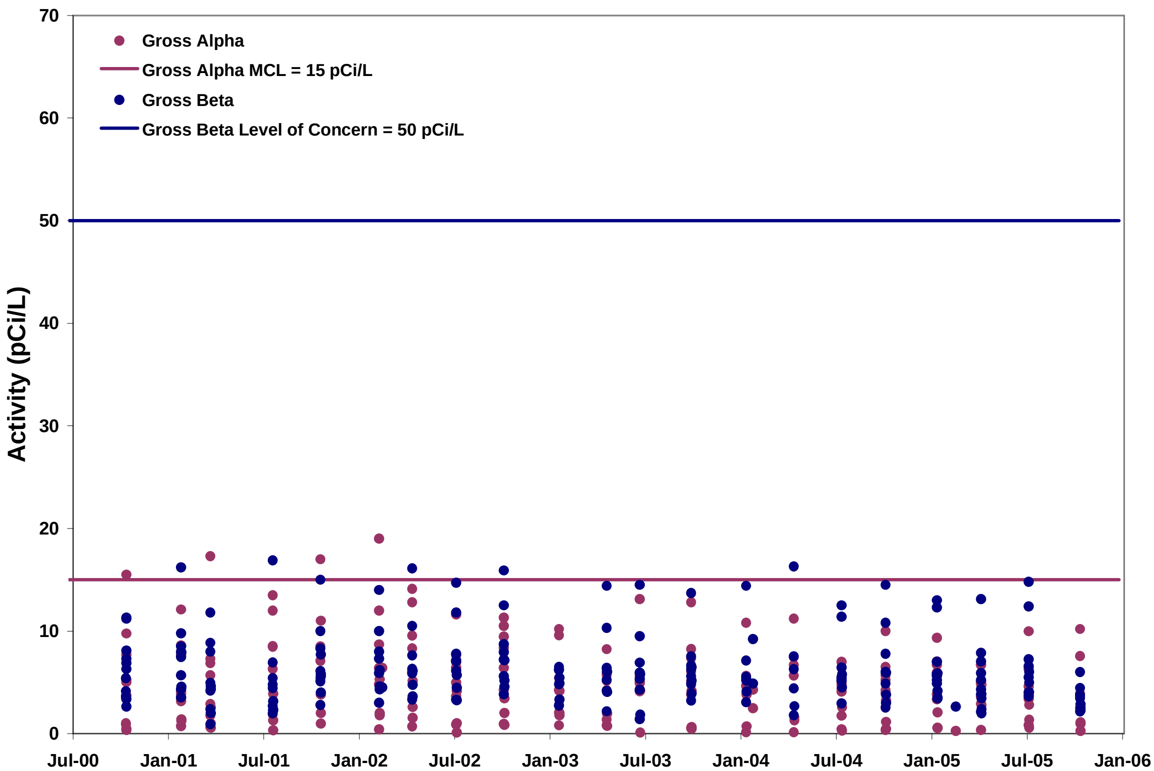

Figure 4-8. Gross alpha and gross beta levels in NTS potable water supply wells from 2000 to 2005

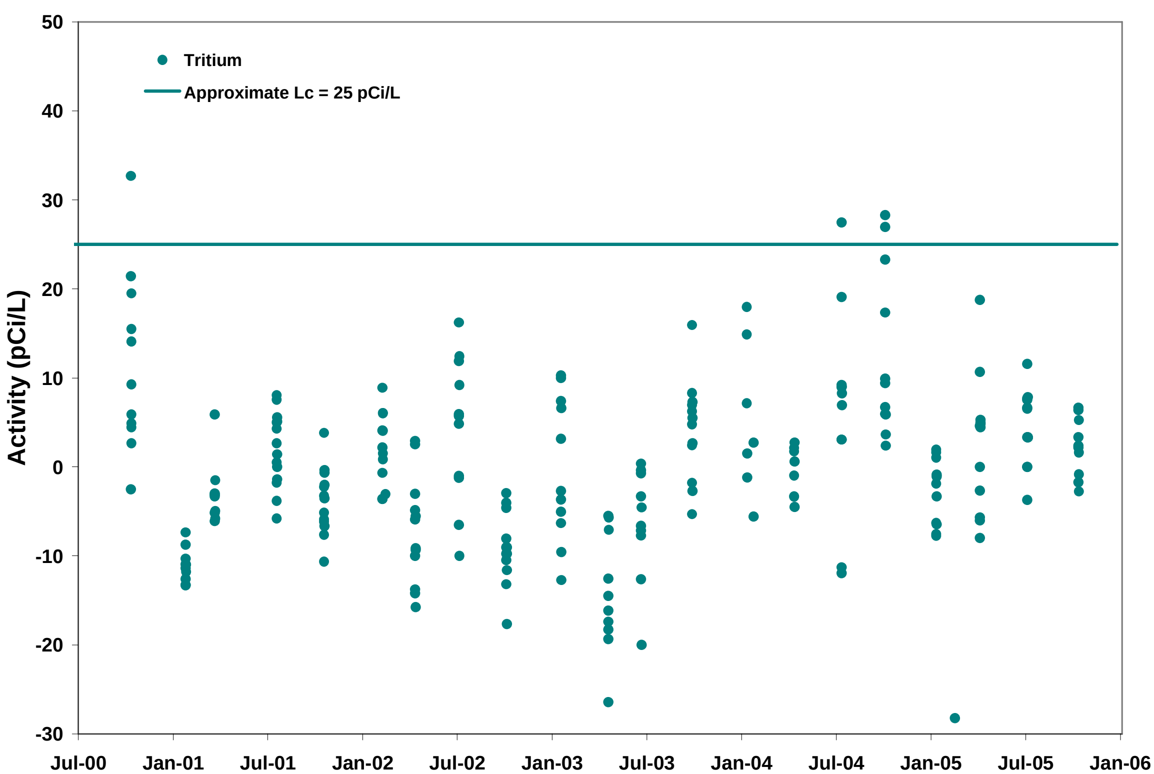

Figure 4-9. Tritium concentrations in NTS potable water supply wells from 2000 to 2005

4.1.7 Results from NTS Monitoring Wells

Analytical results from the network of onsite monitoring wells (see Figure 4-2) indicate that migration of radionuclides from the underground test areas is not significant. Four onsite monitoring wells (PM-1, U-19BH, UE-7NS, and WW A) are known to have detectable concentrations of tritium, although they are all well below the EPA MCL of 20,000 pCi/L (Table 4-4). Note that no tritium analysis was performed for UE-7NS in 2005. Each of these wells is located within 1 kilometer (km) (0.6 miles [mi]) of a historical underground nuclear test. These wells are discussed below, and their historic tritium concentrations are shown in Figure 4-10.

There were also measured tritium levels above the MDC from two other monitoring wells. The duplicate sample from ER-19-1 at 826 m (2,710 ft) bgs had a tritium level above the MDC but the grab sample collected at the same time had a measured tritium level below the MDC. The measured tritium level at UE-25P #1 is very slightly above the MDC but well below the measured tritium levels in the four wells with detectable tritium levels. This low tritium level is probably not significant (Table 4-4).

Tritium was not detectable in other samples from onsite monitoring wells during 2005 (Table 4-4).

Well PM-1 – This well is located in the Central Pahute Mesa CAU. It is constructed with unslotted casing from the surface to 2,300 m (7,546 ft) bgs and is an open hole from 2,300 to 2,356 m (7,546 to 7,730 ft) bgs. Results from depth profile sampling below the static water level in 2001 show a decreasing tritium concentration with depth, indicating that tritium is entering the borehole near the static water level at approximately 643 m (2,109 ft) bgs. Potential sources include the underground nuclear tests FARM (U-20ab), GREELEY (U-20g), and KASSERI (U-20z). The FARM test is closest to PM-1 but is believed to be downgradient from PM-1. The GREELY test is 2,429 m (7,969 ft) upgradient from PM-1, and the KASSERI test is 1,196 m (3,924 ft) upgradient from PM-1.

Well U-19BH – This well is located in the Central Pahute Mesa CAU. It is an inventory emplacement borehole. There were several nuclear detonations conducted near U-19BH, but the source of the tritium in the borehole is unclear. Previous investigations suggest that the water in the well originates from a perched aquifer, but identifying the likely source of tritium is difficult due to a lack of data regarding the perched system (Brikowski et al., 1993). The results from a tracer test conducted in the well indicate that there is minimal flow across the borehole (Brikowski et al., 1993). The lack of measurable flow in the well suggests that the chemistry of the water sampled from the borehole may not be representative of the aquifer. The data are provided as a point of interest due to the detection of tritium.

Well UE-7NS – This well is located in the Yucca Flat CAU and was drilled 137 m (449 ft) from the BOURBON underground nuclear test (U-7n) which was conducted in 1967. This well was routinely sampled between 1978 and 1987, with the resumption of sampling in 1991. Tritium levels in this well have been decreasing in recent years (Figure 4-10). Well UE-7NS is the second known location on the NTS where the regionally important lower carbonate aquifer (LCA) has been impacted by radionuclides from nuclear testing (Smith et al., 1999). The first location where the LCA has been impacted by radionuclides from nuclear testing is Well UE-2CE. Well UE-2CE is located less the 200 m (656 ft) from the NASH test, which was conducted in Yucca Flat in 1967. Well UE-2CE is not currently configured for routine sampling.

Well WW A – This well is completed in alluvium in the Yucca Flat CAU (see Figure 4-2). It is located within 1 km (0.6 mi) of 14 underground nuclear tests, most of which appear to be upgradient of the well. The well has had measurable tritium since the late 1980s. The marked increase between 1985 and 1999 suggests inflow of tritium to this well from the HAYMAKER underground nuclear test (U-3aus) conducted in 1962, 524 m (1,720 ft) north of Well WW A. This well, which supplied non-potable water for construction, was shut down in the early 1990s. The concentrations measured in 2005 at WW A indicate a slight downward trend since 1999 (Figure 4-10).

Detectable concentrations of gross alpha and gross beta were present in water collected from NTS onsite monitoring wells. The low measurable gross alpha and gross beta radioactivity in these wells is likely from natural sources. Elevated levels of dissolved solids in the sample from ER-19-1 at 2710 ft bgs affected the gross beta result as evidenced by the high measurement error and MDC. The high levels of gross alpha and gross beta activity in U-19BH are likely related to contamination. No man-made radionuclides were detected by gamma spectroscopy analyses at concentrations above their respective MDCs in any of the NTS monitoring wells in 2005. Low levels of naturally-occurring ^{40}K were detected in a sample from ER-19-1 at 2,710 ft bgs.

Table 4-4. Gross alpha, gross beta, and tritium analysis results for NTS monitoring wells in 2005

Monitoring Location	Date Sampled	Gross α ± Uncertainty (MDC)[a] (pCi/L)[b]	Gross β ± Uncertainty (MDC) (pCi/L)[c]	^{3}H ± Uncertainty (MDC) (pCi/L)[d]
ER-19-1 (2710 ft bgs)	8/17/2005	4.2 ± 2.4 (3.4)	195 ± 32 (6.6)	9.1 ± 12 (20)
ER-19-1 (2710 ft bgs) FD[e]	8/17/2005	NA[f]	NA	21 ± 13 (20)
ER-19-1 (3280 ft bgs)	8/17/2005	1.1 ± 0.59 (0.83)	31 ± 5.1 (1.5)	12 ± 12 (20)
ER-20-1	7/26/2005	9.0 ± 1.7 (0.70)	16 ± 3.0 (2.1)	16 ± 13 (20)
ER-20-1 FD	7/26/2005	3.5 ± 0.91 (0.85)	6.8 ± 1.5 (1.5)	NA
ER-20-2 #1	7/20/2005	5.5 ± 1.3 (1.1)	10 ± 2.1 (1.9)	2.6 ± 10 (18)
ER-20-2 #1 FD	7/20/2005	2.9 ± 0.90 (0.94)	5.6 ± 1.7 (2.2)	NA
SM-23-1[g]	8/16/2005	0.30 ± 1.5 (2.5)	5.0 ± 0.77 (0.97)	12 ± 13 (20)
U-19BH	3/23/2005	42 ± 6.9 (0.68)	58 ± 9.3 (1.5)	46 ± 18 (28)
UE-18R (1700 ft bgs)	3/16/2005	5.2 ± 1.0 (0.49)	3.3 ± 0.85 (1.0)	-5.4 ± 16 (28)
UE-18R (2130 ft bgs)	3/16/2005	10 ± 1.8 (0.59)	4.6 ± 1.0 (1.0)	-2.7 ± 16 (28)
UE-18R (2130 ft bgs) FD		NA	NA	-2.7 ± 16 (28)
UE-1Q	2/9/2005	8.1 ± 1.7 (1.3)	7.3 ± 0.90 (0.9)	-5.7 ± 17 (29)
UE-1Q FD	2/9/2005	5.7 ± 1.4 (1.3)	7.0 ± 0.91 (0.97)	NA
UE-25 WT #6	8/30/2005	17 ± 8.1 (12)	8.5 ± 2.7 (3.8)	12 ± 12 (20)
UE-25 WT #6 FD	8/31/2005	NA	NA	12 ± 12 (20)
UE-25P #1	8/31/2005	5.1 ± 1.6 (1.9)	3.6 ± 0.58 (0.61)	26 ± 13 (20)
UE-25P #1 FD	8/31/2005	5.8 ± 1.5 (2.0)	3.6 ± 0.44 (0.48)	NA
UE5 PW-1[h]	4/19/2005	4.8 ± 1.7 (2.2)	5.3 ± 2.0 (3.5)	3.7 ± 13 (20)
UE5 PW-1 FD	4/19/2005	3.4 ± 1.5 (2.2)	5.9 ± 1.7 (2.6)	NA
UE5 PW-1	10/11/2005	NA	NA	14 ± 14 (23)
UE5 PW-1 FD	10/11/2005	NA	NA	3.9 ± 14 (23)
UE5 PW-2[h]	4/19/2005	3.9 ± 1.4 (1.7)	2.8 ± 2.0 (3.7)	3.8 ± 13 (20)
UE5 PW-2 FD	4/19/2005	5.8 ± 1.7 (1.7)	5.9 ± 2.0 (3.4)	
UE5 PW-2	10/11/2005	NA	NA	0.81 ± 14 (23)
UE5 PW-2 FD	10/11/2005	NA	NA	10 ± 14 (23)
UE5 PW-3[h]	4/19/2005	3.1 ± 1.3 (1.7)	3.9 ± 1.8 (3.2)	3.6 ± 12 (19)
UE5 PW-3 FD	4/19/2005	4.5 ± 1.8 (2.8)	4.3 ± 2.1 (3.8)	NA
UE5 PW-3	10/11/2005	NA	NA	4.8 ± 13 (22)
UE5 PW-3 FD	10/11/2005	NA	NA	-14 ± 13 (23)
UE-7NS	5/3/2005	0.11 ± 0.40 (1.0)	3.6 ± 1.5 (2.6)	N/A
HTH #1 (1935 ft bgs)	3/15/2005	1.6 ± 0.42 (0.37)	1.8 ± 0.64 (0.89)	2.5 ± 15 (26)
HTH #1 (2040 ft bgs)	3/15/2005	1.9 ± 0.48 (0.42)	1.4 ± 0.65 (0.98)	-16 ± 15 (27)
HTH #1 (2130 ft bgs)	3/16/2005	1.2 ± 0.42 (0.51)	1.5 ± 0.65 (0.96)	-2.4 ± 14 (25)
HTH #1 (2300 ft bgs)	3/15/2005	1.6 ± 0.47 (0.48)	0.97 ± 0.62 (0.97)	-11 ± 16 (28)
HTH #1 (2300 ft bgs) FD	3/15/2005	NA	NA	-5.1 ± 15 (26)
TWD	2/9/2005	1.3 ± 0.97 (1.5)	4.3 ± 0.81 (1.1)	-2.6 ± 15 (26)
WW A	2/8/2005	2.5 ± 1.1 (1.4)	5.2 ± 0.87 (1.1)	461 ± 28 (26)
WW A FD	2/8/2005	NA	NA	492 ± 31 (30)
WW 2	2/8/2005	8.3 ± 2.0 (1.5)	5.8 ± 0.86 (0.99)	-5.6 ± 16 (29)
WELL PM-1	7/20/2005	0.16 ± 0.52 (0.89)	5.2 ± 1.4 (1.7)	179 ± 21 (21)
WELL PM-1 FD	7/20/2005	0.30 ± 0.50 (0.84)	5.6 ± 1.6 (2.1)	NA

Green-shaded results are considered detected (result is greater than the sample-specific MDC)

Yellow-shaded results are any which are equal to or greater than the EPA-designated levels shown below for each analyte:

(a) ±2 standard deviations

(b) The EPA-established MCL in drinking water for gross alpha (α) is 15 pCi/L

(c) The EPA "Level of Concern" in drinking water for gross beta (β) is 50 pCi/L

(d) The EPA-established MCL in drinking water for tritium (^{3}H) is 20,000 pCi/L

(e) FD = field duplicate sample

(f) NA = Specific analysis was not run on the sample

(g) Compliance well for Area 23 sewage lagoon

(h) Compliance well for validation of waste pit P03U at Area 5 RWMS (see Section 9.1.6)

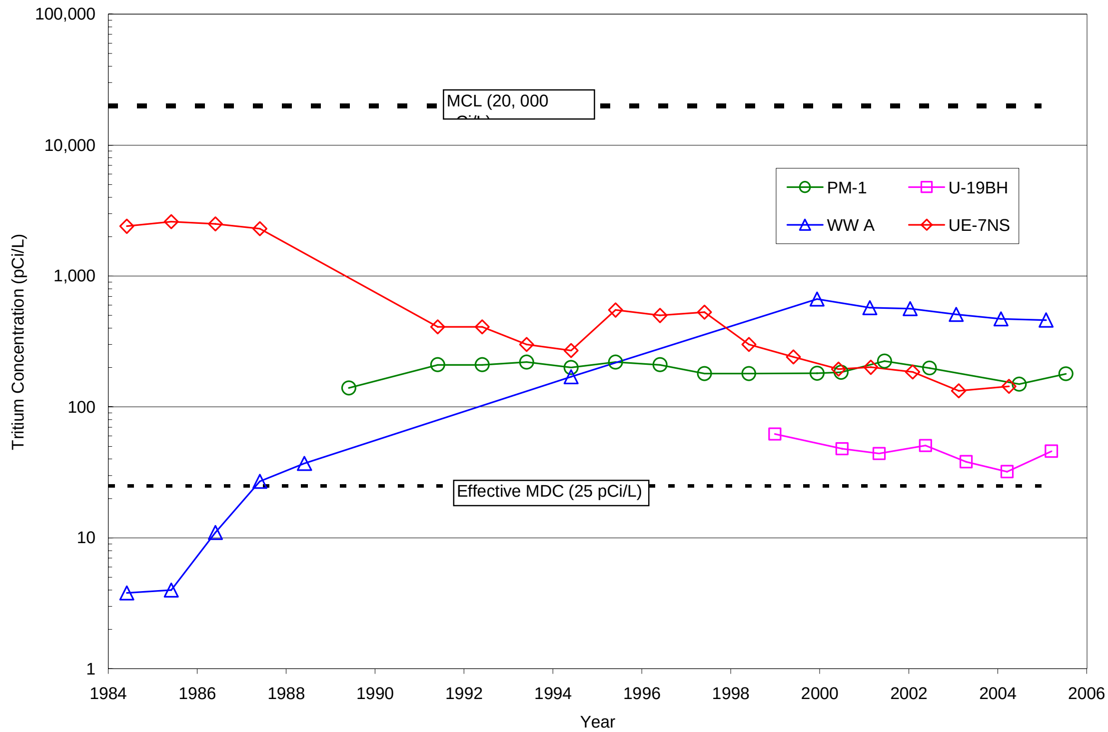

Figure 4-10. Concentrations of tritium in wells with a history of detectable levels

4.1.8 Results from Onsite Springs

Three onsite springs, Gold Meadows Spring, Tub Spring, and White Rock Spring, were sampled in 2005. These springs are derived from perched water tables resulting in highly variable discharge rates. These perched water tables result from surface infiltration of precipitation and are not discharge points from a regional aquifer (Hansen et al., 1997).

Detectable concentrations of gross alpha and gross beta were present in water collected from the springs, although all concentrations are below the EPA MCL for drinking water (Table 4-5). The measured levels of gross alpha and gross beta radioactivity are likely from natural sources.

No detectable concentrations of tritium were found in samples from Gold Meadows Spring or Tub Spring, but tritium was detected in the sample from White Rock Spring (Table 4-5). Tritium has been detected previously in a vegetation sample from White Rock Spring (DOE, 2001a). Although the exact source of tritium in White Rock Spring is unknown, this spring is located near areas of known surface contamination from previous nuclear testing.

Gamma spectroscopy detected levels above the MDC for ^{234}Th at Gold Meadows Spring, ^{214}Bi at Tub and White Rock springs, and ^{224}Ra at Tub and White Rock springs. All of these gamma-emitting radionuclides are naturally-occurring: ^{234}Th and ^{214}Bi are in the uranium decay series and ^{224}Ra is in the thorium decay series. A low level of cerium-144 [^{144}Ce] (a man-made fission product) was also detected at Tub Spring but no other man-made radionuclides were detected in this sample.

Table 4-5. Gross alpha, gross beta, and tritium analysis results for onsite springs in 2005

Monitoring Location	Date Sampled	Gross α ± Uncertainty (MDC)[(a)] (pCi/L)[(b)]	Gross β ± Uncertainty (MDC) (pCi/L)[(c)]	^{3}H ± Uncertainty (MDC) (pCi/L)[(d)]
Gold Meadows Spring	7/19/2005	4.3 ± 1.4 (1.9)	17 ± 0.86 (0.57)	14 ± 9.8 (16)
Tub Spring	7/20/2005	6.3 ± 1.4 (1.7)	7.3 ± 0.63 (0.55)	16 ± 12 (19)
Whiterock Spring	7/20/2005	5.8 ± 1.3 (1.4)	9.1 ± 0.67 (0.53)	46 ± 14 (20)

Green-shaded results are considered detected (result is greater than the sample specific MDC)

(a) ±2 standard deviations

(b) The EPA-established MCL in drinking water for gross alpha (α) is 15 pCi/L

(c) The EPA "Level of Concern" in drinking water for gross beta (β) is 50 pCi/L

(d) The EPA-established MCL in drinking water for tritium (^{3}H) is 20,000 pCi/L

4.1.9 Results from NTS E Tunnel Ponds

Five primary basins were constructed to collect and hold water discharged from the E Tunnels in Area 12 where nuclear testing was conducted in the past (see Figure 4-3). The water is perched groundwater that has percolated through fractures in the tunnel system. The Defense Threat Reduction Agency (DTRA) conducts monitoring of effluent waters from E Tunnel to determine if radionuclides and non-radiological contaminants exceed the allowable contaminant levels regulated under a state water pollution control permit (NEV 96021), which is issued to DTRA. During October 2005, a DTRA contract company sampled the tunnel effluent near where water is discharged. Also during October BN personnel sampled tunnel effluent, water from Pond 5, and sediment from the basin of Ponds 4 and 5. Effluent water was analyzed by DTRA for tritium, gross alpha, and gross beta (Table 4-6) and for 16 non-radiological contaminants and water quality parameters (DTRA, 2005). All other samples were analyzed by BN for tritium (water samples only), gamma-emitting radionuclides, plutonium, ^{90}Sr, and ^{241}Am (Table 4-7).

Table 4-6. Radiological results for E Tunnel Pond effluent pertaining to Water Pollution Control Permit NEV 96021

Parameter	Permissible Limit (pCi/L)	Average Measured Value (pCi/L)
Tritium	1,000,000	600,000
Gross Alpha	35	13
Gross Beta	100	77

Source: Water Pollution Control Permit NEV 96021 Quarterly Monitoring Report and Annual Summary Report for E Tunnel Waste Water Disposal System (DTRA, 2005)

Table 4-7. Routine radiological water monitoring results for E-Tunnel Ponds in 2005

Sample	^{3}H ± Uncertainty[a] (MDC)	^{90}Sr ± Uncertainty (MDC)	^{137}Cs ± Uncertainty (MDC)	^{238}Pu ± Uncertainty (MDC)	$^{239+240}Pu$ ± Uncertainty (MDC)	^{241}Am ± Uncertainty (MDC)
Water - Concentration units are pCi/L						
Influent to Pond 5	610,000 ± 12,000 (490)	0.25 ± 0.20 (0.39)	70 ± 7.4 (2.9)	0.32 ± 0.085 (0.049)	4.1 ± 0.48 (0.029)	0.19 ± 0.091 0.25
Pond 5 Water	620,000 ± 12,000 (500)	0.53 ± 0.27 (0.46)	83 ± 11 (3.8)	0.34 ± 0.090 (0.033)	4.0 ± 0.50 (0.041)	0.28 ± 0.11 0.53
Pond 5 Water FD[b]	610,000 ± 12,000 (490)	-0.11 ± 0.27 (0.68)	69 ± 8.3 (3.2)	0.46 ± 0.098 (0.047)	4.0 ± 0.40 (0.035)	0.22 ± 0.10 -0.11
Sediment - Concentration units are pCi/gram						
Pond 3 Sediment	NA[c]	0.72 ± 0.17 (0.21)	29 ± 2.3 (0.081)	0.10 ± 0.028 (0.0053)	1.3 ± 0.14 (0.014)	0.20 ± 0.043 (0.012)
Pond 4 Sediment	NA	0.52 ± 0.11 (0.10)	140 ± 1.2 (0.23)	0.34 ± 0.062 (0.013)	2.8 ± 0.32 (0.013)	0.28 ± 0.054 (0.0059)
Pond 4 Sediment FD	NA	1.5 ± 0.20 (0.17)	140 ± 12 (0.25)	0.32 ± 0.055 (0.016)	2.6 ± 0.29 (0.010)	0.26 ± 0.050 (0.016)
Pond 5 Sediment	NA	-0.071 ± 0.052 (0.16)	28 ± 2.4 (0.11)	0.016 ± 0.013 (0.019)	0.14 ± 0.036 (0.013)	0.024 ± 0.014 (0.012)

Green-shaded results are considered detected (results greater than the sample-specific MDC)

(a) ± 2 standard deviations

(b) FD = Field duplicate

(c) Not applicable: tritium is not measured in samples which do not contain water

All samples had radionuclide concentrations above their MDC (Table 4-6), with tritium being the highest. While tritium concentrations in pond water and tunnel effluent were elevated, they were about 40 percent lower than the limit allowed under permit NEV 96021 for that discharge system (Table 4-5). Tritium was found in all tunnel effluent and pond water samples at concentrations slightly lower than previous years' samples (Figure 4-11). Concentrations of ^{90}Sr, ^{137}Cs, plutonium, and ^{241}Am were at levels comparable with the past two years.

Due to the elevated concentrations of radionuclides in the E Tunnel containment ponds, the ponds are fenced and posted with radiological warning signs. Given that the ponds are available to wildlife, animals are also sampled under RREMP monitoring to assess potential radiological doses to wildlife and to humans consuming game animals (see Section 7.0 and Section 8.0).

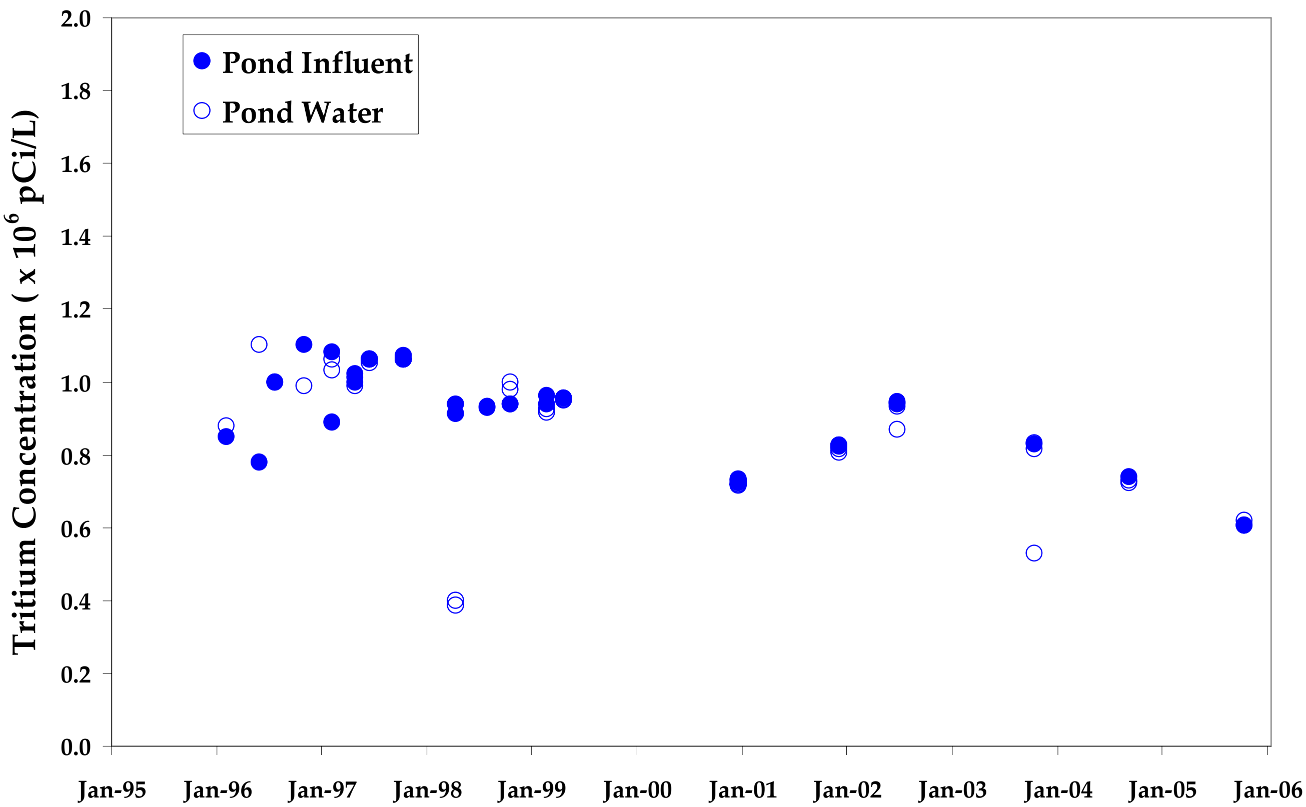

Figure 4-11. **Tritium concentration in E Tunnel Ponds from 1995 to 2005**

4.1.10 Results from NTS Sewage Lagoons

Each sewage lagoon at the NTS is part of a closed system used for the evaporative treatment of sanitary sewage. Sewage storage and treatment at the NTS has transitioned from lagoons to septic systems at several locations in recent years. Two permitted sewage lagoons remain: Area 6 Yucca and Area 23 Mercury (A23) (see Figure 4-3). The permits for these lagoons do not require that the water or sediments be monitored for radioactivity (see Section 4.2.4). However, to more completely demonstrate the proper management of effluents on the NTS, limited radiological analyses are conducted for these lagoons under the RREMP (DOE, 2003b).

The lagoon water samples were analyzed for tritium using standard (un-enriched) analyses and by gamma spectroscopy for other radionuclides. No tritium was detected at concentrations above MDCs in the lagoon water samples (Table 4-8) and no man-made gamma-emitting radionuclides were detected.

Table 4-8. Tritium water monitoring results for NTS sewage lagoons in 2005

Monitoring Location	Date Sampled	^3H ± Uncertainty[a] (MDC) (pCi/L)			
Area 23 Mercury	1/5/2005	-302	±	219	(371)
	4/12/2005	-99.2	±	215	(363)
	7/13/2005	-120	±	227	(382)
	10/5/2005	34.9	±	120	(204)
Area 6 Yucca	1/5/2005	-249	±	219	(371)
	4/12/2005	-99.2	±	216	(363)
	7/13/2005	225	±	236	(382)
	10/5/2005	107	±	125	(205)

(a) ± 2 standard deviations

4.1.11 UGTA Wells

The UGTA Project drilled three new Rainier Mesa/Shoshone Mountain investigation wells in 2005: ER-12-3, ER-12-4 and ER-16-1 (Figure 4-12). The first two wells were in Area 12 (Rainier Mesa) and the third in Area 16 (Shoshone Mountain). Well development and testing of the first two wells were conducted. The groundwater production rate of the third well was too low to conduct well development and testing. A multi-agency team consisting of personnel from Stoller-Navarro Joint Venture (SNJV), Los Alamos National Laboratory (LANL), DRI, and LLNL collected groundwater samples from the Area 12 wells. During development and sampling, water temperature, pH, and conductivity were measured. Samples were then analyzed for selected radionuclides as well as gross alpha and gross beta. Groundwater data are maintained in the UGTA Project geochemical database by SNJV, Las Vegas, Nevada. Preliminary tritium analysis results for ER-12-3 and ER-12-4 are shown in Table 4-9. These two wells are classified as not contaminated, and groundwater from them was pumped into unlined sumps.

Table 4-9. Tritium concentrations in UGTA wells sampled in 2005

UGTA Well	^3H (pCi/L)
ER-12-3	0.5
ER-12-4	89.7
U-20n PS #1DD-H	37,000,000

The UGTA Project also sampled cavity well U-20n PS #1DD-H, the CHESHIRE test cavity (Figure 4-12). Groundwater from this well was pumped into a lined sump. Preliminary results show expected levels of radionuclides for post-shot wells, and tritium concentrations of about 37,000,000 pCi/L. Final laboratory analytical results and reports from LANL and LLNL are pending.

In 2005, water sample analyses were completed for four UGTA Project wells (Figure 4-12) that were sampled at the end of 2004 (Table 4-10).

Table 4-10. Radiochemistry analysis results from UGTA well samples analyzed in 2005

	UGTA Well (Date Sampled)			
Radionuclide (pCi/L)	ER-12-1 (12/08/2004)	ER-20-5 #1 (11/30/2004)	ER-20-5 #3 (11/29/2004)	U-3cn PS#2 (12/09/2004)
^{3}H	3.24	38,000,000	113,000	7,900,000
^{14}C	0.034	224	2.73	372
^{36}Cl	0.00046	3.57	0.0131	25.5
^{99}Tc	NM [a]	0.35	0.017	62.6
^{129}I	NM	0.19	0.0014	0.259
^{234}U	1.43	13.83	4.83	9.77
^{235}U	0.042	0.22	0.09	0.16
^{238}U	0.868	4.71	1.88	3.44
$^{239+240}Pu$	NM	0.42	<0.04	<0.01

Source: Zavarin, 2006 (a) Not measured

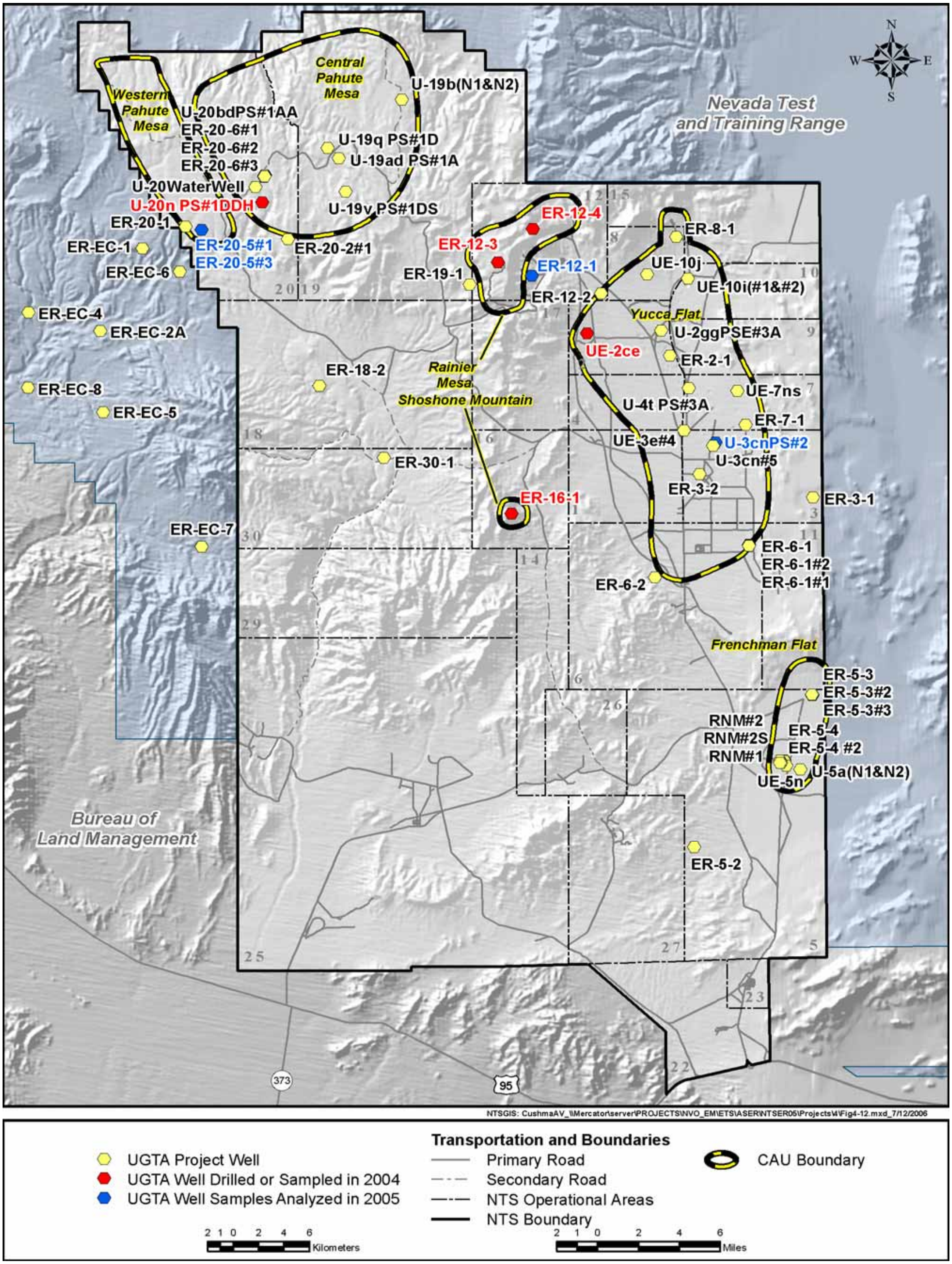

Figure 4-12. UGTA Project wells on and off the NTS

4.1.12 Environmental Impact

The tritium data provide no evidence that radionuclides have traveled significant distances from underground testing areas or to offsite water supply wells or springs. None of the offsite springs or the offsite public or domestic water supply wells had detectable levels of tritium. Among the 12 offsite NNSA/NSO monitoring wells sampled in 2005, all but two had non-detectable concentrations of tritium. The two exceptions came from monitoring wells ER-OV-03C2 and ER-OV-03A, and their tritium levels, though considered detectable, were within the range of concentrations indicative of analytical background levels for tritium.

Even on the NTS, groundwater monitoring results indicate that migration of radionuclides from the underground test areas is not significant. Groundwater from four monitoring wells on the NTS is known to consistently have tritium at levels above detection, and they are each within 1 km (0.6 mi) of an historical underground nuclear test. They have the highest levels of tritium of all wells monitored under the RREMP program. Their concentrations of tritium are still less than 3 percent of the EPA MCL for drinking water of 20,000 pCi/L, and no trend of rising tritium concentrations in these wells have been observed since 2000.

None of the groundwater samples from drinking water supply wells on the NTS had tritium levels above their MDCs in 2005.

No man-made radionuclides were detected by gamma spectroscopy in any offsite or onsite wells monitored under the RREMP.

In contrast to the onsite and offsite groundwater wells monitored under the RREMP, the contaminated post-shot wells on the NTS sampled and analyzed by the UGTA Project in 2005 had tritium concentrations that were between 5 times to 19 hundred times higher than the EPA MCL for drinking water of 20,000 pCi/L.

Most RREMP groundwater and spring samples both on and off the NTS had gross alpha and gross beta levels above detection limits but below the EPA limits for drinking water. The detectable gross alpha and gross beta radioactivity is likely from natural sources. Of the groundwater and springs that have been sampled routinely since 1999, no detectable trends in gross alpha or gross beta activity or tritium concentrations have been found.

Three onsite springs were sampled in 2005. Very low levels of tritium (46 pCi/L) were detected in the White Rock Spring water sample, and the source is expected to be surface contamination from past nuclear testing in the region. Gamma spectroscopy analysis detected the man-made fission product ^{144}Ce in the water sample collected from Tub Spring, but no other man-made radionuclides were detected in the sample. This finding is currently unexplainable. Further monitoring of this spring in subsequent years will determine the validity of the gamma spectroscopy analysis. Neither White Rock or Tub springs are discharge points from a regional aquifer, but instead are perched water tables from surface infiltration of precipitation.

The radiological impact to water resources from current and past activities on the NTS is groundwater contamination from man-made radionuclides within the UGTA Project CAUs shown in Figure 4-1. The current NTS activity of containing tritium-contaminated waters in lined sumps (as for the UGTA Project post-shot wells) and in the E Tunnel ponds exposes NTS wildlife to tritium in their drinking water or aquatic habitat. The effect on wildlife to this radiological exposure is addressed in Section 8.2 of this report and in previous annual environmental reports (DOE, 2004d; 2005a).

4.2 Non-Radiological Drinking Water and Wastewater Monitoring

The quality of drinking water and wastewater on the NTS is regulated by federal and state laws. The design, construction, operation, and maintenance of many of the drinking water and wastewater systems are regulated under state permits. BN was tasked with ensuring that such systems meet the applicable water quality standards and permit requirements (see Section 2.2). The NTS non-radiological water monitoring goals are shown below. BN ES personnel met these goals by conducting field water sampling and analyses, performing assessments, and maintaining documentation. The major compliance measures/actions that BN ES personnel monitor/performed on the NTS are also shown below. This section describes the results of 2005 monitoring. Radiological monitoring of drinking water on and off the NTS was presented in the preceding Sections 4.1.4 and 4.1.6.

Non-Radiological Water Monitoring Goals	Compliance Measures/Actions
Ensure that the operation of NTS public water systems (PWS) and private water systems provide high-quality drinking water to workers and visitors of the NTS. Determine if NTS PWS are operated in accordance with the requirements in Nevada Administrative Code (NAC) 445A under permits issued by the state. Determine if the operation of commercial septic systems to process domestic wastewater on the NTS meets operational standards in accordance with the requirements NAC 445A under permits issued by the state. Determine if the operation of industrial wastewater systems on the NTS meets operational standards of federal and state regulations as prescribed under the GNEV93001 state permit.	Number of PWS samples containing coliform bacteria Concentration of synthetic organic Phase II and V contaminants, inorganic Phase II and V contaminants, disinfection byproducts, and secondary standards in PWS samples Measurements of 5-day Biological Oxygen Demand (BOD), total suspended solids (TSS), and pH in sewage lagoon water Inspection of sewage lagoon systems Concentrations of 16 contaminants/water quality parameters in E Tunnel effluent water

4.2.1 Drinking Water Monitoring

Nine permitted wells supply the potable water needs of NTS operations (Figure 4-13); these are grouped into three PWSs (Figure 4-13) that were operated by BN for NNSA/NSO in 2005. The PWSs are operated in accordance with the requirements in NAC 445A under permits issued by the BHPS, which are renewed annually. There are also four private water systems which are not subject to NAC 445A. To adhere to new, lower allowable drinking water concentrations for arsenic, the Army #1 and 5C wells were taken off the Area 23 and 6 PWS in 2005. WW C-1 was taken off the same PWS due to elevated total dissolved solids and the water's hardness (see discussion below in Section 4.2.1.1). The permit for the effected PWS (NV0000360) will be revised in 2006 upon BHPS's approval of water project completion reports documenting deactivation of the wells.

4.2.1.1 Water Quality of PWS and Permitted Water Hauling Trucks

The three PWS must meet water quality standards for National Primary and Secondary Drinking Water Standards. The PWS must also meet other standards and conditions listed in the regulations relating to design, operation, and maintenance. For work locations at the NTS that are not part of a public water system, NNSA/NSO hauls potable water for use in decontamination and sanitation. The NTS uses two water tanker trucks which are permitted by the BHPS to haul water to a public water system. Normal use of these trucks involves hauling to private water systems and to hand-washing stations at construction sites, activities which are not subject to permitting. NNSA/NSO, however, retains the permits in case of emergency. These permits are also renewed annually. The two permitted

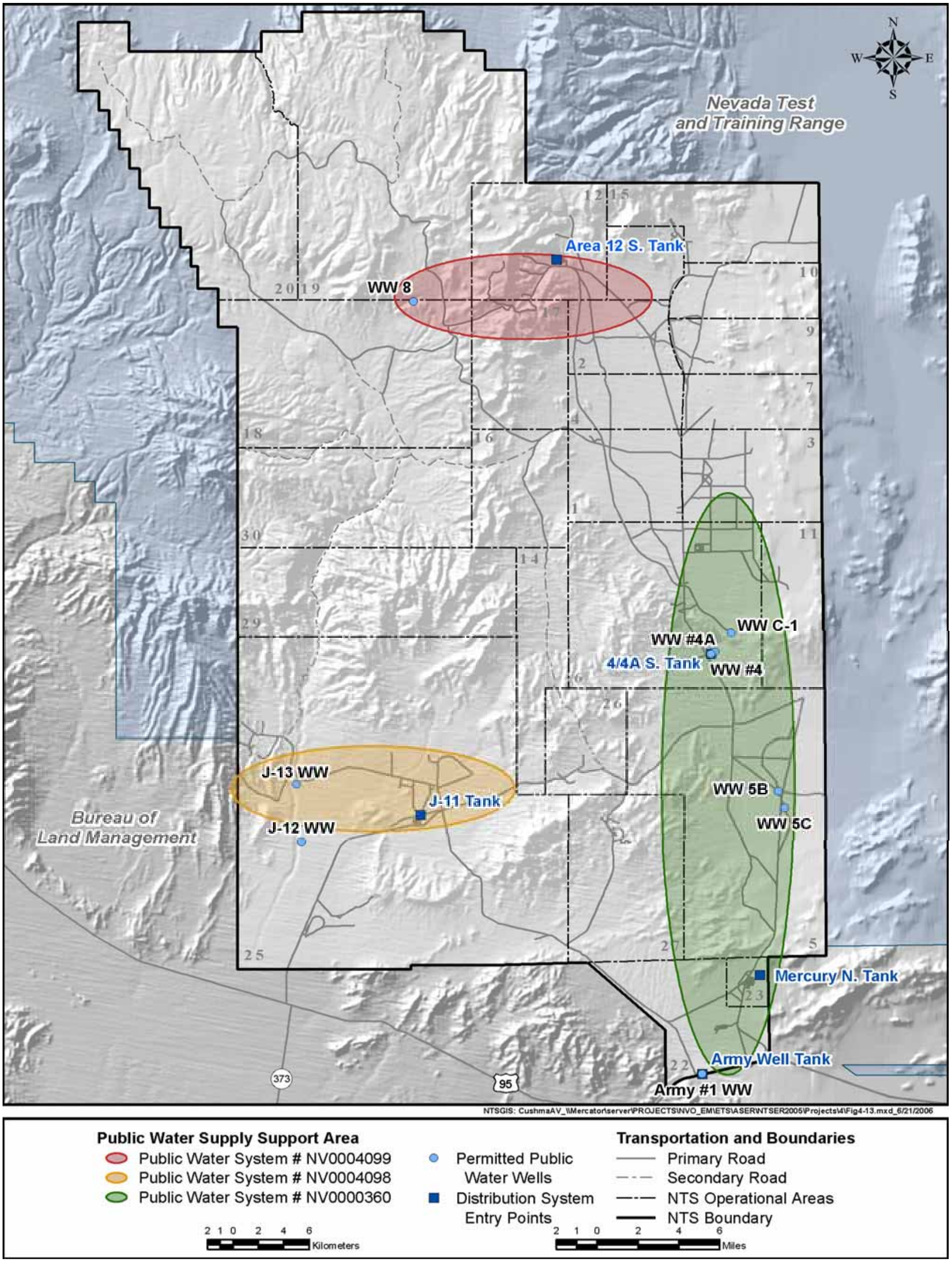

Figure 4-13. Drinking water systems on the NTS

potable water-hauling trucks are subject to water quality standards for coliform bacteria. Table 4-11 lists the water quality parameters monitored in 2005, sample frequencies, and sample locations. The largest PWS (Area 23 and 6) serves the main work areas of the NTS. It was monitored monthly for coliform bacteria at nine locations approved by the BHPS within the distribution systems. The two smaller systems (Area 12 and Area 25) were monitored quarterly for coliform bacteria. At all building locations, the sampling point for coliform bacteria is one of the sinks within one of the building's bathrooms. Monitoring for other contaminants took place at the eight points of entry to the PWSs. Although not required by regulation or permit, the private water systems were monitored quarterly for coliform bacteria to ensure safe drinking water. All potable water-hauling trucks were monitored monthly for coliform bacteria.

All water samples were collected in accordance with accepted practices and the analyses were performed by state-approved laboratories. Approved analytical methods listed in NAC 445A and Title 40 Code of Federal Regulations (CFR) 141 were used by the laboratories.

Table 4-11. Water quality monitoring parameters and sampling design for NTS public drinking water systems

PWS	Contaminant	2005 Monitoring Requirement	Monitoring Locations
Area 23 and 6	Coliform Bacteria	36 samples (3 buildings/ month and 4 samples/ building)	Buildings 5-7, U1H restroom, 6-609, 6-900, 22-1, 23-180, 23-701, 23-777, 23-1103
	Synthetic Organic Chemicals - Phase II and V	4 samples (1/entry point)	<u>Four Entry Points</u>: Army Well Tank, Mercury N. Tank, 4/4A S. Tank, C-1 Wellhead
	Disinfection By-Products	3 samples	Buildings 6-900, 22-1, and 23-180
	Inorganic Chemicals - Phase II	4 samples (1/entry point)	Four entry points (shown above)
	Fluoride (an Inorganic Phase II Chemical)	5 samples (1/entry point)	Four entry points (shown above) and Bldg. 6-900
	Arsenic (an Inorganic Phase V Chemical)	4 samples (1/entry point)	Four entry points (shown above)
	Lead and Copper (Secondary Standards contaminants)	10 samples	Buildings 5-7, CP-214, CP-41, 23-117, 23-143, 23-531, 23-532, 23-535, 23-614, 23-652
Area 12	Coliform Bacteria	4 samples (1/quarter)	Building 12-45
	Synthetic Organic Chemicals - Phase II and V	1 sample	Entry point Area 12 S. Tank
	Disinfection By-Products	1 sample	Building 12-30
	Inorganic Chemicals - Phase II	1 sample	Entry point Area 18 Wellhead 8 [(a)]
	Arsenic (an Inorganic Phase V Chemical)	1 sample	Entry point Area 18 Wellhead 8 [(a)]
	Secondary Standards	1 sample	Entry point Area 12 S. Tank
	Lead and Copper (Secondary Standards contaminants)	5 samples (1/building)	Buildings: 12-31, 12-35, 12-34, 12-35, 12-910
Area 25	Coliform Bacteria	4 samples (1/quarter)	Building 25-4320
	Synthetic Organic Chemicals - Phase II and V	1 sample	Entry point J-11 Tank
	Disinfection By-Products	1 sample	Building 4320
	Inorganic Chemicals - Phase II	1 sample	Entry point J-11 Tank
	Arsenic (an Inorganic Phase V Chemical)	1 sample	Entry point J-11 Tank

Table 4-11. Water quality monitoring parameters and sampling design for NTS public drinking water systems (continued)

PWS	Contaminant	2005 Monitoring Requirement	Monitoring Locations
Area 25 (cont.)	Lead and Copper (Secondary Standards contaminants)	5 samples (1/building)	Buildings 25-3123, 25-4314, 25-4117, 25-4221, 25-4320
Truck			
Water-Hauling Truck 84846	Coliform Bacteria	12 samples (1/month)	From water tank on truck after filling at Area 6 potable water fill stand
Water-Hauling Truck 84847	Coliform Bacteria	12 samples (1/month)	From water tank on truck after filling at Area 6 potable water fill stand

(a) Water sample taken from Area 18 Wellhead 8 instead of Area 12 S. Tank due to tank refurbishment.

On January 22, 2001, the EPA adopted a new standard for arsenic in drinking water at 10 parts per billion (ppb), replacing the old standard of 50 ppb. The rule became effective on February 22, 2002, and the date by which systems must comply with the new standard was January 23, 2006. Arsenic levels in three of the NTS permitted water wells (Army #1 WW, WW 5C, and WW C-1) are known to have arsenic levels above this standard. The source of the arsenic is suspected to be natural deposits in the earth[1]. In preparation for the compliance deadline, Army #1 WW and WW 5C began to be deactivated or removed from the NTS PWSs. In 2005, they were removed from the Area 23 and 6 PWS. Water from WW C-1 had already been diverted from entering the same PWS for the past several years because of elevated total dissolved solids (TDS) levels and hardness. ES is preparing water completion reports documenting the removal of these three permitted wells from the PWS. BHPS will review and approve these reports, after which the PWS permits will be revised. These approvals and permit revisions are anticipated to occur in 2006.

In 2005, monitoring results indicated that the PWS and the permitted water-hauling trucks complied with National Primary Drinking Water Quality Standards (Table 4-12) with one exception. The Area 12 water system (PWS NV0004099) exceeded the action level for lead. BHPS was notified of this in the Third Quarterly Monitoring Report submitted in October 2005. This system had maintained compliance with the lead action levels during previous annual monitoring. ES will revert to semi-annual monitoring of this system to more closely monitor lead levels. The Area 12 buildings were last occupied in March 2005, and there are no immediate plans to use this camp in 2006. As required by 40 CFR 141.85(c)(5), public information on lead will be distributed to potential camp occupants.

[1]The most likely source for the arsenic in groundwater from 5C WW (31 ppb) in Frenchman Flat is the Wahmonie volcanic center immediately west of Frenchman Flat. It is not uncommon for volcanic rocks in the western U.S. to be naturally elevated in arsenic (BN, 2004a). Hydrothermal mineralization processes that resulted in the enrichment of gold and silver in this once marginal mining district (circa 1905 and 1928) (Cornwall, 1972) also are responsible for the anomalously high arsenic content in this area (Castor et al., 1989). Detritus eroded from the Wahmonie hills and deposited as alluvial sediments has carried this high arsenic signature into western Frenchman Flat. Groundwater subsequently picks up some of the naturally-occurring elements from the aquifer matrix (in this case, sediments of the alluvial aquifer) including arsenic.

An explanation for the slightly elevated arsenic level in Army #1 WW (11 ppb) is not so clear as this well produces from the regional carbonate aquifer. Groundwater flow paths are from the NE to the SW in this vicinity (Laczniak et al., 1996; BN, 2005a). It would not be unexpected for groundwater to pick up some arsenic as it moves past the Wahmonie volcanic center and other volcanic aquifers located generally upgradient of Army #1 WW.

Table 4-12. Water quality analysis results for NTS public drinking water systems in 2005

		Results (milligrams per liter [mg/L])		
Contaminant	**Maximum Contaminant Level (mg/L)**	**Area 23 and 6 PWS [(a)]**	**Area 12 PWS**	**Area 25 PWS**
Coliform Bacteria [(b)]	Coliforms present in 1 samples/month	Absent in all samples	Absent in all samples	Absent in all samples
Synthetic Organic Chemicals – Phase II				
Alachlor	0.002	<0.0001	<0.0001	<0.0001
Aldicarb	0.003	<0.0005	<0.0005	<0.0005
Aldicarb sulfoxide	0.004	<0.0005	<0.0005	<0.0005
Aldicarb sulfone	0.002	<0.0007	<0.0007	<0.0007
Atrazine	0.003	<0.0001	<0.0001	<0.0001
Carbofuran	0.04	<0.0009	<0.0009	<0.0009
Chlordane	0.002	<0.0001	<0.0001	<0.0001
Dibromochloropropane	0.0002	<0.00001	<0.00001	<0.00001
2, 4-D	0.07	<0.0001	<0.0001	<0.0001
Ethylene dibromide	0.00005	<0.00001	<0.00001	<0.00001
Heptachlor	0.0004	<0.00004	<0.00004	<0.00004
Heptachlor epoxide	0.0002	<0.00002	<0.00002	<0.00002
Lindane	0.0002	<0.00002	<0.00002	<0.00002
Methoxychlor	0.04	<0.00001	<0.00001	<0.00001
Polychlorinated biphenyls	0.0005	<0.0002	<0.0002	<0.0002
Pentachlorophenol	0.001	<0.00004	<0.00004	<0.00004
Toxaphene	0.003	<0.001	<0.001	<0.001
2, 4, 5-TP	0.05	<0.0001	<0.0001	<0.0001
Synthetic Organic Chemicals – Phase V				
Benzo(a)pyrene	0.0002	<0.00002	<0.00002	<0.00002
Dalapon	0.2	<0.001	<0.001	<0.001
Di (2-ethylhexyl) adipate	0.4	<0.0006	<0.0006	<0.0006
Di (2-ethylhexyl) phthalate	0.006	<0.0006	<0.0006	<0.0006
Dinoseb	0.007	<0.0001	<0.0001	<0.0001
Diquat	0.02	<0.0004	<0.0004	<0.0004
Endothall	0.1	<0.009	<0.009	<0.009
Endrin	0.002	<0.00001	<0.00001	<0.00001
Glyphosate	0.7	<0.006	<0.006	<0.006
Hexachlorobenzene	0.001	<0.0001	<0.0001	<0.0001
Hexachlorocyclopentadiene	0.05	<0.0001	<0.0001	<0.0001
Oxamyl (Vydate)	0.2	<0.001	<0.001	<0.001
Picloram	0.5	<0.0001	<0.0001	<0.0001
Simazine	0.004	<0.00007	<0.00007	<0.00007
Disinfection Byproducts				
Total Trihalomethanes: (bromodichloromethane, chloroform, dibromochloromethane, trichlorofluoromethane)	0.08	0.0023-0.0063	0.0151	0.0028
Haloacetic Acids (HAA5): (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, mono-bromoacetic acid, dibromoacetic acid)	0.06	<0.002-<0.002	0.0037	<0.002

Table 4-12. Water quality analysis results for NTS public drinking water systems in 2005 (continued)

Contaminant	Maximum Contaminant Level (mg/L)	Results (mg/L)		
		Area 23 and 6 PWS [a]	Area 12 PWS	Area 25 PWS
Inorganic Chemicals – Phase II				
Fluoride	2.0	0.84-2.0	0.87	1.2
Barium	2.0	0.0027-0.097	<0.002	0.120
Cadmium	0.005	<0.001-<0.001	<0.001	<0.001
Chromium	0.1	0.0084-0.005	0.0033	0.030
Mercury	0.002	<0.0001-<0.0001	<0.0001	<0.0001
Selenium	0.05	<0.002-0.002	<0.002	<0.002
Nitrate	10 as (N)	0.078 - 4.2	1.2	2.1
Nitrite	1 as (N)	NA[c]	<0.40	NA
Inorganic Chemicals – Phase V				
Arsenic	0.05	0.0067-0.012	<0.002	0.011
Secondary Standards				
Aluminum	0.2	NA	0.0038	NA
Chloride	250.0	NA	7.1	NA
Copper	1.3	0.300	0.130	0.019
Iron	0.3	NA	0.079	NA
Lead	0.015	0.013	0.046	0.003
Magnesium	125.5	NA	1.3	NA
Manganese	0.05	NA	0.027	NA
Silver	0.1	NA	<0.0025	NA
Sulfate	250.0	NA	16	NA
Zinc	5.0	NA	<0.005	NA
Color	15.0 color units	NA	6 color units	NA
Foaming Agents	0.05	NA	<0.02	NA
Odor	3.0 threshold odor number (TON)	NA	<1.0 TON	NA
pH	6.5 - 8.5	NA	7.71	NA
TDS	500	NA	150	NA

Highlighted cells indicate those water quality results which exceeded maximum contaminant levels

(a) Coliform bacteria were not present in any samples collected from Water-Hauling Trucks 84846 and 84847 nor from the following private water systems: JASPER Compound, U3ah/at Complex, Area 6 Weather Station, and G Tunnel Office

(b) Multiple samples analyzed at Area 23 and 6 PWS throughout the year. Results show lowest and highest concentration of contaminant among samples analyzed.

(c) NA = Not applicable

4.2.1.2 Sanitary Survey of PWS and Inspection of Permitted Water-Hauling Trucks

The BHPS conducts a periodic sanitary survey of the permitted PWS. A sanitary survey consists of an inspection of the wells, tanks, and other visible portions of the PWS to ensure that they are maintained in a sanitary configuration. As non-community water systems, the minimum survey frequency for a sanitary survey is five years. The BHPS has been performing the survey more frequently, however. The BHPS inspects the two water-hauling trucks annually at the time of permit renewal to make sure they still meet the requirements of NAC 445A.

The BHPS conducted a sanitary survey of the PWS in 2005. No significant deficiencies were noted, and correction of non-significant deficiencies are in progress. BHPS conducted an annual inspection of the permitted water-hauling trucks in 2005; no findings were noted.

4.2.2 Domestic Wastewater Monitoring

To obtain a permit for a proposed new NTS septic system, an assessment is conducted to ensure that the sources producing discharges are domestic in nature. BN (or the current Management and Operation contractor) and the state of Nevada conduct this assessment. After the design of a new system is completed, a permit package is submitted through NNSA/NSO to the state. Subsequent to state approval, a "permit to construct" is issued. After construction, the state conducts a final inspection. Upon approval, the state issues a "permit to operate."

Existing septic systems that are not permitted may be permitted by submitting a narrative describing facility operations, flow test results, tank and leach field sizing, engineering drawings, personnel numbers, existing flow (volume) information, and a fixture count. The application is reviewed by the state and an onsite inspection is conducted by BHPS. Approval results in the issuance of a "permit to operate."

There are seven active septic systems being used in place of inactive lagoons on the NTS (Figure 4-14). These are inspected periodically for sediment loading and are pumped as required. A state-permitted septic pumping contractor is used. The state conducts onsite inspections of pumper trucks and pumping contractor operations.

ES personnel perform management assessments of permitted facilities and services to determine and document adherence to permit conditions. The assessments are performed according to existing directives and procedures.

In 2005, the following compliance actions relating to domestic wastewater on the NTS occurred:

- One new septic system was permitted at the NTS. This system was for Area 16 Department of Homeland Security (Permit NY-1124).
- A septic system design was initiated for Area 6 ART Hangar. The final permit package submittal will be completed in 2006.
- A septic tank pumping contractor permit (NY-17-03318), septic tank pump truck permits (NY-17-03313, NY-17-03315, NY-17-03317, NY-17-06838), and a septic tanker permit (NY-17-06839) were approved by the state and renewed in November 2005.

4.2.3 Industrial Wastewater Monitoring

Industrial discharges on the NTS were limited to two operating sewage lagoon systems in 2005: Area 6 Yucca Lake and Area 23 Mercury (these lagoon systems also receive domestic wastewater) (Figure 4-14). The Area 6 Yucca Lake system consists of two primary lagoons and two secondary lagoons. All lagoons in this system are lined using compacted native soils that meet the state of Nevada requirements for transmissivity (10^{-7}centimeters per second).

The Area 23 Mercury system consists of one primary lagoon, a secondary lagoon, and an infiltration basin. In 2005, a project was completed that lined the primary lagoon using a geosynthetic clay liner and a high-density polyethylene liner. On August 5, 2005, the Water Pollution Control General Permit GNEV93001 was reissued, and the new permit has reduced monitoring requirements and does not require the sampling of well SM-23-1. A project has been initiated to line the secondary lagoon in 2006.

Both sewage systems are monitored quarterly for influent quality and annually for influent toxicity. The locations where water samples were collected for analysis within each sewage system include:

- Each influent headwork for systems where there is direct access to influent flows
- Each pond near the lagoon's inlet for systems where there is no direct access to influent flows
- Each infiltration basin at a place where a sample most closely representing the infiltrating waste water can be collected

Composite samples were collected over a period of 8 hours at the Area 6 Yucca Lake and Area 23 Mercury systems.

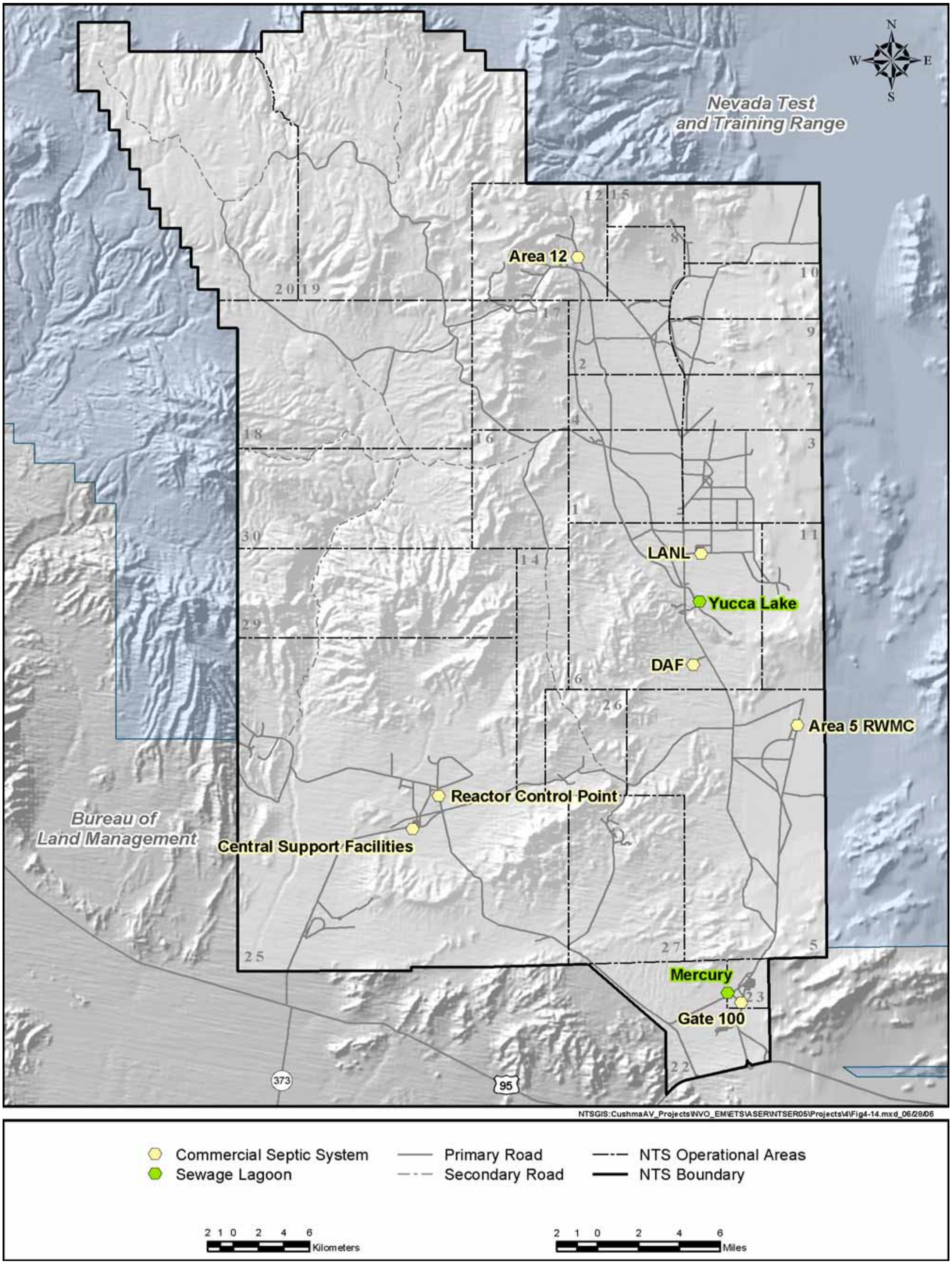

Figure 4-14. Active permitted sewage disposal systems on the NTS

All water samples were collected in accordance with accepted practices, and the analyses were performed by state-approved laboratories. Approved analytical methods listed in NAC 445A and Title 40 CFR 141 were used by the laboratories.

4.2.3.1 *Quarterly Analysis of Influent Water Quality*

A composite sample from each influent headwork was collected quarterly. The composite sample was analyzed for three parameters: 5-day biological oxygen demand (BOD_5), total suspended solids (TSS), and pH (Table 4-13). The compliance limits for these parameters, established under Water Pollution Control General Permit GNEV93001, are shown in Table 4-13. All quarterly monitoring results for BOD_5, TSS, and pH for sewage system influent waters were within permit limits in 2005 with one exception. One BOD_5 Mean Daily Load was exceeded at the Area 6 Yucca Lake Sewage lagoons in the first quarter. The weekly inspection reports were examined and there were no problems observed with respect to odor or color, and no septic conditions were observed. The second quarter samples were collected early and placed on a rush turn-around time. These results showed that the lagoons were once again in compliance and no other action was taken by BN nor requested by the state of Nevada.

Table 4-13. Water quality analysis results for NTS sewage lagoon influent waters in 2005

		Minimum and Maximum Values from Quarterly Samples	
Parameter	**Units**	**Area 6 Yucca Lake**	**Area 23 Mercury**
BOD_5	mg/L	52.0 - 310	45.4 - 140
BOD_5 Permit Limit		No Limit	No Limit
BOD_5 Mean Daily Load [(a)]	kg/d	1.91 – 9.56	7.85 – 26.5
BOD_5 Mean Daily Load Limit		8.66	37.5
TSS	mg/L	89.9 - 161	42.0 – 59.6
TSS Permit Limit		No Limit	No Limit
pH	S.U. [(b)]	7.69 – 8.71	7.18 – 8.30
pH Permit Limit		6.0 – 9.0	6.0 – 9.0

(a) BOD_5 Mean Daily Load in kilograms per day (kg/d) = (mg/L BOD x liters per day (L/d) average flow x 3.785)/10^6

(b) Standard units of pH

4.2.3.2 *Annual Analysis of Toxicity of Sewage Lagoon Pond Waters*

A grab sample from the Area 23 Mercury primary lagoon and an equal-volume composite sample from the two Area 6 Yucca Lake primary lagoons were collected in July.

Each grab and composite sample was filtered, the solids discarded, and the filtrate analyzed directly, using methods of analysis cited in EPA Publication SW-846. Each sample was analyzed for those contaminants listed in Table 4-14. The limits for these contaminants are also specified under state permit; they are the same limits specified in 40 CFR 261.24, Table 1, Maximum Concentration of Contaminants for the Toxicity Characteristic. Annual monitoring of Area 6 Yucca Lake and Area 23 Mercury sewage lagoon waters adjacent to lagoon inlets showed that no contaminants exceeded permit limits (Table 4-14).

Table 4-14. Water toxicity analysis results for NTS sewage lagoon pond water in 2005

Contaminant	Limit[(a)] (mg/L)	Area 6 Yucca (mg/L)	Area 23 Mercury (mg/L)
Benzene	0.5	< 0.005	< 0.005
Carbon Tetrachloride	0.5	< 0.005	< 0.005
Chlordane	0.03	< 0.0001	< 0.0001
Chlorobenzene	100	< 0.005	< 0.005
Chloroform	6.0	< 0.005	< 0.005
Cresol (Total)	200	< 0.010	< 0.010
2,4-D	10	0.0019	< 0.001
1,4-Dichlorobenzene	7.5	< 0.010	< 0.010
1,2-Dichloroethane	0.5	< 0.005	< 0.005
1,1-Dichlorethylene	0.7	< 0.005	< 0.005
2,4-Dinitrotoluene	0.13	< 0.010	< 0.010
Endrin	0.02	< 0.0001	< 0.0001
Heptachlor	0.008	< 0.0001	< 0.0001
Hexachlorobenzene	0.13	< 0.010	< 0.010
Hexachlorobutadiene	0.5	< 0.010	< 0.010
Hexachloroethane	3.0	< 0.010	< 0.010
Lindane	0.4	< 0.0001	< 0.0001
Methoxychlor	10	< 0.0005	< 0.0005
Methylethyl Ketone	200	< 0.010	< 0.010
Nitrobenzene	2.0	< 0.010	< 0.010
Pentachlorophenol	100	< 0.025	< 0.025
Pyridine	5.0	< 0.010	< 0.010
Tetrachloroethylene	0.7	< 0.005	< 0.005
Toxaphene	0.5	< 0.005	< 0.005
Trichloroethylene	0.5	< 0.005	< 0.005
2,4,5-Trichlorophenol	400	< 0.025	< 0.025
2,4,6-Trichlorophenol	2.0	< 0.010	< 0.010
2,4,5-TP (Silvex)	1.0	< 0.0005	< 0.0005
Vinyl Chloride	0.2	< 0.010	< 0.010
Arsenic	5.0	0.0083	0.0142
Barium	100	0.0239	0.0805
Cadmium	1.0	< 0.0003	< 0.0003
Chromium	5.0	0.0018	0.0017
Lead	5.0	< 0.0025	0.0068
Mercury	0.2	< 0.0001	< 0.0001
Selenium	1.0	< 0.0049	< 0.0049
Silver	5.0	< 0.0009	< 0.0009

(a) Source: 40 CFR 261.24, Table 1

4.2.3.3 Sewage System Inspections

The sewage system operators inspect active systems weekly and inactive lagoon systems quarterly. State of Nevada inspections of active and inactive lagoon systems are conducted annually. Operators inspect for abnormal conditions, weeds, algae blooms, pond color, abnormal odors, dike erosion, burrowing animals, discharge from ponds or lagoons, depth of staff gauge, crest level, excess insect population, maintenance/repairs needed, and general conditions.

In 2005, there was one notable inspection finding at the Area 23 lagoons. The lagoons had a problem related to the flow meters located at the influent headworks. The problem was investigated and determined to be caused by several scheduled power outages at the NTS during the third quarter. The Nevada Division of Environmental Protection conducted an annual inspection of active and inactive sewage lagoon systems on June 29 and 30, 2005. The inspection found no problems with the field maintenance program in keeping the lagoons, sites, and access roads functional.

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5.0 Direct Radiation Monitoring

U.S. Department of Energy (DOE) Order 5400.5, *Radiation Protection of the Public and the Environment* and DOE Order 435.1, *Radioactive Waste Management* have requirements to protect the public and environment from exposure to radiation (see Section 2.3). Energy from radionuclides present in the Nevada Test Site (NTS) environment could potentially be deposited inside humans and animals through inhalation and ingestion. Section 3.1 and Section 4.1 present the results of monitoring radionuclides in air and water on the NTS. Monitoring results are used to estimate internal radiation dose to the public via inhalation and ingestion. Energy absorbed from radioactive materials residing outside the body results in an external dose. In 2005, external dose was measured under the Direct Radiation Monitoring Program of Bechtel Nevada (BN) Environmental Technical Services. This section presents the results of monitoring direct ionizing radiation on the NTS from all sources, including natural radioactivity from cosmic or terrestrial sources and from man-made radioactive sources. These data are then used to document and trend gamma radiation exposure rates on the NTS.

Direct radiation monitoring is conducted to assess the state of the external radiation environment, detect changes in that environment, and measure gamma radiation levels near potential exposure sites. DOE Order 450.1, *Environmental Protection Program* states that environmental monitoring should be conducted to detect, characterize, and respond to releases from DOE activities, assess impacts, and estimate dispersal patterns in the environment. In addition, DOE Order 5400.5 states that "it is also an objective that potential exposures to members of the public be as low as is reasonably achievable (ALARA)". The specific goals for the direct radiation monitoring program are shown below.

Direct Radiation Monitoring Program Goals
Assess the proportion of dose to the public which comes from background radiation versus NTS operations
Measure the potential external dose to a member of the public in order to determine if the total dose (internal and external) exceeds 100 millirem per year (mrem/yr) (1 millisievert [mSv]/yr), the dose limit of DOE Order 5400.5
Determine if radiation levels from the Radioactive Waste Management Sites (RWMSs) are likely to result in a dose exceeding the 25 mrem/yr (0.25 mSv/yr) dose limit to members of the public as specified in DOE M 435.1-1
Monitor operational activities involving radioactive material, radiation-generating devices, or accidental releases of radioactive material to ensure exposure to members of the public are kept ALARA as stated in DOE Order 5400.5
Determine if the absorbed radiation dose from external radiation exposure to NTS terrestrial plants and aquatic animals is less than 1 rad per day (1 rad/d) (0.01 gray [Gy]/d), and if the absorbed radiation dose to NTS terrestrial animals is less than 0.1 rad/d (1 milligray [mGy]/d) (limits prescribed by DOE Order 5400.5 and DOE Standard DOE-STD-1153-2002)
Determine the exposure rates through time at various soil contamination areas to fulfill the requirements of DOE Order 450.1 to characterize releases in the environment

An oversight monitoring program has been established by the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office to independently monitor direct radiation within communities adjacent to the NTS. This independent oversight is provided through the Community Environmental Monitoring Program (CEMP) and managed by the Desert Research Institute (DRI). DRI's 2005 direct radiation monitoring results are presented in Sections 6.1.2 and 6.1.3.

5.1 Measurement of Direct Radiation

Direct radiation is exposure to electromagnetic (i.e., gamma and X-ray) radiation. Electromagnetic radiation is able to travel long distances through air and to penetrate living tissue causing ionization within the body tissues. In contrast, alpha and beta particles do not travel far in air (a few centimeters for alpha and about 10 meters (m) (32.8 feet [ft]) for beta particles). Alpha particles deposit only negligible energy externally; they rarely penetrate the outer dead layer of skin. Beta particles are generally absorbed in the immediate layers of skin below the outer layer.

Direct radiation exposure is usually reported in the unit milliroentgen (mR), which is a measure of *exposure* in terms of numbers of ionizations. Generally, the *dose* resulting from an exposure from the most common external radionuclides can be approximated by equating a 1 milliroentgen (mR) exposure with a 1 mrem (0.01 mSv) dose.

5.2 TLD Surveillance Network Design

Monitoring is performed on the NTS because some NTS areas have elevated radiation levels resulting from one or more of the following: (1) historical weapons testing, (2) current and past radioactive waste management activities, and (3) current operational activities involving radioactive material or radiation-generating devices. A surveillance network of thermoluminescent dosimeter (TLD) sampling locations has been established on the NTS. The objectives and design of the network are described in detail in the *Routine Radiological Environmental Monitoring Plan* (RREMP) (DOE, 2003b). For more details on sampling and analysis methods, the reader is encouraged to refer to the RREMP.

TLDs measure ionizing radiation exposure from all sources, including natural and man-made radioactivity. The TLD used is the Panasonic UD-814AS, which consists of four elements housed in an air-tight, water-tight, ultraviolet-light-protected case. A slightly shielded lithium borate element is used to check low-energy radiation levels. The average of three calcium sulfate elements is used to measure penetrating gamma radiation.

A pair of TLDs is placed at 1.0 ± 0.3 m (28 to 51 inches [in.]) above the ground at each monitoring location and is exchanged for analysis quarterly. The quarterly analysis of TLDs is performed using automated TLD readers that are calibrated and maintained. In 2005, TLD calibration and maintenance was performed by the BN Radiological Control Department (RCD). Reference TLDs are exposed to 100 mR from a ^{137}Cs radiation source under tightly controlled conditions. These are then read along with TLDs collected from the environment to calibrate their response.

In 2005, there were 109 active environmental TLD locations on the NTS (Figure 5-1). They include the following numbers and types of locations:

- Background (B) – 10 locations where radiation effects from NTS operations are negligible.
- Environmental 1 (E1) – 41 locations where there is no measurable radioactivity from past operations but which are of interest due to either (1) the presence of personnel or the public in the area or (2) the potential for receiving radiation exposure from a current operation.
- Environmental 2 (E2) – 35 locations where there is measurable added radioactivity from past operations and the locations are of interest due to (1) the potential for personnel to be in the area and (2) the need to monitor exposure trends in the area. Some locations fitting this description are grouped with the WO category below.
- Waste Operations (WO) – 17 locations in and around the Area 3 RWMS and the Area 5 RWMS.
- Control (C) – 6 locations in Building 650 in Mercury. Control TLDs are kept in stable environments and are used as a quality check on the TLDs and the analysis process.

5.2.1 Data Quality

Quality assurance and quality control (QA/QC) protocols, including data quality objectives, have been developed and are maintained as essential elements of direct radiation monitoring, as directed by the RREMP. The QA/QC requirements established for the monitoring program include the use of sample packages to thoroughly document each sampling event, rigorous management of databases, and completion of essential training. Agreement between the results provided by the paired TLDs at each location was very good, with an average relative percent difference between measurements of 2.5 percent for 2005. Quarterly results from Control TLDs were not significantly different from those of previous years. These exhibited quarter-to-quarter coefficients of variation ranging from 6.1 to 10.1 percent and averaging 8.2 percent in 2005. This is a measure of the inherent variation associated with the TLD sampling process; values for control locations ranged from 1.2 to 10.0 percent in recent years. The RCD maintains certification through the DOE Laboratory Accreditation Program for dosimetry.

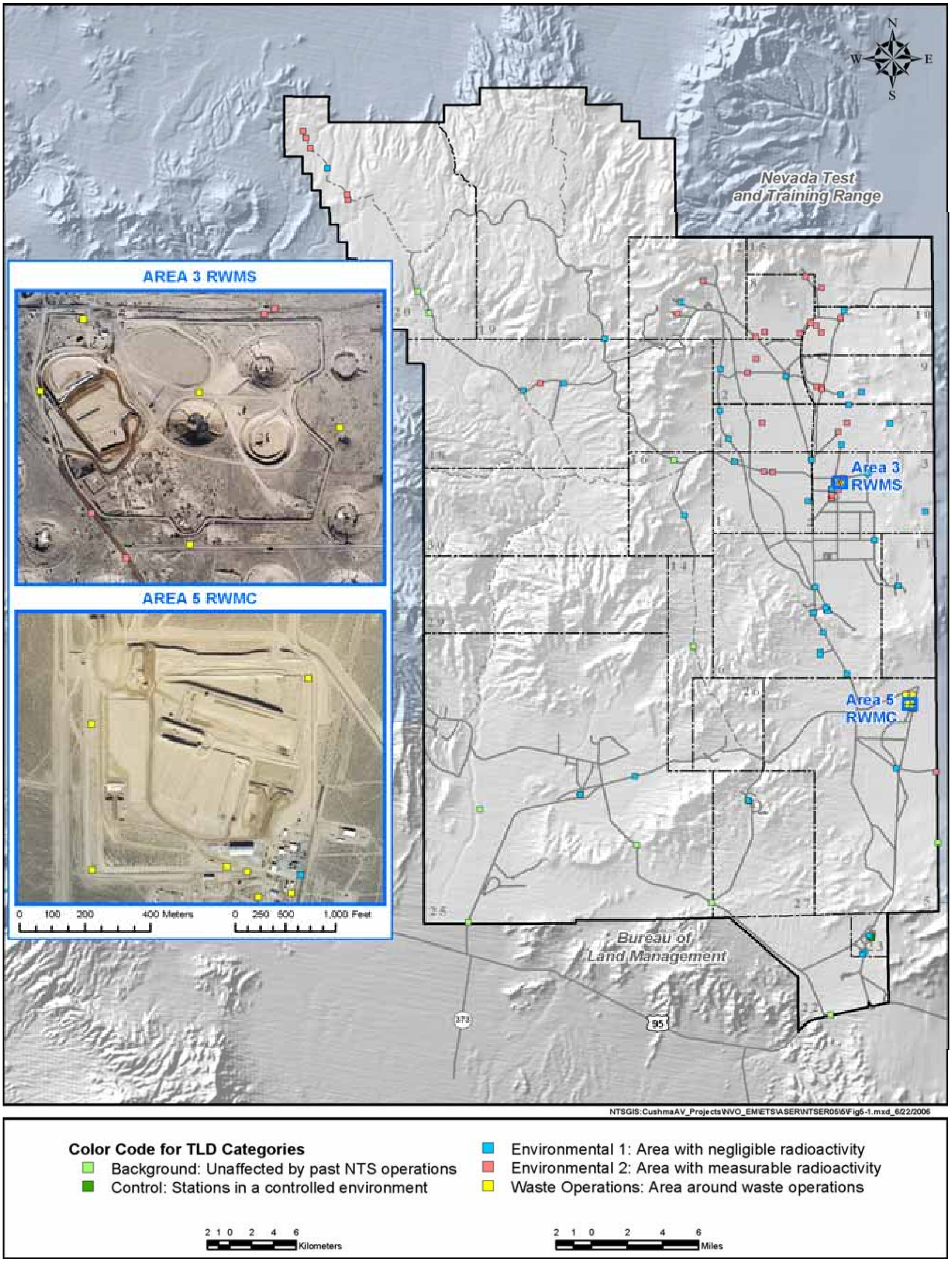

Figure 5-1. Location of TLDs on the NTS

5.2.2 Data Reporting

Direct radiation is reported as exposure per unit of time. TLD analysis results are maintained in a database as mR per day (mR/d), calculated by dividing the measured mR exposure per quarter for each TLD by the number of days in the quarter. For annual reporting purposes, these are multiplied by 365. The estimated annual exposure is the average of the four quarterly annualized values; this is used to determine compliance with federal annual direct radiation exposure limits.

5.3 Results

Estimated annual exposures for all TLD locations are summarized in Table 5-1; summary statistics for the five location types are given in Table 5-2. During 2005, the average of the estimated annual exposures at background locations was 119 mR; these ranged from 65 to 161 mR over the ten background locations (Table 5-2). A 95 percent prediction interval (PI) for annual exposures based on these background location values is 40.5 to 197.3 mR.

For comparison, the CEMP estimated the annual exposure in Las Vegas, Nevada (at 2,040 ft elevation) was 97 mR during 2005 (see Table 6-3). Estimated exposures at CEMP locations ranged from 82 mR at Pahrump (2550 ft elevation) to 155 mR at Twin Springs (5055 ft elevation). There is a generally increasing relationship between exposure and elevation, with a correlation coefficient around 0.45. For comparison, the NTS background locations with lowest and highest estimated exposures are at elevations 3,569 ft and 5,700 ft respectively. Exposure estimates at all locations include the contribution from natural sources. Dose limits prescribed by DOE orders only apply to exposures above background levels.

Table 5-1. Annual direct radiation exposure rates measured at TLD locations on the NTS in 2005

				Estimated Annual Exposure (mR/yr)				
NTS Area	Location	Location Type[(a)]	Number of Quarters	Mean[(b)]	Median[(b)]	SD[(b)]	Min[(b)]	Max[(b)]
5	3.3 Mi SE of Aggregate Pit	B	3	65	62	6	61	72
14	Mid-Valley ETLD	B	4	146	145	7	140	155
16	Stake P-3	B	4	121	119	4	118	127
20	Stake A-112	B	4	161	160	8	154	171
20	Stake A-118	B	4	157	157	5	151	161
22	Army #1 Water Well	B	4	85	85	2	83	87
25	Gate 25-4-P	B	4	133	132	2	131	136
25	Station 510	B	4	130	131	4	124	132
25	Jackass Flats & A-27 Roads	B	3	82	81	2	80	85
25	Skull Mtn Pass	B	4	109	109	2	107	112
23	Bldg 650, Rm 142, Pig,	C	4	27	26	2	25	30
23	Bldg 650, Rm 142, Pig, NE	C	4	26	25	2	25	28
23	Bldg 650, Rm 142, Pig, NW	C	4	26	25	3	25	31
23	Bldg 650, Rm 142, Pig, SE	C	4	26	25	2	25	30
23	Bldg 650, Rm 142, Pig, SW	C	4	26	25	3	25	30
23	Building 650 Dosimetry	C	4	61	60	4	58	66
1	BJY	E1	4	121	120	2	119	124
1	Sandbag Storage Hut	E1	4	116	116	3	111	119
1	Stake C-2	E1	4	121	120	4	118	126
2	Stake M-140	E1	4	133	132	7	127	143
2	Stake TH-58	E1	4	96	94	6	92	105
3	LANL Trailers	E1	4	123	123	2	120	125
3	Stake OB-20	E1	4	90	89	4	87	97
3	Well ER 3-1	E1	3	128	126	6	124	135

Table 5-1. Annual direct radiation exposure rates measured at TLD locations on the NTS in 2005 (continued)

NTS Area	Location	Location Type[(a)]	Number of Quarters	Estimated Annual Exposure (mR/yr) Mean[(b)]	Median[(b)]	SD[(b)]	Min[(b)]	Max[(b)]
4	Stake TH-41	E1	4	113	113	4	109	118
4	Stake TH-48	E1	4	122	122	3	118	125
5	Water Well 5B	E1	4	114	114	4	109	120
6	CP-6	E1	4	71	71	3	69	75
6	DAF East	E1	4	97	96	3	94	101
6	DAF North	E1	4	104	102	3	101	108
6	DAF South	E1	4	137	136	5	133	143
6	DAF West	E1	4	85	84	3	82	89
6	Decon Facility NW	E1	4	129	130	5	124	134
6	Decon Facility SE	E1	4	133	132	6	128	141
6	Stake OB-11.5	E1	4	130	128	5	127	138
6	Yucca Compliance	E1	4	93	93	4	89	98
6	Yucca Oil Storage	E1	4	100	99	4	98	106
7	Reitmann Seep	E1	3	127	124	5	123	133
7	Stake H-8	E1	4	130	129	5	125	137
9	Papoose Lake Road	E1	4	91	89	5	86	97
9	U-9cw South	E1	4	106	105	3	103	111
9	V & G Road Junction	E1	4	115	114	3	112	119
10	Gate 700 South	E1	4	133	132	2	132	137
11	Stake A-21	E1	4	132	131	5	127	138
12	Upper N Pond	E1	4	131	130	6	126	139
16	3545 Substation	E1	4	144	142	5	141	151
18	Stake A-83	E1	4	147	145	5	143	154
18	Stake F-11	E1	4	146	146	7	137	155
19	Stake P-41	E1	4	164	163	4	160	169
20	Stake J-41	E1	4	140	139	6	136	149
23	Gate 100 Truck Parking 1	E1	4	220	221	151	65	374
23	Gate 100 Truck Parking 2	E1	4	68	68	8	61	75
23	Mercury Fitness Track	E1	4	60	60	3	57	64
25	HENRE	E1	4	125	125	3	121	128
25	NRDS Warehouse	E1	4	125	125	3	122	129
27	Cafeteria	E1	4	115	114	2	114	119
27	JASPER-1	E1	4	115	114	3	113	118
1	Bunker 1-300	E2	4	126	126	3	122	130
1	T1	E2	4	313	309	14	302	334
2	Stake L-9	E2	4	174	172	7	169	184
2	Stake N-8	E2	4	582	581	13	566	598
3	Stake A-6.5	E2	4	142	142	2	141	145
3	T3	E2	4	408	410	7	398	413
3	T3 West	E2	4	390	391	11	377	402
3	T3A	E2	4	472	472	4	468	477
3	T3B	E2	4	502	501	9	492	513
3	U-3co North	E2	4	203	206	9	190	211
3	U-3co South	E2	4	150	150	4	146	155
4	Stake A-9	E2	4	725	721	14	714	744
5	Frenchman Lake	E2	4	391	391	10	381	400
7	Bunker 7-300	E2	4	257	255	8	250	269
7	T7	E2	4	120	119	4	116	126

Table 5-1. Annual direct radiation exposure rates measured at TLD locations on the NTS in 2005 (continued)

NTS Area	Location	Location Type[(a)]	Number of Quarters	Estimated Annual Exposure (mR) Mean[(b)]	Median[(b)]	SD[(b)]	Min[(b)]	Max[(b)]
8	Baneberry 1	E2	4	418	416	12	406	434
8	Road 8-02	E2	4	130	126	11	122	145
8	Stake K-25	E2	4	105	105	1	103	106
8	Stake M-152	E2	4	166	163	7	161	176
9	B9A	E2	4	133	133	3	130	138
9	Bunker 9-300	E2	4	125	124	3	123	130
9	T9B	E2	4	574	572	10	563	587
10	Circle & L Roads	E2	4	121	121	1	120	121
10	SEDAN East Visitor Box	E2	4	135	134	3	132	139
10	SEDAN West	E2	4	249	250	4	244	253
10	T10	E2	4	272	273	3	268	275
12	T-Tunnel #2 Pond	E2	4	258	254	11	249	274
12	Upper Haines Lake	E2	4	110	109	6	105	118
15	EPA Farm	E2	4	114	114	2	112	115
18	JOHNNIE BOY North	E2	4	145	143	5	141	152
20	PALANQUIN	E2	4	249	249	5	243	254
20	SCHOONER-1	E2	4	834	835	21	810	855
20	SCHOONER-2	E2	4	292	293	7	283	299
20	SCHOONER-3	E2	4	143	142	3	142	147
20	Stake J-31	E2	4	171	169	5	167	177
3	A3 RWMS Center	WO	4	144	145	3	140	147
3	A3 RWMS East	WO	4	148	148	2	144	149
3	A3 RWMS North	WO	4	126	125	2	124	129
3	A3 RWMS South	WO	4	390	390	6	382	396
3	A3 RWMS West	WO	4	130	130	3	128	133
5	A5 RWMS East Gate	WO	4	127	128	12	113	139
5	A5 RWMS Expansion NE	WO	4	143	143	4	138	148
5	A5 RWMS Expansion NW	WO	4	145	145	3	142	149
5	A5 RWMS NE Corner	WO	4	126	126	3	124	129
5	A5 RWMS NW Corner	WO	4	125	126	3	122	128
5	A5 RWMS South Gate	WO	4	112	112	3	109	115
5	A5 RWMS SW Corner	WO	4	126	125	3	125	131
5	Building 5-31	WO	4	115	116	8	107	122
5	WEF East	WO	4	133	133	8	126	143
5	WEF North	WO	4	135	137	15	117	150
5	WEF South	WO	4	144	142	15	128	164
5	WEF West	WO	4	129	129	6	124	134

(a) Location types:
- B = Background locations
- C = Control locations
- E1 = Environmental locations with exposure rates near background but monitored for potential for increased exposure rates due to NTS operations
- E2 = Environmental locations with measurable radioactivity from past operations, excluding those designated "WO"
- WO = Locations in or near waste operations

(b) Mean, median, standard deviation (SD), minimum, and maximum values from quarterly estimates. In general, each quarterly estimate is the average of two TLD readings per location.

Table 5-2. Summary statistics for 2005 annual direct radiation exposure by TLD location type

Location Type	Number of Locations	Estimated Annual Exposure (mR)				
		Mean[(a)]	Median[(a)]	SD[(a)]	Min[(a)]	Max[(a)]
Background (B)	10	119	125	33	65	161
Control (C)	6	32	26	14	26	61
Environmental 1 (E1)	41	119	122	28	60	220
Environmental 2 (E2)	35	277	203	188	105	834
Waste Operations (WO)	17	147	130	63	112	390
All Locations	**10**	**119**	**125**	**33**	**65**	**161**

(a) Mean, median, standard deviation, minimum, and maximum values from annual estimated exposures

5.3.1 *Potential Exposure to the Public along the NTS Boundary*

Most of the NTS is not accessible to the public, as only the southern portion of the NTS boundary borders public land. Therefore, the only place the public has potential for exposure to direct radiation from the NTS is along the southern boundary.

Gate 100 is the primary entrance point to the NTS. The outer parking areas are accessible to the public. Trucks hauling radioactive materials, primarily low-level radioactive waste being shipped for disposal in the RWMSs, often park outside Gate 100 while waiting for entry to the NTS. Two TLD locations were established in October 2003 to monitor this truck parking area. The TLD on the north end of the parking area (Gate 100 Truck Parking 2) had an estimated annual exposure of 68 mR, with quarterly estimates varying between 61 and 75 mR, all within the range of background exposures observed at the NTS.

The TLD location on the west side of the parking area (Gate 100 Truck Parking 1) had an estimated annual exposure of 220 mR, however, with quarterly estimates decreasing from 374 mR in the first calendar quarter to 65 mR in the fourth quarter. The first two quarterly values are outside the background-based PI; the last two values are within the PI for background. This reverses the increasing trend observed during the latter part of 2004. It is likely that waste shipments entering the NTS are responsible for these changes. A hypothetical individual residing at that location 24 hours a day for the entire year would have received a total exposure of 220 mR, resulting in an external dose of about 101 mrem above the NTS-wide background mean level of 119 mR. That exposure would be 155 mR above the estimated exposure at the nearest background location, or 59 mR above the highest estimated background exposure. These values straddle the allowable dose of 100 mrem during the year, established by DOE Order 5400.5; however, nobody resides or remains full-time in the truck parking area.

While the public has access only to the southern portions of the NTS borders, other people may have access to other boundaries of the NTS. The great majority of the NTS is bounded by the Nevada Test and Training Range (NTTR). Military or other personnel on the NTTR who are not classified as radiation workers would also be subject to the 100 mrem annual dose limit for members of the public. The only place a soil contamination area crosses a boundary with NTTR is in the Frenchman Lake region of Area 5 along the southeast boundary of the NTS. A TLD location was established in July 2003 near the NTS boundary in the Frenchman Lake playa. The estimated annual exposure at Frenchman Lake during 2005 was 391 mR (down from 411 mR in 2004). The resulting above background dose of approximately 230 to 326 mrem (depending on which background value is used) would exceed the 100 mrem dose limit to a hypothetical person residing year-round at this location; again, however, there are no living quarters or full-time workers in this vicinity.

5.3.2 Exposure Rates at RWMSs

The *Radioactive Waste Management Manual*, DOE M 435.1-1 (DOE, 2001b), states that low-level waste disposal facilities shall be operated, maintained, and closed so that a reasonable expectation exists that annual dose to members of the public shall not exceed 25 mrem. Given that the RWMSs are located well within the NTS boundaries, there are no members of the public which could access these areas for significant periods of time. However, exposures are measured by TLDs located at the RWMSs to show the potential dose to a hypothetical person residing year-round at each RWMS.

5.3.2.1 Area 3 RWMS

The Area 3 RWMS is located in Yucca Flat. Between 1952 and 1972, 60 nuclear weapons tests were conducted within 400 m of the Area 3 RWMS boundary. Fourteen of these tests were atmospheric tests which left radionuclide-contaminated surface soil and, therefore, elevated radiation exposures across the area. Waste pits in the Area 3 RWMS are subsidence craters from seven subsurface tests that are being filled with low-level radioactive waste. These are then covered with clean soil; this results in lower exposures inside the Area 3 RWMS compared with the average exposures at the fence line or in Area 3 outside the fence line.

Annual exposures during 2005 in and around the Area 3 RWMS are shown in Figure 5-2. The exposures measured inside Area 3 RWMS and three of four measurements at the boundary were within the range of background exposures. The estimated exposure above the range of NTS background levels at one location on the RWMS boundary is associated with historic above-ground nuclear weapon test locations. Given this, current Area 3 RWMS operations would have contributed negligible external exposure to a hypothetical person residing at the Area 3 RWMS boundary during 2005.

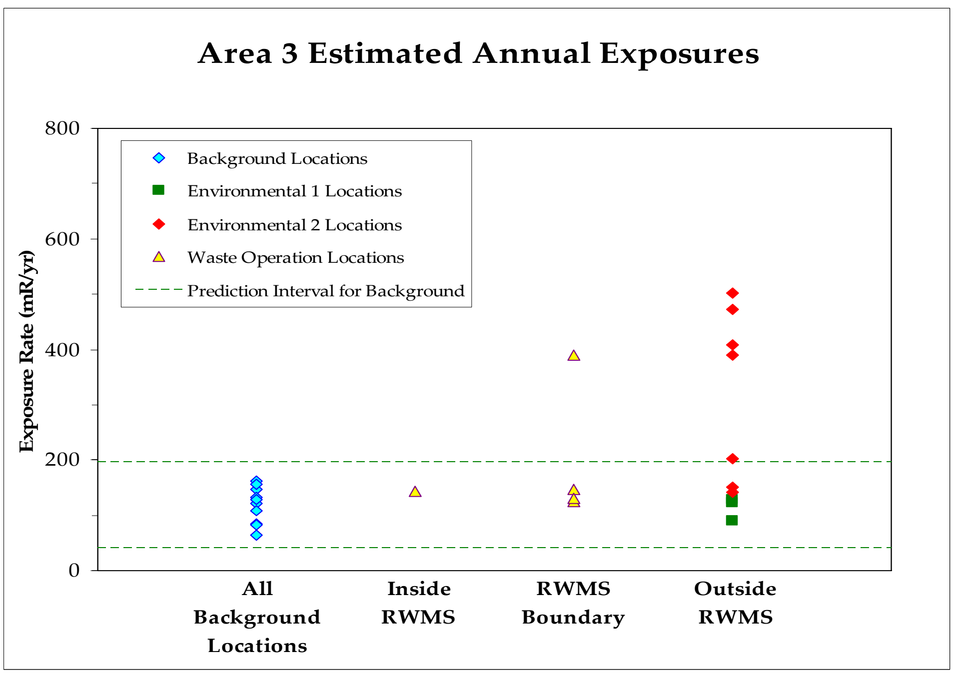

Figure 5-2. Annual exposure rates in and around the Area 3 RWMS plus background during 2005

5.3.2.2 Area 5 RWMS

The Area 5 Radioactive Waste Management Complex (RWMC), consisting of the Area 5 RWMS along with ancillary support facilities, is located in the northern portion of Frenchman Flat. Twenty-five nuclear weapons tests were conducted within 6.3 kilometers (km) (3.9 miles [mi]) of the Area 5 RWMC between 1951 and 1971. Fifteen of these were atmospheric tests and, of the remaining ten, nine released radioactivity to the surface which contribute to exposures in the area. No nuclear weapons testing occurred within the boundaries of the Area 5 RWMC itself. During 2005, estimated annual exposures at Area 5 RWMC TLD locations were within the range of exposures measured at NTS background locations (Figure 5-3). The one exposure rate measured outside the RWMC in Area 5 that was higher than background levels was within 0.5 km (0.3 mi) from 6 atmospheric tests in Frenchman Lake Playa.

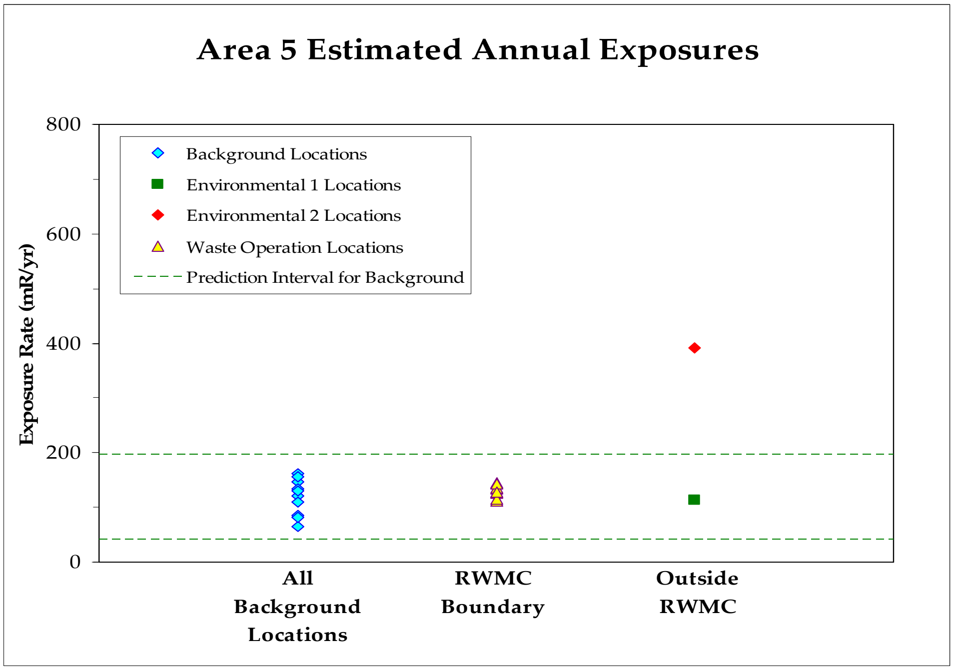

Figure 5-3. Annual exposure rates around the Area 5 RWMS plus background during 2005

5.3.3 Exposures from NTS Operational Activities

During 2005, there were 41 TLDs in locations where there is negligible radioactivity from past operations but which are of interest due to either the presence of personnel or the public in the area or due to the potential for receiving radiation exposure from current operations (E1 locations). The estimated mean annual exposure at these locations was 119 mR, virtually the same as the mean estimated annual exposure at background locations (see Table 5-2). The estimated annual exposures at nearly all E1 locations were within the background-based PIs; therefore, annual exposures were not different between B and E1 locations. The only exception was the Gate 100 Truck Parking #1 location discussed previously.

5.3.4 Exposure to NTS Plants and Animals

The TLD location with the highest annual exposure (Schooner-1) had its highest measured exposure rate of 2.34 mR/d during the second quarter (855 mR/yr, see Table 5-1). At an elevation near the ground (e.g., 3 cm [1.2 in.]), the exposure would be about four times higher than at the 1-m (3.3-ft) height where TLDs are placed. Therefore, the daily exposure rate near the ground surface at the Schooner-1 location would be less than 10 mR/d.

Generally, the *dose* resulting from an exposure from the most common external radionuclides can be approximated by equating a 1 mR exposure with a 1 mrad (0.01 mGy) dose. Therefore, this would result in an external dose that is approximately 10 percent of the most stringent dose rate to biota, which is the 0.1 rad/d limit to terrestrial animals mandated by DOE-STD-1153-2002. Hence, doses to plants and animals from external radiation exposure at NTS monitoring locations are low compared with the mandated dose limit.

5.3.5 Exposure Rate Patterns in the Environment over Time

DOE Order 450.1 states that environmental monitoring should be conducted to characterize releases from DOE activities. Continued monitoring of exposures at locations of past releases on the NTS helps to do this. Small quarter-to-quarter changes are normally seen in exposure rates from all locations. In 2005, for example, the second quarter was higher than the others. The differences were statistically significant ($p=0.000$) for all location types, but fairly small (an average 5.6 percent difference between the second quarter and the other quarters for B locations, 16.9 percent for C locations, 6.6 percent for E 1 locations [with Gate 100 Truck Parking 1 omitted], and 4.4 percent for E2 locations). For WO locations, the second quarter was an average 7.4 percent higher than the third and fourth quarters; the first quarter values were also higher than the third and fourth quarter, but not quite so much as the second quarter. The mildly elevated first quarter WO values were at the Area 5 RWMC.

Long-term trends are displayed in Figure 5-4 for all active locations by type. The Schooner-1 TLD location, established in 2003, has the highest exposure of any current NTS location. It is located approximately 100 m from the edge of the crater created by the Schooner test. The next two highest exposures shown in Figure 5-4, at Stake A-9 and Stake N-8, continue to decrease by 4.3 and 5.3 percent per year, respectively; these correspond to half-lives of about 16 and 13 years. The next four highest exposures shown are at T-Tunnel #2 Pond, Bunker 7-300, Sedan West, and Stake J-31, which are decreasing by 4.3, 2.8, 4.4, and 6.0 percent per year since 1989, respectively. All six of these locations are in the E2 category at known contaminated sites, with the predominant photon-emitting radionuclides being ^{137}Cs, ^{60}Co, ^{152}Eu, and ^{241}Am. The observed decreases are due to a combination of natural radioactive decay and the dispersal of radionuclides in the environment. Exposures at all other locations with long-term data have been relatively stable over time, indicating little added radioactivity at those locations (Figure 5-4).

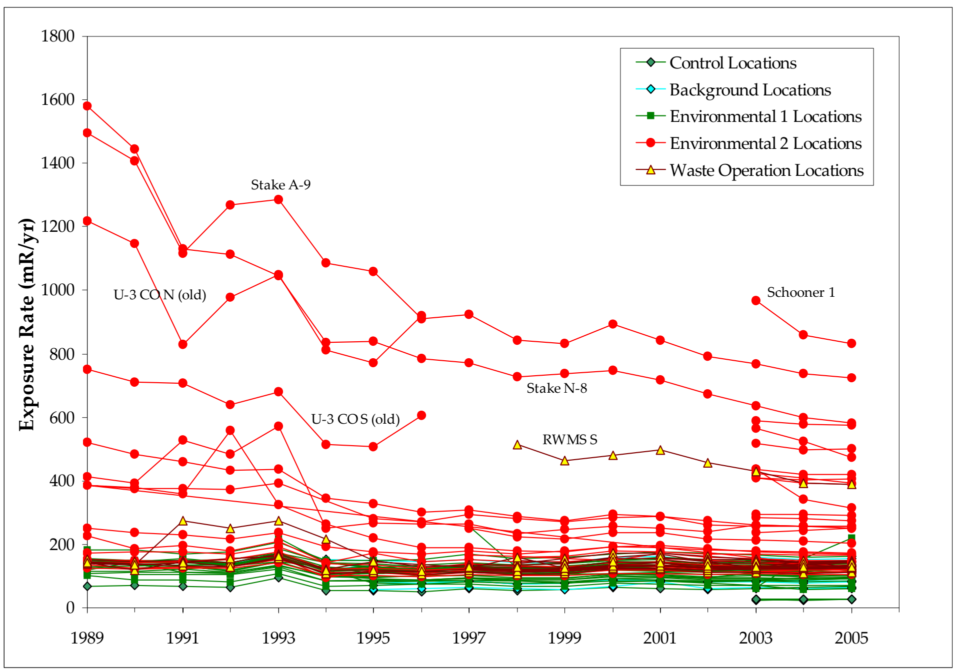

Figure 5-4. Trend in direct radiation exposure measured at TLD locations

5.4 Environmental Impact

Direct radiation exposure to the public from NTS operations in 2005 was negligible. Radionuclides historically released to the environment on the NTS have resulted in localized elevated exposures. These areas of elevated exposure are not open to the public nor are there personnel working in these areas full-time. Overall exposures at the RWMSs appear to be generally lower inside or at the boundary compared with those outside the RWMSs. This is likely due to the presence of radionuclides released from historical testing distributed throughout the area around the RWMSs, compared with the clean soil used inside the RWMSs to cap waste pits. The external dose to plants and animals at the location with the highest measured exposure was a small fraction of the dose limit to biota; hence no detrimental effects to biota from external radiation exposure are expected at the NTS.

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6.0 Oversight Radiological Monitoring of Air and Water

Community oversight for the Nevada Test Site (NTS) is provided through the Community Environmental Monitoring Program (CEMP) whose mission is to monitor and communicate environmental data that are relevant to the safety and well-being of participating communities and their surrounding areas. Previously, the CEMP network functioned as a first line of offsite detection of potential radiation releases from underground nuclear tests at the NTS, and it can be outfitted to fulfill this role again should underground testing resume. It currently exists as a non-regulatory public informational and outreach program, although quarterly reporting of monitoring data is furnished to the U.S. Environmental Protection Agency Region IX as a supplemental requirement to NTS onsite monitoring. The CEMP is sponsored by the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO), and is administered and operated by the Desert Research Institute (DRI) of the Nevada System of Higher Education.

Monitored and collected data include, but are not necessarily limited to, background and airborne radiation data, meteorological data, and tritium concentrations in community and ranch drinking water wells. Network stations, located in Nevada and Utah, are managed by local citizens, many of them high school science teachers, whose routine tasks are to maintain the equipment, collect air filters, and route them to the DRI for analysis. These Community Environmental Monitors (CEMs) are also available to discuss the monitoring results with the public and to speak to community and school groups. DRI's responsibilities include maintaining the physical monitoring network through monthly visitations by environmental radiation monitoring specialists, who also participate in training and interfacing with CEMs and interacting with other local community members and organizations to provide information related to the monitoring data. DRI also provides public access to the monitoring data through maintenance of a project Web site at <http://www.cemp.dri.edu/>. A detailed historical background of the CEMP can be found at <http://www.cemp.dri.edu/CEMPhist.html> along with more detailed descriptions of the various types of sensors found at the stations and on outreach activities conducted by the CEMP.

6.1 Offsite Air Monitoring

During 2005, 27 CEMP stations managed by DRI comprised the Air Surveillance Network (ASN) (Figure 6-1). One new station installed at Mesquite, Nevada in the fall of 2005 has supplied about two months' data for this report concerning background gamma radiation. However, data related to low volume particulate air sampling will not be available until calendar year 2006. The ASN stations include various equipment, as described below. The Mesquite, Nevada CEMP station is shown in Figure 6-2.

CEMP Low-Volume Air Sampling Network - During 2005, the CEMP ASN included continuously operating low-volume particulate air samplers located at 24 of the 27 CEMP station locations. No low-volume air samplers were located at Medlins Ranch, Warm Springs Summit, or Mesquite Nevada during 2005. Duplicate air samples were collected from up to three ASN stations each week. The duplicate samplers are operated at randomly selected stations for three months (one calendar quarter) before being moved to a new location.

Glass-fiber filters from the low-volume particulate samplers are collected by the CEMs, mailed to DRI, then prepared and forwarded to an independent laboratory to be analyzed for gross alpha and gross beta activity. Samples are held for a minimum of seven days after collection to allow for the decay of naturally- occurring radon progeny. Upon completion of the gross alpha/beta analyses, the filters are returned to DRI to be composited on a quarterly basis for gamma spectroscopy analysis.

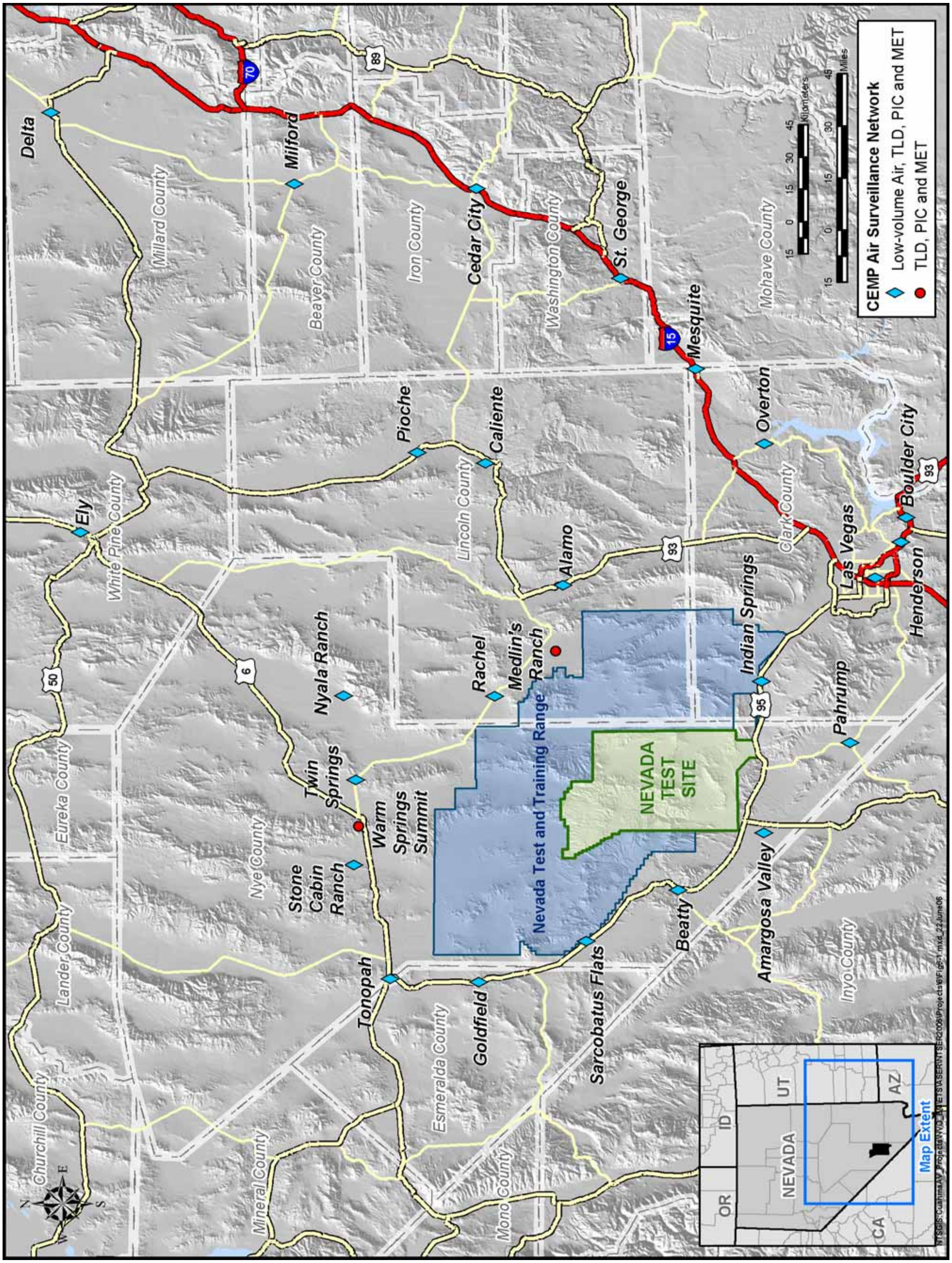

Figure 6-1. 2005 CEMP Air Surveillance Network

Figure 6-2. CEMP station at Mesquite, Nevada

CEMP TLD Network – Thermoluminescent dosimetry (TLD) is another of the essential components of environmental radiological assessments. This is used to determine both individual and population external exposure to ambient radiation from natural and artificial sources. In 2005, the TLD network consisted of fixed environmental TLDs at 26 of the 27 CEMP stations (see Figure 6-1). A TLD is not currently deployed at Warm Springs Summit due to limited access during the winter months. The TLD used was a Panasonic UD-814AS. Within the TLD, a slightly shielded lithium borate element is used to check low-energy radiation levels while three calcium sulfate elements are used to measure penetrating gamma radiation. For quality assurance (QA) purposes, duplicate TLDs are deployed at three randomly-selected environmental stations. An average daily exposure rate was calculated for each quarterly exposure period. The average of the quarterly values was multiplied by 365.25 days to obtain the total annual exposure for each station.

CEMP PIC Network – The pressurized ion chamber (PIC) detector measures gamma radiation exposure rates, and because of its sensitivity may detect low-level exposures that go undetected by other monitoring methods. PICs are in place at all 27 stations in the CEMP network (see Figure 6-1). The primary function of the PIC network is to detect changes in ambient gamma radiation due to human activities. In the absence of such activities, ambient gamma radiation rates vary naturally among locations reflecting differences in altitude (cosmic radiation), radioactivity in the soil (terrestrial radiation), and slight variations at a single location due to weather patterns. Since the addition of a full suite of meteorological instrumentation at the CEMP stations, variations in PIC readings caused by weather events such as precipitation or changes in barometric pressure are more readily identified. These variations can be easily viewed by selecting the Time Series Graph link from the CEMP home page, < http://www.cemp.dri.edu/>, after selecting a desired station and then selecting the desired variables.

CEMP Meteorological (MET) Network – Because changing weather conditions can have a significant effect on measurable levels of background radiation, meteorological instrumentation is in place at each of the 27 CEMP stations. The MET network includes sensors that measure air temperature, humidity, wind speed and direction, solar radiation, barometric pressure, precipitation, and soil temperature and moisture data. All of these data can be observed real-time at the onsite station display, and archived data are accessible by accessing the CEMP home page at <http://www.cemp.dri.edu/>.

6.1.1 Air Particulate Sampling Results

A sample of airborne particulates from a CEMP ASN station is collected by drawing air through a 2-inch (5-centimeter) diameter glass-fiber filter at a constant flow rate of 2 cubic feet (ft^3) per minute (86.6 liters per minute) at standard temperature and pressure. The actual flow rate and volume is measured and recorded with an in-line air-flow calibrator. The particulate filter is mounted in a filter holder that faces downward at a height of 5 ft (1.5 meter [m]) above the ground. The total actual volume collected ranges from approximately 19,000 to 28,000 ft^3 (538 to 793 cubic meters [m^3]) depending on the elevation of the station and changes in air temperature and/or pressure.

6.1.1.1 Gross Alpha and Gross Beta

Gross alpha and beta analysis in airborne particulate samples are used to screen for long-lived radionuclides in the air. The mean annual gross alpha activity across all sample locations was $1.80 \pm 0.54 \times 10^{-15}$ microcuries per milliliter (μCi/mL) ($6.66 \pm 1.99 \times 10^{-5}$ Becquerels [Bq]/m^3) (Table 6-1). Most of the results for 2005 exceeded the analytical minimum detectable concentration (MDC) (see Glossary, Appendix B) and, overall, are similar to results from previous years. Figure 6-3 shows the long-term maximum, mean, and minimum alpha trend for the CEMP stations as a whole.

Table 6-1. Gross alpha results for the CEMP offsite Air Surveillance Network in 2005

Sampling Location	Number of Samples	Concentration (x 10^{-15} μCi/mL [3.7 x 10^{-5} Bq/m^3])			
		Mean	Standard Deviation	Minimum	Maximum
Alamo	52	2.59	1.01	1.17	5.63
Amargosa Valley	52	1.68	0.75	0.72	3.81
Beatty	52	1.79	0.93	0.57	4.65
Boulder City	52	3.22	1.29	1.11	7.63
Caliente	52	2.37	1.22	0.21	5.99
Cedar City	52	2.11	0.83	0.46	4.51
Delta	52	1.56	0.77	0.83	5.17
Ely	50	1.39	0.56	0.19	2.59
Garden Valley	52	1.46	0.59	0.52	3.63
Goldfield	51	1.70	0.72	0.56	3.90
Henderson	50	1.58	0.60	0.53	3.09
Indian Springs	49	1.38	0.56	0.56	3.35
Las Vegas	52	2.61	1.13	0.80	6.30
Milford	51	1.62	0.68	0.63	4.65
Nyala Ranch	52	1.08	0.37	0.42	1.69
Overton	52	1.96	0.93	0.82	4.49
Pahrump	52	1.62	0.65	0.66	3.34
Pioche	50	1.29	0.56	0.48	3.51
Rachel	48	1.63	0.98	0.49	6.08
Sarcobatus Flats	52	2.84	1.23	1.04	5.70
Stone Cabin Ranch	52	1.42	0.46	0.64	2.39
St. George	52	1.57	0.64	0.61	3.30
Tonopah	51	1.53	0.63	0.38	3.06
Twin Springs	51	1.30	0.54	0.51	2.86
Network Mean = 1.80 ± 0.54 x 10^{-15} μCi/ml					
Mean MDC = 0.67 x 10^{-15} μCi/mL			**Standard Error of Mean MDC = 0.12 x 10^{-15} μCi/mL**		

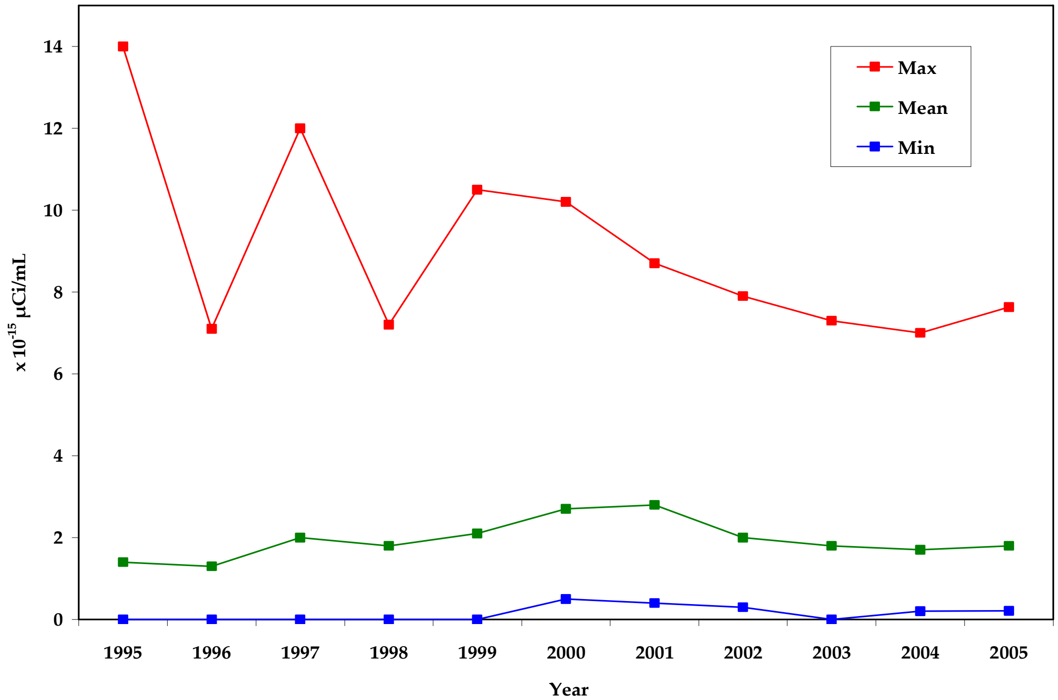

Figure 6-3. Historical trend for gross alpha analysis for all CEMP stations

The mean annual gross beta activity across all sample locations was $2.08 \pm 0.17 \times 10^{-14}$ μCi/mL ($7.70 \pm 0.62 \times 10^{-4}$ Bq/m^3) (Table 6-2). Most of these results also exceeded the MDC, and are similar to previous years' data. Figure 6-4 shows the long-term maximum, mean, and minimum beta trend for the CEMP stations as a whole.

Table 6-2. Gross beta results for the CEMP offsite Air Surveillance Network in 2005

Sampling Location	Number of Samples	Concentration (x 10^{-14} μCi/mL [3.7 x 10^{-4} Bq/m^3])			
		Mean	Standard Deviation	Minimum	Maximum
Alamo	52	2.18	0.68	1.26	4.79
Amargosa Valley	52	2.17	0.62	1.13	4.64
Beatty	52	2.15	0.68	1.02	4.77
Boulder City	52	2.40	0.87	1.31	5.34
Caliente	52	2.21	0.70	1.13	4.30
Cedar City	52	2.04	0.56	1.01	3.76
Delta	52	2.16	0.75	1.07	4.97
Ely	50	1.87	0.51	0.99	2.86
Garden Valley	52	1.97	0.61	0.81	3.73
Goldfield	51	2.06	0.72	1.03	5.25
Henderson	50	2.11	0.68	1.28	4.72
Indian Springs	49	1.96	0.54	1.08	4.02
Las Vegas	52	2.22	0.69	1.08	4.33
Milford	51	2.17	0.76	0.99	4.84

Table 6-2. Gross beta results for the CEMP offsite Air Surveillance Network in 2005 (continued)

		Concentration (x 10^{-14} µCi/mL [37 µBq/m^3])			
Sampling Location	**Number of Samples**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Nyala Ranch	52	1.73	0.55	0.73	3.09
Overton	52	2.27	0.72	1.30	4.26
Pahrump	52	2.06	0.61	1.11	4.05
Pioche	50	1.75	0.49	0.92	2.89
Rachel	48	2.10	0.69	0.92	4.13
Sarcobatus Flats	52	2.32	0.86	1.70	5.37
Stone Cabin	52	1.85	0.48	0.96	3.01
St. George	52	2.19	0.79	1.11	4.69
Tonopah	51	1.95	0.65	0.99	4.28
Twin Springs	51	1.97	0.69	0.96	3.92
Network Mean = 2.08 ± 0.17 x 10^{-14} µCi/mL					
Mean MDC = 0.12 x 10^{-14} µCi/mL		**Standard Error of Mean MDC = 0.02 x 10^{-14} µCi/mL**			

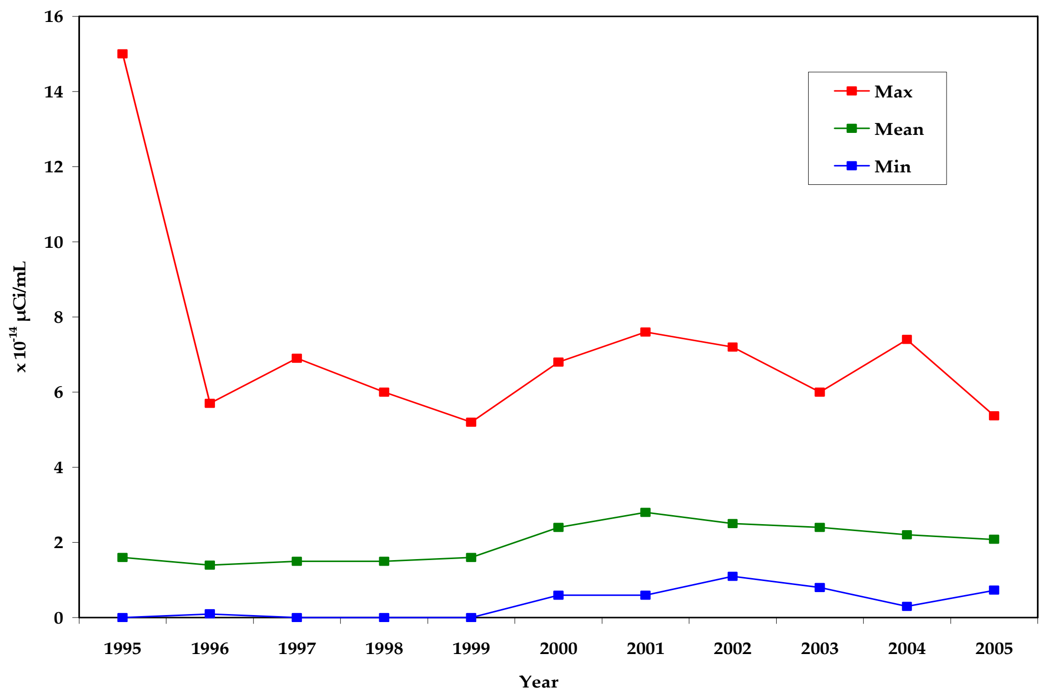

Figure 6-4. Historical trend for gross beta analysis for all CEMP stations

The overall gross alpha results show a generally increasing trend from 1995 to 2001 before trending downward the last four years. Likewise, the gross beta results show a similar trend beginning in 1998. These trends are also reflected by most of the stations on an individual basis. Although this trend merits further evaluation, it may likely be explained as being a result of persistent drought conditions throughout the southwest and Great Basin states. Drought in these regions has existed to varying degrees since 1996. These dry conditions could be directly responsible for an increase in suspended air particles collected by the air-sampling network. The apparent spikes in the maximum trend lines for gross alpha and beta are the result of a single analysis for that year. These analyses occurred prior to the CEMP being directed by DRI, so specific information is not available.

6.1.1.2 Gamma Spectroscopy

Gamma spectroscopy analysis was performed on all samples from the low-volume air-sampling network. The filters were composited by station on a quarterly basis after gross alpha/beta analysis. As in previous years, all samples were gamma spectrum negligible with respect to man-made radionuclides (i.e., gamma-emitting radionuclides were not detected). In most of the samples, naturally occurring ^{7}Be was detected above the analytical MDC. This radionuclide is produced by cosmic ray interaction with nitrogen in the atmosphere. The mean annual activity for ^{7}Be for the sampling network was 75.3 ± 28.1 x 10^{-15} μCi/mL.

6.1.2 TLD Results

TLDs measure ionizing radiation from all sources, including natural radioactivity from cosmic or terrestrial sources and from man-made radioactive sources. The TLDs are mounted in a plexiglass holder approximately 1 m above the ground, and are exchanged quarterly. TLD results are not presented for Warm Springs Summit at this time since its access is limited in the winter months. This does not allow for a proper quarterly change of the TLD as required. The total annual exposure for 2005 ranged from 82 milliroentgens (mR) (0.82 millisieverts [mSv]) at Pahrump, Nevada, to 155 mR (1.55 mSv) at Twin Springs, Nevada, with a mean annual exposure of 120 mR (1.20 mSv) for all operating locations. Results are summarized in Table 6-3 and are consistent with previous years' data. Figure 6-5 shows the long-term trend for the CEMP stations as a whole.

Table 6-3. TLD monitoring results for the CEMP offsite Air Surveillance Network in 2005

Sampling Location	Number of Days	Daily Exposure (mR)			Total Annual Exposure (mR)
		Mean	Minimum	Maximum	
Alamo	364	0.31	0.29	0.35	114
Amargosa Valley	362	0.30	0.29	0.33	109
Beatty	364	0.39	0.37	0.43	143
Boulder City	358	0.30	0.27	0.34	111
Caliente	357	0.35	0.33	0.39	128
Cedar City	356	0.26	0.24	0.29	97
Delta	357	0.27	0.24	0.30	99
Ely	364	0.29	0.28	0.31	105
Garden Valley	356	0.41	0.39	0.43	149
Goldfield	364	0.34	0.32	0.37	126
Henderson	358	0.33	0.30	0.37	121
Indian Springs	362	0.29	0.27	0.33	106
Las Vegas	369	0.27	0.23	0.30	97
Medlin's Ranch	364	0.38	0.36	0.40	137
Milford	357	0.40	0.39	0.43	147
Nyala Ranch	364	0.32	0.29	0.34	116
Overton	356	0.25	0.23	0.30	93
Pahrump	363	0.23	0.20	0.26	82
Pioche	364	0.32	0.29	0.36	118
Rachel	364	0.36	0.33	0.39	133
Sarcobatus Flats	364	0.40	0.39	0.42	147
Stone Cabin Ranch	364	0.38	0.36	0.40	139
St. George	357	0.25	0.23	0.29	91
Tonopah	363	0.33	0.33	0.39	134
Twin Springs	363	0.40	0.40	0.44	155
Overall Annual Mean = 120 mR					

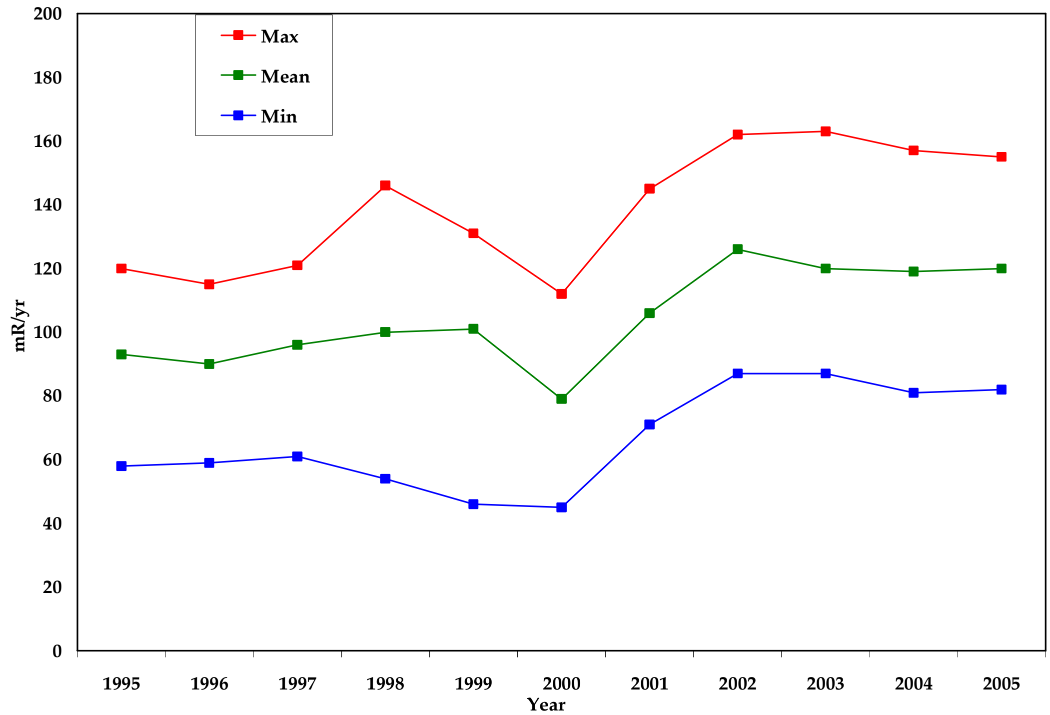

Figure 6-5. Historical trend for TLD analysis for all CEMP stations

As with the gross alpha and beta results, the TLD data also shows a generally increasing trend from 1996 to 2002 before showing a slight decrease the last three years. This again may be consistent with drought conditions observed in the regions around the monitoring network. As the soil becomes drier due to lack of precipitation, the naturally-occurring radionuclides may more easily escape into the atmosphere as part of the increased suspended particle load. This could result in an increase in natural radioactivity detected by the TLD. As with the gross alpha and beta results further evaluation is needed.

6.1.3 PIC Results

The PIC data presented in this section are based on daily averages of gamma exposure rates from each station. Table 6-4 contains the maximum, minimum, and standard deviation of daily averages (in microroentgens per hour [µR/hr]) for the periods during 2005 when telemetry data were available. It also shows the average gamma exposure rate for each station during the year (in µR/hr) as well as the total annual exposure (in mR per year [mR/yr]). The Mesquite station was installed in November 2005, and therefore includes data from November and December only. The exposure rate ranged from 74.55 mR/yr (0.75 mSv) in Pahrump to 183.96 mR/yr (1.84 mSv) in Milford, Utah. Background levels of environmental gamma exposure rates in the United States (from combined effects of terrestrial and cosmic sources) vary between 49 and 247 mR/yr (BEIR III, 1980). Averages for selected regions of the United States were compiled by the EPA and are shown in Table 6-5. The annual exposure levels observed at the CEMP stations in 2005 are well within these United States background levels.

Table 6-4. PIC monitoring results for the CEMP offsite Air Surveillance Network in 2005

Sampling Location	Daily Average Gamma Exposure Rate (µR/hr)				Annual Exposure (mR/yr)
	Mean	Standard Deviation	Minimum	Maximum	
Alamo	13.39	0.26	12.50	14.27	117.25
Amargosa Valley	12.56	0.16	11.98	13.13	109.98
Beatty	13.35	0.94	9.83	16.86	116.90
Boulder City	14.83	0.20	14.24	15.41	129.87
Caliente	15.38	0.32	14.49	16.26	134.69
Cedar City	10.91	0.24	10.00	11.81	95.53
Delta	10.40	0.32	9.34	11.45	91.06
Ely	12.00	0.33	10.59	13.41	105.12
Garden Valley	16.90	1.09	13.66	20.14	148.04
Goldfield	14.40	0.43	12.59	16.20	126.10
Henderson	15.15	0.17	14.48	15.82	132.71
Indian Springs	11.37	0.20	10.75	11.98	99.56
Las Vegas	10.72	0.14	9.99	11.44	93.86
Medlin's Ranch	16.59	0.34	15.46	17.72	145.33
Mesquite [(a)]	11.63	0.22	11.16	12.10	101.88
Milford	21.00	0.36	19.84	22.16	183.96
Nyala Ranch	13.05	0.42	11.79	14.31	114.32
Overton	9.90	0.27	9.18	10.62	86.72
Pahrump	8.51	0.50	7.05	9.97	74.55
Pioche	14.99	0.32	13.71	16.26	131.27
Rachel	14.83	0.45	13.52	16.14	129.91
Sarcobatus Flats	17.14	0.38	16.07	18.21	150.15
Stone Cabin Ranch	16.03	0.76	13.56	18.49	140.38
St. George	9.17	0.30	8.30	10.04	80.33
Tonopah	15.36	0.47	13.59	17.12	134.51
Twin Springs	19.20	0.60	16.92	21.48	168.19
Warm Springs Summit	19.23	0.55	17.57	20.89	168.45

(a) Includes only two months' data (November and December)

Table 6-5. Average natural background radiation for selected U.S. cities (excluding radon)

City	Radiation (mR/yr)
Denver, CO	164.6
Tampa, FL	63.7
Portland, OR	86.7
Los Angeles, CA	73.6
St. Louis, MO	87.9
Rochester, NY	88.1
Wheeling, WV	111.9
Richmond, VA	64.1
New Orleans, LA	63.7
Fort Worth, TX	68.7

Source: <http://www.wrcc.dri.edu/cemp/Radiation.html.> "Radiation in Perspective," August 1990 (Access Date: 3/22/2005)

6.1.4 Environmental Impact

Results of analyses conducted on data obtained from the CEMP network of low-volume particulate air samplers, TLDs, and PICs showed no measurable evidence at CEMP station locations of offsite impact from radionuclides originating on the NTS. Activity observed in gross alpha and beta analyses of low-volume air sampler filters was consistent with previous years' results and are within the range of activity found in other communities of the United States which are not adjacent to man-made radiation sources. Also, no man-made gamma-emitting radionuclides were detected. Likewise, TLD and PIC results remained consistent with previous years' background levels and are well within average background levels observed in other parts of the United States (see Table 6-5).

Occasional elevated gamma readings (10–50 percent above normal average background) were always associated with precipitation events and/or low barometric pressure. Low barometric pressure can result in the release of naturally-occurring radon and its daughter products from the surrounding soil and rock substrates. Precipitation events can result in the "rainout" of globally-distributed radionuclides occurring as airborne particulates in the upper atmosphere. Figure 6-6, generated from the CEMP Web site, illustrates an example of this phenomenon.

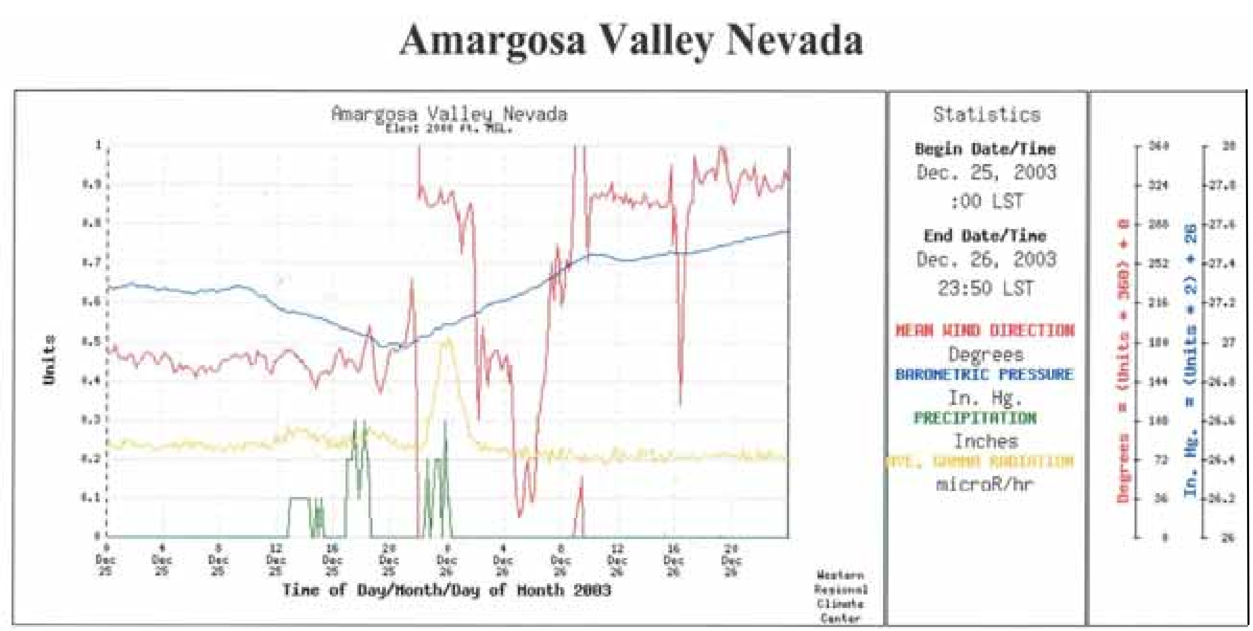

Figure 6-6. The effect of meteorological phenomena on background gamma readings

6.2 Offsite Surface and Groundwater Monitoring

During 2005, the DRI was tasked by NNSA to provide independent verification of the tritium activity within some of the offsite groundwater wells, surface waters, and springs used for water supplies in areas surrounding the NTS. Samples collected by DRI personnel provide a direct comparison to the results obtained by the RREMP (Section 4.1) in some cases.

The sole analyte for this project was tritium. Tritium is one of the most abundant radionuclides generated by an underground nuclear test and, since it is a constituent of the water molecule itself, it is also one of the most mobile.

6.2.1 Sample Locations and Methods

During the period of July 12 to September 22, 2005, 4 springs, 18 wells, and 3 surface water bodies were sampled either directly or through municipal water supply systems. Sample locations were selected based upon input from the CEMs and local ranch owners participating in the CEMP project. All wells were sampled utilizing downhole submersible pumps. Samples from surface water bodies were obtained via discharge from a faucet or valve connected to water supply system that pumps that body of water. Springs were sampled by hand at the orifice, along surface drainage, or from the water supply system connected to the spring discharge. Each well was pumped a minimum of 5 to 15 minutes prior to sampling to purge water from the pump tubing and well annulus. This process ensured that the resultant sample was representative of local groundwater. Table 6-6 lists all of the sample points, their locations, the date they were sampled, and the sampling method. The locations of the sample points are shown in Figure 6-7.

6.2.2 Procedures and Quality Assurance

DRI utilized several methods to ensure that radiological results reported herein conform to current QA protocols (see Section 19.0 for a detailed description of the CEMP QA program). This was achieved through the use of standard operating procedures (SOPs), field QA samples, and laboratory QA procedures. DRI's SOPs are detailed procedures that describe the method and materials, using step-by-step instructions, which are required to collect field water quality samples and protect the samples from tampering and environmental conditions that may alter their chemistry.

The second tier of QA utilized on this project consisted of field QA samples. The intent of these samples and procedures was to provide direct measures of the contribution of radioactive material that was derived from the bottles, sampling equipment, and the environment to the activity of tritium measured within the samples. Duplicate samples were collected to establish a measure of the repeatability of the analysis. Matrix spike duplicates were also collected to ensure no other parameters in the sample water were present that could cause erroneously high or low tritium values. Twelve samples (32 percent of the sample load) were collected for the purposes of meeting field QA requirements. Laboratory QA controls consisted of the utilization of published laboratory techniques for the analysis of enriched tritium, method blanks, laboratory control samples, and laboratory duplicates. The laboratory QA samples provide a measure of the accuracy and the confidence of the reported results.

Enriched tritium analyses were run on all water samples. The decision level (L_C) (see Glossary, Appendix B) of tritium ranged from 7.31 to 10.91 picocuries per liter (pCi/L). The L_C is the result that must be exceeded before there is a 95 percent confidence that the sample contains radioactive material above background. The MDC (see Glossary, Appendix B) for tritium was approximately 23 pCi/L. BN reports that the MDC for enriched tritium analyses for the RREMP water samples is also approximately 23 pCi/L (see Section 4.1.2).

Table 6-6. CEMP water monitoring locations sampled in 2005

Monitoring Location Description	Latitude	Longitude	Date Sampled	Sample Collection Method
Adaven Springs	38 08.25	-115 36.20	7/13/2005	By hand from stream discharging from spring orifice
Alamo city water supply system - source of water is municipal well field	37 21.74	-115 10.14	9/13/2005	By hand from municipal water well
Amargosa Valley school well	36 34.16	-116 27.66	9/22/2005	By hand at wellhead
Beatty Water and Sewer - municipal well	36 54.94	-116 45.65	9/22/2005	By hand at wellhead at utility headquarters
Boulder City – at Hemingway Park from municipal water distribution system	35 59.74	-114 49.90	8/17/2005	By hand from a drinking fountain inside Hemingway Park. Water originates from Lake Mead.
Caliente municipal water supply well	37 36.93	-114 30.98	9/13/2005	By hand at well in municipal well field (sampled new well location this year)
Cedar City municipal water supply well #7 10 miles west of town	37 39.39	-113 13.14	9/15/2005	By hand at wellhead
Delta municipal well	39 21.59	-112 34.65	9/14/2005	By hand at well head
Ely municipal water source	39 13.80	-114 54.01	7/13/2005	By hand from spring discharge used as municipal water supply
Goldfield Municipal Water Supply well about 12 mi north of town	37 52.40	-117 14.96	8/10/2005	By hand at wellhead
Henderson CCSN - source of water is municipal water system originating at Lake Mead	36 00.43	-114 57.95	8/17/2005	By hand from faucet inside college building; water originates from Lake Mead.
Indian Springs municipal well	36 34.15	-115 40.25	9/22/2005	By hand at wellhead (sampled new well location this year)
Las Vegas Valley Water District #103	36 13.94	-115 15.13	9/20/2005	By hand at wellhead
Medlin's Ranch - spring 11 mi west of ranch house	37 24.10	-115 32.25	7/12/2005	By hand at kitchen faucet
Milford municipal well	38 22.88	-112 59.78	9/14/2005	By hand at wellhead of recently drilled well
Nyala Ranch water well	38 14.93	-115 43.72	7/12/2005	By hand from front yard hose faucet at house
Overton water well located at Arrow Canyon about 10 mi west of town	36 44.06	-114 44.87	9/20/2005	By hand at wellhead
Pahrump municipal utility well #11	36 12.32	-115 59.12	9/20/2005	By hand at wellhead (sampled new well location this year)
Pioche municipal well located 1 mile east of town	37 56.98	-114 25.78	9/13/2005	By hand at wellhead
Rachel - Little Ale Inn well	37 38.79	-115 44.75	7/12/2005	By hand from bar faucet inside Lil Ale Inn Restaurant
Sarcobatus Flats well	37 16.78	-117 01.92	8/9/2005	By hand at wellhead
St. George Quail Creek Reservoir	37 10.43	-113 23.96	9/15/2005	By hand at water treatment plant. Water originates from Quail Creek Reservoir
Stone Cabin Ranch Spring	38 12.44	-116 37.91	7/12/2005	By hand from kitchen faucet at ranch house
Tonopah public utilities well field located 10 mi from town	38 11.68	-117 04.70	8/10/2005	By hand at wellhead
Twin Springs Ranch Well	38 12.21	-116 10.55	7/12/2005	By hand from front yard hose faucet at house

Note: Sample locations were resurveyed in 2004 using global positioning satellite data. The following sample locations were moved in 2005: Caliente was moved 224 m based on request by the CEM, Ely monitoring point was added to the monitoring network, Indian Springs was moved approximately 1.4 km on request by the CEM, Milford was moved 2.0 km to a recently drilled well on request by the CEM, Pahrump was moved 112 m on request by CEM, St. George was moved 22 km to the water treatment plant at Quail Creek Reservoir on request by the CEM, Origin of Twin Springs Ranch water has, in the past, been erroneously reported as being from a spring on location. In actuality, water originates from a well drilled near the spring. All updated sample locations are shown in Figure 6-7.

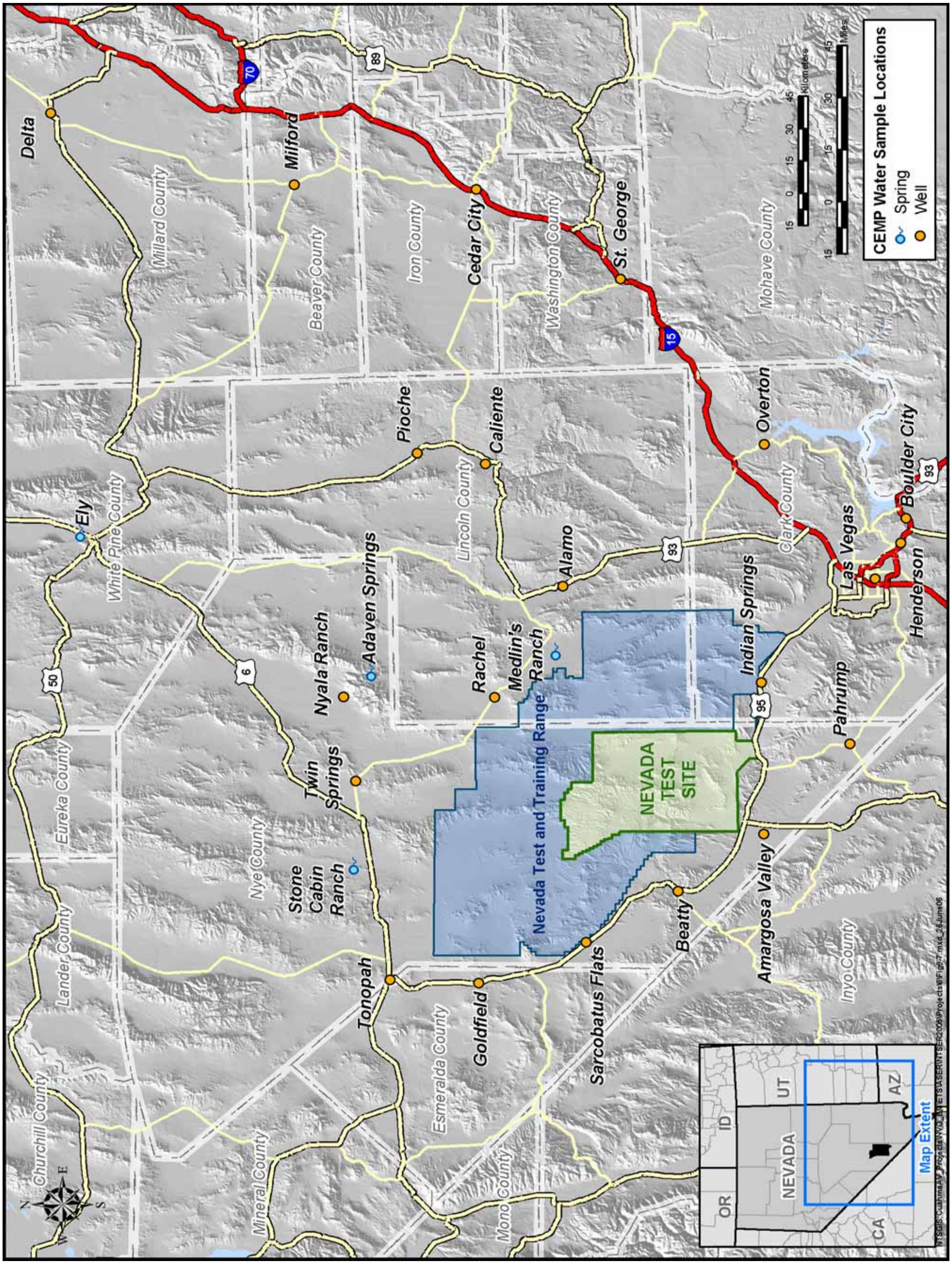

Figure 6-7. 2005 CEMP water monitoring locations

6.2.3 Results of Surface Water and Spring Discharge Monitoring

Measured tritium (^3H) concentrations from the springs and surface waters ranged from -2 to 24 pCi/L (Table 6-7). Three of the samples, Ely, Stone Cabin Ranch, and St. George, yielded results that were indistinguishable from background (i.e., ≤ L_C). The Adaven Springs sample and Medlin's Ranch were above background (i.e., ≥ L_C), yet the activity was too low to quantitatively distinguish from background at 95 percent confidence (i.e, < MDC). Boulder City and Henderson had tritium activities that were sufficiently high to quantify above background with 95 percent confidence (i.e., ≥ MDC). The water in these samples originated from Lake Mead. Slightly elevated tritium activities in Lake Mead are well documented by previous investigations (DOE, 2002c; DOE, 2003c; DOE, 2004d; DOE, 2005a) and are due to residual tritium persisting in the environment that originated from global atmospheric nuclear testing. All tritium results were well below the safe drinking water limit of 20,000 pCi/L. All sample results, with the exception of Ely, were statistically similar to results reported by DRI in the Nevada Test Site Environmental Report 2004 (DOE, 2005a). Ely was added as a monitoring point in 2005. The greatest apparent change was for Adaven Springs, which was measured as 16 ± 20 pCi/L in 2003, 12 ± 22 in 2004, and 20 ± 17 pCi/L in 2005. The degree to which the mean value of Adaven Springs fluctuates from year to year is consistent with its relatively high level of uncertainty.

Table 6-7. Tritium results for CEMP offsite surface water and spring discharges in 2005

Monitoring Location	^3H ± Uncertainty[a] (pCi/L)			L_C (pCi/L)
Adaven Springs	20	±	17	10
Ely Municipal Water Source – springs 3 to 4 miles west of town	-2	±	25	10
Medlin's Ranch - spring located 11 miles west of ranch house	10	±	18	7
Stone Cabin Ranch	2	±	20	7
Boulder City – Source of Water is Lake Mead	24	±	24	10
Henderson – Source of Water is Lake Mead	24	±	24	8
St. George – Source of Water is Quail Creek Reservoir	8	±	19	11

(a) ± 2 standard deviations

6.2.4 Results of Groundwater Monitoring

The results for the 18 groundwater tritium analyses from the DRI Tritium Laboratory are presented in Table 6-8. The measured activities ranged from -7 to 8 pCi/L. All of the samples yielded results that were statistically indistinguishable from background (≤L_C) and were well below the safe drinking water limit of 20,000 pCi/L. No statistically significant trends were evident when the results were compared to samples taken in previous years.

6.2.5 Environmental Impact

Results of the CEMP tritium analyses conducted on selected offsite groundwater wells and water supply systems surrounding the NTS showed no evidence of tritium migration offsite via groundwater. Most of the samples analyzed were below the L_C for tritium (see Tables 6-7 and 6-8). The greatest observed activities, (24 pCi/L for both Henderson and Boulder City) were well below the safe drinking water standard of 20,000 pCi/L.

Table 6-8. Tritium results for CEMP offsite wells in 2005

Monitoring Location	^{3}H ± Uncertainty[a] (pCi/L)	L_C (pCi/L)
Alamo City	-4 ± 23	8
Amargosa Valley	-3 ± 15	10
Beatty	-3 ± 18	10
Caliente	8 ± 21	8
Cedar City	3 ± 20	10
Delta	-8 ± 20	11
Goldfield	0 ± 19	10
Indian Springs	-5 ± 13	10
Las Vegas	-5 ± 23	11
Milford	1 ± 20	8
Nyala Ranch	0 ± 16	7
Overton	-4 ± 16	11
Pahrump	-5 ± 20	11
Pioche	-7 ± 23	8
Rachel	-1 ± 19	7
Sarcobatus Flats	-3 ± 14	10
Tonopah	-4 ± 20	10
Twin Springs Ranch	-2 ± 20	7

(a) ± 2 standard deviations

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7.0 Radiological Biota Monitoring

Historical atmospheric nuclear weapons testing and outfalls from underground nuclear tests provide a source of radiation contamination and exposure to Nevada Test Site (NTS) plants and animals (biota). U.S. Department of Energy (DOE) Order 5400.5, *Radiation Protection of the Public and the Environment* requires that all DOE sites monitor radioactivity in the environment to ensure that the public does not receive a radiological dose greater than 100 millirems per year (mrem/yr) from all pathways of exposure, including the ingestion of contaminated plants and animals.

Current NTS land use precludes the harvest of plants or plant parts (e.g., pine nuts and wolf berries) for direct consumption by humans. Therefore, the ingestion of game animals is the primary potential biotic pathway for radionuclide contamination from the NTS to the public. Game birds and game mammals that occur on the NTS may travel off the site and become available, through hunting, for consumption by the public. Game animals are therefore monitored under the *Routine Radiological Environmental Monitoring Plan* (RREMP) (DOE, 2003b). In 2005, Bechtel Nevada Environmental Technical Services conducted the monitoring.

Game animals and plants are sampled annually from known contaminated sites on the NTS to estimate hypothetical doses to hunters (i.e., the public), measure the potential for radionuclide transfer through the food chain, and determine if NTS plants and animals themselves are exposed to radiation levels harmful to their populations. This section describes the biota monitoring program designed to meet public and environmental radiation protection regulations (see Section 2.3) and presents the results of field sampling and analyses in 2005. The reader is directed to the RREMP (DOE, 2003b) for a more detailed description of monitoring design and methods. The estimated radiological dose, both to humans consuming game animals from the NTS and to biota found in contaminated areas of the NTS, that was calculated based on 2005 monitoring data is presented in Section 8.0.

Radiological Biota Monitoring Goals	***Analytes Measured in Plant and Animal Tissues***
Determine if the potential dose to humans consuming game animals from the NTS is less than 100 mrem/yr, the limit set by DOE Order 5400.5 Determine if the absorbed radiation dose to NTS biota is less than the following limits set by DOE Order 5400.5 and DOE Standard DOE-STD-1153-2002: < 1 rad/day for terrestrial plants and aquatic animals < 0.1 rad/day for terrestrial animals	Americium-241 (^{241}Am) Cesium-137 (^{137}Cs) Tritium (^{3}H) Plutonium-239+240 ($^{239+240}$Pu) Strontium-90 (^{90}Sr) Uranium isotopes

7.1 Species Selection

The goal for vegetation monitoring is to sample the most contaminated plants within the NTS environment. Contaminated plants are generally found inside demarcated radiological areas near the "ground zero" locations of historical above-ground nuclear tests. The plant species selected for sampling represent the most dominant plant life forms (e.g., trees, shrubs, herbs, or grasses) at these sites. Woody vegetation (i.e., shrubs versus forbs or grasses) is primarily selected for sampling because such vegetation is reported to have deeper penetrating roots and higher concentrations of tritium (Hunter and Kinnison, 1998). Additionally, this vegetation serves as a major source of browse for game animals that might eat such vegetation and potentially migrate offsite. Grasses and forbs are also sampled when present, however, because they are also a source of food for wildlife. Plant parts collected for analysis represent new growth over the past year.

Three criteria were used to determine which animal species to monitor for assessing potential dose to the public: 1) the species should have a relatively high probability of entering the human food chain; 2) the species should have a home range which overlaps a contaminated site and, as a result, have the potential for relatively high radionuclide body burdens from exposure to contaminated soil, air, water, or plants at the contaminated site; and 3) the species should be sufficiently abundant at a site to acquire an adequate tissue sample for laboratory analysis. These criteria limited the candidate game animals on the NTS to those listed below.

Candidate NTS Game Animals Monitored

Birds	Small Mammals	Large Mammals
Mourning dove (*Zenaida macroura*)	Cottontail rabbit (*Sylvilagus audubonii*)	Mule deer (*Odocoileus hemionus*)
Chukar (*Alectoris chukar*)	Jackrabbit (*Lepus californicus*)	Pronghorn antelope (*Antilocapra americana*)
Gambel's quail (*Callipepla gambelii*)		

Mule deer and pronghorn antelope are only collected as the opportunity arises if they are found dead on the NTS (e.g., from accidentally being hit by a vehicle). Tissues from other game species, such as predators, may be collected opportunistically as well.

No native fish or amphibians are found in surface waters of the NTS. There is no potential radiological dose pathway directly from NTS aquatic animals to humans. No aquatic invertebrates or non-native fish or amphibians are sampled for radionuclide tissue analyses.

7.2 Site Selection

The monitoring design focuses on sampling those sites having the highest known concentrations of radionuclides in other media (e.g., soil and surface water) and sites that have relatively high densities of candidate game animals. Currently, five sites are selected for regular monitoring; each site is sampled at least once every five years. These sites are E Tunnel Ponds, Palanquin, Sedan, T2, and Plutonium Valley (Figure 7-1). The control site selected for each contaminated site has similar biological and physical features. Control sites are sampled to document radionuclide levels representative of background. In 2005, the Sedan site and its control were sampled. Other sites may be monitored if new sites become radiologically contaminated or if contamination conditions change (e.g., through the addition of water pumped from contaminated ground water or from soil disturbance). In 2005, one such new site was monitored. Below is a brief description of the sites monitored during 2005.

Sedan – The Sedan test was conducted July 6, 1962 in the northern portion of Area 10. This cratering experiment displaced 12 million tons of earth and formed a 390 meter (m) (1,280 foot [ft]) diameter by 97 m (320 ft) deep depression in the desert floor. The purpose of the test was to determine if nuclear devices could be used as cratering or earth-moving mechanisms. Contaminants resulting from this test were primarily tritium (^{3}H), ^{90}Sr, ^{137}Cs, $^{239+240}Pu$, and ^{241}Am. A control area for Sedan is located about 20 kilometers (km) (12.6 miles [mi]) southwest of the sample site near a spring in Area 16. Any of the candidate game species is likely to be present at Sedan the control site.

U-19ad Sump – During 2004, a new well (U-19ad PS#1A) was drilled into the cavity of the underground nuclear test, CHANCELLOR, which was detonated September 1, 1983. This well will be used by the Underground Test Area Project to support the NNSA's continuing characterization and long-term monitoring efforts. Over 200,000 gallons of water were pumped from this well late in 2004 and water remained in the sump, available for wildlife use, through 2005. The tritium concentration of the pumped groundwater held in the sump was 22,000,000 pCi/L (DOE, 2005a). Biota sampling efforts in 2005 focused on collecting mourning doves as they were expected to be the most exposed of game birds and have the highest potential for transport to offsite hunters.

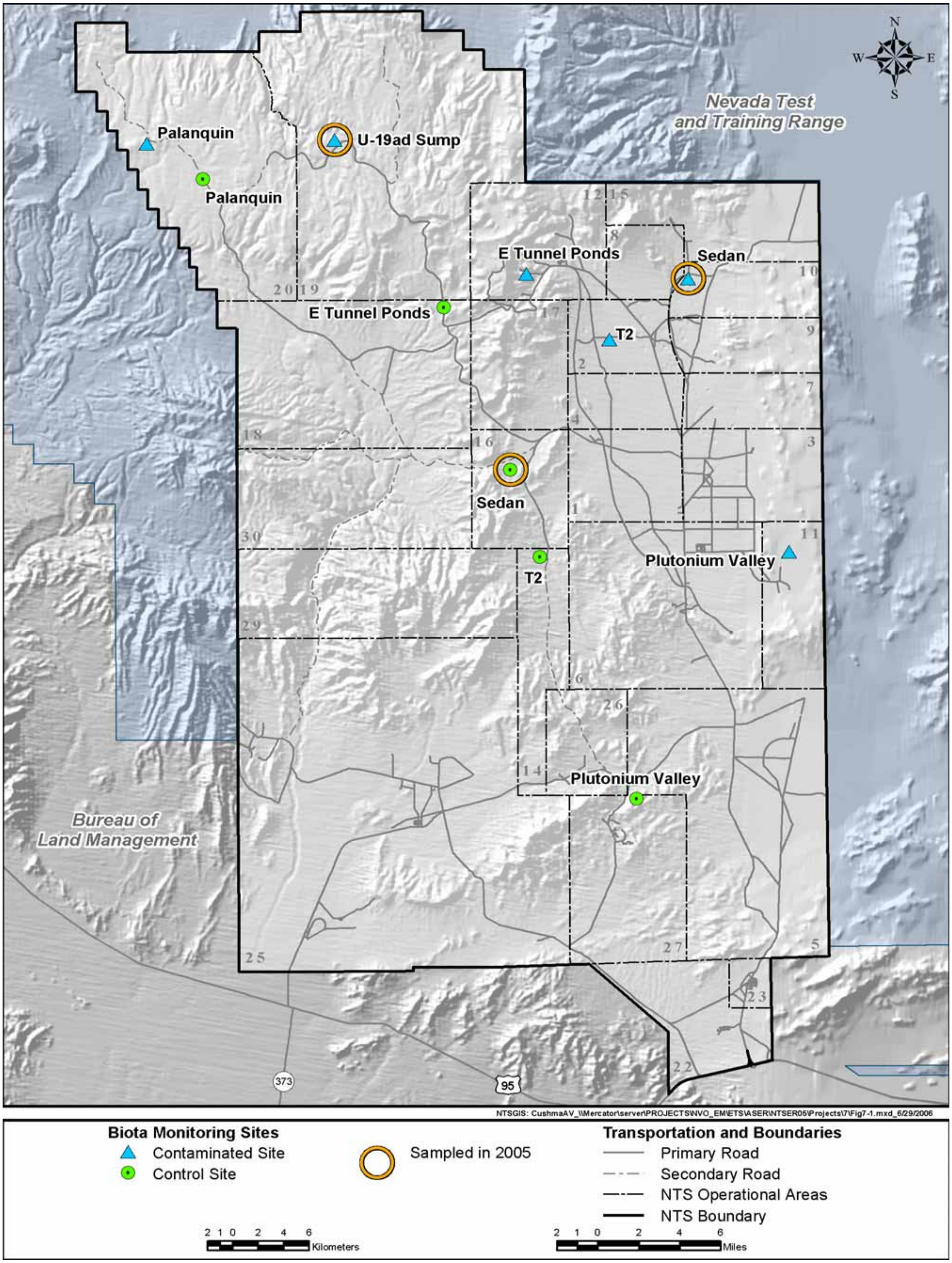

Figure 7-1. Radiological biota monitoring sites on the NTS and sites sampled in 2005

7.3 Sampling Methods

During 2005, biota samples were successfully collected at Sedan, the Sedan control site, and the U-19ad Sump. Sample methods and the numbers and types of samples collected are described below.

7.3.1 Plants

Plant sampling occurred June 28 and 29, 2005. At each site, two samples of each plant species shown in Table 7-1 were collected. These species represent the dominant shrubs, forbs, and grasses present at each site. Each sample consisted of about 300 to 500 grams (10.6 to 17.6 ounces) of fresh-weight plant material and consisted of a composite of material from many plants of the same species in the sample area. Only current year's growth was collected from each plant and consisted of new green leaves and stems. Green leaves and stems from shrubs and forbs were hand-plucked and stored in airtight plastic bags. Rubber gloves were used by samplers and changed between each composite sample collected. Samples were labeled and stored in an ice chest. Within four hours of collection, the samples were delivered to the laboratory. Water was separated from plant samples by distillation. Water and dried plant tissues were submitted to a commercial laboratory for analysis of radionuclides. Water from plants was analyzed for tritium and dried plant tissue was analyzed for gamma-emitting radionuclides, ^{90}Sr, uranium, plutonium, and ^{241}Am.

Table 7-1. Plant species sampled at Sedan and the Sedan control site in 2005

Plant Common Name	Name Abbreviation[(a)]	Plant Scientific Name	Sedan	Sedan Control Site
Indian ricegrass	ACHY	*Achnatherum hymenoides*	X	
Desert needlegrass	ACSP	*Achnatherum speciosum*	X	
Basin big sagebrush	ARTR	*Artemisia tridentata*		X
Four-wing saltbush	ATCA	*Atriplex canescens*		X
Glaucus willowherb	EPGL	*Epilobium glaberrimum*		X
Rubber rabbitbrush	ERNA	*Ericameria nauseosus*	X	X
Baltic rush	JUBA	*Juncus balticus*		X
Hoary tansyaster	MACA	*Machaeranthera canescens*	X	
Desert bitterbrush	PUGL	*Purshia glandulosa*		X
Small wirelettuce	STEX	*Stephanomeria exigua*	X	

(a) Plant name abbreviation used in the sample results table (Table 7-2)

7.3.2 Animals

State and federal permits were secured to trap and analyze rabbits, Gambel's quail, chukar, and mourning doves during 2005 as well as to sample road-killed, large game animals. Animal trapping took place late June through August. Live-traps were run for 84 trap-nights. Three jackrabbits and three mourning doves were trapped at Sedan, two cottontail rabbits were trapped at the Sedan control site, and four mourning doves were trapped by the U-19ad Sump.

Opportunistic sampling of two large predators occurred during 2005. These were of one mountain lion which had died of natural causes in Area 7 and one bobcat which was hit by an automobile on Mercury Highway in Area 5. Only muscle tissue samples were taken from these animals.

In the laboratory, animal specimens were separated into two samples: a muscle tissue sample and a sample representing the whole body minus the portion of muscle (body fraction). All samples, except the two rabbits from the Sedan control site, were individually homogenized using an industrial meat grinder and food processor. The rabbits from the control site were composited and homogenized. Water was distilled from the samples and submitted to a laboratory for tritium analysis. Past results have shown no difference in tritium concentrations in water from muscle tissue versus the rest of the body. Therefore, there was only one water sample for each animal (water from muscle and the body fraction were combined). The dried tissue samples were also submitted, muscle tissue and body fraction separately, to a laboratory for analysis of gamma-emitting radionuclides, ^{90}Sr, uranium, plutonium, and ^{241}Am.

7.4 Results

7.4.1 Plants

Concentrations of man-made radionuclides detected in 2005 NTS plant samples are shown in Table 7-2. Uranium was detected but at levels and isotopic ratios consistent with natural uranium. All plant samples from Sedan had detectable concentrations of man-made radionuclides. These radionuclides were ^{3}H, ^{90}Sr, ^{137}Cs, ^{238}Pu, $^{239+240}$Pu, and ^{241}Am. Only two samples from the Sedan control site had concentrations of man-made radionuclides slightly higher than the minimum detectable concentration (MDC). Given the low concentrations, analysis uncertainty, and the fact that about 5 percent of all samples can be expected to be a false positive, there is question whether these results were true detections.

7.4.2 Animals

Man-made radionuclides were detected in all animals collected from the contaminated sites Sedan and U-19ad Sump; trace ^{137}Cs was detected in the body fraction of rabbits collected from the Sedan control site; and tritium was detected in the mountain lion sampled from Area 7 (Table 7-3). Uranium was detected but at levels and isotopic ratios not different from those expected with natural uranium. Tritium had the highest concentrations of all detected radionuclides with ^{137}Cs following at much lower concentrations. As expected, most plutonium was detected in the body fraction of animals as plutonium tends to concentrate in bone tissue or be bound with soil in the gut rather than in muscle tissue.

7.5 Environmental Impact

As expected, higher concentrations of radionuclides were detected in biota sampled at Sedan and the U-19ad Sump. These locations contained radioactivity associated with historic testing of nuclear weapons. While these radionuclides were detected, they pose negligible risk to humans. The potential dose to a person hunting and consuming these animals is well below dose limits to members of the public (see Section 8.1.4). Also, radionuclide concentrations were below levels considered harmful to the health of the plants or animals as the dose resulting from observed concentrations were less than 1 percent of dose limits set to protect populations of plants and animals (see Section 8.2).

Table 7-2. Radionuclide concentrations in plants from Sedan and the Sedan control site in 2005

Sample	Radioncuclide Concentratons ± Uncertainty[a]					
	^{3}H[b]	^{90}Sr[c]	^{137}Cs[c]	^{238}Pu[c]	$^{239+240}$Pu[c]	^{241}Am[c]
Sedan						
ACHY #1	68,000 ± 1,800	0.17 ± 0.056	0.86 ± 0.16	0.011 ± 0.0086	0.081 ± 0.024	0.023 ± 0.017
ACHY #2	64,000 ± 1,700	0.64 ± 0.098	0.99 ± 0.32	0.021 ± 0.013	0.15 ± 0.032	0.023 ± 0.018
ACSP #1	97,000 ± 2,500	0.52 ± 0.063	0.35 ± 0.22	0.0076 ± 0.0087	0.046 ± 0.017	0.034 ± 0.023
ACSP #2	57,000 ± 1,500	0.46 ± 0.068	0.29 ± 0.21	0.0030 ± 0.0077	0.060 ± 0.021	0.0098 ± 0.013
ERNA #1	2,800,000 ± 72,000	0.17 ± 0.027	0.37 ± 0.084	0.0010 ± 0.0055	0.043 ± 0.014	0.0078 ± 0.010
ERNA #2	1,100,000 ± 27,000	0.43 ± 0.038	0.29 ± 0.073	0.0061 ± 0.0068	0.040 ± 0.014	0.0097 ± 0.0090
MACA #1	120,000 ± 3,100	0.034 ± 0.025	0.52 ± 0.20	0.10 ± 0.022	1.8 ± 0.16	0.33 ± 0.072
MACA #2	140,000 ± 3,700	0.011 ± 0.027	0.80 ± 0.17	0.082 ± 0.021	0.62 ± 0.081	0.18 ± 0.052
STEX #1	200,000 ± 5,300	0.86 ± 0.055	0.71 ± 0.16	0.010 ± 0.0098	0.020 ± 0.011	0.0080 ± 0.0095
STEX #2	570,000 ± 15,000	1.2 ± 0.065	0.16 ± 0.29	0.011 ± 0.0094	0.023 ± 0.012	0.014 ± 0.012
% Above MDC:	**100%**	**80%**	**90%**	**40%**	**100%**	**60%**
Average MDC:	**960**	**0.058**	**0.16**	**0.013**	**0.014**	**0.013**
Sedan - Control						
ARTR #1	170 ± 170	0.012 ± 0.014	0.021 ± 0.046	-0.00077 ± 0.0033	-0.00078 ± 0.0039	0.00042 ± 0.0016
ARTR #2	290 ± 170	0.011 ± 0.014	0.014 ± 0.041	0.0031 ± 0.0057	0.0015 ± 0.0061	-0.00089 ± 0.0033
ATCA #1	40 ± 140	0.014 ± 0.034	-0.0058 ± 0.029	-0.0020 ± 0.0039	0.00063 ± 0.0053	-0.0034 ± 0.0037
ATCA #2	150 ± 150	0.028 ± 0.040	0.062 ± 0.079	0.0027 ± 0.0070	0.0055 ± 0.0072	0.0047 ± 0.0071
EPGL #1	0 ± 140	-0.042 ± 0.032	0.015 ± 0.084	-0.0022 ± 0.0054	0.0050 ± 0.0058	0.0063 ± 0.0092
EPGL #2	130 ± 160	0.011 ± 0.025	0.060 ± 0.14	0.0023 ± 0.0045	0.0030 ± 0.0066	-0.0025 ± 0.0038
ERNA #1	25 ± 140	0.011 ± 0.016	-0.0038 ± 0.041	0.0074 ± 0.0097	0.00092 ± 0.0041	-0.0019 ± 0.0031
ERNA #2	17 ± 140	0.013 ± 0.016	0.097 ± 0.064	-0.00070 ± 0.0047	0.00063 ± 0.0054	0.0032 ± 0.0065
JUBA #1	180 ± 160	0.0054 ± 0.014	0.078 ± 0.095	-0.000016 ± 0.0038	-0.000031 ± 0.0053	-0.0016 ± 0.0043
JUBA #2	310 ± 170	0.0038 ± 0.016	-0.15 ± 0.18	0.00066 ± 0.0067	0.0021 ± 0.0054	-0.00015 ± 0.0046
PUGL #1	120 ± 150	-0.0088 ± 0.017	-0.031 ± 0.045	-0.00079 ± 0.0034	-0.00079 ± 0.0034	-0.0035 ± 0.0046
PUGL #2	160 ± 150	-0.0019 ± 0.024	0.039 ± 0.088	-0.000045 ± 0.0062	-0.0015 ± 0.0041	-0.0035 ± 0.0042
% Above MDC:	**16%**	**0%**	**0%**	**0%**	**0%**	**0%**
Average MDC:	**260**	**0.041**	**0.11**	**0.014**	**0.013**	**0.013**

Green-shaded results are considered detected (result greater than the sample-specific MDC).

(a) ± 2 standard deviation

(b) picocuries per gram liter water from sample

(c) picocuries per gram gram dry weight of sample

Table 7-3. Radionuclide concentrations in animals from Sedan and the Sedan control site in 2005

Sample	Radioncuclide Concentratons ± Uncertainty[(a)]				
	^{3}H[(b)]	^{137}Cs[(c)]	^{238}Pu[(c)]	$^{239+240}$Pu[(c)]	^{241}Am[(c)]
Sedan					
Dove #1 (muscle)	1,400 ± 220	0.20 ± 0.17	0.0029 ± 0.0070	0.012 ± 0.0099	0.0055 ± 0.0072
Dove #1 (body fraction)		1.00 ± 0.27	0.012 ± 0.0088	0.059 ± 0.021	0.015 ± 0.011
Dove #2 (muscle)	7,800 ± 430	0.31 ± 0.12	-0.0015 ± 0.0052	0.011 ± 0.0090	0.0018 ± 0.0036
Dove #2 (body fraction)		3.2 ± 0.14	0.0043 ± 0.0063	0.046 ± 0.018	0.016 ± 0.010
Dove #3 (muscle)	560 ± 220	0.71 ± 0.16	-0.0015 ± 0.0041	0.0059 ± 0.0082	-0.0034 ± 0.0032
Dove #3 (body fraction)		4.5 ± 0.21	0.0069 ± 0.0060	0.051 ± 0.018	0.015 ± 0.013
Jackrabbit #1 (muscle)	97,000 ± 2,500	0.29 ± 0.046	0.0026 ± 0.0036	0.0013 ± 0.0068	0.0038 ± 0.0083
Jackrabbit #1 (body fraction)		0.80 ± 0.11	0.0028 ± 0.0061	0.076 ± 0.018	0.014 ± 0.0087
Jackrabbit #2 (muscle)	290,000 ± 7,600	0.50 ± 0.074	0.0053 ± 0.0075	0.011 ± 0.0090	0.0019 ± 0.0051
Jackrabbit #2 (body fraction)		1.1 ± 0.11	0.0018 ± 0.0062	0.054 ± 0.015	0.015 ± 0.0078
Jackrabbit #3 (muscle)	78,000 ± 2,100	0.79 ± 0.11	0.00075 ± 0.0053	0.0075 ± 0.0059	-0.00060 ± 0.0072
Jackrabbit #3 (body fraction)		1.00 ± 0.087	0.0049 ± 0.0069	0.047 ± 0.015	0.012 ± 0.0079
% Above MDC (Average MDC):	**100% (547)**	**92% (0.083)**	**17% (0.010)**	**50% (0.013)**	**42% (0.011)**
Sedan - Control					
2 Cottontail rabbits (muscle)	-120 ± 200	0.0034 ± 0.056	-0.00081 ± 0.0053	0.0049 ± 0.0060	0.0028 ± 0.0052
2 Cottontail rabbits (body fraction)		0.125 ± 0.0904	0.0013 ± 0.0043	0.0050 ± 0.0070	0.0025 ± 0.0090
% Above MDC (Average MDC):	**0% (360)**	**50% (0.077)**	**0% (0.011)**	**0% (0.011)**	**0% (0.013)**
U-19ad Sump					
Dove #1 (muscle)	360 ± 210	-0.081 ± 0.15	0.010 ± 0.012	0.0060 ± 0.010	-0.0066 ± 0.0058
Dove #1 (body fraction)		0.13 ± 0.13	0.0019 ± 0.0064	0.0094 ± 0.0097	0.0065 ± 0.0095
Dove #2 (muscle)	2,400,000 ± 62,000	16 ± 1.4	-0.0016 ± 0.0053	0.0047 ± 0.0069	0.0066 ± 0.0062
Dove #2 (body fraction)		8.3 ± 0.27	0 ± 0.0053	0.017 ± 0.012	0.00027 ± 0.0086
Dove #3 (muscle)	730,000 ± 19,000	0.91 ± 0.24	0 ± 0.0040	0.010 ± 0.012	0.011 ± 0.0092
Dove #3 (body fraction)		0.60 ± 0.13	-0.0013 ± 0.0068	0.0092 ± 0.0069	0.0018 ± 0.0058
Dove #4 (muscle)	1,600,000 ± 42,000	7.7 ± 0.90	0 ± 0.0030	-0.0015 ± 0.0052	-0.0080 ± 0.0071
Dove #4 (body fraction)		5.5 ± 0.50	0.0040 ± 0.0045	0.0079 ± 0.0090	0.0015 ± 0.0080
% Above MDC (Average MDC):	**100% (2100)**	**75% (0.14)**	**0% (0.12)**	**25% (0.014)**	**13% (0.015)**
Area 7 Mountain lion (muscle)	3,900 ± 414	0.095 ± 0.12	0.0046 ± 0.0093	0.0032 ± 0.0034	0.0069 ± 0.0072
Area 5 Bobcat (muscle)	-30 ± 92	0.20 ± 0.16	0.0019 ± 0.0085	0 ± 0.0054	0.0012 ± 0.0051
% Above MDC (Average MDC):	**50% (260)**	**0% (0.15)**	**0% (0.012)**	**0% (0.014)**	**0% (0.014)**

Green-shaded results are considered detected (result greater than the sample-specific MDC).

(a) ± 2 standard deviation

(b) picocuries per liter water from sample;

(c) picocuries per gram dry weight of sample

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8.0 Radiological Dose Assessment

U.S. Department of Energy (DOE) Order 450.1, *Environmental Protection Program* and DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (see Section 2.3) require DOE facilities to estimate the radiological dose to the general public and to plants and animals in the environment caused by past or present facility operations. This chapter uses data gathered by Bechtel Nevada (BN) in 2005 and radiation surveys in the past that inventoried the radionuclide content of Nevada Test Site (NTS) surface soils to estimate these radiological doses with the aid of mathematical models. The data used are presented in Sections 3.0 through 7.0 of this report and include the 2005 results for onsite compliance monitoring of air, water, direct radiation, and biota, and the offsite monitoring results of air, direct radiation, and water conducted under the Community Environmental Monitoring Program (CEMP). The specific goals for the dose assessment component of radiological monitoring are shown below along with the compliance measures which are calculated in order to accomplish these assessment goals.

Radiological Dose Assessment Goals	Compliance Measures
Determine if the maximum radiation dose to a member of the general public from airborne radionuclide emissions at the NTS is less than the Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAP) limit of 10 millirems per year (mrem/yr) (0.1 millisieverts [mSv]/yr)	Annual average concentrations of radionuclides at six NTS critical-receptor air sampling locations compared to the Concentration Levels for Environmental Compliance, Table 2, Appendix E, 40 CFR 61 (NESHAP)
Determine if the total radiation dose to a member of the general public from all possible pathways (direct exposure, inhalation, ingestion of water and food) as a result of NTS operations is less than the limit of 100 mrem/yr established by DOE Order 5400.5	Committed effective dose equivalent (CEDE) for an offsite resident from all pathways, in mrem/yr (or mSv/yr)
Determine if the absorbed radiation dose to NTS biota is less than the following limits set by DOE Order 5400.5 and DOE Standard DOE-STD-1153-2002: < 1 rad/day for terrestrial plants and aquatic animals < 0.1 rad/day for terrestrial animals	Absorbed dose to onsite plants and animals, in rad/day

8.1 Radiological Dose to the Public

Several steps are taken to compute radiological dose to the public from all pathways. This section briefly describes these steps, identifies how field monitoring data interface with other NTS data sources (e.g., radionuclide inventory data) to provide input to the dose estimates, and presents the results of each step.

8.1.1 Possible Exposure Pathways to the Public

As prescribed in the *Routine Radiological Environmental Monitoring Plan* (RREMP) (DOE, 2003b), BN routinely sampled air, groundwater, and biota to document the amount of radioactivity in these media and to provide data that can be used to assess the radiation dose received by the general public.

The potential pathways by which a member of the general public residing offsite might receive a radiation dose resulting from past or present NTS operations include:

1. Inhalation of, ingestion of, or direct external exposure to airborne radionuclide emissions transported offsite by wind
2. Ingestion of meat from wild game animals which drink from surface waters and eat vegetation containing NTS-related radioactivity

3. Drinking contaminated water from underground aquifers containing radionuclides which have migrated from the sites of past underground nuclear tests
4. Exposure to direct radiation along the borders of the NTS
5. Exposure to direct radiation from the release of property (e.g., equipment, building materials) containing residual radioactive material

In 2005, only the wind transport pathway (pathway 1) and the ingestion of wild game (pathway 2) were considered possible pathways of exposure to the public residing offsite. The subsections below address all of the potential pathways and their contribution to public dose estimated for 2005.

8.1.2 Dose to the Public from NTS Air Emissions

Six air particulate and tritium sampling stations located near the boundaries and the center of the NTS are approved by the U.S. Environmental Protection Agency (EPA) Region IX as critical receptor samplers to demonstrate compliance with the NESHAP public dose limit from air emissions of 10 mrem/yr. Analysis of air particulate and tritium data obtained at these six stations was performed in 2005 (Section 3.1.5). To be in compliance with NESHAP, the annual average concentration of an airborne radionuclide must be less than its NESHAP Concentration Level for Environmental Compliance (CL) (see Table 3-1 of Section 3.1.1). The CL for each radionuclide represents the annual average concentration of that radionuclide in air which would result in a CEDE of 10 mrem/yr. If multiple radionuclides are detected at a station, then compliance with NESHAP is demonstrated when the sum of the fractions (determined by dividing each radionuclide's concentration by its concentration limit and then adding the fractions together) is less than 1.0.

The following radionuclides were detected at three or more of the critical receptor samplers: americium-241 (^{241}Am), plutonium-238 (^{238}Pu), plutonium-239+240 ($^{239+240}$Pu), uranium-233+234 ($^{233+234}$U), uranium-235+236 ($^{235+236}$U), uranium-238 (^{238}U), and tritium (^{3}H) (Section 3.1.5). All concentrations of these radionuclides were well below their CLs. The uranium isotopes are attributed to naturally-occurring uranium. The concentration of each measured radionuclide (excluding uranium, since it has been determined to be of natural origin) at each of the six critical receptor samplers was divided by its respective CL to obtain a "fraction of CL". These fractions were then summed for each location and all were less than 1.0 (see Table 3-12, Section 3.1.5). As in previous years, the 2005 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 NTS had the highest concentrations of radioactive air emissions, yet an individual residing at this station would experience a dose from air emissions of only 2.3 mrem/yr, 23 percent of the admissible does limit. No one resides at this location, and the dose at offsite populated locations 20-80 kilometers (km) (12–50 miles [mi]) from the Schooner station would be much lower due to wind dispersion.

In previous years (1992 – 2004), the air transport model called Clean Air Package 1988 (CAP88-PC) was used to calculate the dose to the public from NTS air emissions, including diffuse emissions from legacy soil contamination. Beginning in 2005, BN discontinued using CAP88-PC to estimate public dose from ongoing legacy-related airborne radionuclide sources on the NTS (Grossman, 2006). The EPA approved this action in 2001 (EPA, 2001) and DOE concurred (DOE, 2004e). The air sampling data from the critical receptor stations provide a more accurate and conservative estimate of potential dose to the public than the CAP88-PC model for the following reasons. The annual dose to the offsite public from NTS emissions, as shown in all past reports, comes from diffuse sources, primarily from the re-suspension of radioactively-contaminated soil from legacy sites containing ^{241}Am, ^{238}Pu, $^{239+240}$Pu, and the evaporation of tritiated water or diffusion of tritiated water vapor from ponds and soils at legacy sites and waste management sites (see Table 3-13, Section 3.1.9). The critical receptor air sampling stations can detect these emissions of airborne radionuclides at very low levels (less than 1 percent of their CL). These levels would reflect the most accurate real-time presence of airborne radionuclides at each station and, in a sense, would be assessing the potential dose to a person residing at each station (a conservative assessment since the onsite stations are much closer to NTS emissions than any offsite location where the public might reside). In contrast, the CAP88-PC model computes offsite dose (called the CEDE to the maximally-exposed individual [MEI]) based on indirect data such as annually-monitored NTS wind pattern data, a soil re-suspension mathematical model, and estimates of radionuclide concentration levels in soils based on field surveys that were conducted in the 1980s. New planned projects, however, will continue to be evaluated each year for NESHAP compliance by running the CAP88-PC model (see Sections 3.1.7–3.1.9). No planned projects evaluated in 2005, or new activities executed and monitored in 2005, produced airborne emissions which resulted in a calculated dose that would be a noticeable addition to the dose from legacy soil contamination (0.2 mrem/yr).

8.1.3 Dose to the Public from Ingestion of Wild Game from the NTS

There are few data suggesting that NTS small game animals travel offsite and become available to hunters. However, they are sampled on the NTS near contaminated areas as a conservative (worst case) estimate of the levels of radionuclides that hunters may consume if game animals did leave the NTS and were harvested. Radiation doses from the ingestion of game animals presented here are calculated from measurements of the radionuclide concentrations in animals trapped near sites where the soil, vegetation, and/or water sources are known to be contaminated with radioactivity from past nuclear tests (see Section 7.0).

Man-made radionuclides were detected in all animals collected from the Sedan and U-19ad Sump locations (see Table 7-3, Section 7.0). Of the radionuclides detected, tritium concentrations were the highest, followed by ^{137}Cs at much lower concentrations. ^{238}Pu, $^{239+240}$Pu, and ^{241}Am were also detected at relatively low levels. No man-made radionuclides were detected in muscle tissue from rabbits collected from the Sedan control site or in the bobcat collected opportunistically along Mercury Highway in Area 5. Tritium was, however, detected in the mountain lion which died of natural causes and was found in Area 7. Because of these very low and below detection level concentrations, no potential dose was calculated from consuming rabbits from the Sedan control site, the bobcat, or the mountain lion. The potential dose from consuming animals sampled from Sedan and the U-19ad Sump were calculated using the following assumptions:

- One individual consumed 20 doves or 20 jackrabbits over the year (these numbers are the possession limits set for these species by the Nevada Division of Wildlife)
- Each game animal that an individual consumed contained the average concentration of radionuclides detected in muscle tissue for that species sampled
- The amount of dove meat an individual consumed per animal was the average weight of the dove breast muscle samples at each site
- The amount of rabbit meat consumed was the average weight of muscle on the animals sampled
- The moisture content of game meat consumed was equivalent to the average moisture content measured in muscle tissue samples

The CEDE was calculated using dose conversion factors (DOE, 1988) multiplied by the total activity estimated to be consumed for each of the detected radionuclides. The resultant potential doses from consuming mourning doves and jackrabbits are shown in Table 8-1.

Radionuclides contributing most to dose were $^{239+240}$Pu, ^{137}Cs, and tritium. Though tritium had, by far, the highest concentrations, it only emits low energy beta particles and has a short biological half-life. Tritium therefore has a very low dose conversion factor and results in a relatively low committed dose (Table 8-2). The higher total dose from consuming jackrabbits from Sedan is primarily a result of the assumption that the quantity of jackrabbit meat consumed is greater than that of dove meat consumed (see footnotes d, e, and f of Table 8-1).

The highest CEDE from game animals sampled during 2005 was 0.32 mrem (0.0032 mSv) which is only 0.32 percent of the annual dose limit for members of the public. This dose is also conservative in that it assumes 20 animals with average concentrations were consumed. It is highly unlikely, given the distances from these locations to areas where animals may be hunted, that 20 animals from these locations would be hunted. It is not as unlikely, however, that an individual would hunt and consume one of these individuals. The maximum potential dose from consuming an individual animal sampled during 2005 would be 0.0005 mrem for doves from Sedan, 0.02 for jackrabbits from Sedan, and 0.009 mrem for doves from the U-19ad Sump (Table 8-1). To put these potential doses in perspective, the dose from naturally-occurring cosmic radiation received during a one-hour airplane flight at 39,000 feet is about 0.5 mrem (0.005 mSv) or about 1.5 times higher than the highest committed dose that would result from consuming even 20 game animals sampled during 2005.

Table 8-1. Hypothetical annual dose to a human consuming the maximum number of NTS game animals based on animals sampled in 2005

Location and Samples	Average Radionuclide Concentrations [(a)]			Dose Conversion Factor (mrem/pCi ingested)[(b)]	Committed Effective Dose Equivalent (mrem)	Total Dose (mrem CEDE)
Sedan						
Dove	^{3}H	3,200	pCi/L	0.000000063	0.000068	
	^{137}Cs	0.41	pCi/g[(c)]	0.000050	0.0026	
Weight of muscle consumed = 464 g [(d)]	^{238}Pu	0.00097	pCi/g[(c)]	0.0038	0.00048	0.0098
	$^{239+240}Pu$	0.0094	pCi/g[(c)]	0.0043	0.0052	
	^{241}Am	0.0024	pCi/g[(c)]	0.0045	0.0014	
Jackrabbit	^{3}H	160,000	pCi/L	0.000000063	0.080	
	^{137}Cs	0.53	pCi/g[(c)]	0.000050	0.084	
Weight of muscle consumed = 11,360 g [(e)]	^{238}Pu	0.0029	pCi/g[(c)]	0.0038	0.036	0.32
	$^{239+240}Pu$	0.0065	pCi/g[(c)]	0.0043	0.090	
	^{241}Am	0.0017	pCi/g[(c)]	0.0045	0.024	
U-19ad Sump						
Dove	^{3}H	1,200,000	pCi/L	0.000000063	0.030	
	^{137}Cs	6.1	pCi/g[(c)]	0.000050	0.046	
Weight of muscle consumed = 540 g [(f)]	^{238}Pu	0.0025	pCi/g[(c)]	0.0038	0.0015	0.082
	$^{239+240}Pu$	0.0052	pCi/g[(c)]	0.0043	0.0034	
	^{241}Am	0.0027	pCi/g[(c)]	0.0045	0.0018	

(a) Negative values were set to zero prior to obtaining average
(b) Dose conversion factors for human ingestion are from DOE (1988)
(c) pCi/g dry weight; average water content = 72% by weight
(d) Assumed breast meat from 20 mourning doves was consumed and each breast weighed 23.2 g
(e) Assumed all meat from 20 jackrabbits was consumed and the meat on each weighed 568 g
(f) Assumed breast meat from 20 mourning doves was consumed and each breast weighed 27 g

Table 8-2. Hypothetical dose to an individual from consuming one jackrabbit or one dove from sample locations on the NTS

Species / Location	CEDE (mrem)
Mourning dove/Sedan	0.0005
Jackrabbit/Sedan	0.02
Mourning dove/U-19ad Sump	0.009

8.1.4 Dose to the Public from Drinking Contaminated Groundwater

The migration of radioactivity in groundwater has not been detected in the past or in 2005 (see Section 4.1). Therefore drinking contaminated groundwater is not a possible pathway of exposure to the public residing offsite.

8.1.5 Dose to the Public from Direct Radiation Exposure Along NTS Borders

The direct exposure pathway from gamma radiation to the public is monitored annually (see Section 5.0). In 2005, the only place where the public has the potential to be exposed to direct radiation along the borders of the NTS is along the southern boundary, namely at Gate 100, the primary entrance point to the site. Trucks hauling radioactive materials, primarily low-level radioactive waste being shipped for disposal at the Area 3 and 5 Radioactive Waste Management Sites, park outside Gate 100 while waiting for entry approval. Only during these times is there a potential for exposure to the public. However, no member of the public resides or remains full-time at the Gate 100 truck parking area.

8.1.6 Dose to the Public from Release of Property Containing Residual Radioactive Material

DOE's radiation protection framework and dose limits are centered around an "all sources and all pathways" philosophy. In addition to radiological air and water discharges to the environment reported in Sections 3.1 and 4.1, respectively, the release of property off of the NTS which contains residual radioactive material is another type of release to the environment and potential contributor to the dose received by the public. This section describes release criteria, materials released during the reporting year, and the resultant dose to the public as a result of any releases.

No vehicles, equipment, structures, or other materials are released from the NTS unless the amount of radiological contamination on such items is less than the authorized limits specified in the NV/YMP Radiological Control Manual (Table 8-3) (DOE, 2000b). These limits are taken from DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. Items proposed for unrestricted release must be surveyed to document compliance with the release criteria. The detailed survey requirements are contained in BN's Organization Instruction OI 0441.212, *Controlled and Unrestricted Release*.

In 2000, DOE placed a moratorium on the release of scrap material from radiological areas for recycling. This moratorium is still in effect. Government vehicles and equipment are routinely released or excessed when they are no longer needed by NTS projects or if they are required to be replaced. They are permitted to be released based on a combination of process knowledge and direct and indirect surveys such that the release criteria of Table 8-3 are met. BN Radiological Control does not authorize the release of materials off the NTS that have detectable radioactivity above background levels, however, even if these levels are less than the criteria levels shown in Table 8-3. During 2005, no vehicles, equipment, or other materials with detectable residual radioactivity were released.

Due to the potential for contamination of building structures that once housed uncontained contamination, the surveys for release of structures are not in a procedure. Instead, the criteria for unrestricted release of structures with potential or actual residual radioactivity are determined through agreements between the affected stakeholders, e.g., DOE and the state of Nevada. There were no releases of such structures in 2005.

NTS materials released for unrestricted use in 2005 contained no detectable radioactivity, therefore, radiological dose to the public from such materials is assumed to be negligible.

Table 8-3. Allowable total residual surface contamination

Radionuclide	Residual Surface Contamination (dpm/100 cm²) (a) Removable	Total (Fixed & Removable)	Maximum Allowable Fixed & Removable
Transuranics, ^{125}I, ^{129}I, ^{226}Ra, ^{227}Ac, ^{228}Ra, ^{228}Th, ^{230}Th, ^{231}Pa	20	100	300
Th-natural, ^{90}Sr, ^{126}I, ^{131}I, ^{133}I, ^{223}Ra, ^{224}Ra, ^{232}U, ^{232}Th	200	1,000	3,000
U-natural, ^{235}U, ^{238}U and associated decay products, alpha emitters	1,000	5,000	15,000
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except ^{90}Sr and others noted above	1,000	5,000	15,000

Source: DOE, 2000b
(a) disintegrations per minute per 100 square centimeters

8.1.7 Total Offsite Dose to the MEI from all Pathways

DOE Order 5400.5, *Radiation Protection of the Public and the Environment* establishes a radiation dose limit to a member of the general public from all possible pathways as a result of DOE facility operations. This limit is 100 mrem/yr over and above background radiation and includes the air transport pathway, ingestion pathway, and direct exposure pathway. For 2005, the only two possible pathways of public exposure to man-made radionuclides from current or past NTS activities included the air transport pathway and the ingestion of game animals. The doses from these two pathways are combined below to present an estimate of the total 2005 dose to the MEI residing offsite.

The dose estimate for an offsite MEI is expected to be no greater than 0.2 mrem/yr (Figure 8-1). If the offsite MEI is assumed to eat 20 jackrabbits from the Sedan sample location (see Table 8-1), this individual would receive an estimated additional 0.32 mrem/yr (0.0032 mSv/yr) dose. The total CEDE to this MEI would be 0.52 mrem/yr (0.0052 mSv/yr) (Table 8-4). The total dose of 0.52 mrem/yr is 0.52 percent of the DOE limit of 100 mrem/yr and 0.15 percent of the total dose the MEI receives from natural background radiation (340 mrem/yr) (Figure 8-2).

Natural background radiation consists of cosmic radiation, terrestrial radiation, radiation from radionuclides (primarily potassium-40 [^{40}K]) within the composition of the human body, and radiation from the inhalation of naturally-occurring radon and its progeny. The cosmic and terrestrial components of background radiation (100 mrem/yr) shown in Figure 8-2 were estimated from the annual mean radiation exposure rate measured with a pressurized ion chamber (PIC) at Indian Springs by the CEMP (99.56 milliroentgens per year [mR/yr], see Table 6-4 in Section 6.0). The radiation exposure in air measured by the PIC in units of mR/yr is approximately equivalent to the unit of mrem/yr for tissue. The portion of the background dose from the internally deposited, naturally-occurring radionuclides and from the inhalation of radon and its daughters shown in Figure 8-2 were estimated as 40 mrem/yr and 200 mrem/yr, respectively, using the approximations by the National Council on Radiation Protection (NCRP) (NCRP,1996).

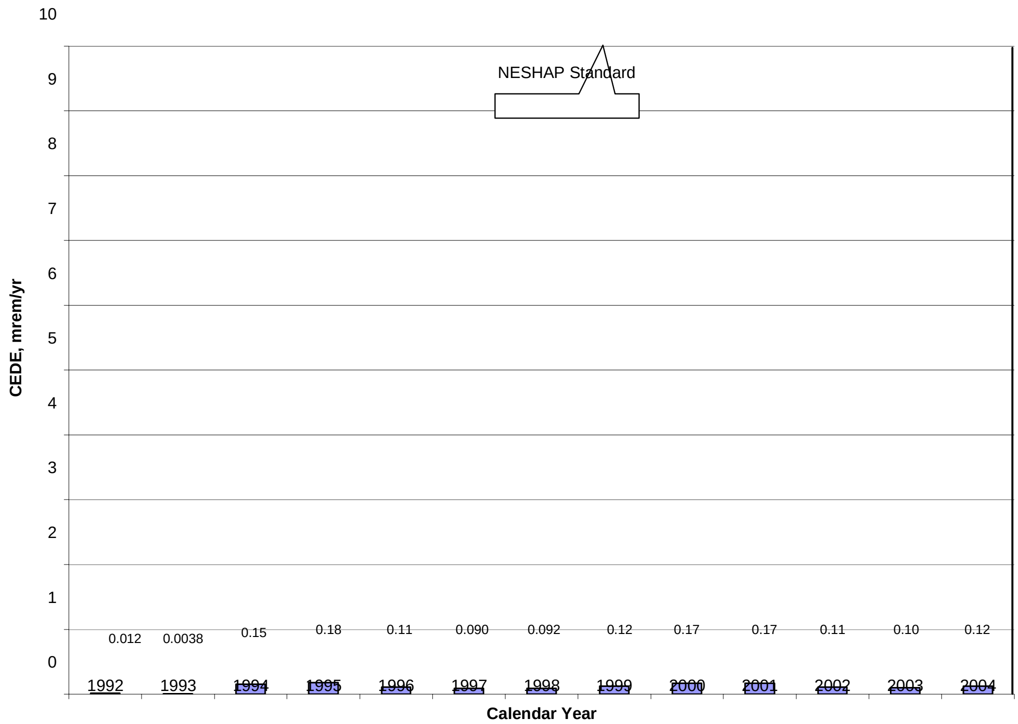

Figure 8-1. Estimated radiation dose from NTS air emissions to the offsite MEI from 1992 to 2004

Table 8-4. Estimated radiological dose to the general public from 2005 NTS operations

Pathway	Dose to MEI (mrem/yr)	(mSv/yr)	Percent of DOE 100-mrem/yr Limit
Air [(a)]	0.2	0.002	0.2
Water [(b)]	0	0	0
Wildlife [(c)]	0.32	0.0032	0.32
Direct [(d)]	0	0	0
All Pathways	0.52	0.0052	0.52

(a) Assumed from historical data from 1992 to 2004.
(b) Based on all offsite groundwater sampling in 2005 (see Sections 4.1 and 5.2).
(c) Assumes that the MEI consumes 20 jackrabbits from the Sedan sample location (see Table 8-2).
(d) Based on 2005 gamma radiation monitoring data (see Sections 5.0, 6.1), 2005 property release tracking information (Section 8.1.6), and previous years' CAP88-PC dose estimates.

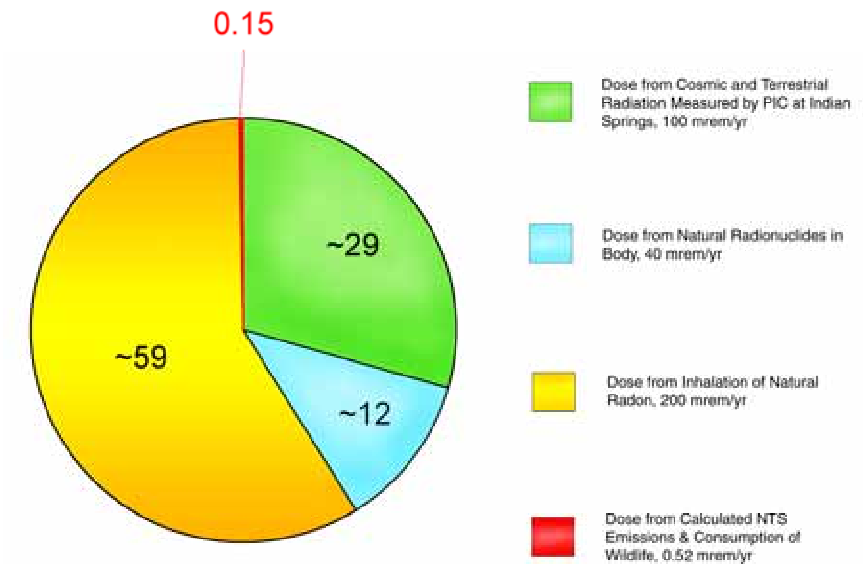

Figure 8-2. Comparison of radiation dose to the MEI and the natural radiation background (percent of total)

8.1.8 Collective Population Dose

The collective population dose to residents within 80 km (50 mi) of the NTS emission sources was not estimated in 2005 because this assessment depends upon CAP88-PC estimations which were not calculated. The collective population dose has been below 0.6 person-rem/yr for the period 1992 to 2004 (Figure 8-3). DOE approved the discontinuance of reporting collective population dose because it is so low for the NTS. DOE recommended, however, that the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office should consider reporting it once again if ever it exceeds 1.0 person-rem/yr (DOE, 2004e).

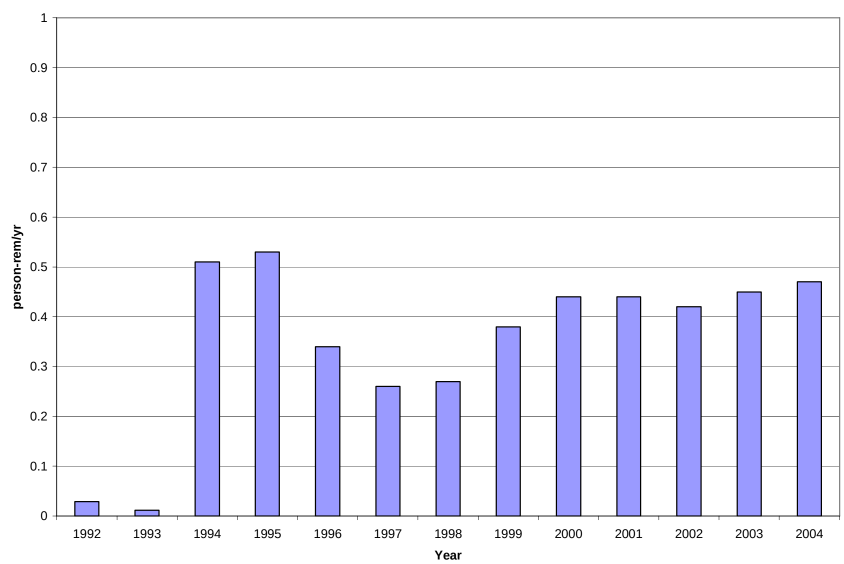

Figure 8-3. Collective population dose within 80 km of NTS emission sources from 1992 to 2004

8.2 Dose to Aquatic and Terrestrial Biota

DOE Order 450.1, *Environmental Protection Program* requires DOE facilities to evaluate the potential impacts of radiation exposure to biota in the vicinity of DOE activities. DOE Standard 1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE, 2002a) was developed by DOE's Biota Dose Assessment Committee to assist in such an evaluation. The following radiological dose limits were established (DOE, 2002a). Dose rates equal to or less than these are expected to have no direct, observable effect on plant or animal reproduction:

- 1 rad/day (0.01 Gy/day) for aquatic animals
- 1 rad/day (0.01 Gy/day) for terrestrial plants
- 0.1 rad/day (1 mGy/day) for terrestrial animals

The goal for the NTS biota dose assessment component of radiological monitoring is to determine if the established dose limits shown above are exceeded at the NTS using the graded approach for dose evaluation described in DOE Standard 1153-2002. The standard also provides concentration values for radionuclides in soil, water, and sediment that are to be used as a guide for determining if biota are potentially receiving radiation doses that exceed the limits. These concentrations are called the Biota Concentration Guide (BCG) values. They are defined as the minimum concentration of a radionuclide that would cause dose limits to be exceeded using very conservative uptake and exposure assumptions.

The graded approach is a three-step process consisting of a data assembly step, a general screening step, and an analysis step. The analysis step consists of site-specific screening, site-specific analysis, and site-specific biota dose assessment. The following information is required by the graded approach:

- Identification of terrestrial and aquatic habitats on the NTS that have radionuclides in soil, water, or sediment
- Identification of terrestrial and aquatic biota on the NTS that occur in contaminated habitats and which are at risk of exposure
- Measured or calculated radionuclide concentrations in soil, water, and sediment in contaminated habitats on the NTS that can be compared to BCG values to determine the potential for exceeding biota dose limits
- Measured radionuclide concentrations in NTS biota, soil, water, and sediment in contaminated habitats on the NTS to estimate site-specific dose to biota

A comprehensive biota dose assessment for the NTS using the graded approach was reported in the *NTS Environmental Report 2003* (DOE, 2004d). This dose assessment demonstrated that the potential radiological dose to biota on the NTS was not likely to exceed dose limits. No data exist to suggest that NTS surface contamination conditions have changed, therefore, the terrestrial biota dose evaluation conclusion remains the same for 2005.

There was, however, one new temporary water source created in late 2005 which contained radioactivity. This was a lined sump that received water pumped from an UGTA Project well near the underground nuclear weapons test CHESHIRE in Area 20. This well, U-20n PS #1DD-H, is discussed in Section 4.1.10. Because this water source will dry up in a matter of months, it is not considered aquatic nor riparian habitat (there is no vegetation growing on the edge of the plastic-lined pond). It is, however, a water source available for terrestrial animals living in the area. Tritium is the predominant radionuclide in this water. Tritium concentrations were compared with the BCG value for tritium and found to be more than six times lower (Table 8-7). Given this difference, the dose limit for terrestrial biota that may drink from this sump is not expected to be exceeded.

Table 8-5. Biota dose assessment to terrestrial biota from temporary water source created on the NTS in 2005

Sump Water Source	^{3}H Sample Concentration (x 10^8 pCi/L)	BCG for ^{3}H in Water for Terrestrial Biota (x 10^8 pCi/L)	Ratio of Maximum ^{3}H Sample Concentration to BCG[(a)]
U-20n PS #1DD-H	0.377[(b)]	2.31	0.16

(a) Per the graded approach (DOE, 2002a), biota dose limits are not exceeded if the sum of fractions of the maximum radionuclide concentrations divided by the radionuclide's BCG value is less than 1.0.
(b) Source: Ortego, 2006

8.2.1 2005 Site-Specific Biota Dose Assessment

Most of the graded approach for assessing dose to biota is based on radionuclide concentrations in soil, water, and sediment. The site-specific biota dose assessment phase however, centers on the actual collection and analysis of biota. This section presents estimates of site-specific doses to biota from two locations on the NTS where plants and/or animals were sampled in 2005.

Animal samples were collected from two contaminated sites: the Sedan site in Area 10 and the U-19ad Sump in Area 19. Plant samples were collected from the Sedan site, but not at the U-19ad Sump. Sampling methods and radionuclide concentrations in these 2005 samples are presented in Section 7.0.

Internal dose coefficient factors, discussed in the graded approach methodology (Section 2, Module 3 of DOE, 2002a), were used with the measured concentrations found in the biota samples (see Section 7.0) to obtain dose rate estimates for both plants and animals. The external dose rate at the Sedan site was taken as the maximum quarterly exposure rate measured at three thermoluminescent dosimeter (TLD) locations in the area (TLD locations Sedan West, Sedan East Visitor Box, and T10) (see Section 5.0). This exposure rate (275 mR/yr) was measured at a height of 1 meter above the ground. To adjust the rate to a height of 10 centimeters above the ground, where plants and small mammals would be exposed, this rate was multiplied by a factor of 1.8. The adjusted exposure rate, 495 mR/yr, was then converted to a dose rate of 495 millirads per year (mrad/yr) assuming 1 mR = 1 mrad. Because there were no measured exposure rates at the U-19ad Sump, the external dose rate at this location was estimated by taking the tritium concentration in water and the external dose coefficient listed in Table 2.2 (Section 2, Module 3 of DOE, 2002a). External dose rate estimates were then added to the internal dose rate estimates to obtain a total dose rate estimate for plants and animals at each location.

Average doses were estimated to be 0.0016 rad/day for animals and 0.0024 rad/day for plants at Sedan and 0.0060 rad/day for doves at the U-19ad Sump (Table 8-6). Dose from internal radionuclides accounted for about 10 percent of the total for animals while it accounted for about 40 percent for plants; this difference attributable primarily to the higher concentrations of $^{239+240}Pu$ and ^{241}Am in the plants. The total estimated dose rates are $\leq$ 6 percent and 0.2 percent of the dose limits, respectively, for terrestrial animals and plants.

Table 8-6. Site-specific dose assessment results for terrestrial plants and animals sampled on the NTS

Location		Estimated Radiological Dose (rad/day)					
		To Animals			To Plants[(a)]		
		Internal	External	Total	Internal	External	Total
Sedan	Doves	0.00015	0.0014	0.0016	0.0010	0.0014	0.0024
	Jackrabbits	0.00016	0.0014	0.0016			
U-19ad Sump	Doves	0.00034	0.0057	0.0060		*(not sampled)*	
DOE Dose Limit:				**0.1**			**1**

(a) For list of plant species sampled, see Table 7-1 of this report

8.2.2 Environmental Impact

Based on the graded approach for assessing potential dose to biota, plants and animals on the NTS are not expected to be exposed to significantly large radiological doses that may be detrimental to their populations. Work will continue to refine this dose assessment, especially in the area of defining dose evaluation areas. Boundaries of plant and animal populations intersecting contaminated areas will be further evaluated in an attempt to ensure that potential populations within currently defined areas are not missed.

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9.0 Waste Management and Environmental Restoration

Several federal and state regulations govern the safe management, storage, and disposal of radioactive, hazardous, and solid wastes generated or received on the Nevada Test Site (NTS) for the purpose of protecting the environment and the public (see Section 2.4). This section describes both the waste management and environmental restoration operations conducted under the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) Environmental Management Program and summarizes the activities performed in 2005 to meet all environmental/public safety regulations. The goals of the program are shown below. The compliance measures and actions tracked and taken to meet the program goals are also listed.

Waste Management and Environmental Restoration Goals	Compliance Measures/Actions
Manage and safely dispose of the following wastes generated by NNSA/NSO and the U.S. Department of Defense (DoD) operations: Low-level radioactive waste (LLW) Low-level radioactive mixed waste (LLMW) Hazardous waste (HW) Continue to characterize, inspect, repackage, load, and ship transuranic (TRU) wastes stored on an interim basis at the NTS to either the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico or to the Idaho National Laboratory (INL) Characterize and remediate historic sites contaminated by NNSA/NSO testing activities Manage and safely dispose of solid/sanitary wastes generated by NNSA/NSO	Completion/maintenance of documents required for a Class II Nuclear Facility Establishment of Waste Acceptance criteria for radioactive wastes received for disposal/storage Volume of disposed LLW Volume of stored non-radioactive hazardous waste Volume of disposed LLMW Weight of approved explosive ordnance wastes detonated Vadose zone monitoring Groundwater monitoring Site characterization, remediation, closure, and post-closure site monitoring Weight and volume of solid waste disposed

9.1 Radioactive Waste Management

U.S. Department of Energy (DOE) Order 435.1, *Radioactive Waste Management* requires that DOE radioactive waste management activities be systematically planned, documented, executed, and evaluated. Radioactive waste is managed to protect the public, the environment, and workers from exposure to radiation from radioactive materials and to comply with all applicable federal, state, and local laws and regulations; Executive Orders; and DOE directives. The major tasks within Radioactive Waste Management include:

- Characterization of LLW and LLMW that has been generated by the DOE within the state of Nevada
- Disposal of LLW and LLMW at the Radioactive Waste Management Complex (RWMC) comprised of the Area 3 Radioactive Waste Management Site (RWMS) and the Area 5 RWMS
- Characterization, visual examination, and repackaging of TRU waste at the Waste Examination Facility (WEF) at the RWMC
- Loading of TRU waste at the Area 5 RWMS for shipment to either the WIPP or INL

9.1.1 Maintenance of Key Documents

Table 9-1 lists the key documents which must be current and in place at each RWMS for disposal operations to occur. In 2005, all of these key documents were maintained and two were revised.

Table 9-1. Key documents required for Area 3 RWMS and Area 5 RWMS operations

Disposal Authorization Statement (DAS)
Disposal Authorization Statement for Area 5 RWMS, December 2000
Disposal Authorization Statement for Area 3 RWMS, October 1999
Performance Assessment (PA)
Performance Assessment for Area 5 RWMS, Revision 2.1, January 1998
Performance Assessment/Composite Analysis for Area 3 RWMS, Revision 2.1, October 2000
Composite Analysis (CA)
Composite Analysis for Area 5 RWMS, February 2000
Performance Assessment/Composite Analysis for Area 3 RWMS, Revision 2.1, October 2000
NTS Waste Acceptance Criteria (NTSWAC)
NTS Waste Acceptance Criteria, Revision 6, October 2005.
(This document was revised to incorporate requirements for accepting LLMW generated outside Nevada.)
Integrated Closure and Monitoring Plan (ICMP)
Integrated Closure and Monitoring Plan for the Area 3 and 5 RWMSs, September 2001
Auditable Safety Analysis (ASA)
Documented Safety Analysis (DSA) for the NTS Area 5 RWMC, Revision 1, November 2004
DSA for the NTS Area 3 RWMS, Revision 1, March 2005
Technical Safety Requirements (TSRs) for the Area 5 RWMC LLW Activities, Revision 3, November 2004
TSR for the Area 5 RWMC TRU Waste Activities, Revision 3, November 2004
TSR for the Area 3 RWMS, Revision 1, March 2005

9.1.2 Characterization of LLW and LLMW

Waste Generator Services (WGS) characterizes LLW and LLMW generated by the DOE within Nevada, primarily at the NTS. Characterization is performed utilizing either knowledge of the generating process or sampling and analysis. Following the characterization of a waste stream, a Waste Profile is completed for approval by an appropriate disposal facility. The Waste Profile delineates the pedigree of the waste, including but not limited to a description of the waste generating process, physical and chemical characteristics, radioactive isotopes and their quantities, and detailed packaging information. WGS then packs and ships approved waste streams in accordance with Department of Transportation requirements to either the Area 3 or Area 5 RWMS or to an offsite treatment, storage, and disposal facility.

In 2005, LLW and MW were characterized by WGS for the following waste stream categories:

- Lead Solids
- Sealed Sources
- Dip Tanks and Miscellaneous Debris
- Engine Maintenance, Assembly, and Dissassembly (EMAD) Remediation Waste
- Miscellaneous Debris
- Compactable Trash
- Condensate Water
- Contact Water

9.1.3 Disposal of LLW and LLMW

The RWMC operates as a Category II Nuclear Facility. The RWMC, which includes the Area 3 and the Area 5 RWMSs, is designed and operated to perform three functions:

- Dispose of LLW from NNSA/NSO activities performed on and off the NTS and from other offsite generators in the state of Nevada.
- Dispose of DOE LLW from around the DOE complex, primarily from the cleanup of sites associated with the manufacture of weapons components.
- Dispose of LLMW from around the DOE complex.

All generators of waste streams must first request to dispose of waste, submit a request to NNSA/NSO requesting to ship waste to the NTS for disposal, submit profiles characterizing specific waste streams, meet the NTS Radioactive Waste Acceptance Criteria, and receive programmatic approval from NNSA/NSO. The NTS Radioactive Waste Acceptance Criteria are based on how well the site is predicted to perform in containing radioactive waste and ensuring that the environment and the public will not be exposed to significant radiation. The NNSA/NSO assesses and predicts the long-term performance of LLW disposal sites by conducting a Performance Assessment (PA) and a Composite Analysis (CA). A PA is a systematic analysis of the potential risks posed by a waste disposal site to the public and to the environment. A CA is an assessment of the risks posed by all wastes disposed in a LLW disposal site and by all other sources of residual contamination that may interact with the disposal site. PA and CA documents are developed as a result of these activities. The RWMC receives LLW generated within the DOE complex from numerous DOE sites across the United States, LLW from DoD sites that carry a national security classification, and LLMW generated within the DOE complex for disposal or indefinite storage.

Disposal consists of placing waste in unlined cells and trenches. Soil backfill is applied over the waste in a single lift, which is approximately 2.4 meters (m) (8 feet [ft]) thick, as rows of containers reach approximately 1.2 m (4 ft) below the original grade. The Area 5 RWMS includes 81 hectares (ha) (200 acres [ac]) of existing and proposed disposal cells for burial of both LLW and LLMW, and approximately 202 ha (500 ac) of land available for future radioactive disposal cells. Waste disposal at the Area 5 RWMS has occurred in a 37 ha (92 ac) portion of the site since the early 1960s. The Area 5 RWMS consists of 31 disposal cells (pits and trenches) and 13 Greater Confinement Disposal (GCD) boreholes (listed below). This site is used for disposal of waste in drums or boxes. Existing cells are expected to be filled and closed by 2010, and new cells extending to the north and west are expected to close by 2021. LLW and LLMW disposal services are expected to continue at Area 5 RWMS as long as the DOE complex requires the disposal of wastes from the weapons program.

<u>31 Disposal Cells at Area 5 RWMS:</u>

6 active which receive standard LLW
1 active and permitted to receive asbestos-form LLW (P06U)
1 active and permitted by the State to receive LLMW (P03U)
1 inactive (open but has not received any waste)
21 closed (containing waste and backfilled) containing LLW
1 closed (containing waste and backfilled) containing asbestiform LLW (P07U)

<u>13 GCD Boreholes at Area 5 RWMS:</u>

4 inactive (open but have not received any waste)
4 closed containing TRU waste
5 closed containing LLW

The Area 3 RWMS consists of seven craters making up five disposal cells. Each subsidence crater was created by an underground weapons test. This site is used for disposal of bulk LLW waste, such as soils or debris, and waste in large cargo containers. Disposal operations at the Area 3 RWMS began in the late 1960s. Waste disposal services at Area 3 RWMS will continue as long as the DOE requires such services. The site consists of the following seven craters:

3 Active Disposal Cells:	2 Closed Cells:	2 Undeveloped Cells:
U3ah/at	U3ax/bl	U3az
U3bh		U3bg

In November, Nevada renewed the Resource Conservation and Recovery Act (RCRA) Part B Permit (NEV HW 0021) which authorizes the disposal of LLMW at the Pit 3 Mixed Waste Disposal Unit (P03U). No LLMW was disposed at the Pit 3 Mixed Waste Disposal Unit (P03U) in 2005.

In 2005, the Area 5 RWMS received shipments containing 36,828 cubic meters (m^3) (48,169 cubic yards [yd^3]) of LLW for disposal. The Area 3 RWMS received shipments containing 9,615 m^3 (12,576 yd^3) of LLW. The majority of disposed LLW was shipped from offsite. A total of 806 m^3 (1.055 yd^3) of LLW disposed in 2005 was generated onsite.

In 2005, the Area 5 RWMS received and disposed of 73.75 tons (net weight), of asbestos-form LLW at P06U.

9.1.4 TRU Waste Operations

The Transuranic Pad Cover Building (TPCB) at the Area 5 RWMC is a RCRA Part B interim status facility designed for the safe storage of TRU waste generated by Lawrence Livermore National Laboratory in the 1970s. The TPCB accepts no other wastes. The TPCB stores TRU waste until it is characterized, visually examined, and repackaged at the WEF at the Area 5 RWMC. Once repackaged, the TRU waste is loaded at the mobile loading unit for shipment either to the WIPP at Carlsbad, New Mexico for disposal or to INL for further processing. Current agreements between NNSA/NSO and WIPP plan for TRU waste shipments to be completed by March 2005. In 2005, TRU wastes stored at the TPCB continued to be characterized, visually inspected, repackaged, loaded, and shipped for disposal.

9.1.5 Assessments

In 2005, assessments were conducted at the RWMC in accordance with Bechtel Nevada (BN) Procedure OP-NOPS.003 *Nuclear Operations Conduct of Operations*. Schedules for BN management self-assessments (MSAs) were included in the Support Execution Plans for each facility. In addition to the MSAs performed internally at the RWMC, assessments were performed periodically by other BN organizations, NNSA/NSO, and the Defense Nuclear Facilities Safety Board. The results of each assessment were logged for DOE/NSO in the BN tracking system known as CaWeb. In 2005, MSAs were conducted monthly at the RWMC.

9.1.6 Groundwater Monitoring for LLW Pit P03U

P03U is operated according to RCRA Interim Status standards for the disposal of mixed LLW. Title 40 Code of Federal Regulations (CFR) 265 (Groundwater Monitoring) Subpart F (40 CFR 265.92) requires groundwater monitoring to verify the performance of P03U to protect groundwater from buried radioactive wastes. Wells UE5 PW-1, UE5 PW-2, and UE5 PW-3 are monitored for this purpose; these wells comprise 3 of the 14 onsite monitoring wells sampled periodically for radionuclide analyses of groundwater (see Section 4.1.7). Investigation levels (ILs) for five indicators of groundwater contamination (Table 9-2) were established by NNSA/NSO and the Nevada Division of Environmental Protection (NDEP) for these three wells in 1998. Further groundwater analyses will be required if a parameter's IL is exceeded. In 2005, none of the water samples collected semi-annually from the wells had contaminant levels above their ILs (Table 9-2). General water chemistry parameters are also monitored; all sample analysis results are presented in BN (2006a). Table 4-4 of Section 4.1.7 presents the tritium results for UE5 PW-1, UE5 PW-2, and UE5 PW-3.

Table 9-2. Results of groundwater monitoring of UE5 PW-1, UE5 PW-2, and UE PW-3 in 2005

Parameter	Investigation Level (IL)	Sample Levels
pH	< 7.6 or > 9.2 S.U.	8.27 to 8.47 S.U.
Specific conductance (SC)	0.440 mmhos/cm	0.352 to 0.377 mmhos/cm
Total organic carbon (TOC)	1 mg/L	<0.5 – 0.65
Total organic halides (TOX)	50 µg/L	< 5.0 – 6.5 µg/L
Tritium (^3H)	2,000 pCi/L	-4.76 – 8.82 pCi/L

Source: BN, 2006a

9.1.7 Vadose Zone Monitoring

Monitoring of the vadose zone (unsaturated zone above the water table) is conducted at the RWMC to demonstrate that: (1) the PA assumptions at the RWMSs are valid regarding the hydrologic conceptual models used, including soil water contents, and upward and downward flux rates and (2) that there is negligible infiltration of precipitation into zones of buried waste at the RWMSs. Vadose zone monitoring (VZM) offers many advantages over groundwater monitoring, including detecting potential problems long before groundwater resources would be impacted, allowing corrective actions to be made early, and being less expensive than groundwater monitoring. All VZM conducted in 2005 continued to demonstrate that there is negligible infiltration of precipitation into zones of buried waste at the RWMC and that the performance criteria of the waste disposal cells are being met to prevent contamination of groundwater and the environment. A few components of the VZM monitoring program implemented in 2005 are presented below. For more details on the program refer to the *Nevada Test Site 2005 Waste Management Monitoring Report Area 3 and Area 5 Radioactive Waste Management Sites* (BN, 2006b).

9.1.7.1 Area 3 RWMS Drainage Lysimeter Facility

In December 2000, a Drainage Lysimeter Facility was constructed immediately northwest of the U-3ax/bl disposal unit at the Area 3 RWMS. The facility consists of eight cylindrical drainage lysimeters, each 3.1 m (10.0 ft) in diameter and 2.4 m (8.0 ft) deep. Each lysimeter is filled with native soil and packed to mimic the U-3ax/bl soil cover. Each lysimeter has eight Time Domain Reflectometry (TDR) probes to measure moisture content depth profiles paired with eight heat dissipation probes to measure soil water potential depth profiles. Measured water contents at the bottom of the lysimeters and drainage from the lysimeters provide an indirect measure of potential drainage from the U-3ax/bl soil cover. The lysimeter facility was constructed to fulfill data needs including reducing uncertainty in the expected performance of monolayer-evapotranspiration closure covers under various surface vegetation treatments and climatic change scenarios such as increased rainfall.

There are three surface vegetation treatments subject to two climate treatments on the lysimeters. The three surface vegetation treatments are bare soil; natural plant recolonization (primarily by invader species *Salsola tragus* [prickly Russian thistle], *Halogeton glomeratus* [halogeton], and *Sisymbrium alitissimum* [tumblemustard]); and revegetation with former plant community species (primarily *Atriplex confertifolia* [shadscale], *Krascheninnikovia lanata* [winterfat], *Ephedra nevadensis* [Nevada ephedra], and *Achnatherum hymenoides* [Indian ricegrass]). The bare soil lysimeters mimic operational waste covers, the invader species lysimeters mimic operational waste covers that are not maintained, and revegetation lysimeters mimic final closure covers. The climate treatments are natural precipitation and three times the amount of natural precipitation. The increased precipitation lysimeters receive natural precipitation and are irrigated at a rate equal to two times natural precipitation.

No drainage occurred from any of the four non-irrigated lysimeters, but moisture accumulated at the bottom of the bare-soil lysimeter and the revegetated lysimeter. There was drainage from every irrigated lysimeter, but the vegetated lysimeters had much less drainage than the bare soil lysimeter. Measured volumetric water contents confirm that vegetation effectively removes moisture from the lysimeters, helping prevent deep percolation of infiltrated precipitation.

9.1.7.2 Area 5 RWMS Weighing Lysimeter Facility

The Area 5 Weighing Lysimeter Facility consists of two precision weighing lysimeters located about 400 m (0.25 mi) southwest of the Area 5 RWMS. Each lysimeter consists of a 2 x 4-m (6.6 x 13-ft) by 2-m (6.6-ft) deep steel box filled with soil. The load cells in each lysimeter can measure approximately 0.1 millimeters (mm) (0.004 inches [in.]) of precipitation or evapotranspiration. One lysimeter is vegetated with native plant species at the approximate density of the surrounding desert, and one lysimeter is kept bare to simulate operational waste covers at the Area 5 RWMS. The load cells have been monitored continuously since March 1994, providing an accurate dataset of the surface water balance at the Area 5 RWMS.

The weighing lysimeter data represent a simplified water balance: the change in soil water storage is equal to precipitation minus evaporation (E) on bare lysimeters, or precipitation minus evapotranspiration (ET) on vegetated lysimeters. The water balance is simplified because no drainage can occur through the solid bottoms of the lysimeters and because a 2.5 centimeters (cm) (1 in.) lip around the edge of the lysimeters prevents run-on and runoff. No water has ever accumulated at the bottom of the vegetated lysimeter. Heavy precipitation and low E rates during the period from October 2004 to February 2005 combined with initially higher water contents, resulted in water accumulating at the bottom of the bare lysimeter starting in March 2005. Long-term numerical simulations (30 years) using a unit gradient bottom boundary were used to determine the amount of drainage that would have occurred if water could drain from the lysimeters. These simulations indicate an average of 1.0 cm/year of water reaches the bottom of the bare lysimeter and that essentially no water reaches the bottom of the vegetated lysimeter (Desotell et al., 2006).

9.1.7.3 RWMS Waste Cover Automated Monitoring

Automated monitoring systems are installed in the operational covers on Pit 3 (P03U), Pit 4 (P04U), Pit 5 (P05U), the floor of Pit 5 underneath the waste, and the closure cover on U-3x/bl. These monitoring systems measure moisture content depth profiles with TDR probes. The system at Pit 5 also has heat dissipation probes to measure water potential depth profiles. The precipitation events, beginning in October 2004, infiltrated into the operational covers of Pits 3, 4, and 5, and percolated below the deepest probes at 180 cm (71 in.) in March 2005. This moisture is below the range of substantial surface evaporation, and the observed gradual drying at these locations is most likely due to downward percolation. This is the deepest observed moisture percolation in the operational covers. Precipitation percolated to 152 cm (60 in.) in the U-3x/bl closure cover by March 2005 but was removed to the atmosphere by ET in six months. The measurements in the floor of Pit 5 do not show any evidence of water movement.

9.1.7.4 RWMS Supplemental Automated Monitoring

Additional automated data-acquisition stations are maintained to provide ancillary data in support of the more direct monitoring of RWMS disposal units and the lysimeters in Areas 3 and 5. These stations include meteorological towers that continuously measure precipitation, air temperature, humidity, wind speed, wind direction, barometric pressure, and solar radiation. Data are also obtained from a flume north of the Area 3 RWMS and one northwest of the Area 5 RWMS for assessing, in part, the potential for surface water runoff near the RWMSs. An automated system has also been deployed within a subsidence crater in Area 3 (U3-bw) to study the potential for infiltration into the underlying chimney.

9.1.7.5 Gas-phase Tritium Monitoring

Tritium monitoring is conducted via soil gas sampling at Well GCD-05U, one of the 13 GCD boreholes at the Area 5 RWMS. Radioactive wastes were buried in this borehole from 36 to 20 m (119 to 65 ft) below the surface. The borehole was then backfilled with clean soil. Monitoring provides a direct measure of changes in tritium activity with depth due to degradation of waste containers, advection, and diffusion. The 16-year trend in results indicates that upward migration of tritium through the soil from the buried waste is extremely slow. The tritium concentrations from sample ports adjacent to the buried waste at depths of 20, 26, 33, and 36 m (65, 85, 110, and 119 ft) have increased by a factor of three since 1990, with the highest concentration of 381 microcuries per cubic meter ($\mu Ci/m^3$) of soil gas measured at 26 m (85 ft) in September 2001. Tritium concentrations have remained constant and low at about 0.01 $\mu Ci/m^3$ in soil gas samples taken above the tritium source at depths of 3, 6, 9, and 12 m (10, 20, 30, and 40 ft).

9.1.7.6 Radon Flux

Radon flux measurements were taken at the Area 5 RWMS at P01U, on the north end of P13U, and on the north end of P14U during 2005. Electrets inserted in domes (Rad Elec, Inc.) measure radon flux from the ground. All radon flux measurements from the covers are not higher than those from undisturbed or control locations.

9.2 Hazardous Waste Management

Hazardous wastes (HW) (see Glossary, Appendix B) regulated under RCRA are generated at the NTS from a broad range of activities including onsite laboratories, paint shops, vehicle maintenance, communications and photo operations, and environmental restoration of historic contaminated sites (see Section 9.3). HW exclude radioactive wastes by definition; a waste which is both hazardous and radioactive is termed a mixed waste. All HW are presently transported to approved offsite RCRA HW treatment, storage, and disposal facilities. The RCRA Part B Permit (NEV HW 0021) regulates the operation of the Hazardous Waste Storage Unit (HWSU) in Area 5 and the Explosive Ordnance Disposal Unit (EODU) in Area 11. The volume of HW managed (i.e., temporarily stored or detonated [in the case of explosive ordnance]) at each of these units per quarter is reported to the state of Nevada. NNSA/NSO pays fees to the state of Nevada based on the weight of HW managed.

9.2.1 Hazardous Waste Storage Unit and Satellite Accumulation Areas

The permit allows NNSA/NSO to store HW that have been generated at the NTS in containers on a pad specifically designed for waste storage. The HWSU is a pre-fabricated, rigid steel framed, roofed shelter which is permitted to store a maximum of 61,600 liters (16,280 gallons) of approved waste at a time. HW generated at BN restoration sites off the NTS (e.g., at TTR) or generated at the North Las Vegas Facility are direct-shipped to approved disposal facilities. HW generated at restoration sites, or other project sites, on the NTS may also be direct-shipped if the volume capacity of the HWSU is near its permitted limits. The permit allows satellite accumulation areas (SAAs) at restoration sites for the temporary storage of HW prior to shipment directly offsite or to the HWSU.

In 2005, a total of 38,228 pounds (lbs) of HW were received at the HWSU for temporary storage and 27,172 lbs were shipped offsite from the HWSU (Table 9-3). Quarterly reports of these waste quantities were submitted on time to NDEP. The HW managed at the HWSU in 2005 included drums of liquid polychlorinated biphenyls (see Section 10.1). In 2005, a total of 27,140 lbs of HW were shipped offsite from SAAs. No HW storage limits were exceeded.

9.2.2 Explosive Ordnance Disposal Unit

The RCRA Hazardous Waste Operating Permit also covers operations at the Explosive Ordnance Disposal Unit (EODU) in Area 11. Conventional explosive wastes are generated at the NTS from tunnel operations, the NTS firing range, the resident national laboratories, and other activities. The permit allows NNSA/NSO to treat explosive ordnance wastes, which are hazardous wastes as defined under 40 CFR (Sections 261.21, 261.23, 261.24, and 261.33), by open detonation in a specially constructed and managed area designed for the safe and effective treatment of explosive HW. The permit allows a maximum of 45.4 kilograms (kg) (100 lbs) of approved waste to be detonated at a time, not to exceed one detonation event per hour.

In 2005, no explosive ordnance were detonated at the EODU (Table 9-3). Quarterly reports were submitted on time to NDEP. During the first and second quarters of 2005, the quantities reported to the state in the quarterly reports were for the total weight of HW *stored* at the HWSU. Fees to the state of Nevada are based on HW *received* each quarter, not the amounts still being stored after receipt. Therefore, beginning in the third quarter of 2005, only the quantities received each quarter were reported to the state of Nevada and fees based on these quantities were paid.

Table 9-3. Hazardous waste managed at the NTS in 2005

Permitted Unit	Waste Received	Waste Shipped
Hazardous Waste Storage Unit (HWSU)	38,228 lbs[(a)]	27,172 lbs[(a)]
NTS satellite accumulation areas (SAAs)	ND[(b)]	27,140 lbs
Explosive Ordnance Disposal Unit (EODU)	0 kg	0 kg

(a) The permitted storage limit for HW at the HWSU is 61,600 liters (16,280 gallons); however, the reporting units are pounds, on which quarterly fees to the state of Nevada are based.

(b) Amount of HW received annually over all SAAs is not documented. Each SAA receives up to 55 gallons of HW and up to 1 quart of acute HW prior to shipment of wastes directly offsite or to the HWSU.

9.3 Underground Storage Tank (UST) Management

By 1998, the NTS UST program met all regulatory compliance schedules for the reporting, upgrading, or removal of documented USTs. The NNSA/NSO operates one deferred UST and three excluded USTs at the Device Assembly Facility. The NNSA/NSO also maintains a fully-regulated UST at the Area 6 helicopter pad which is not in service.

9.4 Environmental Restoration - Remediation of Historic Contaminated Sites

In April 1996, the DOE, DoD, and the state of Nevada entered into a Federal Facilities Agreement and Consent Order (FFACO) to address the environmental restoration of historic contaminated sites at the NTS, parts of TTR, parts of the Nellis Air Force Range (now known as the Nevada Test and Training Range, the Central Nevada Test Area, and the Project Shoal Area. These sites, known as Corrective Action Sites (CASs), may be contaminated with both radioactive and non-radioactive wastes. Appendix VI of the FFACO describes the strategy that will be employed to plan, implement, and complete environmental corrective actions at facilities where nuclear-related operations were conducted. Stoller-Navarro Joint Venture conducts most site characterization activities, while BN Environmental Restoration conducted site restoration, soil remediation, and some facility decontamination and decommissioning activities in 2005.

9.4.1 Corrective Actions

The corrective action strategy is based on four steps: (1) identifying the CASs, (2) grouping the CASs into Corrective Action Units (CAUs), (3) prioritizing the CAUs for funding and work, and (4) implementing the corrective action investigations (CAIs) and/or corrective actions, as applicable. CASs are broadly organized into the following four categories based on the source of contamination:

- Industrial Sites – CASs located on the NTS and TTR where activities were conducted that supported nuclear testing activities
- Underground Test Area (UGTA) Sites – CASs located where underground nuclear test have resulted or might result in local or regional impacts to groundwater resources
- Soil Sites – CASs where tests have resulted in extensive surface and/or shallow subsurface contamination
- Nevada Off-Sites – Additional CASs associated with underground nuclear testing at the Project Shoal Area and the Central Nevada Test Area, located in northern and central Nevada, respectively

Identifying CASs – The first step in the strategy is to identify CASs potentially requiring CAIs and/or corrective actions. As CASs are identified, a literature search may be completed and each CAS is verified on aerial photographs or in the field to confirm its condition and location. A data repository has been created containing or referencing all information currently available for each CAS.

Grouping CASs into CAUs – A CAU may have several CASs or only one. In addition to the four categories noted above, criteria for grouping CASs into CAUs include the following:

- Potential source of contamination
- Agency responsible for cleanup of the CAS
- Function of the CAS and the nature of the contamination
- Geographic proximity of CASs to one another
- Potential for investigation or cleanup of grouped CASs to be accomplished within a similar time frame

Implementing Corrective Action Investigations and/or Corrective Actions – When a CAU is assigned priority and funding, environmental restoration activities follow a formal work process beginning with a Data Quality Objectives (DQO) meeting between the NNSA/NSO, Defense Threat Reduction Agency, NDEP, and contractors. If existing information about the nature and extent of contamination at the CASs is insufficient to evaluate and select preferred corrective actions, a CAI will be conducted. A Corrective Action Investigation Plan (CAIP) is prepared that provides a conceptual model of the site and defines how the site is to be characterized in conformance with the DQO process.

Site characterization is performed in the field and documented in a Corrective Action Decision Document (CADD). This document provides the information that either confirms or modifies the preliminary conceptual model. If suitable information is available to make a decision, a remedial action alternative is selected that best provides site closure. In some instances, additional site characterization may be required before the CADD can be prepared.

If a site requires a closure action, a Corrective Action Plan (CAP) is prepared that will implement the recommended remedial action/closure alternative. A CAP is comprised of the following elements for site closure which include: a detailed scope of work, target field schedule, quality control measures, waste management strategy, design specifications/drawings (when applicable), verification sampling strategies (for clean closures), and other information necessary for satisfying the specific closure requirements. Some sites also require a Post Closure Plan as the site or parts of the site are closed in place. Information on field inspections, types of monitoring, monitoring frequency, and maintenance/repairs are provided in an Annual Post Closure Monitoring Report.

Once the closure has been completed, a Closure Report is prepared. This report provides information on the scope of work performed, results of verification sampling, as-built drawings, waste management, and post closure requirements for closed-in-place sites, etc. Some sites are closed under the Streamlined Approach for Environmental Restoration (SAFER) process identified in the FFACO. These sites typically have enough information available to remediate the site within a a shorter duration. For such sites, a SAFER plan is prepared that will implement the plan for site closure. After closure, a SAFER closure report is prepared that documents the scope of work performed.

The NDEP is a participant throughout the remediation process. The Community Advisory Board (CAB) is also kept informed by NNSA/NSO of the progress made. The Board's comments are strongly considered before final prioritization of corrective actions. A public participation working group made up of representatives from DOE, DoD, the state of Nevada , and the CAB meets twice a year to discuss quarterly progress, upcoming environmental restoration activities, priority-setting activities established under the FFACO, and the level of public involvement required.

Table 9-4 lists the 42 CAUs for which some step of the site remediation process was completed in calendar year 2005. All 2005 milestones were met. A total of 49 CASs were closed, either under the SAFER process or the standard closure process. For DOE UGTA CAUs, 2005 milestones included well development and testing of new wells, model calibration and development, data documentation and evaluations, and completion of draft and final reports.

9.4.2 Post-Closure Monitoring and Inspections

There are nine sites on the NTS for which remediation was indicated or completed under RCRA regulations prior to enactment of the FFACO. Eight have been closed and are referred to as historic RCRA closure units. For the ninth site, the Area 5 Retired Mixed Waste Pits and Trenches, the NDEP has determined that NNSO/NSA shall close the site (in the future) subject to the conditions of 40 CFR 265.310. Three of the eight RCRA closure units require no further post-closure monitoring (Area 23 Building 650 Leachfield, Area 6 Steam Cleaning Effluent Ponds, and Area 2 U-2bu Subsidence Crater). Three of the eight closed units require periodic site inspections only (Area 2 Bitcutter Containment, Area 6 Decon Pond, and Area 3 U-3fi Injection Well), and two currently require post-closure inspections as well as VZM. VZM for the Area 3 U-3fi Injection Well is no longer conducted because the most recent monitoring results demonstrated continuing stable conditions at the site. The two sites still requiring VZM, and the methods prescribed by state permit at each site, are:

Table 9-4. Environmental restoration activities conducted in 2005

CAU	CAU Description	Number of CASs	Milestone	Due Date	Date Submitted	Date NDEP Approved
	DOE Industrial Sites – Defense Project					
219	Septic Systems and Injection Wells	6	CAIP to State	02/28/05	01/25/05	02/02/05
300	Surface Release Areas	7	CADD to State	11/13/05	03/15/05	03/18/05
322	Areas 1 & 3 Release Sites and Injection Wells	3	CAP to State	10/31/05	09/01/05	09/14/05
357	Mud Pits and Waste Dump	14	Closure Report to State	05/01/05	04/22/05	05/11/05
390	Areas 9, 10, and 12 Spill Sites	4	Closure Report to State	11/30/05	10/19/05	10/27/05
395	Area 19 Spill Sites	9	Closure Report to State	10/31/05	10/20/05	11/02/05
530	LANL Preshot Mud Pits	54	SAFER Plan to State	09/15/05	07/19/05	08/08/05
531	LANL Postshot Mud Pits	13	SAFER Plan to State	09/15/05	07/19/05	08/08/05
532	LLNL Preshot Mud Pits	78	SAFER Plan to State	09/15/05	07/19/05	08/08/05
533	LLNL Postshot Mud Pits	69	SAFER Plan to State	09/15/05	07/19/05	08/08/05
534	Exploratory/Instrumentation Mud Pits	39	SAFER Plan to State	09/15/05	07/19/05	08/08/05
535	Mud Pits/Disposal Areas	15	SAFER Plan to State	09/15/05	07/19/05	08/08/05
536	Area 3 Release Site	1	CAP to State	09/30/05	08/25/05	08/31/05
540	Spill Sites	9	SAFER Plan to State	12/31/05	11/30/05	12/27/05
555	Septic Systems	5	CAIP to State	02/28/06	12/27/05	01/09/06
	Defense Threat Reduction Agency/DOE - Industrial Sites					
383	Area 12 E-Tunnel Sites	3	CADD to State	03/31/05	03/09/05	03/18/05
	DOE Industrial Sites – Environmental Restoration Project (ERP)					
137	Waste Disposal Sites	8	CAIP to State	02/28/06	12/01/05	12/19/05
140	Waste Dumps, Burn Pits, and Storage Area	9	Closure Report to State	09/30/05	09/01/05	09/07/05
165	Area 25 and 26 Dry Well and Washdown Areas	8	Closure Report to State	01/31/06	12/05/05	12/20/05
214	Bunkers and Storage Areas	9	CAP to State	05/31/05	04/01/05	04/12/05
224	Decon Pad and Septic Systems	9	CADD to State	08/31/05	05/03/05	05/11/05
274	Septic Systems	5	CAIP to State	11/30/05	08/11/05	08/19/05
286	Lead/Chemical/Spill Sites and Material Dumps	9	Closure Report to State	09/30/05	08/15/05	08/31/05
309	Area 12 Muckpiles	3	CADD to State	02/28/06	12/23/05	01/10/06
309	Area 12 Muckpiles	3	Closure Report to State	02/28/06	12/23/05	01/10/06
489	WWII UXO Sites (TTR)	3	SAFER Plan to State	08/30/05	06/07/05	06/15/05
511	Waste Dumps (Piles & Debris)	9	CADD to State	01/31/06	12/12/05	01/03/06
511	Waste Dumps (Piles & Debris)	9	Closure Report to State	01/31/06	12/12/05	01/03/06
516	Septic Systems and Discharge Points	6	CAP to State	09/30/05	09/01/05	09/12/05

Table 9-4. Environmental restoration activities conducted in 2005 (continued)

CAU	CAU Description	Number of CASs	Milestone	Due Date	Date Submitted	Date NDEP Approved
		DOE Industrial Sites – ERP cont.				
528	Polychlorinated Biphenyls Contamination	1	CAP to State	08/31/05	06/16/05	07/05/05
543	Liquid Disposal Units	7	CADD to State	10/31/05	09/14/05	09/26/05
551	Area 12 Muckpiles	4	CADD to State	09/30/05	07/07/05	07/25/05
552	Area 12 Muckpile and Ponds	1	Closure Report to State	09/30/05	09/01/05	09/23/05
552	Area 12 Muckpile and Ponds	1	CADD to State	09/30/05	09/01/05	09/23/05
554	Area 23 Release Site	1	CADD to State	09/30/05	07/18/05	07/19/05
554	Area 23 Release Site	1	Closure Report to State	09/30/05	07/18/05	07/19/05
		DOE Soils Sites - ERP				
413	Clean Slate II Plutonium Dispersion (TTR)	1	CADD to State	01/31/05	01/04/05	03/09/05
		DOE UGTA Sites				
97	Yucca Flat/Climax Mine	720	Complete Earth Vision base model	03/30/05	03/23/05	03/24/05
97	Yucca Flat/Climax Mine	720	Complete the Hydrology Phase I Analyses & Evaluation	09/30/05	09/29/05	09/30/05
98	Frenchman Flat	10	Complete Frenchman Flat Phase II Flow Model	09/30/05	09/29/05	09/30/05
99	Rainier/Shoshone	66	Complete Drilling Phase I	09/29/05	09/29/05	09/30/05
101	Central Pahute Mesa	64	Submit Draft Contaminant Boundary Phase I Flow Model Report	07/31/05	06/14/05	08/12/05
102	Western Pahute Mesa	18	Submit Draft Contaminant Boundary Phase I Flow Model Report	07/31/05	06/14/05	08/12/05

CAU 110, U-3ax/bl Subsidence Crater – Post-closure inspections are performed quarterly and consist of visual observations to check that the cover is intact. The U-3ax/bl Subsidence Crater cover is designed to limit infiltration into the disposal unit and is monitored using TDR soil water content sensors buried at various depths within the waste cover to provide water content profile data. The soil water content profile data are used to demonstratewhether the cover is performing as expected. Annual reports of post-closure monitoring include monthly precipitation data for the reporting period and are submitted to NDEP by the last day of August.

CAU 112, Area 23 Hazardous Waste Trenches – Soil moisture monitoring data are collected and analyzed semiannually (January and July); site inspections are conducted quarterly. Soil moisture data are obtained from 30 neutron access tubes specified in the permit. Annual reports of post-closure monitoring include monthly precipitation data for the reporting period and are submitted to NDEP by the last day of January.

All required VZM and inspections of closed sites were conducted in 2005 as specified by RCRA permit or by each site's closure report. VZM results for the RCRA closure sites CAU 110 and CAU 112 indicated that surface water is not migrating into buried wastes. VZM reports were submitted to the state of Nevada prior to their due dates.

The sites at which physical inspections were conducted in 2005 are:

CAU 90	Area 2 Bitcutter Containment
CAU 91	Area 3 U-3fi Injection Well
CAU 92	Area 6 Decon Pond Facility
CAU 110	Area 3 U-3ax/bl Subsidence Crater
CAU 112	Area 23 Hazardous Waste Trenches
CAU 143	Area 25 Contaminated Waste Dumps
CAU 254	Area 25 R-MAD Decontamination Facility
CAU 261	Area 25 Test Cell A Leachfield
CAU 262	Area 25 Septic Systems and UDP
CAU 271	Areas 25, 26, and 27 Septic Systems
CAU 333	U-3auS Disposal Site
CAU 335	Area 6 Injection Well and Drain Pit
CAU 339	Area 12 Fleet Operations Steam Cleaning Effluent
CAU 342	Mercury Fire Training Pit
CAU 400	Bomblet Pit and Five Points Landfill (TTR)
CAU 404	Roller Coaster Lagoons and Trench (TTR)
CAU 407	Roller Coaster RadSafe Area (TTR)
CAU 417	Central Nevada Test Area -Surface
CAU 423	Area 3 Underground Discharge Point, Building 0360 (TTR)
CAU 424	Area 3 Landfill Complexes (TTR)
CAU 426	Cactus Spring Waste Trenches (TTR)
CAU 427	Area 3 Septic Waste Systems 2, 6 (TTR)
CAU 453	Area 9 UXO Landfill (TTR)
CAU 487	Thunderwell Site (TTR)
CAU 357	Mudpits and Waste Dump
CAU 529	Area 25 Contaminated Materials
CAU 552	Area 12 Muckpiles and Ponds
CAU 554	Area 23 Release Sites

9.5 Solid and Sanitary Waste Management

9.5.1 Landfills

The NTS has three landfills for solid waste disposal that are regulated and permitted by the state of Nevada (see Table 2-11 for list of permits). No liquids, hazardous waste, or radioactive waste are accepted in these landfills. They include:

- Area 6 Hydrocarbon Disposal Site – accepts hydrocarbon-contaminated wastes, such as soil and absorbents.
- Area 9 U10c Solid Waste Disposal Site – designated for industrial waste such as construction and demolition debris.
- Area 23 Solid Waste Disposal Site – accepts municipal-type wastes such as food waste and office waste. Regulated asbestos-containing material is also permitted in a special section. The permit allows disposal of no more than an average of 20 tons/day at this site.

These landfills are designed, constructed, operated, maintained, and monitored in adherence to the requirements of their state-issued permits. The NDEP visually inspects the landfills and checks the records on an annual basis to ensure compliance with the permits.

The vadose zone is monitored at two of the permitted sanitary landfills: the Area 6 Hydrocarbon Disposal Site and the Area 9 U10c Solid Waste Disposal Site. VZM is performed in lieu of groundwater monitoring to demonstrate that contaminants from the landfills are not leaching into the groundwater. In previous years, semiannual reports containing VZM data, rainfall data, and conclusions were sent to the state of Nevada, as specified in the landfill permits. In July 2004, the state of Nevada granted a reduction in the frequency of VZM at these landfills. Monitoring now takes place annually instead of semiannually. VZM of the Area 6 and Area 9 landfills in 2005 indicated that there was no soil moisture migration and therefore no waste leachate migration to the water table.

The amount of waste disposed of in each solid waste landfill in 2005 is shown in Table 9-5. An average of 2.1 tons/day was disposed at the Area 23 landfill, well within permit limits. State inspections of the three permitted landfills were conducted in March 2005. No out-of-compliance issues were noted.

Table 9-5. Quantity of solid wastes disposed in NTS landfills in calendar year 2005

Metric Tons (Tons) of Waste		
Area 6 Hydrocarbon Disposal Site	**Area 9 U10c Solid Waste Disposal Site**	**Area 23 Solid Waste Disposal Site**
215 (237)	14,056 (15,446)	681 (749)

9.5.2 Sewage Lagoons

The NTS also has two state-permitted sewage lagoons that were operated by BN Waste Management in 2005, as were the solid waste landfills. They are the Area 6 Yucca Lake and Area 23 Mercury lagoons. The operations and monitoring requirements for these sewage lagoons are specified by Nevada water pollution control regulations. Because of this, the discussion of their operations and compliance monitoring are presented in Section 4.2.3.

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10.0 Hazardous Materials Control and Management

Hazardous materials used or stored on the Nevada Test Site (NTS) are controlled and managed through the use of a Hazardous Substance Inventory database. Bechtel Nevada (BN), the Management and Operations contractor in 2005, and all other U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) subcontractors who use or store hazardous materials utilize this database and are required to comply with the operational and reporting requirements of the Toxic Substances Control Act (TSCA); Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); the Emergency Planning and Community Right-to-Know Act (EPCRA); and the Nevada Chemical Catastrophe Act (see Section 2.5). Chemicals to be purchased are subject to a requisition compliance review process. BN's Environmental Services personnel reviewed each chemical purchase to ensure that restricted chemicals were not purchased when less hazardous chemical substitutes were commercially available. Requirements and responsibilities for the use and management of hazardous/toxic chemicals were provided in company documents and were aimed at meeting the goals shown below. The reports or activities that are prepared or performed annually to document compliance with hazardous materials regulations are also listed below.

Hazardous Materials Control and Management Goals	Compliance Activities/Reports
Minimize the adverse effects of improper use, storage, or management of hazardous/toxic chemicals Ensure compliance with applicable federal and state environmental regulations related to hazardous materials	Use of Hazardous Substance Inventory database Annual TSCA report FIFRA management assessments Annual EPCRA Toxic Release Inventory (TRI) Report, Form R Annual Nevada Combined Agency (NCA) Report Nevada Division of Environmental Protection (NDEP)-Chemical Accident Prevention Program Annual Registration Form Use of electronic hazardous material tracking database called HAZTRAK

10.1 TSCA Program

There are no known pieces of polychlorinated biphenyl (PCB)-containing electrical equipment (transformers, capacitors, or regulators) at the NTS; however, sometimes during demolition activities, old hydraulic systems are found to contain PCB liquids. The TSCA program consists mainly of properly characterizing, storing, and disposing of various PCB wastes generated through remediation activities and maintenance of fluorescent lights. The remediation waste is generated by BN and Stoller-Navarro Joint Venture at Corrective Action Sites during environmental restoration activities (see Section 9.4) and during maintenance activities and building decontamination and decommissioning activities performed by BN. These activities can generate PCB-contaminated fluids and bulk product waste containing PCBs.

Waste classified as bulk product waste generated on the NTS can be disposed of onsite in the U10c landfill with prior state of Nevada approval. PCB-containing light ballasts removed during normal maintenance can also go to an onsite landfill, but when remediation or upgrade activities generate several ballasts, these must be disposed of offsite at an approved PCB disposal facility. Soil and other materials contaminated with PCBs must also be sent offsite for disposal.

During 2005, 15 drums of liquid PCB generated from draining hydraulic systems prior to building demolition, and 1 drum of clothing and rags contaminated from draining the systems were shipped offsite for disposal. Offsite disposal was required because the drums contained more than 50 parts per million (ppm) of PCB.

When PCB equipment or PCB fluids are managed during a calendar year, NNSA/NSO has been submitting an annual report to the U.S. Environmental Protection Agency (EPA) by July 1 of the following year. In 2003, NNSA/NSO determined that annual reports were not required to be sent to regulators since the NTS is not considered a commercial storer or disposer of PCBs. On April 24, 2006, an Annual Report was generated for calendar year 2005, but was not sent to outside regulators.

There were no TSCA inspections by outside regulators performed at the NTS in 2005.

10.2 FIFRA Program

BN Environmental Services performed the following oversight functions to ensure FIFRA compliance: (1) screened all purchase requisitions for restricted-use pesticides; (2) reviewed operating procedures for handling, storing and applying pesticide products; and (3) conducted facility inspections for unauthorized pesticide storage/use. On the NTS, pesticides are applied under the direction of a state of Nevada certified applicator. This service was provided by BN Solid Waste Operations (SWO). BN SWO maintained appropriate Commercial Category (Industrial) certifications for applying restricted-use pesticides, but only non-restricted pesticides were used. Pesticide applications in food service facilities are subcontracted to state-certified vendors.

BN SWO did not purchase any restricted-use pesticides during 2005. The SWO procedure for pesticide application was updated in 2003, and training is provided to affected personnel annually. Certifications were kept current in 2005 for Industrial Category application(s) of restricted-use pesticides. Facility inspections were conducted and indicated that there were no restricted-use pesticides being used or stored in violation of federal/state requirements. There was one FIFRA inspections by an outside regulator during 2005, with no findings.

10.3 EPCRA Program

In response to the EPCRA requirements, all chemicals that are purchased are entered into a hazardous substance inventory database and assigned specific hazard classifications (e.g., corrosive liquid, flammable, diesel fuel). Annually, this database is updated to show the maximum amounts of chemicals that were present in each building at the NTS, the Non-Proliferation Test and Evaluation Complex, the North Las Vegas Facility (NLVF) (see Section A.1.4), and the Remote Sensing Laboratory (see Section A.3.3). This information is then used to complete the Nevada Combined Agency (NCA) Report. This report provides information to the state of Nevada, community, and local emergency planning commissions on the maximum amount of any chemical, based on its hazard classification, present at any given time during the preceding year. This report also provides the commissions with new chemicals or chemical classes that were not previously onsite. The State Fire Marshall then issues permits to store hazardous chemicals on the NTS, as well as at the RSL and the NLVF.

In 2005, the chemical inventory at NTS facilities was updated and submitted to the state of Nevada in the NCA Report on February 23, 2006. No accidental or unplanned release of an extremely hazardous substance (EHS) occurred on the NTS in 2005.

The hazardous substance inventory database is also used to complete the TRI Report, Form R. This report provides EPA and the State Emergency Response Commission information on any toxic chemical that enters the environment above a given threshold. It also provides these agencies with the amounts of toxic chemicals that are recycled. NNSA/NSO submitted this report for calendar year 2005 to EPA on June 22, 2006. Lead was the only listed toxic chemical released into the NTS environment in 2005 that was reportable. Lead releases at the NTS consisted of 5,485.7 pounds from ammunition fired at the Mercury Firing Range and air releases of 7.47 pounds from ammunition and 7.08 pounds from solders. Lead, which either is recovered during site remediation activities or is excess to NTS operational needs (e.g., lead bricks, lead shielding), is sent offsite for recycling or proper disposal. A total of 31,575 pounds was sent offsite for recycling and 104,838 pounds sent off for disposal.

There were no EPCRA inspections by outside regulators performed at the NTS in 2005.

HAZTRAK is a tracking system that monitors hazardous materials while they are in transit. When a truck transporting hazardous material enters the NTS, all information concerning the load is entered into the tracking system. Once the delivery is complete, the information provided at the time of entry is removed from the tracking system.

10.4 Nevada Chemical Catastrophe Prevention Act

If EHSs are stored in quantities which exceed threshold quantities established by the NDEP, then NNSA/NSO submits a report notifying the state of Nevada. During 2005, no NTS facility stored EHSs in quantities which required state notification. Therefore, no Nevada Chemical Accident Prevention Program Report was prepared regarding calendar year 2005 NTS operations.

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11.0 Pollution Prevention and Waste Minimization

The U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) has pollution prevention (P2) and waste minimization (WM) initiatives. These initiatives establish a process to reduce the volume and toxicity of waste generated by the NNSA/NSO on the Nevada Test Site (NTS) and its satellite facilities. They also ensure that proposed methods of treatment, storage, and disposal of waste minimize potential threats to human health and the environment. These initiatives also address the requirements of several federal and state regulations applicable to operations on the NTS (see Section 2.7). The following information provides an overview of the P2/WM goals, major accomplishments during the reporting year, a description of efforts undertaken by Bechtel Nevada (BN) during 2005 to reduce the volume and toxicity of waste generated by the NNSA/NSO, and a summary of the Secretary of Energy's P2/WM goals and NNSA/NSO's status towards reaching those goals.

11.1 P2/WM Goals and Components

It is the priority of NNSA/NSO to minimize the generation, release, and disposal of pollutants to the environment by implementing cost-effective P2 technologies, practices, and policies. A commitment to P2 minimizes the impact on the environment, improves the safety of operations, improves energy efficiency, and promotes the sustainable use of natural resources. This commitment includes providing adequate administrative and financial materials on a continuing basis to ensure goals are achieved. When economically feasible, source reduction is the preferred method of handling waste, followed by reuse and recycling, treatment, and as a last resort, landfill disposal.

Source Reduction – Source reduction is the minimization or elimination of waste before it is generated by a project or operation. Examples of source reduction include chemical substitution, process modification, and segregation. NNSA/NSO's Integrated Safety Management System requires that every project/operation address waste minimization issues during the planning phase and ensure that adequate funds are allocated to perform any identified waste minimization activities.

To minimize the generation of waste, project managers are required to incorporate waste minimization into the planning phase of their projects. Waste generating processes must be assessed to determine if the waste can be economically reduced or eliminated. Waste minimization activities that are determined to be cost effective should be incorporated into the project plan and adequate funding allocated to ensure their implementation.

Recycling – For wastes that are generated, an aggressive recycling program is maintained. Items recycled through the NNSA/NSO recycling program include paper, cardboard, aluminum cans, toner cartridges, inkjet cartridges, tires, used oil, food waste from the cafeteria, plastic, scrap metal, rechargeable batteries, lead-acid batteries, alkaline batteries, fluorescent light bulbs, mercury lamps, metal hydride lamps, sodium lamps, and electronic media (diskettes, audio and video tapes, backup tapes, reel-to-reel tapes, etc.).

An effective method for reuse is the coordination of the Material Exchange Program. Created in 1998, the Material Exchange Program diverts supplies, chemicals, and equipment from landfills. Unwanted chemicals, supplies, and equipment are made available through electronic mail or postings on the intranet Material Exchange Database so that individuals in need can obtain the items at no cost. These materials are destined for disposal, either as solid or hazardous waste, as a result of process modification, discontinued use, or shelf life expiration. Rather than disposing of these items, the majority of them are provided to other employees for their intended purpose, thus avoiding disposal costs and costs for new purchases. If items are not placed with another user, they can be returned to the vendor for recycle/reuse, or given to other U.S. Department of Energy (DOE) sites, other government agencies, or local schools.

Affirmative Procurement - As required by Resource Conservation and Recovery Act (RCRA), Section 42 Unites States Code (USC) 6962, the NNSA/NSO maintains an Affirmative Procurement process that stimulates a market for recycled content products and closes the loop on recycling. RCRA section 42 USC 6962 requires the U.S. Environmental Protection Agency (EPA) to develop a list of items containing recycled materials that should be purchased. The EPA is also required to determine what the minimum content of recycled material should be for each item. Once this EPA-designated list was developed, federal facilities were required to ensure that a process was in place for purchasing the EPA-designated items containing the minimum content of recycled materials. Executive Order 13101, *Greening the Government through Waste Prevention, Recycling and Federal Acquisition* went one step further and requires federal facilities to ensure that 100 percent of purchases of items from the EPA-designated list contain recycled materials at the specified minimum content. Of the items NNSA/NSO currently purchases from the EPA-designated list, about 90 percent of those purchases contain recycled materials.

Assessments – P2 assessments are conducted twice a year. These assessments look at facilities or processes throughout the complex and focus on what waste streams are generated, what waste minimization activities are practiced, if there is room for improvement, and if these activities are tracked and reported in order to document that a waste minimization program is in place and operating. The assessments also look for new P2 opportunities.

Employee and Public Awareness – The NNSA/NSO P2 and WM initiatives also include an employee and public awareness program. Awareness of P2/WM issues is accomplished by dissemination of articles through both electronic mail and the NNSA/NSO site newsletters, the maintenance of a P2/WM intranet Web site, employee training courses, and participation at employee and community events. These activities are intended to increase awareness of P2/WM and environmental issues and point out the importance of P2/WM for improving environmental conditions in the workplace and community.

11.2 Major P2/WM Accomplishments and Awards

In 2005, a source room in Building 23-600 was converted into office space. Through segregation, approximately 13,800 metric tons (mtons) (15,180 tons) of potential hazardous waste (concrete with lead shielding) was eliminated. The lead shielding was segregated from the concrete and sent to the BN scrap metal salvage group for recycle. The concrete was sampled, found to be clean, and placed in 23 55-gallon drums for disposal in the NTS sanitary landfill.

The NTS Calibration Lab eliminated a small hazardous waste stream in 2005 by replacing a hazardous freon cleaning solvent used to clean pressure gauges with a nonhazardous solvent, 3M Novec HFE-71DE. The new solvent is low in toxicity, non-ozone-depleting, has a low global warming potential, and is listed as "acceptable without restriction" under the EPA's Significant New Alternatives Policy program.

The Material Exchange Program reused 2.2 mtons (2.4 tons) of solid waste in 2005.

NNSA/NSO received three NNSA Pollution Prevention Awards for P2 activities in 2005. BN's Pollution Prevention Team was awarded an Environmental Stewardship Award for developing a Material Exchange Program that utilizes an interactive website where employees from different organizations can "shop" for used items and add items they no longer need to the list of available items. This reduces the amount of waste that would be slated for the NTS landfill. Two NNSA Best-In-Class Awards for 2005 went to recognize the efforts of the Joint Actinide Shock Physics Experimental Research (JASPER) team (from Lawrence Livermore National Laboratory and BN) to eliminate the generation of low-level mixed transuranic waste, and to the BN Fleet Fuel Efficiency Team's efforts to use B-20 Bio-diesel, E-85 Ethanol/Gasoline mixtures, and "Micro" vehicles resulting in reductions in the amount of petroleum usage at the NTS.

11.3 Waste Reductions

P2/WM techniques and practices are implemented for all activities that may generate waste. These P2/WM activities result in reductions to the volume and/or toxicity of waste actually generated onsite. Table 11-1 compares the amounts of radioactive, hazardous, and solid wastes reduced in 2005 to prior years.

Table 11-1. Volumes of waste reduced through P2/WM activities by year

Calendar Year	Radioactive Waste Reduced (m^3)[(a)]	Hazardous Waste Reduced (mtons)[(b)]	Solid Waste Reduced (mtons)
2005	0	13,992	1,194.4
2004	0	114.8	1,437.5
2003	40.0	207.3	1,547.2
2002	63.2	177.2	904.2
2001	79.6	123.5	799.0

(a) 1 m^3 = 1.3 yd^3 (b) 1 mton = 1.1 ton

Table 11-2 shows a summary of the estimated volume reductions of hazardous and solid waste accomplished during 2005 through just recycling and reuse activities (i.e., not including reductions from reducing volumes of waste generated). An estimated 191.7-mtons (218.9-tons) reduction of hazardous waste including RCRA, Toxic Substance Control Act, and state-regulated hazardous waste; and a 1,194.5-mtons (1,313.9-tons) reduction of solid waste (sanitary waste) occurred in 2005 from recycling and reuse.

Table 11-2. Volumes of waste reduced through recycling and reuse activities in 2005

Activity	Volume Reduction (mtons)[(a)]
Hazardous Waste	
Bulk used oil was sent to an offsite vendor for recycling	166.3
Lead scrap metal was sold for reuse/recycling	14.3
Lead acid batteries were shipped to an offsite vendor for recycling	7.5
Spent fluorescent light bulbs, mercury lamps, metal hydride lamps, and sodium lamps were sent to an offsite vendor for recycling	2.6
Lead tire weights were reused instead of being disposed as hazardous waste	0.7
Rechargeable batteries were sent to an offsite vendor for recycling	0.2
Hazardous chemicals were relocated to new users through the Material Exchange Program, diverting them from landfill disposal	0.1
Total	**191.7**
Solid Waste	
Mixed paper and cardboard was sent offsite for recycling	509.8
Scrap ferrous metal was sold to a vendor for recycling	463.2
Tires were sent to a vendor for recycling	103.0
Food waste from the cafeterias was sent offsite to be reused as pig feed for a local pig farmer	55.4
Scrap non-ferrous metal was sold to a vendor for recycling	30.5
Shipping materials including pallets, styrofoam, bubble wrap, and shipping containers were reused	20.4
Cardboard was sent offsite for recycle	6.2
Spent toner cartridges were sent offsite for recycling	2.9
Nonhazardous chemicals, equipment, and supplies were relocated to new users through the Material Exchange Program, diverting them from landfill disposal	2.1
Aluminum cans were sent offsite for recycling	0.6
Electronic media were sent offsite for recycling	0.2
Number 1 plastic was sent offsite for recycling	0.1
Glass was sent offsite for recycling	0.1
Total	**1,194.5**

(a) 1 mton = 1.1 ton

11.4 Secretary of Energy's P2/WM Leadership Goals

On November 12, 1999, the Secretary of Energy set numerous P2 and energy-efficiency goals that each DOE site is required to meet. They are presented below along with a discussion of NNSA/NSO's performance towards meeting them. A tabulated summary of the goals and their compliance status at the NTS is presented in Chapter 2.0, Compliance Summary (Table 2-7b).

- <u>Goal 1.</u> **Reduce waste from routine operations by 2005, using a 1993 baseline, for the following waste types:**
  - **Hazardous by 90 percent**
  - **Low Level Radioactive by 80 percent**
  - **Low Level Mixed Radioactive by 80 percent**
  - **Transuranic (TRU) by 80 percent**

  NNSA/NSO generated 3,724 mtons (4,096 tons) of hazardous waste in the 1993 baseline year. During 2005, NNSA/NSO generated only 23.2 mtons (2.55 tons), for a reduction of 99.2 percent, easily meeting the 90-percent goal.

  The 1993 baselines for routine radioactive low-level waste, mixed waste, and TRU waste were all 0 m^3, making this goal impossible to meet for any time in the future if such wastes, regardless of their quantities, were generated on the NTS. The JASPER project began generating TRU waste in 2004. For P2 purposes, however, such waste is not documented until it is received by Waste Management for disposal, and JASPER TRU waste has yet to be sent to Waste Management. It will be sent when enough has been generated to cost effectively ship it to the disposal facility.

- <u>Goal 2.</u> **Reduce solid waste from routine operations by 75 percent by 2005 and 80 percent by 2010, using a 1993 baseline.**

  The 1993 baseline for solid waste generation is 13,735 mtons (15,108 tons). NNSA/NSO generated 5,380 mtons (5,918 tons) of solid waste in 2005 for a reduction of 61 percent, not quite meeting the goal of 75-percent reduction.

- <u>Goal 3.</u> **Reduce releases of toxic chemicals subject to Toxic Chemical Release Inventory (TRI) reporting by 90 percent by 2005, using a 1993 baseline.**

  Before 2001, NNSA/NSO was not required to submit a TRI Report, Form R to the EPA. Effective January 1, 2001, the EPA lowered the reporting threshold for lead, a toxic chemical subject to TRI reporting, to 100 pounds (lbs) (45 kilograms [kg]). NNSA/NSO has since reported lead releases from ammunition at the security contractor firing range on the NTS. Since 0 lbs of lead were reported released in 1993, the baseline year, it is impossible to meet the 90-percent reduction goal. Lead releases at the NTS consisted of 5,485.7 lbs (2,488.3 kg) from ammunition fired at the Mercury Firing Range and air releases of 7.47 lbs (3.39 kg) from ammunition and 7.08 lbs (3.21 kg) from solders.

- <u>Goal 4.</u> **Recycle 45 percent of solid waste from all operations by 2005 and 50 percent by 2010.**

  NNSA/NSO recycled 6.7 percent of solid wastes generated by all operations in 2005. Annual budget constraints and budget prioritization in past years as well as in 2005 have made meeting this goal difficult; it is less costly to dispose solid wastes onsite than to fund recycling efforts.

- <u>Goal 5.</u> **Reduce waste resulting from cleanup, stabilization, and decommissioning activities by 10 percent on an annual basis.**

  In 2005, NNSA/NSO generated 26,108 mtons (28,719 tons) of clean-up/stabilization waste. Through P2/WM activities, NNSA/NSO reduced clean-up/stabilization wastes by 14,308 mtons (15,739 tons), resulting in a 55-percent reduction. This easily met the annual reduction goal.

- <u>Goal 6.</u> **Increase purchases of EPA-designated items with recycled content to 100 percent, except when not available competitively at a reasonable price or if items do not meet performance standards.**

  In 2005, 90 percent of NNSA/NSO purchases of EPA-designated items met the EPA requirements for containing recycled materials, not quite meeting the goal of 100 percent.

12.0 Historic Preservation and Cultural Resources Management

The historic landscape of the Nevada Test Site (NTS) contains archaeological sites, buildings, structures, and places of importance to American Indians and others. These are referred to as "cultural resources". U.S. Department of Energy (DOE) Order 450.1 *Environmental Protection Program* requires that NTS activities and programs comply with all applicable cultural resources regulations (see Section 2.8) and that such resources on the NTS be monitored. The Cultural Resources Management (CRM) program has been established and is implemented by the Desert Research Institute (DRI) on the NTS to meet this requirement. The CRM program is designed to meet the specific goals shown below.

Cultural Resources Management Program Goals
Ensure compliance with all regulations pertaining to cultural resources on the NTS (see Section 2.8)
Inventory and manage cultural resources on the NTS
Provide information that can be used to evaluate the potential impacts of proposed projects and programs to cultural resources on the NTS and mitigate adverse effects
Curate archaeological collections in accordance with 36 Code of Federal Regulations (CFR) Part 79
Conduct American Indian consultations related to places and items of importance to the Consolidated Group of Tribal Organizations

In order to achieve the program goals and meet federal and state requirements, the CRM program is multi-faceted and contains the following major components: (1) surveys, inventories, and historical evaluations; (2) curation of archaeological collections; and (3) the American Indian Program. The guidance for the CRM program work is provided in the *Cultural Resources Management Plan for the Nevada Test Site* (Drollinger et al., 2002). Historic preservation personnel and archaeologists of DRI who meet the Secretary of the Interior standards conduct the work and the archaeological efforts are permitted under the Archeological Resources Protection Act (ARPA).

A brief description of the CRM program components and their 2005 accomplishments are provided in this chapter. The methods used to conduct surveys, inventories, and historical evaluations in support of NTS operations were summarized in the 2003 NTS Environmental Report (NTSER) (DOE, 2004d). The reader is directed to Appendix A, Section A.5 of the 2004 NTSER (DOE, 2005a) for a summary of the known human occupation and use of the NTS from the Paleo-Indian Period, about 12,000 years ago, until the mining and ranching period of the twentieth century, just before NTS lands were withdrawn for federal use. For convenience, an electronic file of this Appendix A from the 2004 NTSER is included on the compact disc for this 2005 NTSER and is called Attachment A.

12.1 Cultural Resources Surveys, Inventories, Historical Evaluations, and Associated Activities

Cultural resources surveys are conducted at the NTS to meet the requirements of the National Historic Preservation Act (NHPA) and the ARPA. The surveys are completed prior to proposed projects that may disturb or otherwise alter the environment. The following information is maintained in databases:

- Number of cultural resources surveys conducted
- Location of each survey
- Number of acres surveyed at each project location
- Types of cultural resources identified at each project location
- Number of cultural resources determined eligible to the National Register of Historic Places (NRHP)
- Eligible properties avoided by project activities
- Cultural resources requiring mitigation to address an adverse effect
- Final report on results

12.1.1 Cultural Resources Surveys

In 2005, six surveys were conducted: Fire Station No. 2 Project, Fire Break for a Fiber Optic Line Project, the Truck Parking Area, the Revegetation of Two Study Plots, the Area 22 Borrow Pit and Access Road, and the Area 6 Borrow Pit Expansion. The only cultural resources identified within these project areas were two isolated artifacts found by the survey of the revegetation study plots. The Area 6 Borrow Pit Expansion area was adjacent to two fenced locations that contain wooden benches that had been used for viewing atmospheric nuclear tests and determined eligible to the NRHP (see Section 12.1.2). As a result, it was recommended that the project area be modified to avoid any potential impact to the bench locations.

12.1.2 Cultural Resources Inventories

One cultural resources inventory was conducted for the sets of benches from which atmospheric nuclear tests were observed at the NTS between 1951 and 1962 (Jones, 2005a). Six sets of benches were examined. Three sets had previously been determined eligible to the NRHP; two are part of the Frenchman Flat Historic District and the other one is at News Nob. These benches were recorded in more detail than during previous efforts. Three other sets of benches were also documented. One set is on the west side of Frenchman Flat and two sets are at the southwest end of Yucca Flat. All three of these sets are now eligible to the NRHP. The benches are constructed of wood and consist of a seat, support posts, and bracing. They are set up in parallel rows.

12.1.3 Evaluations of Historic Structures

One historical evaluation was conducted in 2005 for the buildings within the Pluto Control Facility in Area 26. The Pluto Control Facility was one of three facilities in the Pluto Complex. The facility was in operation from 1958 to 1964 to develop and test nuclear reactors for ramjets to be used in long-range, low-altitude missiles for the U.S. Department of Defense. The building numbers and names include: 2101, the Control Building; 2102, the Assembly and Shop Building; 2103, the Critical Assembly Building (also known as the Hot Critical Experiment Building or the Hot Box); 2106, an open interior warehouse; and 2107, the Delta Reduction Building.

As summarized in Table 12-1, a total of 70.12 hectares (ha) (173.9 acres [ac]) were examined during cultural resources surveys, inventories, and historical evaluations. No prehistoric or historic archaeological sites were studied for inclusion to the NRHP. Four nuclear testing-related structures were documented and their determinations are pending.

Table 12-1. Summary data for cultural resources surveys, inventories, and historical evaluations conducted in 2005

Survey/Inventory/Historic Evaluation	Prehistoric/Historic Sites Found	Structures Evaluated	Sites Determined NRHP Eligible	Area Surveyed	
				Acres	Hectares
Fire Station No. 2	0	0	0	7.0	3.0
Fire Break for a Fiber Optic Line	0	0	0	25.0	10.0
Truck Parking Area	0	0	0	4.1	1.66
Re-vegetation of Two Study Plots	0	0	0	18.4	7.3
Historical Evaluation of the Pluto Control Facility	1	4	P[a]	25.5	10.33
Area 22 Borrow Pit and Access Road	0	0	0	3.84	1.5
Proposed Borrow Pit Expansion in Area 6	0	0	P	88.74	35.8
Inventory of Historic Benches	0	3	3	1.32	.53
Totals	**1**	**7**	**3**	**173.9**	**70.12**

(a) P = determination is pending

12.1.4 Associated Cultural Resources Activities

12.1.4.1 Adverse Effect Assessments and Mitigation Activities

There were no determinations of adverse effect to cultural resources in 2005. No mitigation activities were undertaken or were in progress.

12.1.4.2 General Reconnaissance/Archival Research

General reconnaissance and other activities were also conducted in 2005 and included five field reconnaissance and two archival research projects. One field visit was to record Magazine 802 and a nearby unnumbered magazine in Area 5. The second field visit was to accompany NTS personnel to nine corrective action sites (CASs) within Corrective Action Unit (CAU) 537 in Areas 2, 3, 5, 18, and 19. DRI was requested to make recommendations regarding the historical importance of the materials scheduled for removal at these CASs. Three of the CASs (02-01-02, 03-23-06, and 19-19-01) did not contain historic materials and six of the sites (05-19-02, 18-99-01, 18-99-02, 18-99-04, 18-99-05, and 18-9907) are associated with historic events. The third field project was a preliminary assessment for five tunnel sites (U12b, U12e, U12n, U12t and U16a) and two vertical shaft sites (U15a and U15e) regarding their historical importance and potential eligibility to the NRHP.

The other two field visits were for monitoring purposes. The first involved nine properties eligible to the NRHP. The NHPA requires federal agencies to identify and maintain the integrity of historic properties under their jurisdiction. Historic properties have been deemed so through consultation between the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) and the Nevada State Historic Preservation Office and include prehistoric and historic archaeological sites and objects, and historic buildings, structures, and objects. The purpose of the monitoring program is to periodically document that the historic properties, traditional cultural properties, and American Indian sacred sites on the NTS retain their integrity and NRHP eligibility. Monitoring the condition of cultural resources is an integral part of the NNSA/NSO historic preservation program. Two of the prehistoric sites were not visited due to access problems. The sites monitored are temporary American Indian camps and a tool manufacturing area. All of the sites were in a very good state of preservation. The second monitoring effort was for two prehistoric sites near Underground Test Area Project wells.

The monitoring was conducted during and after construction activities to ensure the sites were avoided by construction activities. All construction remained within the area of potential effect and the sites retain their integrity.

Two projects required archival research but no field visits. One was a 8,392-ha (20,738- ac) area impacted by the Air Force Wildfire (BTH 2) that occurred on June 4-8, 2005. Background research was conducted on the DRI Geographic Information System to determine the number of previously recorded sties and surveys that had been conducted within the area. It was determined that 19 Class III Cultural Resource Inventories were performed covering a total of 266.0 ha (657.4 ac) or 3.17 percent of the burned area. These inventories were on the NTS and in the Yucca Mountain Project Area. The inventories located 44 sites with seven eligible to the NRHP (Holz and Rager, 2005). The second project was a historical statement regarding CAU 210, CAS 10-23-01 (twisted metal tower fragment). The tower fragment was in an isolated location not near any roads. Based on the absence of other items, this place was not used to discard unwanted materials. Therefore, it is assumed that the force from an atmospheric test explosion blew this tower fragment to its present location near the Teapot craters (Beck, 2005).

12.1.4.3 Reports

Four survey reports, two historical evaluations, and one letter report were completed and are listed in Table 12-2. Site location information is protected from public distribution and those reports containing such data are not available to the public. Technical reports can be obtained from the DOE's Office of Scientific and Technical Information at email address <http://www.osti.gov/bridge>.

The data on NTS archaeological activities also were provided to DOE Headquarters in the formal Archeology Questionnaire for transmittal to the Secretary of the Interior and, ultimately, to the U.S. Congress as part of the Secretary of the Interior's Annual Archeology Report to Congress.

Table 12-2. Short reports, historical evaluations, technical reports, and letter reports prepared in 2005

Project	Report No.	Author(s) (see References)
Fire Station No. 2	SR082905-1	Holz, 2005a
Fiscal Year 2005 Monitoring Report	LR042105-1	Holz, 2005b
Inventory of Historic Benches	SR020904-1	Jones, 2005a
Fire Break for Fiber Optic Line	SR082905-2	Jones, 2005b
Truck Parking Area	SR102605-1	Jones, 2005c
Re-vegetation of Two Study Plots	SR120805-1	Jones, 2005d
Magazine 802 and Unnumbered Magazine	LR030305-1	Jones, 2005e
Borrow Pit Expansion	SR112304-2	Jones, 2005f
Monitoring of Underground Test Area Well Pad	LR091405-2	Jones, 2005g
Tippipah Spring	SR051302-1	Jones, 2005h
Yucca Lake Historic District	TR102	Jones et al., 2005
Nine Corrective Action Sites	LR071305-1	Jones and Holz, 2005
Tunnels U12b, U12e, U12n, U12t, and U16a, and Shafts U15a and U15e	LR100605-1	Drollinger, 2005a
Historical Evaluation Pluto Control Facility	HE041305-1	Drollinger, 2005b
Borrow Pit and Access Road	SR122704-1	Drollinger, 2005c
Nineteen Artifacts for the Atomic Testing Museum	LR011005-1	Drollinger, 2005d
Historical Significance of CAU20, CAS-10-23-01	LR121705-1	Beck, 2005

12.2 Curation

The NHPA requires that archaeological collections and associated records be maintained at professional standards; the specific requirements are delineated in 36 CFR Part 79, Curation of Federally-Owned and Administered Archeological Collections. Requirements for curation of the NTS archaeological collection include the following:

- Maintain a catalog of the items in the NTS collection
- Package the NTS collection in materials that meet archival standards (e.g., acid-free boxes)
- Store the NTS collection and records in a facility that is secure and has environmental controls
- Establish and follow curation procedures for the NTS collection and facility
- Comply with the Native American Graves Protection and Repatriation Act

In the 1990s, the NNSA/NSO completed the required inventory and summary of NTS cultural materials accessioned into the NTS Archaeological Collection and distributed the inventory list and summary to the tribes affiliated with the NTS and adjacent lands. Consultations followed, and all artifacts the tribes requested were repatriated to them. This process was completed in 2002; it will be repeated for any new additions to the NTS collection in the future. The known locations of American Indian human remains at the NTS continued to be protected from NTS activities in 2005.

The NTS Archaeological Collection contains over 400,000 artifacts and is curated in accordance with 36 CFR Part 79. The curation procedures provide guidelines to follow in order to comply with 36 CFR Part 79 (Drollinger, 2004). In 2005, a review of the documents in the curation archives was initiated. This review was undertaken to identify records for disposal, such as draft documents and records no longer pertinent to the cultural resources program. This effort was combined with a reorganization of the archives that is in progress. In regard to the artifact collection, one change implemented was to organize the collection overall by provenience, that is by site. Previously, items were organized according to artifact types, such as chipped stone, ground stone, pottery, etc.; but now, these items have been grouped together whenever possible on the shelves according to their origin (Drollinger, 2005e). Archival plastic carton boxes were ordered to replace the current cardboard boxes. This type of box will be more protective of the artifact collections in regard to accidents, such as water damage, and to nesting insects. They are also less likely to deteriorate due to handling and age. As part of the curation activities, assistance was provided to the Atomic Testing Museum for the loan of the McGuffin collection and historic artifacts from ranching and mining sites from the NTS artifact collection as well as various activities in support of the American Indian display in the Atomic Testing Museum including creating a photographic record of the display items (Drollinger, 2005d).

12.3 American Indian Program

The NNSA/NSO has had an active American Indian Program since the late 1980s. The function of the program is to conduct consultations between NNSA/NSO and NTS-affiliated American Indian tribes. Such consultation occurs through the Consolidated Group of Tribes and Organizations (CGTO). The CGTO is comprised of 16 groups of Southern Paiute, Western Shoshone, and Owens Valley Paiute-Shoshone, along with the Las Vegas Indian Center, a Pan-Indian organization (see Table 12-3). A history of this program is contained in *American Indians and the Nevada Test Site, A Model of Research and Consultation* (Stoffle et al., 2001). The goals of the program are to:

- Provide a forum of the CGTO to express and discuss issues of importance
- Provide the CGTO with opportunities to actively participate in decisions that involve places and locations that hold significance for them
- Involve the CGTO in the curation and display of American Indian artifacts
- Enable the CGTO and its constituency to practice their religious and traditional activities

Table 12-3. Culturally affiliated tribes and organizations in the CGTO

Ethnic Group	Tribe/Band
Southern Paiute	Chemehuevi Indian Tribe Colorado River Indian Tribes Kaibab Paiute Tribe Las Vegas Paiute Tribe Moapa Paiute Tribe Paiute Indian Tribe of Utah Pahrump Band of Paiutes
Western Shoshone	Duckwater Shoshone Tribe Ely Shoshone Tribe Timbisha Shoshone Tribe Yomba Shoshone Tribe
Owens Valley Paiute-Shoshone	Benton Paiute-Shoshone Tribe Big Pine Paiute Tribe Bishop Paiute Tribe Fort Independence Indian Tribe Lone Pine Paiute-Shoshone Tribe
Pan-Indian Organization	Las Vegas Indian Center

In 2005, two field visits were made to the NTS by ethnographers with representatives from the CGTO, accompanied by one or two archaeologists. The first trip was a four-day scoping trip in late May and early June to visit several sites within the Timber Mountain Caldera that could have importance to the CGTO. Representatives from each of the ethnic groups participated in the field trip. Seven locations were visited with the representatives examining each location to identify those most appropriate for immediate study. The places they reviewed included Scrugham Peak, a geoglyph (rock alignments), rockshelters, an obsidian quarry, Cat Canyon, and the BUGGY site. The BUGGY site was a point of interest because a large archaeological site that no longer exists was identified and recorded at this location prior to the BUGGY event. The second fieldtrip was for three days in late September. The ethnographers conducted in-depth interviews with elders and cultural specialists from the ethnic groups at five of the sites visited in May.

In 2003, the CGTO established an Atomic Testing Museum (ATM) subgroup to work with the museum on the content of a planned exhibit for the NTS American Indian history, culture, and views regarding the NTS landscape. In 2004, the subgroup, facilitated by NNSA/NSO, finalized the concept for the exhibit. In early 2005, recently made American Indian items that represent traditional life ways were loaned to the museum for the display with the subgroup completing the exhibit in time for the opening of the ATM.

13.0 Ecological Monitoring

U.S. Department of Energy (DOE) Order 450.1, *Environmental Protection Program* requires ecological monitoring and biological compliance support for activities and programs conducted at the DOE facilities. The Bechtel Nevada (BN) Ecological Monitoring and Compliance Program (EMAC) provides this support for the Nevada Test Site (NTS). The major sub-programs and tasks within EMAC include: (1) the Desert Tortoise Compliance Program, (2) biological surveys at proposed construction sites, (3) monitoring important species and habitats, (4) the Habitat Restoration Program, (5) ecosystem mapping and data management, and (6) biological impact monitoring at the Non-Proliferation Test and Evaluation Complex (NPTEC). A brief description of these program components and their 2005 accomplishments are provided in this chapter. More detailed information may be found in the most recent annual EMAC report (BN, 2006c) which is distributed to several federal and state natural resource agencies. EMAC annual reports are available electronically at <http://www.osti.gov/bridge>.

Ecological Monitoring and Compliance Program Goals
Ensure compliance with all state and federal regulations and stakeholder commitments pertaining to NTS flora, fauna, wetlands, and sensitive vegetation and wildlife habitats (see Section 2.9)
Delineate NTS ecosystems
Provide ecological information that can be used to evaluate the potential impacts of proposed projects and programs on NTS ecosystems and important plant and animal species

13.1 Desert Tortoise Compliance Program

The desert tortoise inhabits the southern one-third of the NTS at fairly low estimated densities (Figure 13-1). This species is listed as threatened under the Endangered Species Act. In December 1995, the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) completed consultation with the U.S. Fish and Wildlife Service (FWS) concerning the effects of NNSA/NSO activities on the desert tortoise, as described in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE, 1996a). A final Biological Opinion (Opinion) (FWS, 1996) was received from the FWS in August 1996. The Opinion concluded that the proposed activities on the NTS were not likely to jeopardize the continued existence of the Mojave population of the species and that no critical habitat would be destroyed or adversely modified. The Opinion established compliance limits for the numbers of accidentally injured and killed tortoises, captured and displaced tortoises, and acres of tortoise habitat that can be disturbed. All terms and conditions listed in the Opinion must be followed when activities are conducted within the range of the desert tortoise on the NTS.

A separate Opinion was issued to NNSA/NSO by the FWS in June 2005 for proposed chemical release studies which fall outside the scope of activities covered under the 1996 Opinion. This Opinion, *Proposed Chemical Release Tests at the Nevada Test Site, Nye County, Nevada*, File No. 1-5-05-F-455 (FWS, 2005), prescribes terms and conditions to ensure that tortoises are protected from harmful chemicals. No habitat destruction is proposed by the studies.

The Desert Tortoise Compliance Program within EMAC was developed to implement the terms and conditions of all Opinions issued to NNSA/NSO by the FWS, to document compliance actions taken, and to assist NNSA/NSO in FWS consultations.

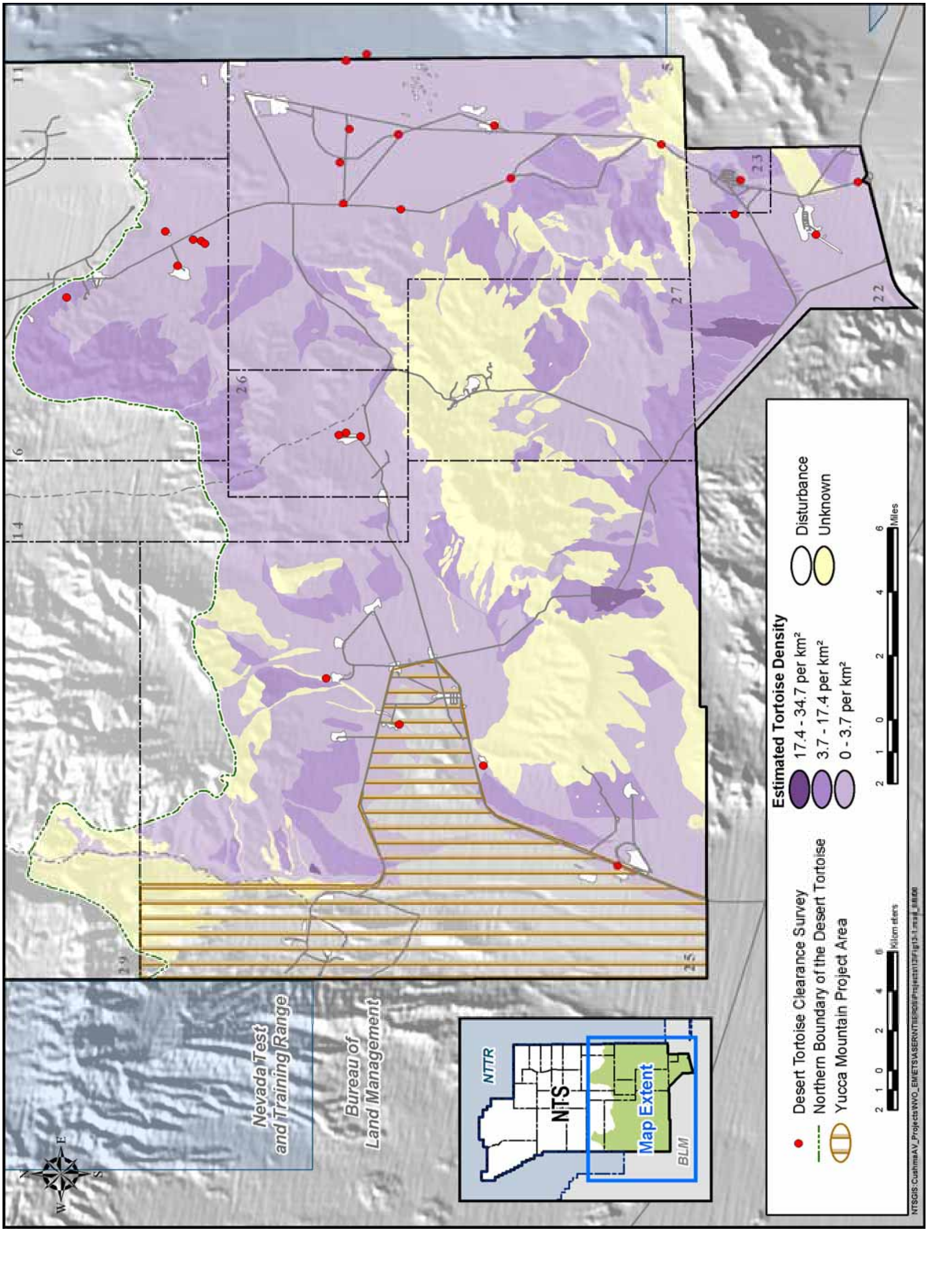

Figure 13-1. Desert tortoise distribution and abundance on the NTS and locations of clearance surveys conducted in 2005

In 2005, biologists conducted desert tortoise clearance surveys at 27 sites for 18 proposed projects. Only one inactive tortoise burrow was found. It was examined with a fiber-optic scope, determined to be empty, and crushed within 24 hours of the start of construction. On-site construction monitoring was conducted by a designated environmental monitor at all sites, where required.

A total of 10.33 hectares (ha) (25.53 acres [ac]) of tortoise habitat were disturbed in 2005. No desert tortoises were accidentally injured or killed, nor were any captured or displaced from project sites. A cumulative total of 107.52 ha (265.70 ac) of tortoise habitat on the NTS has been disturbed since the desert tortoise was listed as threatened in 1992. During 2005, none of the threshold levels for compliance measures established by the FWS in the 1996 or 2005 Opinions were exceeded (Table 13-1). In January 2006, NNSA/NSO submitted a report to the FWS Southern Nevada Field Office that summarized tortoise compliance activities for the 1996 Opinion conducted on the NTS from January 1 through December 31, 2005. In February 2006, a report was sent to the same FWS office documenting compliance activities for the 2005 Opinion.

Table 13-1. Compliance limits and status for NTS operations in tortoise habitat

Compliance Measure	Threshold Value	2005 Value
1996 Opinion for NTS Programmatic Activities:		
Number of tortoises accidentally injured or killed as a result of NTS activities per year	3	0
Number of tortoises captured and displaced from NTS project sites per year	10	0
Number of tortoises taken in form of injury or mortality on paved roads on the NTS by vehicles other than those in use during a project	Unlimited	1
Number of total ha (ac) of desert tortoise habitat disturbed during NTS project construction since 1992	1,220 (3,015)	107.52 (265.70)
2005 Opinion for NPTEC Test Cell C Activities:		
Number of desert tortoises that may be captured and moved as a result of project activities	1	0
Number of tortoises taken in the form of indirect mortality through predation by ravens	0	0
Number of tortoises taken indirectly in the form of harm as a result of release of potentially harmful chemicals	<5	0

Mitigation for the loss of tortoise habitat is required under the terms and conditions of the 1996 Opinion. The Opinion requires NNSA/NSO to perform either of two mitigation options: (1) pre-pay Clark County $1,600/ha ($648/ac) of habitat disturbed, or (2) revegetate disturbed habitat following specified criteria. Since 1992, NNSA/NSO has been using the balance of $81,000 that NNSA/NSO deposited into the Clark County Desert Tortoise Habitat Conservation Fund Number 236-8290 to pre-pay for the future disturbance of 101 ha (250 ac) of tortoise habitat on the NTS. During 2005, this pre-paid fund would have been exhausted; however, NNSA/NSO submitted plans to revegetate 8.14 ha (20.11 ac) of tortoise habitat in lieu of paying the mitigation fee. This left a total of 2.19 ha (5.42 ac) remaining in the mitigation bank. Projects that propose to disturb tortoise habitat are now directed to pay the fee to Clark County or revegetation is conducted. In 2005, biologists prepared two site specific plans to revegetate the 8.14 ha mentioned above as mitigation for three projects. These plans were approved by FWS in December 2005. Revegetation was started in 2005 and will continue in 2006.

13.2 Biological Surveys at Proposed Project Sites

Biological surveys are performed at proposed project sites where land disturbance will occur. The goal is to minimize the adverse effects of land disturbance on important plant and animal species and their associated habitat, important biological resources (i.e., nest sites, active tortoise burrows), and wetlands. Biological surveys comply with the terms and conditions of the 1996 Opinion and with the mitigation measures specified in the *Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada* (DOE, 1996a) and its Record of Decision.

Species considered important include those protected or managed under federal or state regulations, plants listed on the Nevada Natural Heritage Program's Nevada At-Risk Plant and Lichen Tracking List (called "sensitive" plants), animals listed on Nevada Natural Heritage Program's Nevada At-Risk Animal Tracking List (called "sensitive animals), and bats assigned a high or moderate risk assessment designation under the Nevada Bat Conservation Plan (Altenbach et al., 2002). The important species known to occur on the NTS include 19 plants and 48 animals (Tables 13-2 and 13-3). All of these species are evaluated for their inclusion in long-term monitoring activities on the NTS. Important biological resources include such things as cover sites, nest or burrow sites, roost sites, wetlands, or water sources important to sensitive species. The biological survey parameters which are documented include:

- Number of biological surveys conducted
- Number of hectares/acres surveyed per proposed project
- Types and numbers of important species and biological resources found
- Mitigation recommendations and actions taken to protect species/resources

Table 13-2. Important plants which are known to occur on or adjacent to the NTS

Flowering Plant Species	**Common Name**	**Status**[(a)]
Arctomecon merriamii	White bearpoppy	S, IA
Astragalus beatleyae	Beatley's milkvetch	S, A
Astragalus funereus	Black woolypod	S, A
Astragalus oopherus var. *clokeyanus*	Clokey's egg milkvetch	S, A
Camissonia megalantha	Cane Spring suncup	S, IA
Cymopterus ripleyi	Ripley's springparsley	S, IA
Eriogonum concinnum	Darin's buckwheat	S, A
Eriogonum heermannii var. *clokeyi*	Clokey's buckwheat	S, A
Frasera albicaulis var. *modocensis*[(b)]	Pahute green gentian or Modoc elkweed	S, IA
Galium hilendiae ssp. *kingstonense*	Kingston Mountain bedstraw	S, IA
Hulsea vestita ssp. *inyoensis*	Inyo hulsea	S, IA
Ivesia arizonica var. *saxosa*	Whitefeather ivesia	S, A
Lathyrus hitchcockianus	Hitchcock's peavine	S, A
Penstemon pahutensis	Pahute penstemon	S, IA
Phacelia beatleyae	Beatley's phacelia	S, A
Phacelia mustelina	Weasel phacelia	S, IA
Phacelia parishii	Parish's phacelia	S, IA
Sclerocactus polyancistrus	Mojave fishhook cactus	S, IA
Moss Species		
Entosthodon planoconvexus	Planoconvex entosthodon	S, E

(a) Status Codes:

State of Nevada
S – Listed on Nevada Natural Heritage Program's Nevada At-Risk Plant and Lichen Tracking List

Long-term Sensitive Plant Monitoring Status under EMAC
A - Active: currently included in long-term population monitoring activities
IA - Inactive: not currently included in long-term population monitoring activities
E - Evaluate: species for which more information on distribution, abundance, and susceptibilities to threats on the NTS must be gathered before deciding to include in long-term monitoring activities

(b) Nevada Natural Heritage Program calls this plant *Frasera pahutensis*

Note: The state of Nevada protects all cactus, yucca, and "Christmas trees" from unauthorized collection on public lands. Such plants are not protected from harm on private lands or on withdrawn public lands such as the NTS.

Table 13-3. Important animals which are known to occur on or adjacent to the NTS

Mollusk Species	**Common Names**	**Status [(a)]**
Pyrgulopsis turbatrix	Southeast Nevada springsnail	S, A
Reptile Species		
Eumeces gilberti rubricaudatus	Western red-tailed skink	S, E
Gopherus agassizii	Desert tortoise	LT, NPT, S, IA
Bird Species[(b)]		
Accipiter gentilis	Northern goshawk	S, NPS, IA
Alectoris chukar	Chukar	G
Aquila chrysaetos	Golden eagle	EA, NP
Athene cunicularia hypugaea	Western burrowing owl	S, NP, A
Buteo regalis	Ferruginous hawk	S, NP, IA
Buteo swainsoni	Swainson's hawk	S, NP, A
Callipepla gambelii	Gambel's quail	G
Charadrius montanus	Mountain plover	PT, NP
Chlidonias niger	Black tern	S, NP, IA
Coccyzus americanus	Western yellow-billed cuckoo	S, NPS, IA
Falco peregrinus anatum	American peregrine falcon	<LE, S, NPE, IA
Gavia immer	Common loon	S, NP, IA
Haliaeetus leucocephalus leucocephalus	Bald eagle	LT-PD, EA, S, NPE, IA
Ixobrychus exillis hesperis	Western least bittern	S, NP, IA
Lanius ludovicianus	Loggerhead shrike	NPS
Oreoscoptes montanus	Sage thrasher	NPS
Phainopepla nitens	Phainopepla	S, NP, IA
Plegadis chihi	White-faced ibis	S, NP, IA
Spizella breweri	Brewer's sparrow	NPS
Mammal Species		
Antrozous pallidus	Pallid bat	M, NP, A
Antilocapra americana	Pronghorn antelope	G
Corynorhinus townsendii pallescens	Townsend's big-eared bat	S, H, NPS, A
Equus asinus	Burro	HB
Equus caballus	Horse	HB
Euderma maculatum	Spotted bat	S, M, NPT, A
Felis concolor	Mountain lion	G
Lasionycteris noctivagans	Silver-haired bat	M, A
Lasiurus blossevillii	Western red bat	S, H, NPS, A
Lasiurus cinereus	Hoary bat	M, A
Lynx rufus	Bobcat	F
Microdipodops megacephalus	Dark kangaroo mouse	NP
Microdipodops pallidus	Pale kangaroo mouse	NP
Myotis californicus	California myotis	S, M, A

Table 13-3. Important animals which are known to occur on or adjacent to the NTS (continued)

Mammal Species (continued)	Common Name	Status[a]
Myotis ciliolabrum	Small-footed myotis	S, M, A
Myotis evotis	Long-eared myotis	M, A
Myotis thysanodes	Fringed myotis	S, H, NP, A
Myotis yumanensis	Yuma myotis	M, A
Ovis canadensis nelsoni	Desert bighorn sheep	G
Odocoileus hemionus	Mule deer	G
Pipistrellus hesperus	Western pipistrelle	M, A
Sylvilagus audubonii	Audubon's cottontail	G
Sylvilagus nuttallii	Nuttall's cottontail	G
Tadarida brasiliensis	Brazilian free-tailed bat	NP
Urocyon cinereoargenteus	Gray fox	F
Vulpes velox macrotis	Kit fox	F

(a) Status Codes:

U.S. Fish and Wildlife Service, Endangered Species Act

LT - Listed Threatened
PT - Proposed for listing as Threatened
PD - Proposed for delisting
<LE- Former listed endangered species

U.S. Department of Interior

HB - Protected under Wild Free Roaming Horses and Burros Act
EA - Protected under Bald and Golden Eagle Act

State of Nevada

NPE - Species protected as endangered under Nevada Administrative Code (NAC) 503
NPT - Species protected as threatened under NAC 503
NPS - Species protected as sensitive under NAC 503
NP - Species listed as protected under NAC 503
S - Listed on Nevada Natural Heritage Program's Nevada At-Risk Animal Tracking List
G - Regulated as game species
F - Regulated as fur-bearer species

Long-term Sensitive Animal Monitoring Status under EMAC

A - Active: currently included in long-term population monitoring activities
IA - Inactive: not currently included in long-term population monitoring activities
E - Evaluate: species for which more information on distribution, abundance, and susceptibilities to threats on the NTS must be gathered before deciding to include in long-term monitoring activities

Nevada Bat Conservation Plan – Bat Species Risk Assessment Designations

H - High: species imperiled or at high risk of imperilment and having the highest priority for funding, planning, and conservation actions
M - Moderate: species which warrant closer evaluation, more research, and conservation actions and lacking meaningful information to adequately assess species' status

(b) All bird species on the NTS are protected by the Migratory Bird Treaty Act except for the following five species: Gambel's quail, chukar, English house sparrow, rock dove, and European starling
Also, the state of Nevada protects all birds that are protected by federal laws in addition to the species listed in this Table.

In 2005, surveys at 88 sites for 36 projects were conducted. These sites included 20 old buildings scheduled for demolition which were surveyed for the presence of active bird nests and bat roosts. The summary of survey results are shown in Table 13-4. No wetlands or important species were impacted by these projects except for two barn owl (*Tyto alba*) eggs and four great-horned owl (*Bubo virginianus*) eggs which were removed from nests in buildings scheduled for demolition. They were taken to Wild Wing Project, Inc. in Las Vegas, a state of Nevada-approved wildlife rehabilitation organization. The barn owl eggs were not viable, and three of the great-horned owl eggs hatched. The young owls were reared and released to the wild (Figure 13-2). Some resources used by important species were impacted: 15 empty bird nests were removed from buildings which were demolished. Biological survey sites for 2005 are shown in Figure 13-3.

Table 13-4. Summary of 2005 biological survey results

Measure	Result
Number of biological surveys conducted	88 for 36 projects
Area surveyed	Total: 296.10 ha (731.68 ac) Undisturbed habitat: 119.71 ha (295.81 ac) Previously-disturbed habitat: 176.39 ha (435.87 ac)
Important species/biological resources found	2 raptor nests with 6 eggs; 6 passerine bird nests with over 20 eggs 1 raptor nest with 3 chicks; 3 passerine bird nests with 7 chicks 1 active bird nest (unknown eggs/nestlings) 15 empty bird nests 1 potential tortoise burrow used by burrowing owl 1 kit fox dens 6 predator burrows
Mitigation actions taken	Removed empty bird nests prior to building demolitions Postponed one building repair until eggs hatched and nestling fledged Took 2 great-horned owl eggs and 3 great-horned owl chicks to Wild Wing Project, Inc. with FWS approval prior to building demolitions that could not be postponed Ensured no birds or bats were present prior to building demolitions Avoided potential tortoise burrow occupied by burrowing owl Avoided kit fox/predator burrows or verified they were inactive prior to construction

Figure 13-2. Three great-horned owl chicks at Wild Wing Project, Inc. (Photo by Lisa Ross, May 2005)

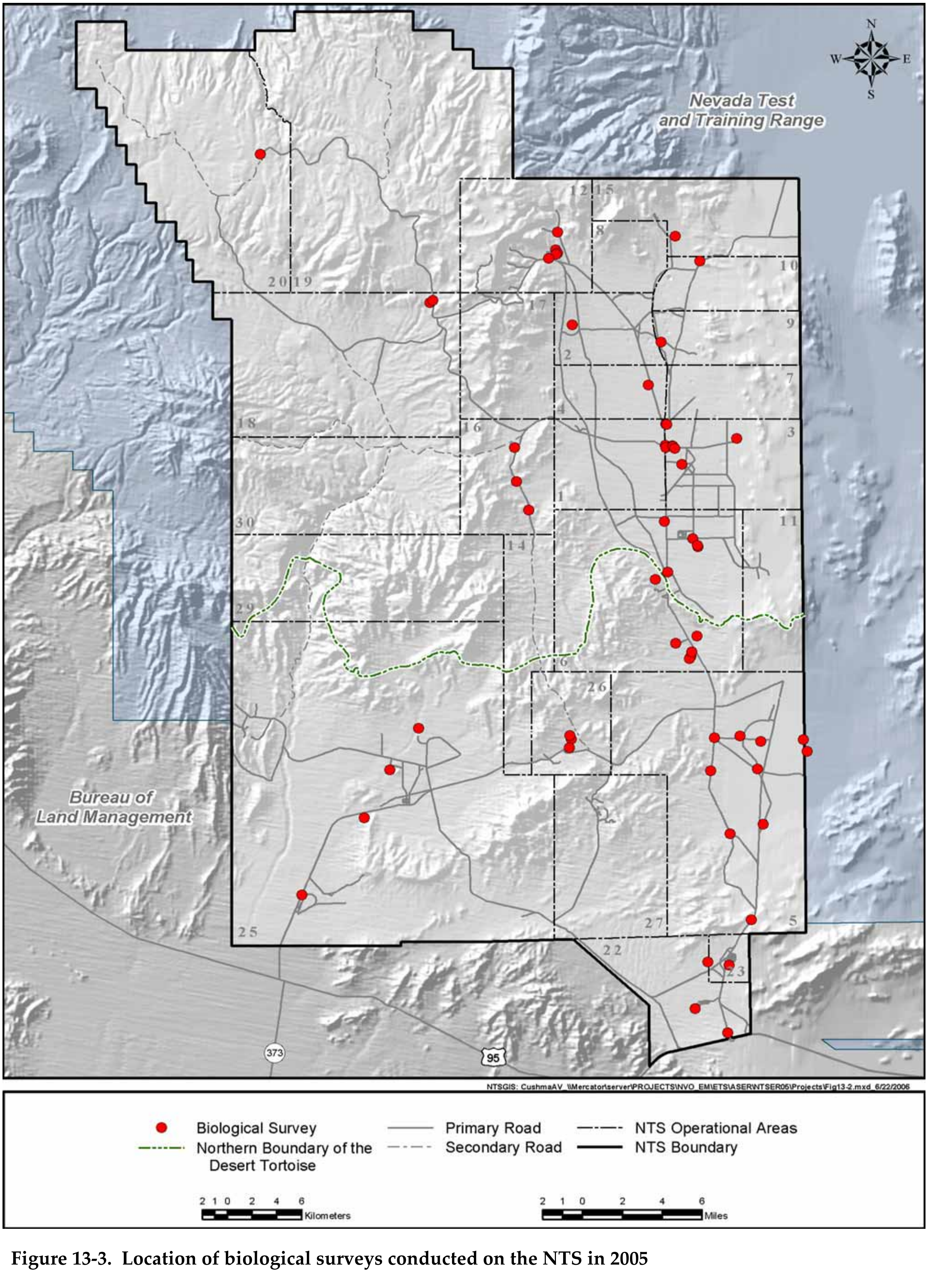

Figure 13-3. Location of biological surveys conducted on the NTS in 2005

13.3 Important Species and Habitat Monitoring

Over the last three decades, NNSA/NSO has taken an active role in collecting or supporting the collection of information on the status of important plants and animals and their habitat on the NTS and has produced numerous documents reporting their occurrence, distribution, and susceptibility to threats on the NTS (see *Ecology of the Nevada Test Site: An Annotated Bibliography* [Wills and Ostler, 2001]). In 1998, NNSA/NSO prepared a Resource Management Plan (DOE, 1998). One of the many natural resources goals stated in the plan is to protect and conserve sensitive plant and animal species found on the NTS and to minimize cumulative impacts to those species as a result of NNSA/NSO activities. The EMAC goals of species and habitat monitoring on the NTS are to:

- Ensure that impacts caused directly by NTS projects can be detected, quantified, and managed so that a species' occurrence on the NTS is not threatened by such projects
- Ensure adherence to state and federal regulations aimed at protecting wild horses, migratory birds, wetlands, and wildlife habitat

Data collected for monitored species include:

- Distribution on the NTS
- Relative abundance, density, or population size on the NTS
- Susceptibility to threats from NTS projects
- Location of nest burrows, nests, or roost sites of sensitive animals
- Location of preferred habitats
- Incidence and cause of mortality

In 2005, the major accomplishments under this EMAC task are presented below. Detailed descriptions of these actions and results can be found in *Ecological Monitoring and Compliance Program Calendar Year 2005 Report* (BN, 2006c).

13.3.1 Sensitive Plants

Known populations and potential habitat of two sensitive plant species were visited in 2005 (Figure 13-4). The species were *Astragalus beatleyae* and *Astragalus funereus,* both herbaceous perennials. Evaluation surveys were also conducted for *Entosthodon planoconvexus*, a non-vascular plant. All sites monitored in 2005 showed no signs of human disturbance.

13.3.1.1 Astragalus beatleyae

Six of the 14 *A. beatleyae* populations on the NTS were selected and surveyed. All 14 of the known NTS populations had last been visited in 2002. A representative number of the permanent transects established at each site during earlier studies were sampled. Monitoring was completed in May and June when plants were in flower and setting seed. The density of *A. beatleyae*, averaged over the six sites, was 0.67 plants per square meter (plants/m^2), similar to what they were in 1991 for the same six sites (0.73 plants/m^2) (Blomquist et al., 1995), and higher than for all other years when plant density was monitored at these sites.

13.3.1.2 Astragalus funereus

The two known population locations of *A. funereus* on the NTS, one on the southern slopes of French Peak and one on the southeastern slopes of Shoshone Mountain, were surveyed. About 240 plants were found at the French Peak population in June. Estimates in previous years ranged from 170 to 287 plants (Blomquist et al. 1995). About 20 plants were found at the Shoshone Mountain site in 2005. Surveys in 1991 and 1992 at this location reported about 30 individuals. In the future, permanent plots will be established at each population site, including known sites off the NTS, and densities will be estimated within each plot. This will facilitate comparisons between years and provide a more accurate assessment of species status from year to year. The western slope of Shoshone Mountain, where *A. funereus* plants have been reported to occur in the past (but not confirmed by specimen collection and identification), was also surveyed in 2005. As in past years, no individuals of *A. funereus* were found. It was determined that reports of *A. funereus* in this area were in error.

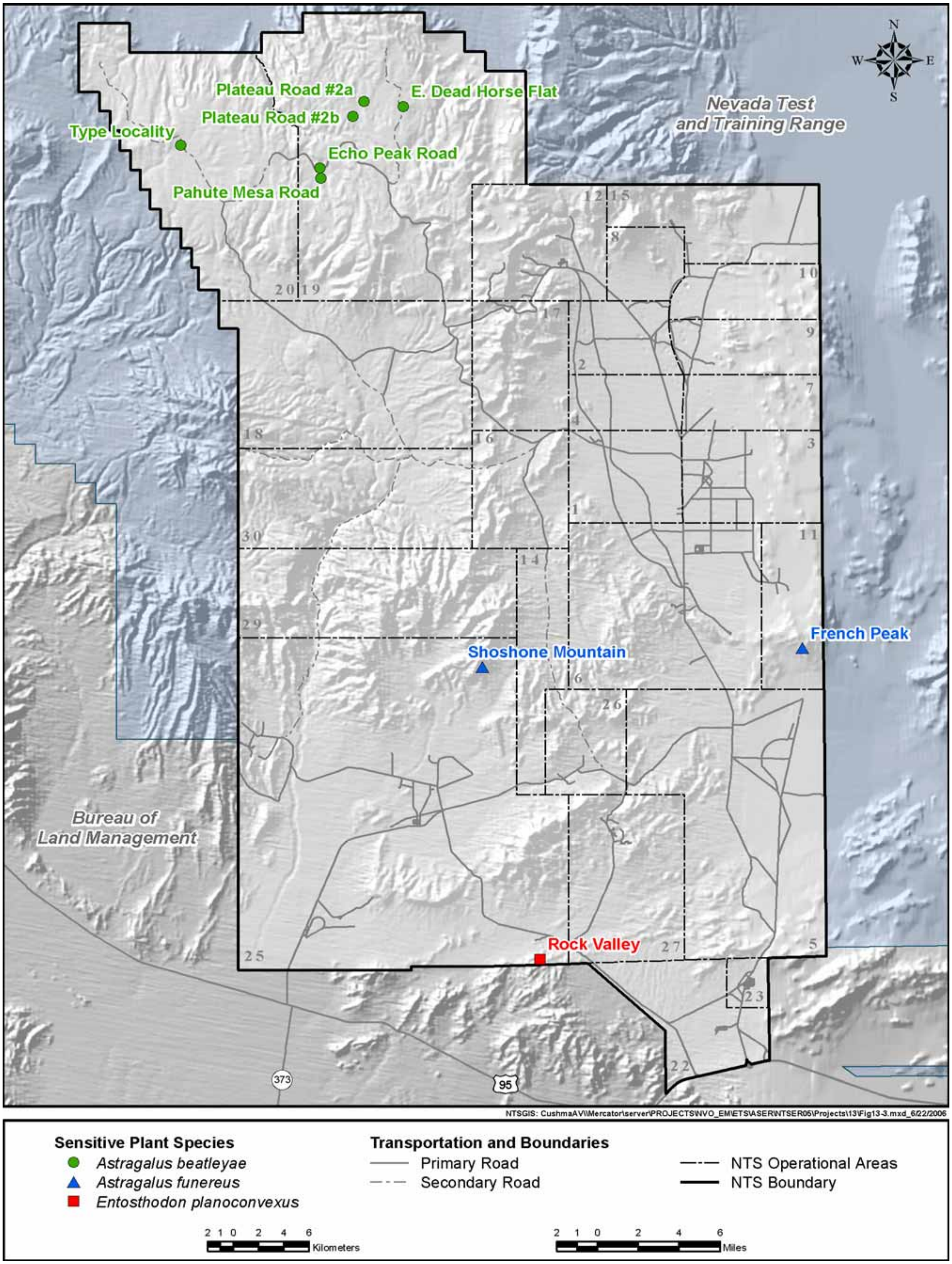

Figure 13-4. Sensitive plant populations monitored on the NTS in 2005

13.3.1.3 Entosthodon planoconvexus

In May 2005, a former collection site of the moss *E. planoconvexus* was surveyed. A specimen of this species, which resides in the University of Nevada, Las Vegas herbarium, was collected in the 1970s in Rock Valley in Area 25 along north-facing limestone foothills of the Specter Range, at an elevation of 1149 m (Stark et al., 2002). Several collections of mosses were made in this area in May, one of which appears to be *E. planoconvexus.* The specimen will be verified in 2006 by taxonomic experts.

13.3.2 Important Bat Species

As mentioned in Section 13.2, bat species considered important include those protected or managed under federal or state regulations, species listed on Nevada Natural Heritage Program's Nevada At-Risk Animal Tracking List (called "sensitive"), and species assigned a high or moderate risk assessment designation under the Nevada Bat Conservation Plan (Altenbach et al., 2002). The majority of the bat species known to occur on the NTS (13 out of 15) are important species, and 6 of the 13 important species are state-protected (see Table 13-3*).* A noteworthy change in Table 13-3 from 2004 is that the pallid bat (*Antrozous pallidus*), fringed myotis (*Myotis thysanodes*), and Brazilian free-tailed bat (*Tadarida brasiliensis*) became Nevada Protected species under NAC 503, and the Townsend's big-eared bat (*Corynorhinus townsendii*) and the western red bat (*Lasiurus blossevillii*), became Nevada Protected-Sensitive species under NAC 503.

13.3.2.1 Night Monitoring of Water Sources and Potential Roost Sites

In 2005, night monitoring surveys for bats were conducted at seven water sources and five potential roost sites (Figure 13-5) to help identify the distribution of important bat species and their roosts on the NTS. Bat monitoring involves a variety of techniques including direct capture with mist nets, recording ultrasonic echolocation calls using the Anabat II™ system (Titley Electronics, Ballina, Australia), recording bat activity with a special night vision camera equipped with NightSight™ technology attached to a camcorder, and observing bat activity with night vision goggles.

Bats were detected at all seven water sources. A total of 13 bat species (including 11 important species were detected acoustically. Only one bat was captured: a juvenile, male, long-legged myotis (*Myotis volans*) at Rainier Mesa Pond in June, suggesting that this species (not an important species) breeds on the NTS. Bat activity was detected at each of the five potential roost sites monitored in 2005. A total of nine species, including seven important species, were detected acoustically across the five sites. E and N Tunnels were determined to be day roosts. T and V Tunnels and the shaft above V Tunnel were determined to be night roosts/foraging sites. No new maternity roosts of important species were identified. Of the 15 known bat species to occur on the NTS, all but the silver-haired bat (*Lasionycteris noctivagans*) and the Townsend's big-eared bat were detected during 2005 monitoring activities. The reader is directed to the 2005 EMAC annual report (BN, 2006c) for details on monitoring activities and results.

13.3.2.2 Documented Day Roosts in NTS Buildings

Reports of bats found in buildings during biological surveys and bats found by others in buildings are documented to augment knowledge about bat roosting sites on the NTS. In 2005, a total of 14 bats were found roosting in or around 5 buildings (3 in Mercury, 1 in Area 5, and 1 in Area 6) (Figure 13-5). Eleven bats were either California or small-footed myotis, two were California myotis (*Myotis californicus*), and one was a Townsend's big-eared bat.

13.3.2.3 Passive Acoustic Monitoring of Seasonal Bat Activity at Camp 17 Pond

In order to learn more about long-term bat activity over different seasons and years, a passive acoustic monitoring system was installed at Camp 17 Pond (Figure 13-5) on September 22, 2003, and continued to be operated during 2005. To date, the winter (December – February) data show that silver-haired bats, small-footed myotis, and long-legged myotis are active at this pond over winter months. Winter activity of these species had previously not been documented based on capture data (O'Farrell, 2005). The data also show that bat activity was highest in December and steadily declined to its lowest level in February. Previous capture data for this region

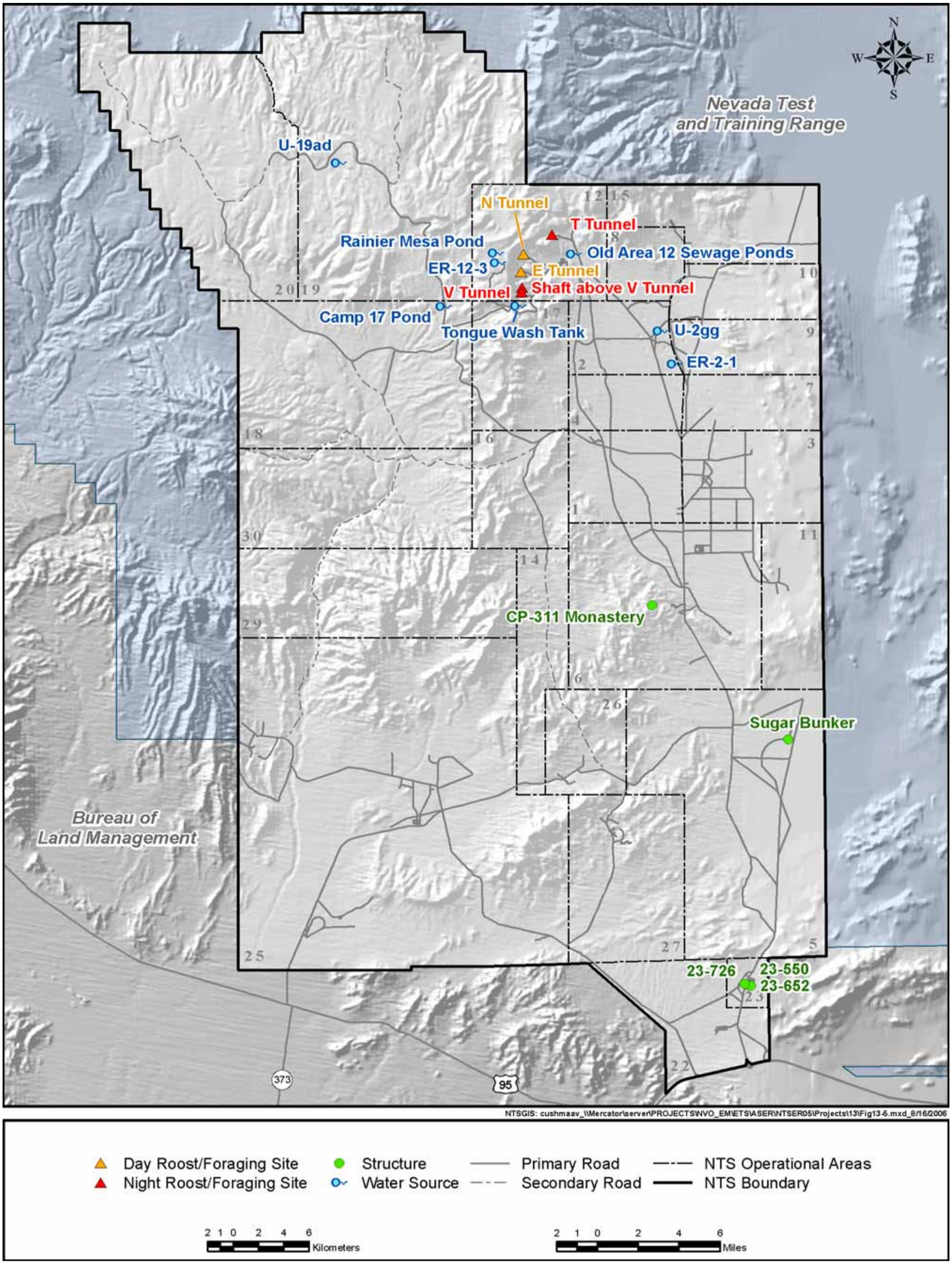

Figure 13-5. Sites monitored for bat activity in 2005 on the NTS

showed that bats were not active greater than four hours after sunset during winter months (O'Farrell, 2005). The passive acoustic data, however, show that 37.6 percent of all winter bat activity (2,402 of 6,395 minutes) occurred greater than four hours after sunset. This system will continue to be used to collect data which is published and shared with regional bat conservation biologists and organizations.

13.3.3 State Protected Small Mammals

Each year the Nevada Natural Heritage Program's Nevada At-Risk Animal Tracking List and the NAC 503 are reviewed to identify changes in the status of animals known to occur on the NTS. A noteworthy change was the addition of the dark kangaroo mouse (*Microdipodops megacephalus*) and the pale kangaroo mouse (*Microdipodops pallidus*) to the list of Nevada Protected species under NAC 503. As a result, small mammal trapping was initiated in 2005 to help assess these species' distribution and abundance on the NTS. With the assistance of Dr. John Hafner, BN biologists visited the typically sandy habitats of the NTS in Areas 3, 16, 17, 18, 19, and 20 where these two species of kangaroo mice have been periodically trapped from 1959 to 1990. Nine trap sites were selected in Areas 17, 18, 19, and 20. Trapping was conducted for one night at each of the nine sites on August 1 and 2 and October 25 for a total of 1,395 trap nights (i.e., the number of total traps multiplied by the number of total nights trapping is conducted). A total of 330 rodents representing 9 species was captured. However, neither the dark nor the pale kangaroo mouse was captured. Trapping efforts will continue during 2006.

13.3.4 Wild Horses

An annual horse census was conducted by driving selected roads along the boundaries of the suspected annual horse range in the northern portion of the NTS (Figure 13-6). Forty-nine adult horses and five foals were counted in 2005. Five horse bands (composed of stallions, subordinate males, females, and their offspring) were observed. The bands ranged in size from 3 to 13 individuals excluding foals. The population showed a moderate increase in number over last year due to the survival of several younger-aged horses (yearlings and 2 year olds) (Table 13-5).

Table 13-5. Number of individual horses observed on the NTS by age class, gender, and year

Age Class	Number of Individuals Observed by Year																			
	1996		1997		1998		1999		2000		2001		2002		2003		2004		2005	
Foals	1		3		8		5		11		11		5		6		5		5	
Yearlings	0		0		0		2		4		2		0		8 1[b]		9		6	
	M[a]	F[a]	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
2-Year Olds	0	1	0	0	0	0	0	0	2[b]	0	2	2	0	2	0	0	4	4	5	4
3-Year Olds	0	0	0	1	0	0	0	0	0	0	0	0	2	2	0	2	0	0	4	4
Adults (>3-Year Olds)	21	24	19	20	16	21	11	20	13	21	11	20	8	19	8	20	6	21	5	21
Total (excluding foals)	**46**		**40**		**37**		**31**		**38**		**37**		**33**		**38**		**44**		**49**	

[a] M=male, F=female

[b] = number found dead

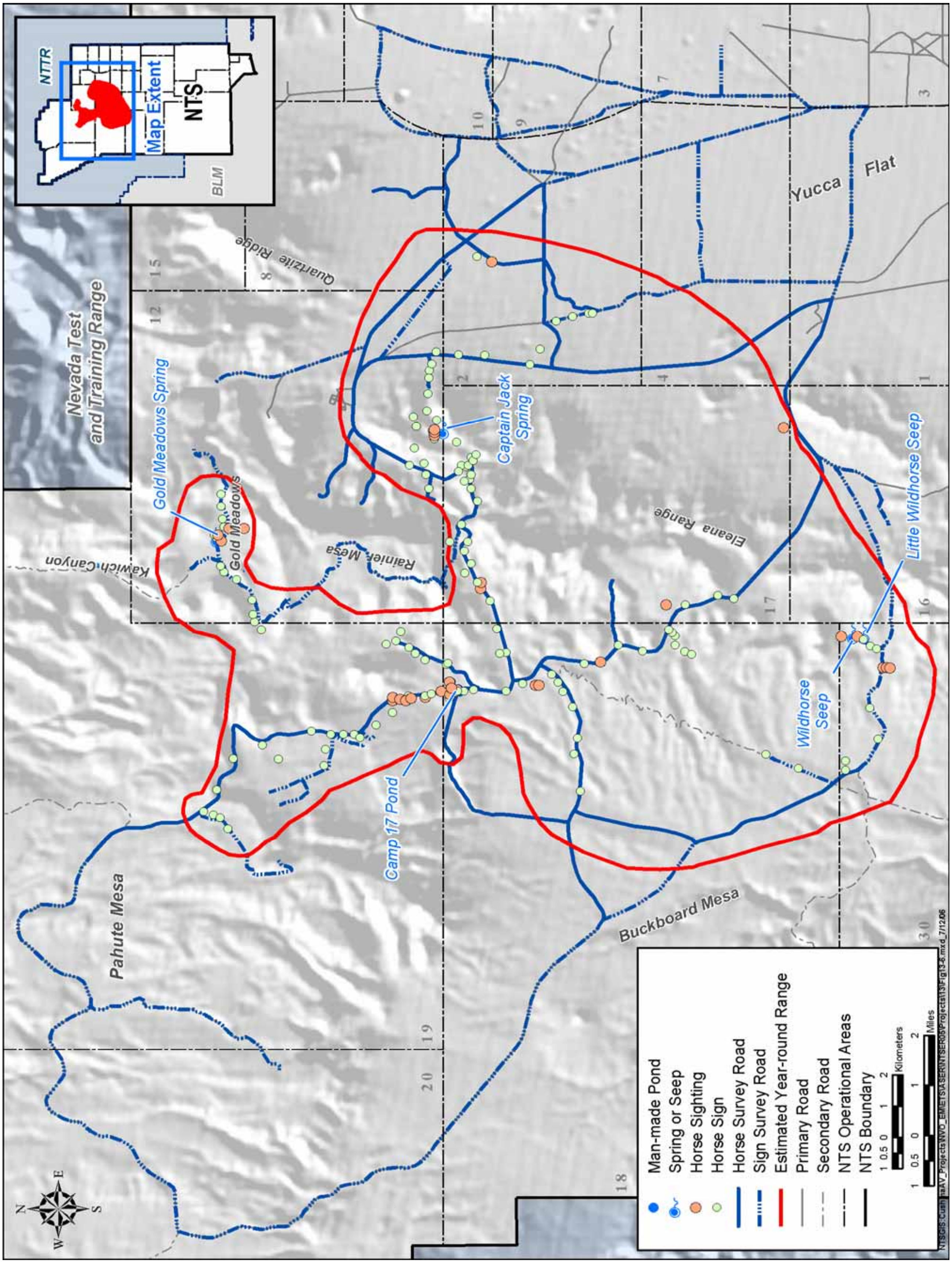

Figure 13-6. Feral horse range on the NTS and sighting locations of horses and horse sign in 2005

13.3.5 Birds

13.3.5.1 Bird Monitoring and Mortality

All but 5 of the 239 bird species observed on the NTS are migratory birds protected under the Migratory Bird Treaty Act or are regulated by the state of Nevada as game birds (see footnote b of Table 13-3). No field surveys for raptor nests were conducted in 2005. Raptor breeding is periodically monitored at least once every five years. Opportunistic sightings of birds in 2005, including raptors, raptor nests, and any reported or observed bird mortalities, were entered into wildlife databases. As mentioned in Section 13.2, two active great-horned owl nests were found during surveys of buildings scheduled for demolition. Short-eared owls (*Asio flammeus*) were observed in three locations on the NTS this year representing the first observations of this species on the NTS in over 20 years.

Bird mortality is recorded as a measure of potential impacts that NNSA/NSO activities may have on protected birds. In 2005, 12 bird deaths were documented and all but one death (of unknown cause) was human-related (Table 13-6). The majority was roadkills. In May, NTS workers reported an injured red-tailed hawk (*Buteo jamaicensis*) to BN biologists. In September, NTS workers brought an injured barn owl to BN biologists, and in early December workers reported an injured juvenile golden eagle (*Aquila chrysaetos*). All three of these birds were presumed to have been hit by vehicles. Biologists responded immediately to each report and transported each bird to a North Las Vegas animal hospital for examination and treatment. The red-tailed hawk was cared for by the Wild Wing Project, Inc. and later released near Corn Creek on the Desert National Wildlife Range. Both the barn owl and the juvenile golden eagle, however, were euthanized because their injuries were too severe to repair.

No feasible mitigation actions were identified in 2005 that may reduce the incidence of bird mortality on the NTS. The overall reported number of bird deaths on the NTS related directly to NTS activities over the past 15 years is low and the causes are varied (Figure 13-7).

Table 13-6. Records of bird mortality and injury on the NTS in 2005

Species	Cause of Death			
	Electrocution	Road Kill	Unknown	Injury
Barn owl (*Tyto alba*)		1[(a)]		
Common loon (*Gavia immer*)			1	
Common raven (*Corvus corax*)	3	1		
Crissal thrasher (*Toxostoma crissale*)		1		
Golden eagle (*Aquila chrysaetos*)		2[(b)]		
Loggerhead shrike (*Lanius ludovicianus*)		1		
Red-tailed hawk (*Buteo jamaicensis*)				1[(c)]
Turkey vulture (*Cathartes aura*)		1		
White-crowned sparrow (*Zonotrichia leucophrys*)		1		
Total	**3**	**8**	**1**	**1**

(a) Taken to veterinary clinic for treatment, euthanized due to severity of injury
(b) One eagle found injured, taken to veterinary clinic for treatment, euthanized due to severity of injury
(c) Taken to veterinary clinic for treatment, rehabilitated at Wild Wing Project, Inc. and released

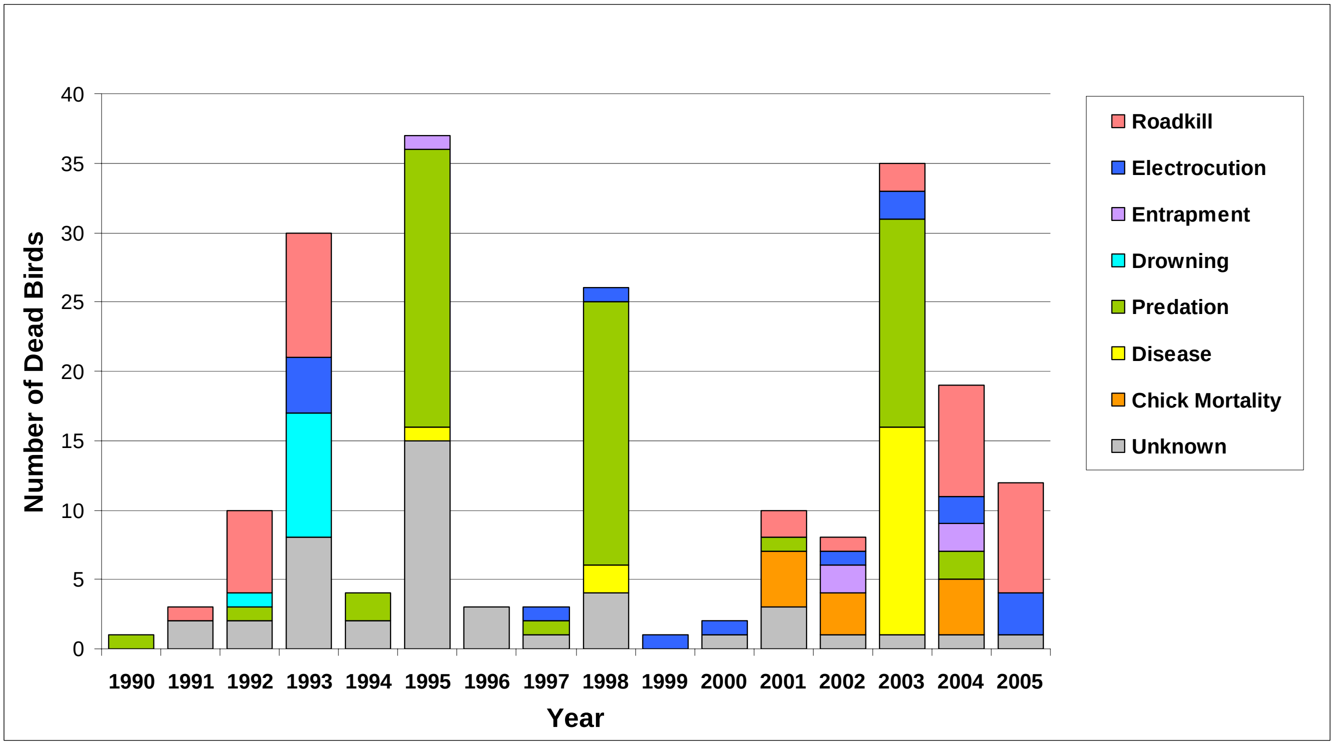

Figure 13-7. Number of bird deaths recorded on the NTS by year and by cause

13.3.5.2 Western Burrowing Owl Monitoring

Western burrowing owl monitoring in 2005 entailed monitoring reproduction with remote cameras (Figure 13-8) and trapping owls at their burrows. Eighteen burrow sites were sampled between May 31 and August 10, 2005, and 11 breeding pairs were documented. A total of 58 young were detected for an average of 5.3 young owls per pair. Four non-breeding pairs were also documented.

Figure 13-8. Western burrowing owl family, Yucca Flat (Photo by automatic camera, June 9, 2005)

Trapping was conducted for the first time in 2005 to assist Dr. Courtney Conway of the University of Arizona who had asked BN biologists for help in gathering data. Dr. Conway is evaluating migratory linkages of western burrowing owls in western North America through a U.S. Department of Defense Legacy-funded project. Traps were set out at ten burrow sites in July. Twenty-one juveniles and one adult owl were captured and banded. Feather samples were taken from all captured owls and blood samples were taken from 16 owls. Information from this cooperative effort will give BN biologists a greater understanding of this owl's residency and migratory status on the NTS. It may also help determine where owls from the NTS are wintering. Trapping will continue over the next two to three years.

Also, five new burrow sites were found on the NTS. There are 126 known western burrowing owl locations (30 owl sightings and 96 burrow sites) on the NTS (Figure 13-9).

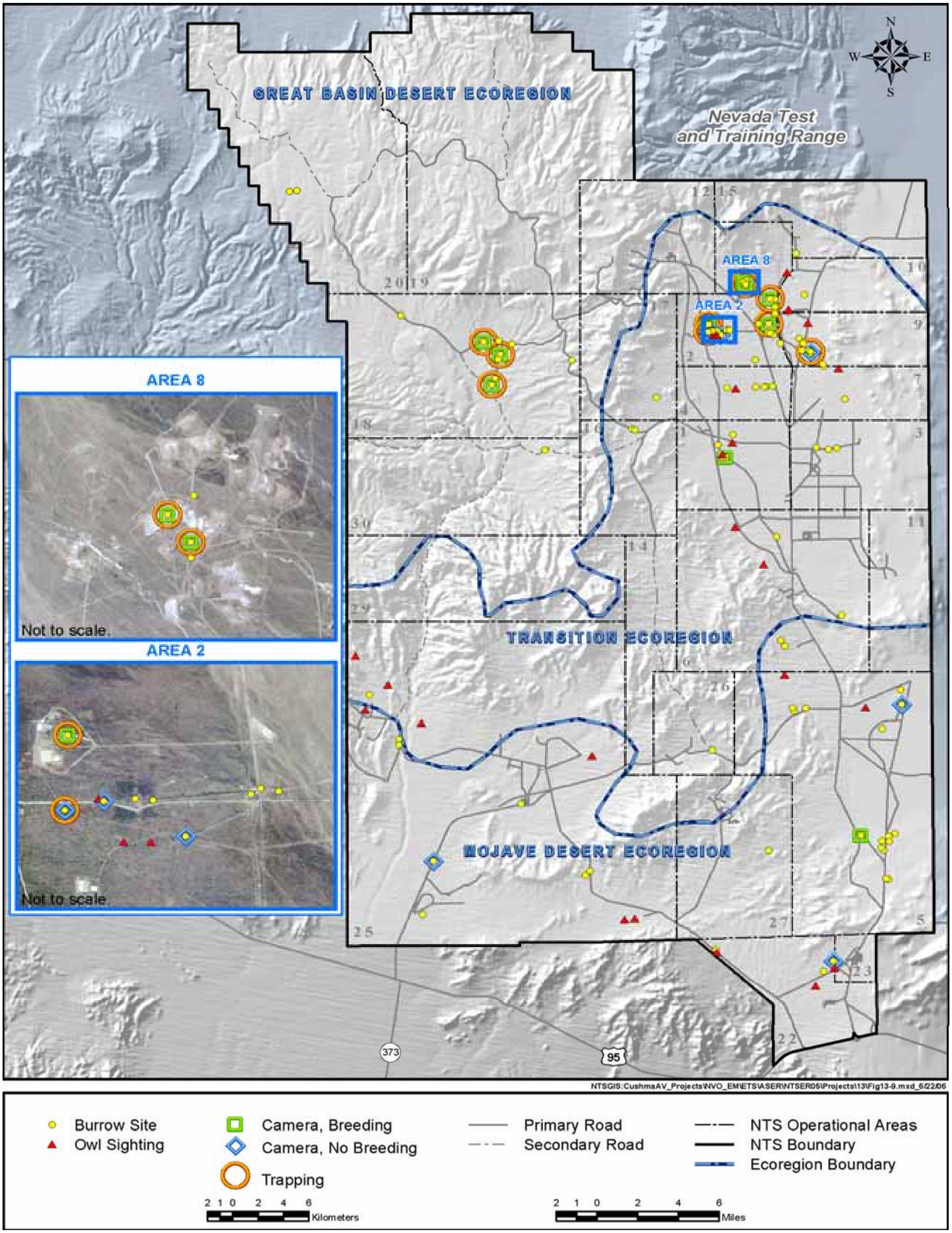

Figure 13-9. Known western burrowing owl distribution on the NTS and burrow sites where motion-activated cameras were set up and/or trapping occurred

13.3.6 Natural and Human-Made Water Sources

Natural wetlands (e.g., vegetated seeps and springs) and man-made water sources (e.g., sumps and sewage lagoons) provide unique habitats for vegetation and wildlife. NTS wetlands are monitored and are protected when feasible as unique and important habitats for plants and wildlife per the intent of Executive Order (EO) 11990, *Protection of Wetlands*. Characterization of these mesic habitats and periodic monitoring of their hydrologic and biotic parameters was started in 1997. Monitoring will help identify annual fluctuations and ranges in measured parameters that are natural versus those related to NNSA/NSO activities.

Monitoring activities in 2005 included: (1) documenting surface area, surface flow, observed disturbances, and wildlife use at 12 selected natural wetlands, and (2) documenting wildlife use and mortality observed at 12 natural wetlands, 39 plastic-lined sumps, 3 unlined well ponds, and 2 radioactive containment ponds. Sizes of wetlands monitored varied greatly from very small areas (<1 m^2) to moderately sized springs and playa ponds (>23,000 m^2). Surface flow rates were low (<3.6 liters per minute) at all wetlands where flow was measurable. Disturbances noted at the 12 natural wetlands were trampling and grazing of vegetation by horses at six sites. No NNSA/NSO projects disturbed these natural water sources. Overall, 4 mammal species and 27 species of birds were detected at water sources in 2005. Detailed results are reported in *Ecological Monitoring and Compliance Program Calendar Year 2005 Report* (BN, 2006c).

13.4 Habitat Restoration Monitoring Program

The native vegetation and wildlife habitat at disturbed NTS sites are sometimes restored by seeding and/or planting native plant species. This effort is called revegetation. NNSA/NSO evaluates revegetation as a potential method to stabilize soils at a site based on site size, future use, nature of soils, annual precipitation, slope, aspect, and site location (DOE, 1996a). Revegetation supports the intent of EO 13112, *Invasive Species,* which is to prevent the introduction and spread of invasive (non-native) species and restore native species to disturbed sites. To date, the majority of NNSA/NSO projects for which revegetation has been pursued are abandoned industrial or nuclear test support sites that have been characterized and remediated under the Environmental Restoration (ER) Program. Also, the ER Program has funded revegetation of soil closure covers to protect against soil erosion and water percolation into buried waste. In 2003, a wildland fire burn site in Area 12 (Egg Point Fire burn site) was revegetated to help minimize soil erosion and the invasion of non-native species which would make the site more prone to future wildland fires. In addition to conducting all revegetation efforts on the NTS, the Habitat Restoration Monitoring Program conducts short- and long-term monitoring of revegetated sites. The summary of this program's goals are to:

- Design and implement site-specific revegetation plans at approved disturbed sites.
- Monitor the short- and long-term outcome of revegetation efforts.
- Monitor the long-term outcome of natural vegetation succession at disturbed sites where revegetation has not occurred.
- Develop a site-wide habitat restoration plan based on evaluations of past revegetation efforts, natural succession processes, and wildlife habitat requirements.
- Monitor the effectiveness of revegetation to restore wildlife habitat.

13.4.1 Egg Point Fire

Vegetation monitoring of the Egg Point Fire burn site has been conducted annually since 2003 to assess the recovery of the vegetation from the effects of the fire and to evaluate the revegetation techniques used in restoration efforts. In 2005, the non-seeded area was sampled for comparison to adjacent seeded areas. On the upper slope, the density of perennial plants on the non-seeded area was less than one-tenth of the density on the seeded area (Figure 13-10). On the lower slope, the density of perennial plants on the non-seeded area was one-third of the density on the seeded areas (Figure 13-11). Results of all monitoring conducted in 2005, including overall plant densities by life form (grasses, forbs, shrubs) and plant cover measurements are reported in the annual EMAC report (BN, 2006c).

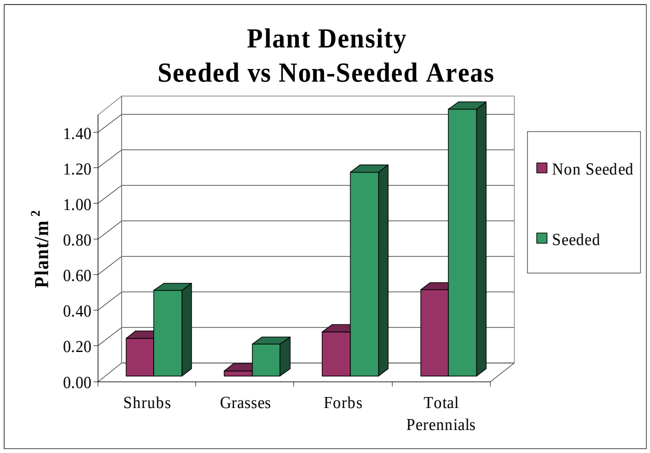

Figure 13-10. Plant density on seeded and non-seeded sites on the upper slopes of Egg Point fire site

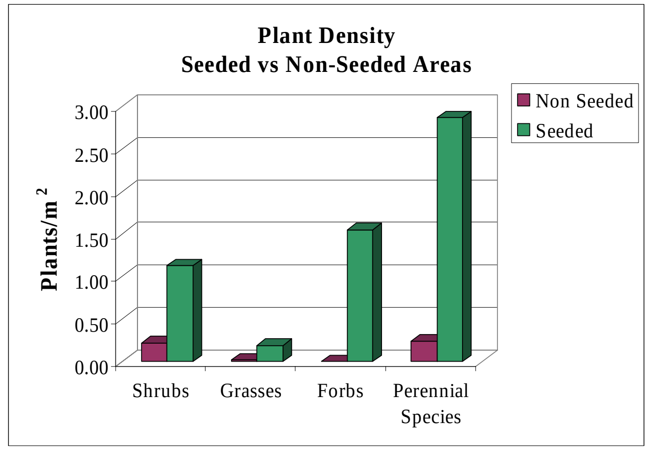

Figure 13-11. Plant density on seeded and non-seeded sites on the lower slopes of Egg Point fire site

13.4.2 Habitat Restoration at CAU 110, U-3ax/bl Closure Cover

A closure cover for the U-3ax/bl disposal unit in Area 3 of the NTS was approved and constructed in the fall of 2000. Immediately after the construction of the closure cover, the reestablishment of a cover of native vegetation was initiated. The success of the reseeding effort on the closure cover has been evaluated each year since 2001. In 2005, 53 one-meter quadrats were sampled on the closure cover and 10 were sampled in the non-seeded areas along the periphery of the closure cover. Plant density in 2005 was 5.1 plants/m^2, which represents a slight increase over the previous two years. Based on revegetation efforts in similar ecoregions, a goal of 12 percent plant cover after five years was set for this closure cover. The five-year goal was met in 2005. Actual total plant cover is 20 percent and the majority (17 percent) is attributable to seeded perennial native plants (Figure 13-12).

With the establishment of vegetation on the closure cover came a corresponding influx of small mammals and small mammal burrows. A concern was expressed that the closure cover structure may be compromised with the burrowing animals. In April 2005, an initiative began with the objective of removing burrowing animals from the closure cover. A total of 102 small mammal traps were used to capture a total of 190 animals over six trap nights in April, three in June, and three in September. All animals were relocated approximately 5 miles (mi) from the site. Seventy-five percent of the animals captured and relocated were Merriam's kangaroo rats (*Dipodomys merriami*), 25 percent were deer mice (*Peromyscus maniculatus*), and one long-tailed pocketmouse (*Chaetodipus formosus*) was captured.

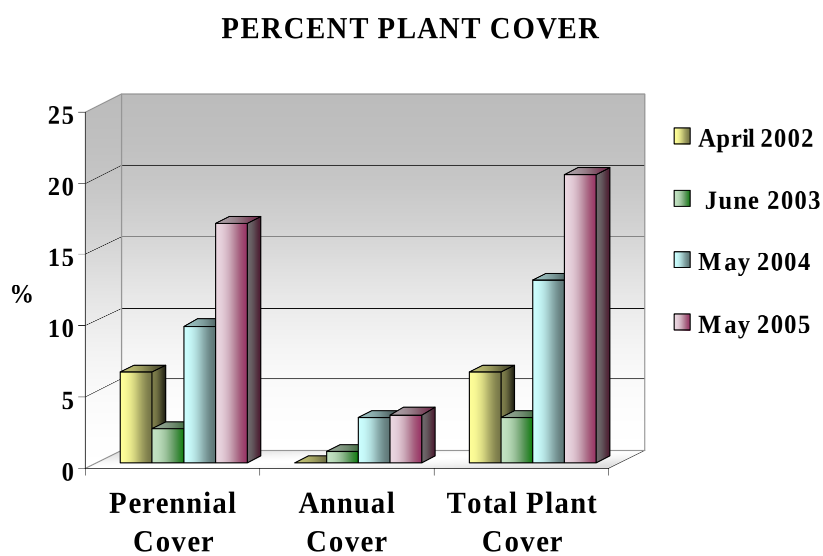

Figure 13-12. Percent plant cover on Uax/bl closure cover

13.5 Ecosystem Mapping and Data Management

BN biologists began comprehensive mapping of plant communities and wildlife habitat on the NTS in 1996. Data were collected describing selected biotic and abiotic habitat features within field mapping units called Ecological Landform Units (ELUs). ELUs are landforms (Peterson, 1981) with similar vegetation, soil types, slope, and hydrology. Boundaries of the ELUs were defined using aerial photographs, satellite imagery, and field confirmation. ELUs are considered by NTS biologists to be the most feasible mapping unit by which sensitive plant and animal habitats can be described. In December 2000, a topical report describing the classification of habitat types on the NTS was published and distributed (Ostler et al., 2000). Ten vegetation alliances and 20 associations were recognized as occurring on the NTS. In 2005, efforts continued to update and improve this habitat data. Efforts were focused on the tasks listed below in support of ecosystem mapping and data management of all NTS geospatial ecological data. The reader is directed to the 2005 annual EMAC report (BN, 2006c) which describes these efforts and results.

- Consolidation of data tables into a comprehensive database
- Sampling of selected ELUs for canopy cover data
- Vegetation survey for determining wildland fire hazards
- Coordination with ecosystem management agencies and scientists

13.6 Biological Monitoring of the NPTEC

Biological monitoring at NPTEC on the playa of Frenchman Lake in Area 5 will be performed as an EMAC task whenever there is a risk of significant exposure to downwind plants and animals from planned test releases of hazardous materials. The Desert National Wildlife Refuge (DNWR) lies just east of the NTS border, approximately 5 kilometers (km) (3 mi) downwind from the NPTEC. The National Wildlife Refuge Administration Act forbids the disturbance or injury of native vegetation and wildlife on any National Wildlife Refuge lands unless permitted by the Secretary of the Interior; the DNWR is administered within this System. Biological monitoring is conducted to verify that approved tests do not disperse toxic chemicals that could harm biota on DNWR. This is also a requirement of the facility's Programmatic Environmental Assessment (DOE, 2002b).

An unpublished BN document titled *Biological Monitoring Plan for Hazardous Materials Testing at the Liquefied Gaseous Fuels Spill Test Facility on the Nevada Test Site,* prepared in 1996 and updated in 2002, describes how field surveys will be conducted to meet the following two goals: (1) document significant impacts of chemical testing on plants and animals and (2) verify that NPTEC operations comply with the National Wildlife Refuge Administration Act (see Section 2.9). Monitoring will entail sampling established transects both downwind and upwind of the NPTEC. Since 1996, the majority of chemical releases being studied at the center have used such small quantities that downwind test-specific monitoring has not been necessary. The parameters to be measured whenever transects must be sampled will include:

- Number and type of dead animals observed
- Number and type of wildlife observed
- Presence of observed vegetation damage

In 2005, BN reviewed chemical spill test plans for the following two activities: Divine Shrike and Scorpion. Chemicals were released at such low volumes or low toxicity that there was no need to monitor downwind transects for biological impacts. Baseline monitoring was conducted at established control-treatment transects near the NPTEC in April-May and September-October. This monitoring noted the condition of plants and the presence of wildlife sign during the period of vegetative growth and following summer drought, respectively. No differences in biota were noted along downwind (treatment) versus upwind (control) transects. Baseline monitoring data are collected to document any cumulative impacts over time of test center activities on biota downwind of the facility. These data are made available to neighboring land managers on request.

14.0 Underground Test Area Project

The Underground Test Area (UGTA) Project is the largest project in the Environmental Restoration Project. It addresses groundwater contamination resulting from past underground nuclear testing conducted in shafts and tunnels on the Nevada Test Site (NTS). From 1951 to 1992 more than 800 underground nuclear tests were conducted at the NTS (U.S. Department of Energy, 2000a). Most of these tests were conducted hundreds of feet above groundwater; however, over 200 of the tests were within or near the water table. Underground testing was limited to specific areas of the NTS including Pahute Mesa, Rainier Mesa, Shoshone Mountain, Frenchman Flat, and Yucca Flat.

The UGTA Project collects data to define groundwater flow rates and direction to determine the nature and location of aquifers (geologic formations of permeable rock containing or conducting groundwater). In addition, project team members gather information regarding the hydrology and geology of the area under investigation. Data from these studies are used to produce hydrogeologic models that will be used to predict groundwater flow and contaminant transport. Numerous surface and subsurface investigations are ongoing to ensure that these issues are addressed.

Surface investigations include:

- Evaluating discharges from springs located downgradient of the NTS
- Assessing surface geology

Subsurface investigations include:

- Drilling deep wells to access groundwater hundreds to thousands of feet below the surface
- Sampling groundwater to test for radioactive contaminants
- Assessing NTS hydrology and subsurface geology to determine possible groundwater flow direction

14.1 Aquifer Tests

There were no aquifer/tracer testing activities conducted during 2005.

14.2 Groundwater Sampling

Well development, testing, and sampling operations were conducted at the ER-12-3 and ER-12-4 investigation wells. Groundwater samples were also collected from cavity well (or "Hot Well") U-20n PS #1DD-H. The results of sampling in 2005 are presented in Section 4.1.11 of this report along with all other radiological groundwater monitoring results.

14.3 3-D Hydrostratigraphic Framework Models

A regional three-dimensional (3-D) computer groundwater model (International Technology Corporation, 1996) has been developed to identify any immediate risk and to provide a basis for developing more detailed models of specific NTS test areas designated as individual Corrective Action Units (CAUs). The regional model constituted Phase I of the UGTA Project. For Phase II, four CAU-specific models are planned, geographically covering each of the six former NTS testing areas (Figure 14-1). To date, three models have been built: Frenchman Flat (BN, 2005a), Pahute Mesa-Oasis Valley (BN, 2002d) and Yucca Flat-Climax Mine (BN, 2006). A model for the Rainier Mesa-Shoshone Mountain CAU is in progress. These more detailed CAU-specific groundwater flow and contaminant transport models will be used to determine contaminant boundaries based on the maximum extent of contaminant migration. The results of the individual CAU groundwater models will be used to refine the Routine Radiological Environmental Monitoring Plan groundwater monitoring network to ensure public health and safety.

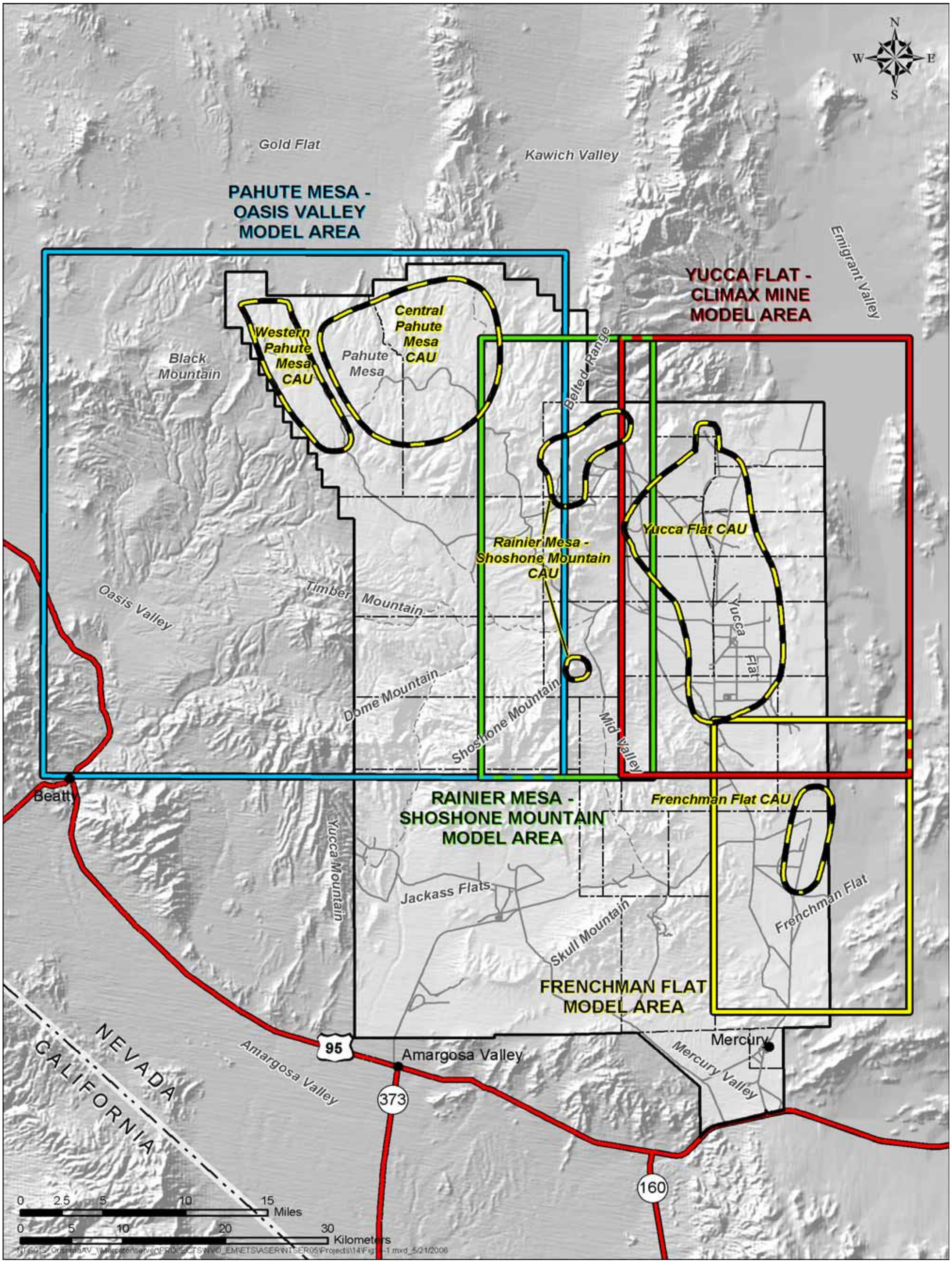

Figure 14-1. Location of UGTA Project model areas

15.0 Hydrologic Resources Management Program

The primary responsibility of the Hydrologic Resources Management Program (HRMP) is to provide the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) with hydrologic data and information on groundwater supplies to support ongoing and future activities at the Nevada Test Site (NTS). The main objective of this program is to provide a sound technical basis for NTS groundwater use decisions regarding the quality and quantity of water resources available on the NTS, and the potential impacts of large-scale water withdrawals from or near the groundwater basins of the NTS. Participants in the HRMP include Los Alamos National Laboratory, Lawrence Livermore National Laboratory, the U.S. Geological Survey (USGS), and the Desert Research Institute.

15.1 Program Goals and Activities

The goal of the HRMP is to support national security operations at the NTS by the investigation of site hydrology, radionuclide migration, and protection of NTS water resources. The HRMP meets this goal through long-term research activities including data collection, analysis, evaluation, modeling, equipment development, and documentation. These activities provide reliable information for decision-making on groundwater utilization, stewardship, and environmental protection. Research and technology development activities essential to the achievement of these goals are an integral part of the HRMP.

Results of program activities are available as technical reports and documents. Project participants also disseminate information and transfer technologies through publication in technical reports and peer-reviewed journals, presentations at professional meetings and symposia, and educational outreach activities.

15.1.1 Hydrology and Radionuclide Investigations for Operations

The HRMP assists NNSA/NSO in maintaining capabilities in hydrology and radiochemistry to support test readiness and science-based stockpile stewardship through applied field and laboratory studies of the occurrence, distribution, and movement of radionuclides in groundwater at the NTS. Scientific expertise is utilized in the assembly, analysis, and evaluation of data to produce requested hydrologic and radionuclide information. State of Nevada regulations require NNSA/NSO to provide detailed information on hydrologic conditions of the NTS. At the request of NNSA/NSO management, the HRMP gathers, analyzes, and transfers science-based information to the state of Nevada and other external customers.

Hydrologic services, provided upon request to NNSA/NSO programs, include depth-to-groundwater estimates, water level measurements, containment evaluations, and determining emplacement hole integrity. Technology development projects and research investigations are conducted to address gaps in the capabilities and knowledge required to support safe conduct of operations for stockpile stewardship, nuclear test readiness, and national security. Previous and current activities include:

- Determining the steady state and transient hydrologic conditions in the subsurface, such as the location of the groundwater table, perched water zones, and regions of enhanced permeability
- Using and developing state-of-the-art radiochemical instrumentation to analyze rock and water samples to assist in predicting the fate and transport of radioactive isotopes deposited from subsurface experiments
- Supporting the development of enhanced borehole radionuclide monitoring and sampling equipment capability
- Achieving a more fundamental understanding of chemical fractionation in underground nuclear tests through sample analysis and experimentation
- Investigating the subsurface geology and fracture propagation in the vicinity of underground nuclear tests for containment issues

- Building public confidence by conducting public and government outreach and education programs on the hydrologic environment and the impact of nuclear testing on water resources at the NTS
- Investigating the free water and bound water relationships in boreholes and cores

15.1.2 Long-Term Groundwater Stewardship

A major element of the HRMP mission is the protection and long-term stewardship of NTS groundwater resources. Numerous activities are conducted to accomplish this element. These include the following: monitoring of groundwater levels, quality and consumption; evaluating monitoring wells; maintaining a wellhead protection program; and utilization of groundwater modeling to evaluate water resource availability and the impacts of potential groundwater withdrawals. HRMP supports the development and ongoing refinement of groundwater flow models for both the Death Valley Region (which includes the NTS) and for the NTS specifically. Based upon hydrologic investigations and modeling, HRMP will evaluate proposed new groundwater uses on and near the NTS for their potential impacts on NTS groundwater reserves, quality, flow paths, and radionuclide migration. The HRMP protects NTS groundwater by implementing a well installation and maintenance program to ensure:

- Reliability of the potable water supply.
- Optimal location, design, and construction of new potable water wells.
- Long-term reliability of monitoring wells to supply representative water samples.
- Integrity of emplacement and groundwater boreholes.

The HRMP also provides assistance to NNSA/NSO regarding the impact of NTS water usage on offsite water supplies and springs, such as Devil's Hole. In addition, the HRMP assists in addressing compliance issues and is responsive to the needs of NNSA/NSO that result from state and federal regulations not within the purview of other programs or which may be well-addressed by the capabilities of the HRMP. For example, implementation of the Safe Drinking Water Act dictates substantial compliance efforts both on and outside the boundaries of the NTS, a process to which HRMP can provide valuable support.

HRMP also has a groundwater review and advice capability with a unique NTS perspective that is invaluable to NNSA/NSO. HRMP scientists conduct competent, informed, and independent reviews of NNSA/NSO groundwater-related program documents prior to their release to extensive regulatory and public scrutiny. This capability enhances both the protection of NTS groundwater resources and the accuracy and credibility of NNSA/NSO program documentation.

15.2 2005 Field Monitoring

The USGS Water Resources Division collects, compiles, stores, and reports hydrologic data used in determining the local and regional hydrogeologic conditions in and around the NTS for HRMP and for the UGTA Project. Hydrologic data are collected quarterly or semi-annually from wells within three monitoring networks: the Environmental Restoration program (ERP) Network, the NTS Network, and the Regional Network. The ERP Network includes wells owned by ERP/UGTA both on and off the NTS. The NTS Network is comprised of all remaining wells on the NTS which are of importance for NTS site modeling activities. The Regional Network includes wells located in the regional area surrounding the NTS which also are of interest for site modeling activities.

15.2.1 Water Levels and Temperature

By the end of 2005, the USGS monitored water levels in approximately 181 wells on and off the NTS. They included 75 wells in the ERP Network, 41 in the NTS Network, and 65 in the Regional Network. Also during 2005, annual temperature data were collected from wells at 1.5 and 16.8 meters (5 and 55 feet) below the water surface. All water level and temperature data are posted on the USGS/NNSA web site at http://nevada.usgs.gov/doe%5Fnv/. The water level data is also published in the USGS Nevada Water Science Center Annual Water-Resources Data Report available at http://nevada.usgs.gov/.

15.2.2 Water Usage

Groundwater use from water supply wells on the NTS is collected using flow meters which are read monthly by the NTS M&O subcontractor and then reported to the USGS WRD. The principal water supply wells monitored include Army #1 WW, J-12 WW, J-13 WW, UE-16d WW, WW #4, WW #4A, WW 5B, WW 5C, WW 8, and WW C-1. The USGS compiles the annual water use data and reports annual withdrawals in millions of gallons. Discharge data from these wells for 2005 have been compiled, processed, and entered onto the USGS/NNSA Web site at http://nevada.usgs.gov/doe_nv/wateruse/wu_map.htm. Discharge from these wells during 2005 was approximately 269 million gallons.

Water-use data is also published in the USGS Nevada Water Science Center Annual Water-Resources Data Report on a Water-Year calendar (October through September). The Water-Year 2005 report is available at http://nevada.usgs.gov/ and will include monthly water-use data for each well listed from October 2004 through September 2005.

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16.0 Meteorological Monitoring

16.1 Meteorological Monitoring Goals

Meteorological and climatological data are collected on the Nevada Test Site (NTS) by the Air Resources Laboratory, Special Operations and Research Division (ARL/SORD). Data are collected through the Meteorological Data Acquisition (MEDA) system, a network of approximately 30 mobile meteorological towers located primarily on the NTS. The MEDA system became operational in 1981, replacing an older system. MEDA is used to measure, transmit, and display vital meteorological data to SORD meteorologists and U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO) customers. These data are used daily for operational support to a wide variety of projects on the NTS and from the climatological database for the NTS. The data are also used in safety analysis reports, emergency response activities, radioactive waste remediation projects, environmental reports, and consequence assessments. Section A.3 of Appendix A from the *Nevada Test Site Environmental Report 2004* (DOE, 2005a) presents descriptive NTS climatological data collected by the MEDA system. Appendix A from that 2004 environmental report is included on the compact disc of this 2005 report for easy reference (it is called Attachment A on the compact disc).

16.2 MEDA Station Locations

A standard MEDA unit consists of an enclosed trailer, a portable 10-meter (m) (32.8-feet [ft]) tower, an electric generator (when needed), a microprocessor, and a microwave radio transmitter (Figure 16-1). Locations of the MEDA stations are shown in Figure 16-2. All towers were sited according to standards set by the Federal Meteorological Handbook No. 1 (NOAA, 1995) and the World Meteorological Organization (WMO, 2002) so as not to be influenced by natural or man- made obstructions or by heat dissipation and generation systems. MEDA station locations are based on the following criteria:
(1) availability of power, (2) access by road, (3) line-of-sight to a microwave repeater, and (4) project support. A primary goal of the network is to provide details in the surface wind field for emergency response activities related to the transport and dispersion of hazardous materials. Another primary goal is to provide data used in computing off-site radiological dose estimates.

Figure 16-1. Example of a typical MEDA station with a 10-meter tower

16.3 MEDA Station Instrumentation

MEDA station instrumentation is located on booms oriented into the prevailing wind direction and at a minimum distance of two tower widths from the tower. Wind

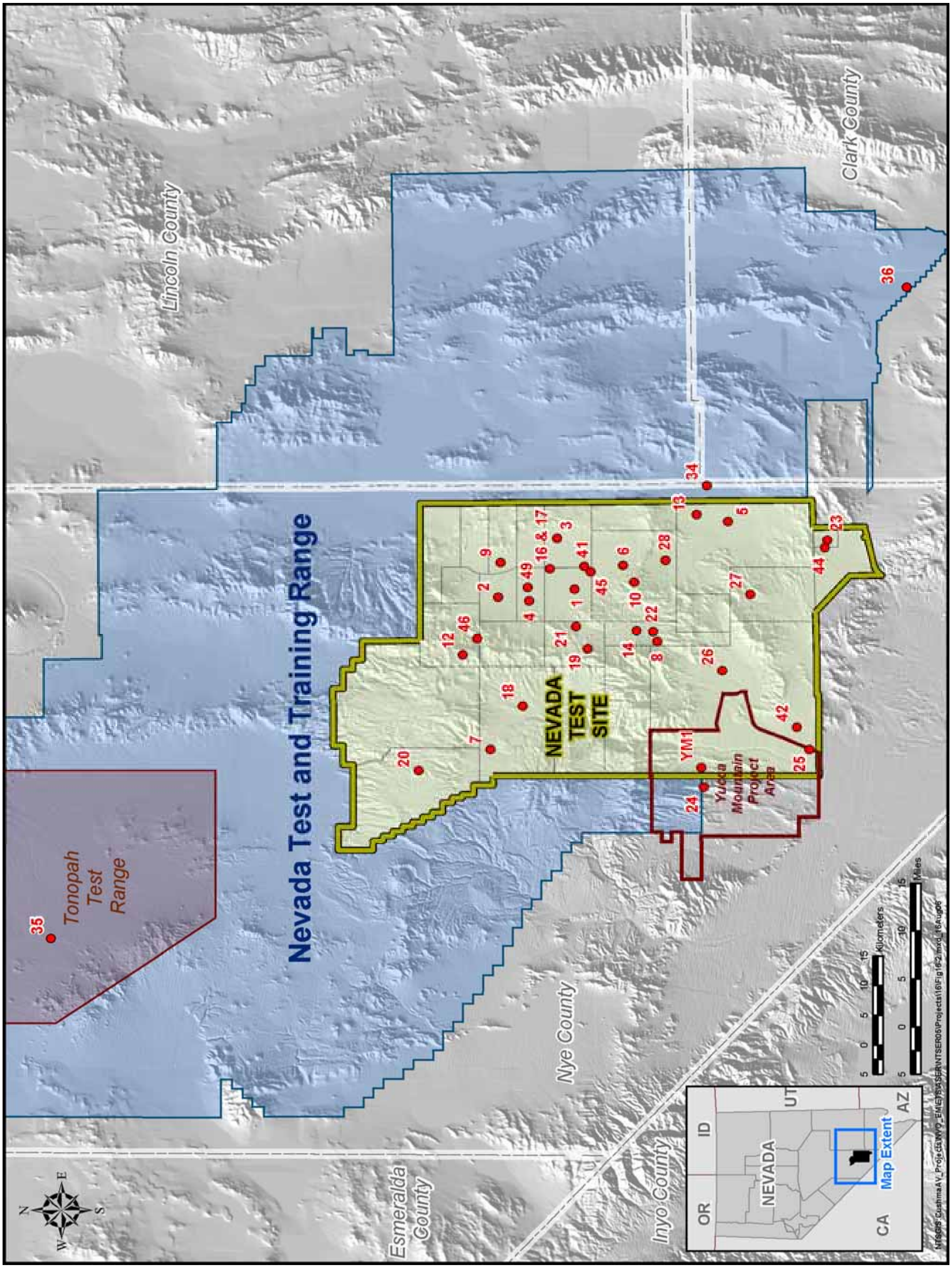

Figure 16-2. MEDA station locations on and near the NTS

direction and at a minimum distance of two tower widths from the tower. Wind direction and speed are measured at the 10-m (32.8-ft) level, in accordance with the *American National Standard for Determining Meteorological Information at Nuclear Facilities* American Nuclear Society, 2000) specifications. Ambient temperature, relative humidity, and atmospheric pressure measurements are taken at approximately the 2-m (6.6-ft) level so as to be within the surface boundary layer. Observations are collected and transmitted every 15 minutes on the quarter hours. Wind data are 5-minute averages of speed and direction. The peak wind speed is the fastest instantaneous gust measured within the 15-minute time interval. Temperature, relative humidity, and pressure are instantaneous measurements.

16.4 Rain Gauge Network

ARL/SORD also operates and maintains a climatological rain gauge network on the NTS. This network consists of 17 Belford Series 5-780 Universal Precipitation Gauges (Figure 16-3). These are strip chart recorders that are read at least every 30 days. Once read and checked, the data are entered into the SORD precipitation climatological database. Data are recorded as daily totals. Under special circumstances, 1- to 3-hour totals can be obtained.

16.5 Data Access

The meteorological parameters measured at each station are listed on the SORD website <http://www.sord.nv.doe.gov> along with other information. MEDA data are also processed and archived in the ARL/SORD climatological database. Climatological data summaries are posted on the ARL/SORD website under the Climate section. SORD meteorologists provide specially tailored climatological summaries by request through NNSA/NSO. For new NTS projects and facility modifications which may produce radiological emissions, wind data from the MEDA stations are used to calculate radiological doses to members of the public residing near the NTS (see Section 3.1.7).

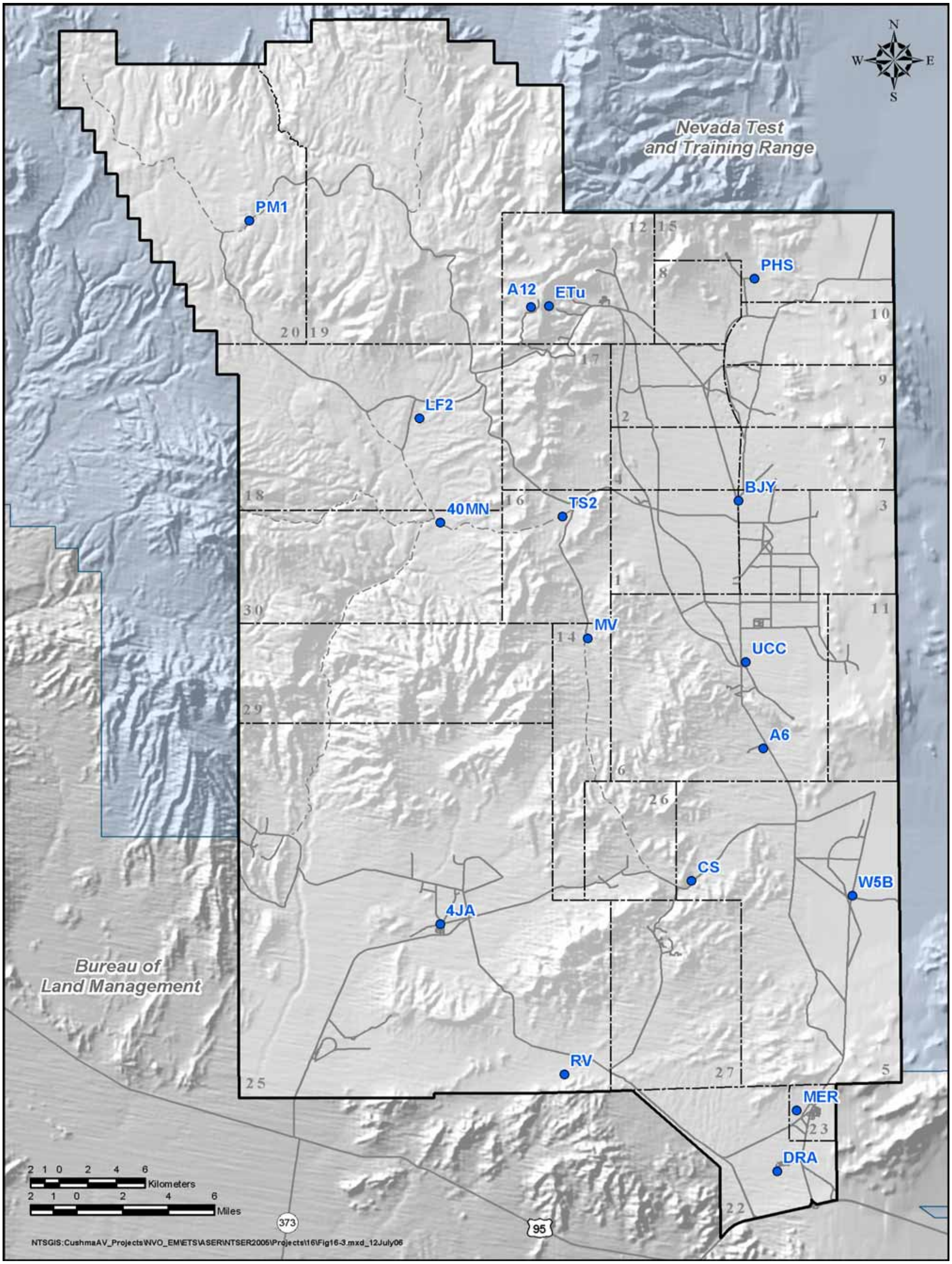

Figure 16-3. Climatological rain gauge network on the NTS

17.0 Integrated Safety Management System and Environmental Management System

A plan to integrate environmental, safety, and health (ES&H) management programs at the Nevada Test Site (NTS) was developed and initiated at the NTS in 1996. The NTS Integrated Safety Management System (ISMS) is designed to ensure the systematic integration of ES&H concerns into management and work practices so that missions are accomplished safely. The term *safety* is used synonymously with *environment, safety, and health* throughout the NTS ISMS implementation policies to encompass protection of the public, the workers, and the environment. The seven guiding principles of ISMS and the five core functions are presented below.

Seven Guiding Principles	Five Core Functions
Line management is directly responsible for the protection of the public, the workers, and the environment	Define the scope of work
Clear roles and responsibilities for ES&H are established and maintained	Identify and analyze the hazards and environmental aspects associated with the work
Personnel competence is commensurate with their responsibilities	Develop and implement hazard and aspect controls
Resources are effectively allocated to address ES&H, programmatic, and operational considerations with balanced priorities	Perform work within the controls
ES&H standards and requirements are established that ensure adequate protection of the employees, the public, and the environment	Provide feedback on the adequacy of the controls for continuous improvement
Administrative and engineering controls to prevent and mitigate ES&H hazards are tailored to the work being performed	
Operations are authorized	

The use of an ISMS helps ensure that (1) all levels of program organizations are accountable for environmental protection, (2) all projects are planned with ES&H concerns in mind, and (3) continuous improvements in program implementation occur.

Bechtel Nevada's (BN's) implementation of an ISMS at the NTS was verified by the National Nuclear Security Administration Nevada Site Office (NNSA/NSO) in July, 2001. NNSA/NSO oversees ISMS implementation through the ISM Council. Each Council member performed a self-assessment in September 2004 and verified that the ISMS was being effectively implemented at the NTS.

Work Smart Standards (WSS) are an integral part of the ISMS whereby hazards and environmental aspects of work are identified and standards of operation are established that are specific to the work environment, its associated hazards, and its threats to the environment. BN WSS were approved at the management level with the most expertise in the work. NNSA/NSO approved the initial complete set of BN WSS in September, 1996. The approved WSS identified within each program of BN, the contractual commitment to meet applicable laws, regulations, and policies which protect the public and the environment. Compliance with WSS was tracked through management assessments.

In 2000, President Clinton issued Executive Order (EO) 13148, *Greening of the Government Through Leadership in Environmental Management*. This EO requires all federal agencies to adopt an environmental management system (EMS). An EMS is a globally embraced business management practice that allows an organization to strategically address its environmental, health and safety matters. EMSs are designed to incorporate concern for environmental performance throughout an organization, with the ultimate goal being continual reduction of the organization's impact on the environment. EMS implementation reflects accepted quality management principles based on the "Plan, Do, Check, Act" model, using a standard process to identify goals, implement them, determine progress, and make improvements to ensure continual improvement.

EO 13148 applies to most of the NNSA as well as to DOE and NNSA contractors. The U.S. Department of Energy (DOE) required contractors who operate DOE sites to develop an EMS and expected full integration of their EMS into their ISMS by December 2005. This chapter, written in April 2006, reflects the status of EMS and ISMS while BN was the Management and Operation contractor.

17.1 Previous Work on EMS and ISMS Integration

BN's EMS is modeled after ISO 14001 and was developed to satisfy the requirements of DOE Order 450.1 *Environmental Protection Program*. In 2000, BN developed the BN Process Description PD-0442.001, "Environmental Management System Description" (EMS Description) which describes how each of the 17 elements of ISO 14001 is addressed, including controlling documents and organizations. The EMS Description is a roadmap to all the environmental processes and governing documents in the different EMS elements. The EMS Description is revised as needed to reflect system improvements, updated procedures, and the blending in of DOE Order 450.1 requirements.

After DOE Order 450.1 was approved in 2003, BN evaluated it and identified Order requirements that were not fully implemented on the NTS. These were primarily in the pollution prevention areas, where DOE funding has been greatly reduced in the last few years. There were also areas such as resource protection from wildland and operational fires that are not traditionally thought of as environmental programs that had to be included in the EMS. A table was prepared that lists all the requirements in the Order and identifies how each requirement is or will be met and what organization is responsible for implementation and/or oversight. During 2003, progress was made in the areas of aspect identification and mitigation. An outside consultant evaluated BN's progress toward satisfying each of these requirements in 2004. The final report verified the progress that was made and provided suggestions for satisfying the last few requirements.

BN has an Environmental Policy that was updated in 2004 to reference DOE Order 450.1 as a driver and model for the EMS. The BN ISMS Program Plan was updated in 2004 to specify that the EMS and DOE Order 450.1 are the methods by which the environmental part of ISMS is implemented. An example of how this is being accomplished is that aspect identification and mitigation were incorporated into a hazard analysis procedure that is required for Work Execution Plans. Goal setting is also included in the planning phase of performing work. Each year BN has several environmental goals identified in the Contractor Performance and Fee Award Program. These are measurable goals where performance is tracked and reported to ensure the maximum chance for successful completion. Affirmative Procurement goals are also tracked and reported annually. During 2004 a committee was formed that represented all programs. This committee identified priority areas of improvement (Objectives) and began to identify organization specific goals (Targets) within these priority areas. These were reviewed and approved by the Executive Safety Committee.

During 2004, the employee environmental awareness program was expanded. Copies of the revised Environmental Policy were mailed to all mail stops and posted on many bulletin boards, as well as on the BN intranet home page. Articles about the new policy and the EMS were put in employee publications, and a section on environmental issues was added to the project manager training course.

17.2 2005 Status of EMS

During 2005, the Objectives and Targets which were identified, reviewed, and approved by the Executive Safety Committee were assigned to specific BN organizations for tracking and reporting beginning in 2006 (Table 17-1) (in addition to those measures presented in Section 2.0). The Integrated Safety Management Council, led by NSO and having representatives from all NTS contractors and national laboratories, coordinated the effort to gather EMS implementation status from each organization. A matrix of requirements and applicability for each organization was made, and how that organization met the applicable requirement was documented. This matrix showed that full implementation of DOE Order 450.1 is complete, and NNSA/NSO made the Self Declaration to DOE Headquarters on December 15, 2005. The environmental performance measures tracked in 2005 are shown in all tables in Section 2.0, Compliance Summary.

Table 17-1. BN environmental objectives and targets identified in 2005 to be tracked in 2006

Environmental Aspect	Objectives	Targets	Goals	Measures to Track
Disturbances to Natural and Cultural Resources	Mitigate environmental impacts of new activities	Maintain compliance with National Environmental Policy Act (NEPA) without creating project delays	80% of NEPA checklists to be submitted to the NNSA/NSO NEPA Compliance Officer for NEPA evaluation at least two weeks prior to scheduled project start	Number of NEPA checklists and submittal dates
	Mitigate environmental impacts of approved activities	Revegetate disturbed desert tortoise habitat on the NTS in lieu of paying habitat loss fee to Clark County	Revegetate one acre for each acre disturbed	Acres disturbed and revegetated
Waste Generation	Reduce paper use by using double-sided printers and copiers	BN organizations with high volume paper use will be identified, double-sided printing will be promoted within these target organizations, metrics to track solid waste reduction will be developed	Identify organizations, conduct targeted promotions, and develop waste reduction metric to track	To be determined
	Institute affirmative procurement	Implement a system to ensure purchased items conform to the Comprehensive Procurement Guidelines for products that contain recovered and recycled materials	Educate all BN buyers to recognize affected items and actions to take to achieve Investigate implications and possible rework of Just-In-Time procurement contracts Modify the procurement system to make recycled products the default choice	Number of procurement system procedural revisions Number of buyers who have received awareness training Number of contract revisions
Industrial Chemical Use and Storage	Reduce chemical waste	Plan for implementing a chemical pharmacy system for HazMat	Assess the hazardous materials program Develop plan for centralization of system for purchasing chemicals	To be determined

Table 17-1. BN environmental objectives and targets identified in 2005 to be tracked in 2006 (continued)

Environmental Aspect	Objectives	Targets	Goals	Measures to Track
Industrial Chemical Use and Storage	Reduce chemical waste	Enhance Requisition Compliance Reviews (RCRs) to identify purchase requests for "excess" chemical purchases	Train at least three Environmental Services personnel to recognize "excess" chemical purchase requests	Number of RCRs for chemicals vs. number of RCRs that received extra scrutiny Volume of chemicals that were not approved for purchase
Groundwater Contamination	Protect groundwater quality	Plug boreholes in accordance with the Borehole Management Plan	Meet schedule in Plan	Number of boreholes plugged
Natural Resource Use		Increase the percentage of sedan/ minivans/light duty trucks/ minitrucks vs. sport utility vehicles (SUVs) and large pickup trucks used solely for people transport	Determine current use ratio of sedan/minivan/light duty truck/minitruck vs. SUV/large truck and increase the ratio by 20%	Ratio of sedans/minivans/ light duty trucks/ minitrucks vs. SUVs/large trucks rented from Fleet Services
	Reduce consumption of petroleum-based fuels	Promote increased use of alternative fuels	Increase use of petroleum-based fuels by 20%	Gallons of gasoline and alternative fuel used in government vehicles within Fleet Services
		Purchase vehicles that accept alternative fuels	75% of new vehicles ordered must accept alternative fuel	Percentage of alternative fuel vehicles received based upon total number of vehicles received per quarter
Liquid Effluents and Disposal Systems	Manage North Las Vegas Facility (NLVF) pumped groundwater	Develop a system to collect and manage NLVF groundwater after pumping	Use 50% of water for beneficial use such as irrigation	Volume of groundwater pumped and volume of groundwater used for onsite irrigation

17.3 Elements of Bechtel Nevada's EMS

17.3.1 NTS Environmental Policies

The BN Environmental Policy is a statement of BN's intentions and principles regarding overall environmental, safety, security, and health performance. It provides a framework for planning and action. The BN Environmental Policy contains the following key goals and commitments:

- Protect the environment by meeting all applicable DOE Orders and federal, state, and local environmental laws and regulations.
- Evaluate activities to identify potential environmental impacts, and then take mitigative actions to eliminate or minimize the hazards.
- Establish objectives and targets in order to continually improve the environmental program.
- Protect valued natural resources and support waste minimization and pollution prevention activities.
- Communicate and instill an organizational commitment to environmental excellence in company activities.

17.3.2 Environmental Aspects and Impacts

When operations have an environmental aspect, BN implements the EMS to minimize or eliminate any potential impact. BN evaluates its operations by performing a Hazard Assessment, identifies the aspects of operations that can impact the environment, and determines which of those potential impacts are significant. The Hazard Assessment requires the activity manager to go through a series of questions that identify potential environmental impacts. The assessment also lists available mitigations, such as training and applicable procedures and guidance. The completed hazard assessment is then reviewed, and when approved by ES&H, becomes part of the authorization basis for performing the work. BN has determined that the following aspects of its operations have the potential to affect the environment:

- Waste generation
- Waste disposal
- Atmospheric emissions
- Liquid effluents and disposal systems
- Industrial chemical use and storage
- Natural resource use – fuel, electricity, and water consumption
- Disturbances to historical and cultural resources
- Environmental noise
- Disturbances to natural resources (e.g., endangered species/sensitive habitats)
- Groundwater contamination

17.3.3 Legal and Other Requirements

To implement the compliance commitments of the BN Environmental Policy and to meet its legal requirements, BN has a procedure in place to review changes in federal, state, or local environmental regulations and to communicate those changes to affected staff. These regulatory changes frequently require amendments to operating permits, modifications to record keeping or hours of operation, revisions to procedures, and upgraded training.

17.3.4 Objectives, Targets, and Programs

Objectives and Targets are developed by BN on a fiscal year (FY) basis (October 1 through September 30) by prioritizing environmental aspects. Objectives to improve performance with respect to these aspects are then established. Finally Targets to meet the Objectives are suggested. The potential Objectives and Targets are then presented to the Executive Safety Council for final selection and approval. BN also works with NNSA/NSO to clearly define expectations and performance measures. Objectives and Targets, established in FY 2005 and to be initiated and implemented in FY 2006, are described in Table 17-1. Organizations within BN are assigned responsibility for Targets, and develop action plans detailing how they will achieve their objectives and targets and commit the necessary resources to successfully implement them.

Several Environmental Management Programs exist throughout the company. These programs are discussed in sequential sections of this report:

- Environmental Compliance – Section 2.0
- Air Quality Protection – Section 3.0
- Groundwater Protection – Section 4.0
- Routine Radiological Environmental Monitoring – Sections 3.1, 4.1, 5.0, 7.0, and 8.0
- Waste Management and Environmental Restoration – Section 9.0
- Hazardous Materials Control and Management – Section 10.0
- Pollution Prevention and Waste Minimization – Section 11.0
- Historic Preservation and Cultural Resources Management – Section 12.0
- Ecological Monitoring – Section 13.0
- Underground Test Area Project – Section 14.0
- Hydrologic Resources Management Program – Section 15.0
- Meteorological Monitoring – Section 16.0

17.3.5 Resources, Roles, Responsibilities, and Authorities

All employees at BN have specific roles and responsibilities in key areas, including environmental protection. Employee-stop-work authority applies to potential environmental issues as well as health and safety problems. Job-specific environmental training is identified for workers and included on their company-required training matrix. Environmental Services technical support personnel assist the line organizations with developing and meeting their environmental responsibilities.

17.3.6 Competence, Training, and Awareness

Extensive training on EMS requirements has been provided to staff whose responsibilities include environmental protection. The training program includes general environmental awareness for all employees, regulatory compliance training for selected staff, and specific courses for managers, internal assessors, and operations personnel whose work can impact the environment.

17.3.7 Communication and Community Involvement

BN communicates environmental issues to employees through e-mails, articles in newsletters, safety meetings, and pre-task briefings. BN assists NNSA/NSO in soliciting input from interested external parties such as community members, activists, civic organizations, Indian tribes, elected officials, and regulators. This is accomplished primarily through Community Advisory Board (CAB) meetings. The CAB is comprised of 10-15 volunteer Nevada citizens who represent rural and urban areas. CAB meetings occur monthly and focus on the Environmental Management program and projects onsite. EM also sponsors a Speakers Bureau which provides representatives to give presentations to schools, groups, or organizations and sponsors community exhibits and displays for communicating NTS environmental issues and interacting one-on-one with the public.

17.3.8 Documentation and Control of Documents

BN has comprehensive environmental documents as part of the EMS which detail information on regulatory requirements, site-wide operating procedures, and work control procedures on how to control processes and perform work at BN in a way that protects the environment. The BN document control system ensures effective management of procedures and other requirements documents. When facilities require additional procedures to control their work, document control protocols are implemented to ensure that workers have access to the most current versions of procedures.

17.3.9 Operational Control

Operations are evaluated through Hazard Assessments for the adequacy of current controls to prevent or minimize impacts to the environment. When required, task-specific procedures or work plans are developed. As needed, additional administrative or engineered controls are identified, and plans for upgrades and improvements are developed and implemented. Lessons learned are incorporated into work processes to continually improve environmental performance.

17.3.10 Emergency Preparedness and Response

BN has an emergency preparedness and response program and specialized onsite staff to provide timely response to hazardous materials releases or other environmental emergencies. This program includes procedures for preventing, as well as responding to, emergencies.

17.3.11 Monitoring and Measurement

BN has an extensive network of environmental compliance programs with defined monitoring, surveillance, and compliance and performance measures tracking (see Section 2.0, Compliance Summary). These programs help ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective measures for all work performed by BN for NNSA/NSO. In addition to BN monitoring programs, an oversight program called the Community Environmental Monitoring Program, established by NNSA/NSO, monitors air and groundwater within communities adjacent to the NTS. Onsite and offsite monitoring and surveillance results are reported to regulatory agencies and are summarized annually in this report, the *Nevada Test Site Environmental Report.* In addition, BN tracks and trends its progress and performance in achieving environmental objectives and performance measures which are not strictly compliance-driven (see Table 17-1).

17.3.12 Evaluation of Compliance

BN has procedures for periodically evaluating its compliance with relevant environmental regulations. Line managers and facility managers periodically inspect their operations and facilities. BN Environmental Services also performs regulatory assessments in a particular topical area to verify the compliance status of multiple organizations, or a comprehensive assessment of a particular organization. Lastly, external regulatory agencies and/or technical experts frequently conduct independent audits of compliance.

17.3.13 Nonconformity and Corrective and Preventive Actions

BN continues to improve processes that identify and correct problems. Lessons Learned and Root Cause Analyses are used in an attempt to prevent recurrences of environmental problems, and an electronic Web-based system is used to identify and track corrective actions.

17.3.14 Control of Records

EMS-related records, including audit and training records, are maintained according to federal standards to ensure integrity, facilitate retrieval, and protect them from loss.

17.3.15 Internal Audit

BN has used internal staff and subcontractors to identify the EMS elements that are fully implemented and those that still require strengthening. This is an ongoing activity intended to continually improve the environmental program. In addition, compliance with regulatory requirements is verified through routine inspections, operational evaluations, and periodic audits.

17.3.16 Management Review

The BN General Manager for ES&H will ensure periodic review of the EMS to ensure its continuing suitability, adequacy, and effectiveness. The review process will be scheduled in the BN ES&H Execution Plan and documented.

18.0 Compliance Quality Assurance

The Bechtel Nevada (BN) Quality Assurance Program (QAP) establishes the requirements necessary to comply with: (1) Title 10 Code of Federal Regulations (CFR) 830, Subpart A, *Quality Assurance Requirements*; (2) U.S. Department of Energy (DOE) Order 414.1A, *Quality Assurance*; (3) contractual Work Smart Standards; and (4) other relevant requirements documents for the operation, process, or program to which they apply. The BN QAP requires a graded approach to quality for determining the level of rigor that effectively provides assurance of performance and conformance to requirements.

In the conduct of environmental management activities employing sampling and analysis, the U.S. Environmental Protection Agency (EPA)-developed Data Quality Objectives (DQO) process is generally used to provide the quality assurance (QA) structure for designing, implementing, and improving upon environmental monitoring efforts. Sampling and Analysis Plans are developed prior to performing an activity to ensure complete understanding of the data use objectives. Personnel are trained and qualified in accordance with company and task-specific requirements. Access to sampling locations is coordinated with operations conducting work at or having authority over those locations in order to de-conflict activities and communicate hazards to better ensure successful execution of the work and the safety and health of sampling personnel. Sample collection activities adhere to organization instructions and/or procedures that are designed to ensure that samples are representative and data are reliable and defensible. Sample shipments onsite and to offsite laboratories are conducted in accordance with the U.S. Department of Transportation and International Air Transport Association regulations, as applicable. Quality Control (QC) in the analytical laboratories is maintained through adherence to standard operating procedures that are based on methodologies developed by nationally-recognized organizations such as the EPA, DOE, and American Standard for Testing and Materials International. Key quality-affecting procedural areas cover sample preparation, instrument calibration, instrument performance checking, testing for precision and accuracy, and laboratory data review. BN data users perform review as required by the project-specific objectives before they are used to support decision making. The *Routine Radiological Environmental Monitoring Plan* (RREMP) (DOE, 2003b) provides a formalized process to ensure that all sampling and analytical objectives are appropriate, economically feasible, reliable, and defensible within its area of application.

Elements of the QAP are listed below. A discussion of these program elements follows, together with the results of the 2005 assessment.

- **Data and Measurement Quality Objectives are developed** to ensure that clear goals and objectives are established for data collection, analyses, and projected data use.
- **A Sampling Plan is developed** to ensure that an appropriate plan of action is developed to execute scope in accordance with DOE, administrative, or legal requirements such as environmental, safety, and health concerns.
- **Laboratory Sample Analyses are implemented** to ensure that analysis of samples for required parameters meet BN, customer, and regulatory-defined requirements.
- **Data Management Procedures are used** to ensure that all data are readily retrievable, protected through a system of checks and balances, and defensibly archived.
- **Data Review and Systematic Assessments are made** to ensure that analytical data quality are improved and enhanced, and to adequately assess procedures, identify nonconforming items, implement corrective actions, monitor for corrective action effectiveness, and provide feedback and lessons learned.

18.1 Data and Measurement Quality Objectives

The DQO process is a strategic planning approach used to plan a data collection activity. It provides a systematic process for defining the criteria that a data collection design should satisfy, including when to collect samples, where to collect samples, tolerable level of decision errors for the study, and how many samples to collect.

Measurement Quality Objectives (MQOs) can generally be considered as DQOs for the analytical process. MQOs provide direction to the laboratory concerning performance objectives or requirements for specific method performance characteristics. Default MQOs are established in the subcontract, but may be altered on a project-by-project basis in order to satisfy the DQOs. MQOs may generally be described in terms of precision, accuracy, representativeness, completeness, and comparability requirements. The following discussion includes brief statements on these terms as they apply to the overall monitoring effort to provide correlation with laboratory efforts. The RREMP (DOE, 2003b) provides additional discussions on monitoring, precision, accuracy, representativeness, completeness, and comparability.

18.1.1 Precision

Precision refers to "the degree of mutual agreement characteristic of independent measurements as the result of repeated application of the process under specified conditions" (Taylor, 1987). Practically, precision is determined by comparing the results obtained from performing the sample analysis on split samples, or on duplicate samples taken at the same time from the same location, maintaining sampling and analytical conditions as nearly identical as possible. Precision related to the overall monitoring effort is evaluated by comparing results for field duplicate samples of particulates in air, tritiated water vapor, thermoluminescent dosimeters (TLDs), and some water samples. Precision related to laboratory operations is evaluated by comparing the agreement of laboratory duplicates/replicates with established control limits. The laboratory is directed in the subcontract to establish and maintain precision control limits for various matrices and analytes. Control limits may be specified in the subcontract or by the specific method, but are more commonly generated and maintained by the laboratory in order to develop controls specific to their operations. In most cases, however, laboratory specific limits should not be less stringent than those published in the standard methods.

18.1.2 Accuracy

Accuracy refers to "the degree of agreement of a measured value with the true or expected value of the quantity of concern" (Taylor, 1987), and may be defined as the ratio of the measured value divided by the true value, expressed as a percent. Accuracy related to the overall monitoring effort is evaluated by comparing field sample results with historic data to determine whether the data points fall within acceptable statistical trends, or by other criteria. Accuracy related to laboratory operations is monitored by performing measurements and evaluating results of control samples containing known quantities of the analytes of interest. Control samples are analyzed using the same sample preparation and analytical methods as employed for project samples. The subcontract may provide required control limits or may direct the laboratory to establish control limits. Control limits may be specified for a specific analytical method, but may be generated and maintained by the laboratory in order to develop controls specific to their operations. In cases where a laboratory is authorized to establish in-house limits, those limits may not be less stringent than those published in the standard methods. Compliance with accuracy control limits is usually required in order for data to be considered acceptable for use in further analyses.

18.1.3 Representativeness

Representativeness is the degree to which a sample is truly representative of the sampled medium (i.e., the degree to which measured analytical concentrations represent the concentrations in the medium being sampled) (Stanley and Verner, 1985). From a sample collection standpoint representativeness is managed through sampling plan design and execution. Representativeness related to laboratory operations is managed primarily through direction to the laboratory. For example, sample of a heterogeneous matrix (soil, sludge, solids, etc.) should be homogenized prior to aliquoting for preparation or analysis. Water samples are generally considered homogeneous unless observation suggests otherwise. Individual and composite air samples are necessarily homogenized by the laboratory during the preparation process. Field sample duplicate analyses are additional controls allowing the evaluation of sample representativeness and medium heterogeneity.

18.1.4 Comparability

Comparability refers to "the confidence with which one data set can be compared to another" (Stanley and Verner, 1985). Comparability from an overall monitoring perspective is ensured by sampling design, sample collection and handling, laboratory analyses, and data review which are performed in accordance with established Organization instructions (OIs) and Organization procedures (OPs) and standardized methodologies. Comparability regarding laboratory operations is managed through direction to the laboratory requiring that standard methods will be used when available. When a standard method is not available, or when analytes may be determined by multiple techniques, equivalent QA controls must be applied; in these cases, more attention should be paid to review in order to draw conclusions on comparability.

18.2 Sampling Plan

Quality assurance in field operations includes development of an execution sampling plan, sampling assessments, surveillances, and oversight. Key elements of this plan include: (1) development of a sample package, (2) data management, and (3) appropriate training.

18.2.1 Sample Packages

For each data collection activity, a Sample Package is prepared containing the data quality objectives, execution sampling plan or statement of work (SOW), OIs, and field logs. Sample packages must be prepared prior to conducting any sampling and may include the following items:

- Checklists to include:
  - Routing list showing all personnel who must review and approve the sample package
  - Pre-job and post-job checklists describing personal protective equipment, safety, etc.
  - Sample package task lead summary
  - Requested analyses
  - Performance evaluation or certification for all labs that do the requested analyses
  - Signature page which documents signatures of all personnel associated with the work
- Field logs for all samples required to be taken
- Work Package, including a "Traveler" form (a work notification and authorization tool), if required
- Specific, detailed work instructions
- Material Safety Data Sheets for all chemicals that are being used for the job
- Authorization Basis Documents including Execution Plans (Facility, Project, Support) that apply to the sampling effort as well as Real Estate/Operations Permits that identify U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office real property assets and operations involved in the sampling effort
- Chains-of-custody forms

This managed approach to sampling ensures that the sampling is traceable and enhances the value of the final results to project managers. The sample package also ensures that the sampler is prepared for the sampling event. The manager or QA Officer routinely performs assessments or surveillances of each type of sampling event to ensure that samplers are adhering to the OIs and sampling protocol and that the OIs represent what is actually being done.

18.2.2 Database Support

Database support includes the Bechtel Environmental Integrated Data Management System (BEIDMS) for field data and laboratory results. In addition, completed Sample Packages, analysis results, data review checklists, etc., are optically scanned and entered into the Optix database to enhance accessibility to these documents. The Optix system is used for scanning, long-term storage, and retrieval of the sample package as a graphic image. Data obtained in the course of executing field operations are entered into the sample package during field work, and then in the BEIDMS after completion of the field activities.

18.2.3 Training

BN ensures that all personnel are properly trained and qualified prior to doing work under the RREMP. BN-provided training is documented and maintained in the company tracking system (currently the PLATEAU system). In addition, an organizational training matrix is maintained to efficiently identify training required for each individual and their current status.

18.3 Laboratory Sample Analyses

Because most of the laboratory sample analyses are not done internally, but through subcontracts for laboratory services, BN ensures that DOE Order 414.1A, *Quality Assurance* requirements are met by structuring subcontracts for services that emphasize quality assurance. This is accomplished through a multifaceted approach that focuses on three areas: (1) Procurement, (2) Initial and Continuing Assessment, and (3) a Laboratory Quality Assurance Plan (LQAP).

18.3.1 Procurement

Laboratory services are procured through subcontract. The subcontract specifies the requirements and technical specifications needed to determine compliance with those requirements and to evaluate overall performance of the subcontractor. Subcontracts are established through a competitive bid process and a formal request for proposal (RFP) process. They are awarded on a "best value" basis. The RFP generally requires a prospective vendor to submit a proposal. Successful proposals include:

- All procedures pertinent to subcontract scope
- An Environmental, Safety and Health Plan
- Examples of deliverables, both hardcopy and electronic
- Proficiency testing (PT) results from previous year participation in recognized PT programs
- Resumes of those conducting the work
- A description of the facility or its design
- Accreditations and certifications
- Licenses
- Audits performed within the last year by the DOE Consolidated Audit Program (DOECAP), other DOE sites, or other audits covering comparable scope and acceptable to BN
- Past performance surveys
- A LQAP
- Pricing

Proposal evaluations are conducted and scored as detailed in the RFP. Pricing evaluation is performed by the procurement representative separately from the technical evaluation. The BN technical evaluation team does not receive pricing information. Rather, it bases its evaluation solely on technical capability, ensuring that the technical evaluation is not biased by pricing.

18.3.2 Initial and Continuing Assessment

An initial assessment is made during the RFP process above, including a pre-award audit. If an acceptable audit has not been performed within the past year, BN will consider performing an audit (or participating in a DOECAP audit) of those laboratories awarded the contract. However, in no instance does BN initiate work with a laboratory without approval of BN personnel authorized for ensuring vendor acceptability. A continuing assessment consists of the ongoing monitoring of a laboratory's performance against contract terms and conditions, of which the technical specifications are a part. Tasks supporting continuing assessment are:

- Tracking schedule compliance.
- Review of analytical data deliverables (Appendix F of DOE, 2003b).
- Conducting regular audits or participating in evaluation of DOECAP audit products.
- Monitoring for continued successful participation in PT programs. The subcontract requires or suggests participation in the following PT programs:
  - National Institute of Standards and Technology Radiochemistry Intercomparison Program
  - Studies equivalent to the former EPA Water Pollution and EPA Water Supply programs that support certification by the state of Nevada for analyses performed in support of Clean Water Act and Safe Drinking Water Act monitoring
- Monitoring of the lab's adherence to the LQAP.

18.3.3 Laboratory Quality Assurance Plan

Each laboratory must develop a LQAP. The LQAP is a statement of the laboratory's policies and approach to the implementation of DOE Order 414.1A for ensuring the generation of quality data. Elements of the plan include: (1) LQAP requirements, (2) LQAP management responsibilities, and (3) additional subcontract requirements.

18.3.3.1 LQAP Requirements

The LQAP must do the following:

- Establish that senior management shall be responsible for the scope of the LQAP and implementing, assessing, and continually improving an effective quality system.
- Designate an individual responsible for developing, implementing, and routinely monitoring the LQAP program.
- Describe the organizational structure, functional responsibilities, levels of authority, and interfaces for those managing, performing, and assessing the work.
- Define the organization's policies regarding, and its commitment to, ethical standards, client confidentiality, and the implementation of safety and quality standards.
- Establish that line management shall be responsible for achieving quality in specific activities.
- Establish that all personnel, including samplers, field analysts, laboratory technicians, scientists, researchers, principal investigators, operators, craftspeople, clerical/support staff, and internal auditors shall retain responsibility for the quality of their work.
- Establish that regulatory actions toward the organization or its parent corporation shall be reported immediately to cognizant management and affected clients. This includes actions, such as suspension of contracts with other federal agencies, notices of investigations, and legal actions against the organization or its personnel.
- Establish that functional responsibilities shall include the following activities as a minimum:
  - Participating with the client for planning and developing analytical work scope
  - Training and personnel development
  - Preparing, reviewing, approving, and issuing instructions, procedures, schedules, and procurement documents; identifying and controlling hardware and software
  - Managing and operating facilities
  - Calibrating and controlling the equipment used to measure and test
  - Conducting investigations and improving methods

- Acquiring, evaluating, and reporting data
- Performing maintenance, repair, and improvements
- Controlling records

18.3.3.2 LQAP Management Responsibilities

QA and/or QC positions shall report to the highest level of management (e.g., manager or director). The QA program identifies personnel positions that are given the responsibility and authority to do the following:

- Stop unsatisfactory work. The plan shall identify the chain of command through which any employee may initiate a stop-work order where detrimental ethical, contractual, quality, safety, or health conditions exist.
- Initiate action to prevent reporting laboratory results from a measurement system that is out of control.
- Prevent further reporting of measurements until corrective action has been completed.
- Identify any method or procedure that poses quality problems.
- Recommend, initiate, or provide solutions through designated channels and monitor effectiveness of corrective actions.

18.3.3.3 Additional Subcontract Requirements

Additional requirements are placed on the laboratory through the subcontract. Compliance with these requirements is verified through Initial and Continuing Assessment. These requirements include the following items.

Personnel Training and Qualification – The laboratory organization shall be clearly structured with well-defined responsibilities for each individual in the management system. This system shall ensure that sufficient resources are maintained to perform the requirements specified in the subcontract. Personnel performing services specified by the subcontract SOW and personnel performing QA activities shall receive suitable and timely training in such things as technical skills, laboratory analytical methods, QC procedures, safety policies, and waste management practices and essential elements of the QA Program prior to performing work. Records of the training shall include descriptions of the training provided, attendance sheets, training logs, and personnel training records.

Quality Improvement – A system shall be established and implemented to identify, document, correct, and prevent quality problems; this system shall be subject to ongoing documented review by management to assess its effectiveness.

Documents and Records – Activities affecting quality shall be prescribed by documented instructions, procedures, or drawings that include quantitative or qualitative acceptance criteria that can be used to determine whether activities are satisfactorily accomplished. Revisions to instructions, procedures, and drawings that affect the process or are technical in nature shall receive the same level of review and approval by the affected parties as the original document. Editorial changes may be made to instructions, procedures, and drawings without review and approval. Document control shall include measures by which documentation can be controlled, tracked, and updated in a timely manner to ensure that applicability and correctness are established. Control measures shall be used to ensure that documents are reviewed for adequacy, approved for release by authorized personnel, and distributed to and used at the location of the prescribed activity.

Work Processes – Work shall be performed to established technical standards and administrative controls. Work shall be performed under controlled conditions using approved instructions, procedures, or instructions. Analytical procedures shall be listed by method number and matrix. Any method variances employed by the laboratory shall be documented. The laboratory shall specify protocols for reporting any incident that delays sample processing for a period of time, affects holding times, or delays work, and also specify the corrective action implemented. Examples of forms used to document out-of-control events are to be provided in the LQAP.

Analysis of QC Samples and Documentation – A summary of QC procedures and documentation to be employed in the day-to-day operation of the laboratory shall be included. The discussion will emphasize the following as they relate to the different QC levels:

- Analysis of method and reagent blanks
- Analysis of duplicates, spiked samples, spiked laboratory blanks, and reference or control standards such as EPA, National Institute of Standards and Technology, or other recognized authority check standards
- The criteria used to establish warning and control limits for the above types of QC samples
- Documentation and examples of control data and control charts
- The frequency of analyzing blanks and other QC samples
- How data from QC samples are reported and reviewed
- Who reviews and makes decisions relative to QC data

Procurement – A process shall be established and implemented to control purchased items and services; this process shall be subject to ongoing review by management to assess its effectiveness. Subcontract documents require that suppliers of all tiers comply with technical and QA requirements, including but not limited to standards, measuring and test equipment, calibration services, and analytical test activities. Contracted items and services that have the potential to affect the quality of analytical tests shall be controlled to ensure conformance with contractual requirements. Such control shall include one or more of the following: source evaluation and selection (pre-performance/pre-award survey), source verification, audit, and examination of items or services before use. Procurement documents shall specify the quality system elements for which the supplier is responsible and how the supplier's conformance to the customer's requirements will be verified. Procurement documents shall be reviewed for accuracy and completeness by qualified personnel prior to release. Changes to procurement documents shall receive the same level of review and approval as the original documents.

Inspection and Acceptance Testing – Inspection and acceptance testing of items, services, and processes shall be conducted using established acceptance and performance criteria. Equipment used for inspection and testing shall be calibrated and maintained. There shall be a current list of available (on hand) equipment types, models, and years along with a general description of the facility. General information shall be included as to who performs major, preventative, and day-to-day equipment maintenance and how this maintenance is documented. A schedule of preventive maintenance activities shall be developed and the performance of preventive maintenance shall be documented. A documented inventory of critical spare parts and/or equipment necessary to minimize the downtime of measurement systems related to analytical test samples that have a holding time of 48 hours or less shall be maintained. A documented evaluation of the usage of such inventory shall be performed at least annually. Control processes shall be maintained for all instrument spikes, replicates/splits, blanks, and other standards.

Management Assessment – A method shall be established whereby management with executive authority assesses the adequacy of the QAP at least annually to ensure its continuing suitability and effectiveness in satisfying the requirements of the SOW and the supplier's stated policies and objectives. The method shall include provisions for reporting the results of management assessments, including the distribution of those reports. Problems that hinder the organization from achieving its objectives shall be identified and corrected.

Independent Assessment – Designated persons or organizations shall be responsible for ensuring that an appropriate QAP is established and for verifying that activities affecting the quality of the services specified in the SOW have been correctly performed. Such person or organization shall have sufficient authority, access to work areas, and organizational freedom necessary to independently assess all activities affecting quality and to report the results of such assessments. Persons conducting independent assessments shall be technically qualified and knowledgeable in the areas assessed. Assessment results shall be documented, reported to, and reviewed by the level of management with authority to affect any necessary corrective actions. Assessments shall be conducted of subcontractors that perform work affecting the integrity of analytical results and to assure continued conformance to contractual requirements.

18.4 Data Management Procedures

The RREMP describes the need for and the details of the collection and analysis of environmental data to support various drivers at the Nevada Test Site (NTS). A data management system is essential for understanding and sustaining the quality of data collected under the program, allowing programs to identify data gaps or data requirements for other environmental efforts, and eliminating unnecessary duplication of data collection efforts. Because decisions are based on environmental data, and the effectiveness of operations is measured at least in part by environmental data, reliable and accurate records of defensible environmental data are essential. Detailed records that must be kept include temporal, spatial, numerical, geotechnical, chemical, and radiological data, and all sampling and analytical procedures used. Failure to maintain these records in a secure but accessible form may result in exposure to legal challenges and the inability to respond to demands from regulators and third parties.

BEIDMS is a hierarchical relational database management system developed by Bechtel Environmental, Inc. that is designed to achieve standardization and integrity in managing environmental data. The primary objective of BEIDMS is to store and manage unclassified environmental data that are directly or indirectly tied to field sampling events. This includes information on construction, analytical, geotechnical, and field parameters at the NTS. Database integrity and security are enforced through the assignment of role memberships and the provision of available menu items.

18.5 Data Review and Systematic Assessments

The final element of the process-based QA is the review of data and systematic assessments than can be used to evaluate data quality and usability. Four components of this review and assessment are: data checks, data verification, data validation, and data quality assessment. A description of these components follows.

18.5.1 Data Checks

Data checks are conducted to ensure the accuracy and consistency of data collected during field operations prior to and upon data entry into the BEIDMS.

18.5.2 Data Verification

Data verification is defined as a subcontract compliance and completeness review to ensure that all laboratory data and sample documentation are present and complete. Sample preservation, sample temperature, chain-of-custody, and other field sampling documentation shall also be reviewed during the verification process. Data verification ensures that the reported results entered in BEIDMS correctly represent the sampling and/or analyses performed and includes evaluation of quality control sample results. A Tier I review form and/or a Verification Checklist is completed for all data packages.

18.5.3 Data Validation

Data validation is the process of reviewing a body of analytical data to determine if it meets the data quality criteria defined in OIs. Data validation ensures that the reported results correctly represent the sampling and analyses performed, determines the validity of the reported results, and assigns data qualifiers (or "flags"), if required. The process of data validation consists of:

- Evaluating the quality of the data to ascertain whether all project requirements are met.
- Determining the impact on data quality of those requirements that are not met, if any.
- Verifying compliance with QA requirements.
- Checking QC values against defined limits.
- Applying qualifiers to analytical results in BEIDMS for the purpose of defining the limitations in use of the reviewed data.
- Documenting the results of the data validation.

It is the goal to conduct data validation on 20 percent of laboratory data (10 percent using laboratory-reported calibration data, QC results, and sample results, and 10 percent recalculating the laboratory results using submitted raw data to verify laboratory reported results). OIs and OPs, applicable project-specific work plans, field sampling plans, Quality Assurance Project Plans, analytical method references, and laboratory SOW may all be used in the process of data validation. Documentation of data validation includes: checklists, qualifier assignment, and summary forms.

18.5.4 Data Quality Assessment

Data Quality Assessment (DQA) is the scientific evaluation of data to determine if data obtained from environmental data operations are of the right type, quality, and quantity to support their intended use. DQA requires a systematic review against pre-established criteria to verify that the data are valid for their intended use. DQA is conducted by the technical lead and is the final review performed.

The overall effectiveness of the QA program is determined through systematic assessments and surveillances of the plan execution work flow (e.g., sampling plan development and execution, chain of custody, sample receiving, shipping, subcontract laboratory analytical activities, and data review) as well as the program requirements. Deficiencies are addressed on an assessment/surveillance checklist, and if warranted, will be tracked for corrective action and disposition (e.g., using the CaWeb Issues Tracking System).

18.6 Results

A brief discussion of the 2005 results for field duplicates, laboratory control samples, blank analysis, and inter-laboratory comparison studies are provided within this section. Summary tables are also included. Based on implementation and evaluation of the QA/QC program and the results presented below, it can be concluded that the analytical data reported in the Nevada Test Site Environmental Report 2005 are reliable and of high quality.

18.6.1 Field Duplicates

Field duplicates obtained at nearly the same locations and times as their primary samples are used to evaluate the precision of the data. A field duplicate is collected, handled, and analyzed in the same fashion as the primary sample. The relative percent difference (RPD) between the field duplicate result and corresponding field sample result is a measure of the variability in the process caused by the sampling uncertainty (matrix heterogeneity, collection variables, etc.) and the measurement uncertainty (field and laboratory) used to derive the final result. The average absolute RPD, expressed as a percentage, was determined and listed in Table 18-1. The relative error ratio (RER) is the standardized absolute difference between the sample and its field duplicate. The RER compared to the RPD is a more appropriate monitor of precision near the minimum detectable concentration (MDC) and provides a better indicator of precision anomalies that may need to be further evaluated.

18.6.2 Laboratory Control Samples

Laboratory control samples (LCS) are used to evaluate analytical accuracy by the subcontract laboratory. The analytical accuracy is the degree of agreement of a measured value with the true or expected value. Samples of known concentration are analyzed using the same methods as used for the project samples. The results are determined as the measured value divided by the true value, expressed as a percent. To be considered valid, the results must fall within established control limits (or percentage range) for further analyses to be performed. The LCS results obtained for samples analyzed in 2005 are summarized in Table 18-2. The LCS results were satisfactory with no more than one result being out of control for any given analysis or matrix category for the year.

Table 18-1. Summary of field duplicate samples for compliance monitoring in 2005

Analysis	Matrix	Number of Samples Reported[a]	Number of Samples Reported above MDC[b]	Average Absolute RPD of those above MDC (%)[c]	Average Absolute RER[d]
Gross Alpha	Air	103	20	5.3	0.3
Gross Beta	Air	103	102	2.5	0.4
^{241}Am, Alpha	Air	26	2	27.1	3.7
^{241}Am, Gamma	Air	27	0	NA	NA
7Be	Air	29	24	1.9	0.4
^{238}Pu	Air	27	0	NA	NA
$^{239+240}$Pu	Air	27	6	19.9	3.4
Tritium	Air	53	33	3.3	0.6
^{241}Am	Soil	1	1	1.9	0.3
^{238}Pu	Soil	1	1	1.1	0.2
$^{239+240}$Pu	Soil	1	1	0.5	0.3
^{90}Sr	Soil	1	1	24.8	3.2
^{241}Am, Alpha	Water	1	0	NA	NA
^{241}Am, Gamma	Water	18	0	NA	NA
Gross Alpha	Water	20	13	8	0.9
Gross Beta	Water	20	18	6.6	0.8
^{238}Pu	Water	1	0	NA	NA
$^{239+240}$Pu	Water	1	0	NA	NA
^{90}Sr	Water	1	0	NA	NA
Tritium	Water	26	4	5.1	0.8
TLDs	Ambient Radiation	432	432	2.5	NA

(a) Represents the number of field duplicates reported for the purpose of monitoring precision. If an associated field sample was not processed, the field duplicate was not included in this table.

(b) Represents the number of field duplicate - field sample result sets reported above the MDC. The MDC does not apply to TLD measurements. If either the field samples or its duplicate was reported below MDC, the precision was not determined.

(c) Reflects the average absolute RPD calculated for sample and field duplicate pairs reported above the detection limit.

The absolute RPD is calculated as follows:

$$Absolute\ RPD = \frac{|FD - FS|}{(FD + FS)/2}\ X\ 100\,\%$$

Where: FD = Field duplicate result
FS = Field sample result

(d) Relative error ratio (RER) determined by the following equation is used to determine whether a sample result and the associated field duplicate result differ significantly when compared to their respective uncertainty (standard deviation). The RER is calculated for all sample and field duplicate pairs reported without regard to the MDC.

$$Absolute\ RER = \frac{|FS - FD|}{\sqrt{(TPU_S)^2 + (TPU_D)^2}}$$

Where: S = Sample result
D = Duplicate result
TPU_S = Total propagated uncertainty of the field sample
TPU_D = Total propagated uncertainty of the field duplicate

Table 18-2. Summary of laboratory control samples (LCS) for 2005

Analysis	Matrix	Number of LCS Results Reported	Number Within Control Limits[a]
$^{239+240}Pu$	Air	18	18
^{241}Am	Air	27	27
^{137}Cs	Air	14	14
^{60}Co	Air	14	14
Gross Alpha	Water	11	11
Gross Beta	Water	11	11
$^{239+240}Pu$	Water	6	6
Tritium	Water	51	51
^{90}Sr	Water	6	6
^{241}Am	Water	8	8
^{137}Cs	Water	9	9
^{60}Co	Water	9	9
^{90}Sr	Soil	5	5
$^{239+240}Pu$	Soil	13	13
^{241}Am	Soil	21	21
^{137}Cs	Soil	12	12
$^{239+240}Pu$	Air	18	18
^{241}Am	Air	27	27

(a) Control limits are 70 to 130 percent for all analyses

18.6.3 Blank Analysis

Blank analysis and control samples are used to evaluate overall laboratory procedures including sample preparation and instrument performance. Laboratory blank sample analyses are essentially the opposite of control samples discussed in Section 18.6.2. These samples do not contain any of the analyte of interest. Results of these analyses are expected to be "zero," or more accurately, below the detection limit of a specific procedure. The laboratory blank sample results obtained for 2005 are summarized in Table 18-3. The laboratory blank results were satisfactory with no more than one result being out of control for any given analysis/matrix category for the year.

Table 18-3. Summary of laboratory blank samples for 2005

Analysis	Matrix	Number of Blank Results Reported	Number Within Control Limits[a]
Gamma	Air	29	28
$^{239+240}Pu$	Air	29	28
^{241}Am	Air	52	50
Gross Alpha	Water	19	19
Gross Beta	Water	19	18
$^{239+240}Pu$	Water	11	11
Gamma	Water	19	18
Tritium	Water	58	56
^{90}Sr	Water	13	13
^{241}Am	Water	20	19
^{226}Ra	Water	1	1
^{228}Ra	Water	1	1
^{241}Am	Soil	31	31

(a) Control limit is less than MDC

18.6.4 Inter-laboratory Comparison Studies

Table 18-4 shows the summary of 2005 inter-laboratory comparison sample results for the subcontract radiochemistry laboratories. The subcontractors participated in the InterLaB RadCheM™ Proficiency Testing Program directed by Environmental Resource Associates (ERA) and the Mixed Analyte Performance Evaluation Program (MAPEP) conducted by the Radiological and Environmental Sciences Laboratory of the Idaho National Engineering and Environmental Laboratory. The subcontractors performed very well during the year by passing 80 out of 81 parameters analyzed.

Table 18-5 shows the summary of interlaboratory comparison sample results for the BN Radiological Health Dosimetry Group. This internal evaluation was based on National Voluntary Laboratory Accreditation Program (NVLAP) criteria. The Dosimetry Group participated in the Battelle Pacific Northwest National Laboratory performance evaluation study program during the course of the year. The Dosimetry Group performed very well during the year by passing 33 out of 33 TLDs analyzed.

Table 18-4. Summary of inter-laboratory comparison samples of the subcontract radiochemistry laboratories for compliance monitoring in 2005

Analysis	Matrix	Number of Results Reported	Number Within Control Limits[(a)]
		ERA Results	
Gross Alpha	Water	8	8
Gross Beta	Water	7	6
Gamma	Water	7	7
Tritium	Water	7	7
^{89}Sr	Water	7	7
^{90}Sr	Water	7	7
^{226}Ra	Water	8	8
^{228}Ra	Water	8	8
		MAPEP Results	
Gamma	Water	1	1
$^{239+240}$Pu	Water	1	1
^{90}Sr	Water	1	1
Gamma	Soil	1	1
$^{239+240}$Pu	Soil	1	1
^{90}Sr	Soil	1	0

(a) Control limits are determined by the individual interlaboratory comparison study

Table 18-5. Summary of inter-laboratory comparison TLD samples for the BN Radiological Health Dosimetry Group in 2005

Analysis	Matrix	Number of Results Reported	Number Within Control Limits[(a)]
TLDs	Ambient Radiation	33	33

(a) Based upon NVLAP criteria; absolute value of the bias plus one standard deviation < 0.3.

19.0 Oversight Quality Assurance Program for CEMP

The Community Environmental Monitoring Program (CEMP) Quality Assurance Program Plan (QAPP) was followed for the collection and analysis of radiological air and water data presented in Section 6.0 of this report. The CEMP QAPP ensures compliance with U.S. Department of Energy (DOE) Order 414.1A, *Quality Assurance* which implements a quality management system ensuring the generation and use of quality data. This QAPP addresses the following items previously defined in Section 18.0:

- Data Quality Objectives (DQOs)
- Sampling plan development appropriate to satisfy the DQOs
- Environmental health and safety
- Sampling plan execution
- Sample analyses
- Data review
- Continuous improvement

19.1 Data Quality Objectives (DQOs)

The DQO process is a strategic planning approach that is used to plan data collection activities. It provides a systematic process for defining the criteria that a data collection design should satisfy. These criteria include when and where samples should be collected, how many samples to collect, and the tolerable level of decision errors for the study. DQOs are unique to the specific data collection or monitoring activity, and are further explained in Appendices A through E of the *Routine Radiological Environmental Monitoring Plan* (DOE, 2003b).

19.2 Measurement Quality Objectives (MQOs)

MQOs are basically equivalent to DQOs for analytical processes. The MQOs provide direction to the laboratory concerning performance objectives or requirements for specific method performance characteristics. Default MQOs are established in the subcontract, but may be altered in order to satisfy changes in the DQOs. The MQOs for the CEMP project are described in terms of precision, accuracy, representativeness, completeness, and comparability requirements. These terms are defined and discussed in Section 18.1 for onsite activities.

19.3 Sampling QA Program

Quality Assurance (QA) in field operations for the CEMP includes sampling assessments, surveillances, and oversight of the following supporting elements:

- The sampling plan, data quality objectives, and field data sheets accompanying the sample package
- Database support for field and laboratory results, including systems for long-term storage and retrieval
- A training program to ensure that qualified personnel are available to perform required tasks

Sample packages include the following items:

- Station manager checklist confirming all observable information pertinent to sample collection
- An Air Surveillance Network Sample Data Form documenting air sampler parameters, collection dates and times, and total sample volumes collected
- Chains-of-custody forms

This managed approach to sampling ensures that the sampling is traceable and enhances the value of the final data available to the project manager. The sample package also ensures that the station manager Community Environmental Monitor (CEM) (see Section 6.0 for description of CEMs) has followed proper procedures for sample collection. The CEMP Project Manager or QA Officer routinely performs assessments of the station managers and field monitors to ensure that standard operating procedures and sampling protocol are being followed properly.

Data obtained in the course of executing field operations are entered in the documentation accompanying the sample package during sample collection and in the CEMP database along with analytical results upon their receipt and evaluation.

Completed sample packages are kept as hard copy in file archives. Analytical reports are kept as hard copy in file archives as well as compact disk-read only memory by calendar year. Analytical reports and databases are protected and maintained in accordance with Desert Research Institutes (DRI's) Computer Protection Program.

19.4 Laboratory QA Oversight

CEMP ensures that DOE Order 414.1A, *Quality Assurance* requirements are met with respect to laboratory services through review of the vendor laboratory policies formalized in a Laboratory Quality Assurance Plan (LQAP). CEMP is assured of obtaining quality data from laboratory services through a multifaceted approach involving specific procurement protocols, the conduct of quality assessments, and requirements for selected laboratories to have an acceptable QA program. These elements are discussed below.

19.4.1 Procurement

Laboratory services are procured through subcontracts. The subcontract establishes the technical specifications required of the laboratory and provides the basis for determining compliance with those requirements and evaluating overall performance. The subcontract is awarded on a "best value" basis as determined by pre-award audits. The prospective vendor is required to provide a review package to CEMP that includes the following items:

- All procedures pertinent to subcontract scope
- ES&H Plan
- LQAP
- Example deliverables (hard copy and/or electronic)
- Proficiency testing (PT) results from the previous year from recognized PT programs
- Resumes
- Facility design/description
- Accreditations and certifications
- Licenses
- Audits performed by an acceptable DOE program covering comparable scope
- Past performance surveys
- Pricing

CEMP evaluates the review package in terms of technical capability. Vendor selection is based solely on these capabilities and not biased by pricing.

19.4.2 Initial and Continuing Assessment

An initial assessment of a laboratory is managed through the procurement process above, including a pre-award audit. Pre-award audits are conducted by CEMP (usually by the CEMP QA Officer). In no instance shall CEMP initiate work with a laboratory without approval of the CEMP Program Manager.

A continuing assessment of a selected laboratory involves ongoing monitoring of a laboratory's performance against the contract terms and conditions, of which technical specifications are a part. Tasks supporting continuing assessment are:

- Tracking schedule compliance
- Review of analytical data deliverables
- Monitoring of the lab's adherence to the LQAP
- Conducting regular audits
- Monitoring for continued successful participation in approved PT programs

19.4.3 Laboratory QA Program

The laboratory policies and approach to the implementation of DOE Order 414.1A must be verified in a LQAP prepared by the laboratory. The elements of a LQAP required for the CEMP are similar to those required by Bechtel Nevada for onsite monitoring, and are described in Section 18.3.3.

19.5 Data Review

Essential components of process-based QA are data checks, verification, validation, and data quality assessment to evaluate data quality and usability.

Data Checks – Data checks are conducted to ensure accuracy and consistency of field data collection operations prior to and upon data entry into CEMP databases and data management systems.

Data Verification – Data verification is defined as a subcontract compliance and completeness review to ensure that all laboratory data and sample documentation are present and complete. Sample preservation, chain-of-custody, and other field sampling documentation shall be reviewed during the verification process. Data verification ensures that the reported results entered in CEMP databases correctly represent the sampling and/or analyses performed and includes evaluation of quality control (QC) sample results.

Data Validation – Data validation is the process of reviewing a body of analytical data to determine if it meets the data quality criteria defined in operating instructions (OIs). Data validation ensures that the reported results correctly represent the sampling and/or analyses performed, determines the validity of the reported results, and assigns data qualifiers (or "flags"), if required. The process of data validation consists of:

- Evaluating the quality of the data to ensure that all project requirements are met
- Determining the impact on data quality of those requirements if they are not met
- Verifying compliance with QA requirements
- Checking QC values against defined limits
- Appling qualifiers to analytical results in the CEMP databases for the purposes of defining the limitations in the use of the reviewed data

OIs. procedures, applicable project specific work plans, field sampling plans, QAPPs, analytical method references, and laboratory statements of work may all be used in the process of data validation. Documentation of data validation includes checklists, qualifier assignments, and summary forms.

Data Quality Assessment – Data Quality Assessment (DQA) is the scientific evaluation of data to determine if the data obtained from environmental data operations are of the right type, quality, and quantity to support their intended use. DQA review is a systematic review against pre-established criteria to verify that the data are valid for their intended use.

19.6 QA Program Assessments

The overall effectiveness of the QA program is determined through management and independent assessment as defined in the CEMP QAPP. These assessments evaluate the plan execution work-flow (sampling plan development and execution, chain-of-custody, sample receiving, shipping, subcontract laboratory analytical activities, and data review) as well as program requirements as it pertains to the organization.

19.7 2005 Sample QA Results

QA procedures were performed by the CEMP, including the laboratories responsible for sample analyses. These assessments ensure that sample collection procedures, analytical techniques, and data provided by the subcontracted laboratories comply with CEMP requirements. Data was provided by Severn Trent Laboratories (gross alpha/beta and gamma spectroscopy data), Global Dosimetry Solutions (thermoluminescent dosimeter [TLD] data), and DRI (tritium data). A brief discussion of the 2005 results for field duplicates, laboratory control samples, blank analysis, and interlaboratory comparison studies are provided along with summary tables within this section. The 2005 CEMP radiological air and water monitoring data themselves are presented in Section 6.0.

19.7.1 Field Duplicates (Precision)

A field duplicate is a sample collected, handled, and analyzed following the same procedures as the primary sample. The Relative Percent Difference (RPD) between the field duplicate result and the corresponding field sample result is a measure of the variability in the process caused by the sampling uncertainty (matrix heterogeneity, collection variables, etc.) and measurement uncertainty (field and laboratory) used to arrive at a final result. The average absolute RPD, expressed as a percentage, was determined for the calendar year 2005 samples and is listed in Table 19-1. An RPD of zero indicates a perfect duplication of results of the duplicate pair, whereas an RPD greater than 100 percent generally indicates that a duplicate pair falls beyond QA requirements and are not considered valid for use in data interpretation. These samples are further evaluated to determine the reason for QA failure and if any corrective actions are required. Overall, the RPD values for all analyses indicate very good results, with only one alpha duplicate exceeding an RPD of 100 percent.

19.7.2 Laboratory Control Samples (Accuracy)

Laboratory control samples (a.k.a. matrix spikes) are performed by the subcontract laboratory to evaluate analytical accuracy, which is the degree of agreement of a measured value with the true or expected value. Samples of known concentration are analyzed using the same methods as employed for the project samples. The results are determined as the measured value divided by the true value, expressed as a percent. To be considered valid, the results must fall within established control limits (or percentage range) for further analyses to be performed. The laboratory control samples (LCS) results obtained for 2005 are summarized in Table 19-2. The LCS results were satisfactory with only 3 percent of the beta control samples falling outside of control parameters for the air sample matrix.

Table 19-1. Summary of field duplicate samples for oversight monitoring in 2005

Analysis	Matrix	Number of Samples Reported[(a)]	Number of Samples Reported above MDC[(b)]	Average Absolute RPD of those above MDC (%)[(c)]
Gross Alpha	Air	147	144	29.1
Gross Beta	Air	147	147	7.5
Gamma - Beryllium-7	Air	9	8	17.1
Tritium	Water	4	1	16.6
TLDs	Ambient Radiation	12	12	6.2

(a) Represents the number of field duplicates reported for the purpose of monitoring precision. If an associated field sample was not processed, the field duplicate was not included in this table.

(b) Represents the number of field duplicate - field sample result sets reported above the minimum detectable concentration (MDC) (MDC is not applicable for TLDs). If either the field sample or its duplicate was reported below the detection limit, the precision was not determined.

(c) Reflects the average absolute RPD calculated for those field duplicates reported above the MDC. The absolute RPD calculation is as follows:

$$Absolute\ RPD = \frac{|FD - FS|}{(FD + FS)/2}\ X\ 100\,\%$$

Where: FD = Field duplicate result
FS = Field sample result

Table 19-2. Summary of laboratory control samples (LCS) for oversight monitoring in 2005

Analysis	Matrix	Number of LCS Results Reported	Number Within Control Limits[(a)]
Gross Alpha	Air	106	106
Gross Beta	Air	106	103
Gamma	Air	8	8
Tritium	Water	13	13

(a) Control limits are as follows: 80 to 134 percent for gross alpha; 74 to 121 percent for gross beta; 80 to 114 percent for gamma (^{137}Cs, ^{60}Co, ^{241}Am); 80 to 120 percent for tritium.

19.7.3 Blank Analysis

Laboratory blank sample analyses are essentially the opposite of control samples discussed in Section 19.7.2. These samples do not contain any of the analyte of interest. Results of these analyses are expected to be 'zero,' or more accurately, below the MDC of a specific procedure. Blank analysis and control samples are used to evaluate overall laboratory procedures, including sample preparation and instrument performance. The laboratory blank sample results obtained for 2005 are summarized in Table 19-3. The laboratory blank results were satisfactory with only 3 percent of the alpha and beta blank samples outside of control parameters for the air sample matrix.

Table 19-3. Summary of laboratory blank samples for oversight monitoring in 2005

Analysis	Matrix	Number of Blank Results Reported	Number Within Control Limits[(a)]
Gross Alpha	Air	106	103
Gross Beta	Air	106	102
Gamma	Air	8	8
Tritium	Water	5	5

(a) Control limit is less than the MDC.

19.7.4 Inter-laboratory Comparison Studies

Inter-laboratory comparison studies are conducted by the subcontracted laboratories to evaluate their performance relative to other laboratories providing the same service. These types of samples are commonly known as 'blind' samples, in which the expected values are known only to the program conducting the study. The analyses are evaluated and, if found satisfactory, the laboratory is certified that its procedures produce reliable results. The inter-laboratory comparison sample results obtained for 2005 are summarized in Tables 19-4 and 19-5. Note: the DRI tritium laboratory did not participate in any of these programs.

Table 19-4 shows the summary of inter-laboratory comparison sample results for the Subcontract Radiochemistry Laboratory. The Laboratory participated in the Quality Assurance Program administered by the Environmental Measurements Laboratory (EML) and the Mixed Analyte Performance Evaluation Program (MAPEP) for gross alpha, gross beta, and gamma analyses. The subcontractor performed very well during the year by passing all of the parameters analyzed.

Table 19-5 shows the summary of the in-house performance evaluation results conducted by the Subcontract Dosimetry Group. This internal evaluation was based on National Environmental Laboratory Accreditation Program (NELAP) criteria and was performed biannually. The Dosimetry Group performed very well during the year passing 20 out of 20 TLDs analyzed.

Table 19-4. Summary of inter-laboratory comparison samples of the subcontract radiochemistry laboratory for oversight monitoring in 2005

Analysis	Matrix	Number of Results Reported	Number Within Control Limits[(a)]
		MAPEP and EML Results	
Gross Alpha	Air	6	6
Gross Beta	Air	6	6
Gamma	Air	4	4

(a) Control limits are determined by the individual inter-laboratory comparison study.

Table 19-5. Summary of inter-laboratory comparison TLD samples of the subcontract dosimetry group for compliance monitoring in 2005

Analysis	Matrix	Number of Results Reported	Number Within Control Limits[(a)]
TLDs	Ambient Radiation	20	20

(a) Based upon NELAP criteria; absolute value of the bias plus one standard deviation < 0.3.

Appendix A

Nevada Test Site Satellite Facilities

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Appendix A: Nevada Test Site Satellite Facilities

This appendix provides a general description of the three Nevada Test Site (NTS) satellite facilities in Nevada which support work on the NTS and all environmental monitoring and compliance activities conducted in 2005 related to these facilities. The NTS and these facilities are managed by the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (NNSA/NSO). They include the North Las Vegas Facility (NLVF), Cheyenne Las Vegas Facility (CLVF), and Remote Sensing Laboratory (RSL)-Nellis. They are all located in Clark County (Figure A-1).

A.1 North Las Vegas Facility

The NLVF is a fenced complex comprised of 31 buildings which houses much of the NTS project management, diagnostic development and testing, design, engineering, and procurement. The 80-acre facility is located along Losee Road, a short distance west of Interstate 15 (Figure A-1). The facility is buffered on the north, south, and east by general industrial zoning. The western border separates the property from fully developed, single-family residential-zoned property. The NLVF is a controlled-access facility.

Environmental compliance and monitoring activities associated with this facility in 2005 included the maintenance of four wastewater permits, one air quality operating permit, one hazardous materials permit (Table A-1), and the monitoring of tritium in air and ambient gamma-emissions to comply with radiation protection regulations.

Table A-1. Environmental permits for NLVF in 2005

Permit Number	Description	Expiration Date	Reporting
Wastewater Discharge			
VEH-112	NLVF Wastewater Contribution Permit	December 31, 2006	Annually
TNEV2004364	NLVF Temporary Well Test/Discharge Permit	May 21, 2005	Monthly
TNEV2005437	NLVF Temporary Well Test/Discharge Permit	December 6, 2005	Monthly
TNEV2006369	NLVF Temporary Authorization to Discharge	June 6, 2006	Monthly
Air Quality			
Facility 657, Mod. 2	Clark County Authority to Construct/Operating Permit for a Testing Laboratory	None	March
Hazardous Materials			
2287-5144	NLVF Hazardous Materials Permit	February 28, 2006	Annually

A.1.1 Compliance with Water Permits

Wastewater permits for NLVF include: (1) a Class II Wastewater Contribution Permit with the City of North Las Vegas (CNLV) for sewer discharges and (2) three temporary discharge permits to support groundwater characterization and dewatering issued by the Nevada Division of Environmental Protection (NDEP).

Discharges of sewage and industrial wastewater from NLVF are required to meet permit limits set by the CNLV. These limits support the permit limits for the Publicly Owned Treatment Works (POTW) operated by the City of Las Vegas. Regulations for wastewater discharges are codified in the municipal codes for both cities. Groundwater discharges are state-regulated by the NDEP, and are used onsite for dust suppression and landscape irrigation.

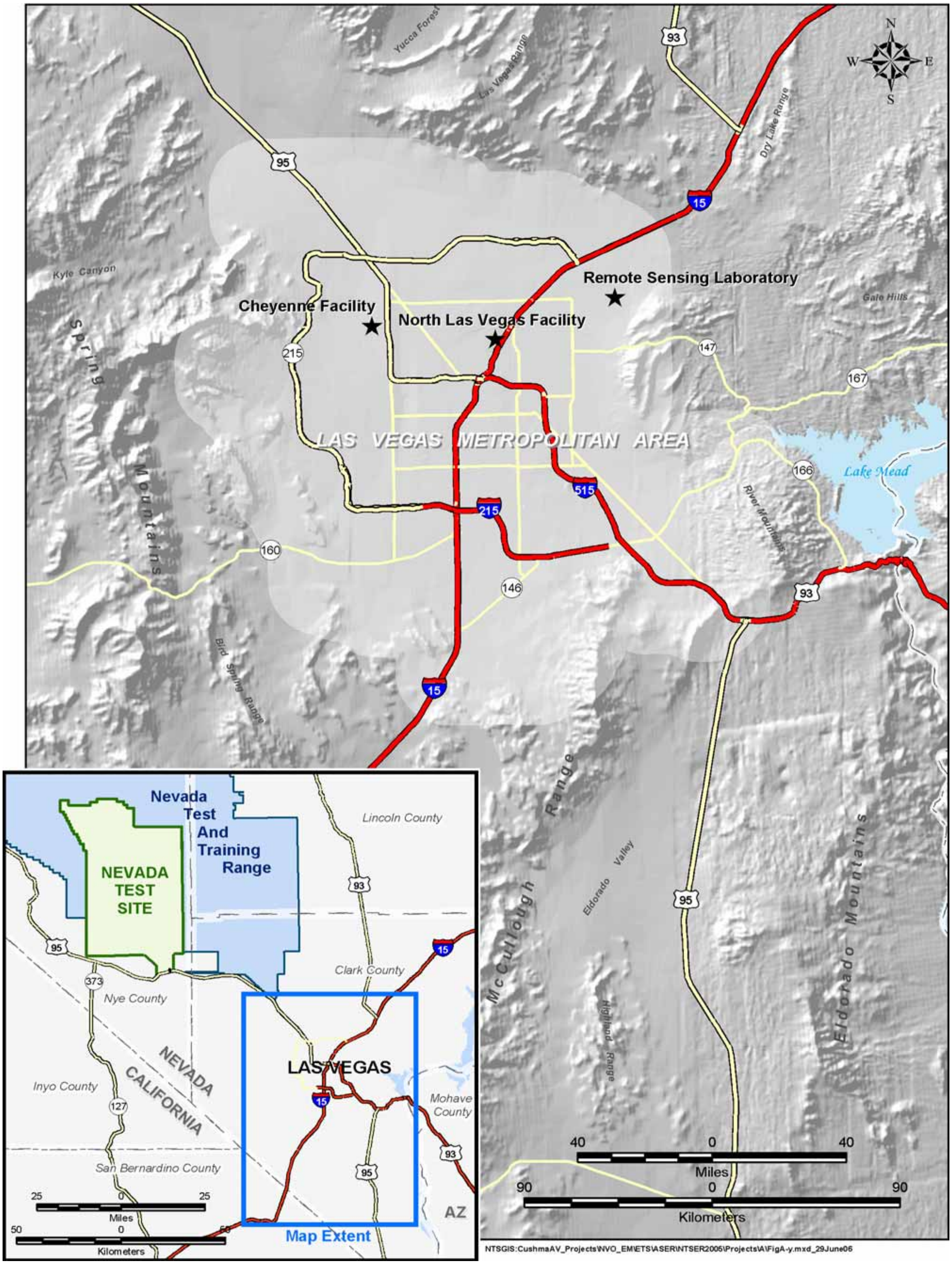

Figure A-1. Location of NTS satellite facilities

A.1.1.1 Wastewater Contribution Permit VEH-112

This permit specifies concentration limits for contaminants in domestic and industrial wastewater discharges. Self-monitoring and reporting of the levels of non-radiological contaminants in sewage and industrial outfalls is conducted. In 2005, contaminant concentrations (in milligrams per liter [mg/L]) were below established permit limits (Table A-2) in all water samples from NLVF outfalls and all sludge and liquid samples from NLVF sand/oil interceptors except for total dissolved solids (TDS) samples collected from Outfall B and C2. In response to these exceedances, Bechtel Nevada (BN) wrote a Salinity Control Plan (SCP) discussing steps taken to reduce the TDS levels. The SCP was submitted to CNLV within the required timeframe and additional samples will be collected and results reported by May 22, 2006. CNLV conducted an annual inspection on September 13, 2005 that resulted in no findings or corrective actions. In compliance with this permit, the following report summarizing wastewater monitoring was generated for NLVF operations and was submitted on October 17, 2005 to CNLV: *Self-Monitoring Report for the National Nuclear Security Administration's North Las Vegas Facility: Permit VEH-112.*

Table A-2. Results of 2005 monitoring at NLVF for Wastewater Contribution Permit VEH-112

Contaminant	Permit Limit (mg/L)	Outfall A (mg/L)	Outfall B (mg/L)	Outfall C2 (mg/L)
Ammonia	61	8.0	13	1.7
Barium	13.1	0.143	0.196	0.188
BOD	600	58	260	18
Cadmium	0.15	< 0.0004	< 0.0004	0.0026
Chromium (hexavalent)	0.10	< 0.01	0.013	< 0.01
Chromium (total)	5.60	< 0.0007	< 0.0007	0.0119
Copper	0.60	0.155	0.207	0.198
Cyanide (total)	19.9	< 0.005	< 0.005	< 0.005
Lead	0.20	< 0.0029	< 0.0029	0.0295
Nickel	1.10	0.0043	0.0061	0.0128
Oil & Grease (animal or vegetable)	250	< 2.5	2.5	< 2.5
pH (Standard Units)	5.0 – 11.0	7.45	7.09	7.55
Phenols	33.6	< 0.02	< 0.02	< 0.02
Phosphorus (total)	14.0	2.3	5.1	1.9
Silver	2.70	< 0.0008	0.0014	0.0017
TDS (total dissolved solids)	1200	885	1260	1360
TSS (total suspended solids)	750	40.6	91.2	100
Zinc	8.20	0.219	0.207	0.261
Ammonia	61	8.0	13	1.7
Barium	13.1	0.143	0.196	0.188

Yellow-shaded results are any which are equal to or greater than the permit limit.

A.1.1.2 NPDES Permits TNEV2004364, TNEV2005437, and TNEV2006369

Temporary National Pollutant Discharge Elimination System (NPDES)/State Pollutant Discharge Elimination System permits covered the groundwater characterization study and remedial dewatering operation conducted in 2005 at the NLVF (see Section A.1.2 below). Each permit was valid for a period of six months. In 2005, the U.S. Environmental Protection Agency (EPA) informed the state of Nevada that they were in direct violation of the Clean Water Act by issuing the temporary permits allowing pumped groundwater to be discharged to the CNLV storm water drainage system. In response, the active permit was amended to only allow discharge of the groundwater onsite, and the subsequent temporary permits issued for the remainder of 2005 also only allowed onsite discharge. The water is used onsite for irrigation and dust control. The volume of water pumped is reported monthly to the state per the requirements of each permit (Table A-3). In 2006, BN will apply for a permanent individual NPDES permit with the state of Nevada and EPA Region 9 which will allow discharge of pumped groundwater into the CNLV storm water drainage system.

Table A-3. NPDES/SPDES Non-Compliances

Permit Type	Outfall	Parameter	Number of Permit Exceedances	Number of Samples Taken	Number of Compliant Samples	Percent Compliance	Date(s) Exceeded	Description /Solution
TNEV 2004364 2005437 2006369	001	Discharge volume	NA	12 (1/month)	12	100	NA	NA

NA = not applicable
Note: These permits only allow onsite discharge of groundwater.

A.1.2 Groundwater Control Study and Dewatering Operations

Rising groundwater below Building A-1 at the NLVF intruded into the elevator pit in 1999. Between November 1999 and January 2001, the water level in a well installed in the basement of Building A-1 rose at a rate of 0.61 meters (m) (2 feet [ft]) per year (BN, 2001), and slowed to less than 0.3 m (1.0 ft) per year by the end of 2003 (BN, 2003). Sealing of the elevator pit and interim pumping at the nearby basement sump slowed the encroaching water. However, if the water level is not lowered, it could jeopardize the integrity of deep-footed infrastructure (e.g., elevator pits, utility trenches, foundation footers, etc.). Subsequent groundwater studies have guided the current dewatering initiative. These hydrogeologic investigations and initial dewatering efforts were reported in the 2004 NTS environmental report (U.S. Department of Energy [DOE], 2005a). Work performed in 2005 is summarized here following a brief review of the rising groundwater situation and past efforts to understand and remediate the problem. More detailed information regarding this project, including figures and data presentations, is reported in annual summary reports (e.g. BN, 2003; 2004b; 2005b).

A.1.2.1 Review and Past Work

In 2002 and 2003, BN conducted a groundwater control study. This comprehensive investigation included the installation of 25 wells (Figure A-2), soil and water sampling, hydrologic testing, and rudimentary modeling (BN, 2003). The study indicated a complex hydrogeologic setting, and implicated multiple factors for the rise of the water table. The preliminary geologic interpretation of borehole data indicates that these fine-grained sediments represent a low-energy, mid-valley alluvial and fluvial environment. Individual lithologic units of sand, silt, and clay are complexly interbedded and several normal faults have been mapped in the vicinity.

The near-surface (unconfined) water table at the NLVF was encountered in the depth range of 3.8 to 14.9 m (12.6 to 49 ft). Artesian water flow of 3.0 to 7.6 liters per minute (lpm) (0.8 to 2 gallons per minute [gpm]) was encountered at two wells.

Water chemistry reveals that this water is not related to the near surface "nuisance water" commonly supplied by excessive irrigation, but is from a deeper alluvial aquifer. The hydrogeologic setting suggests that the source of this rising groundwater is water flowing upward along local faults from deeper confined aquifer(s) (Figure A-3). This condition is considered a long-term adjustment that can be attributed to a combination of causes, including a seasonal water injection program conducted by the Southern Nevada Water Authority and shifting of regional pumping centers away from the vicinity of NLVF.

Figure A-2. Monitoring wells and hydrologic test wells constructed at the North Las Vegas Facility

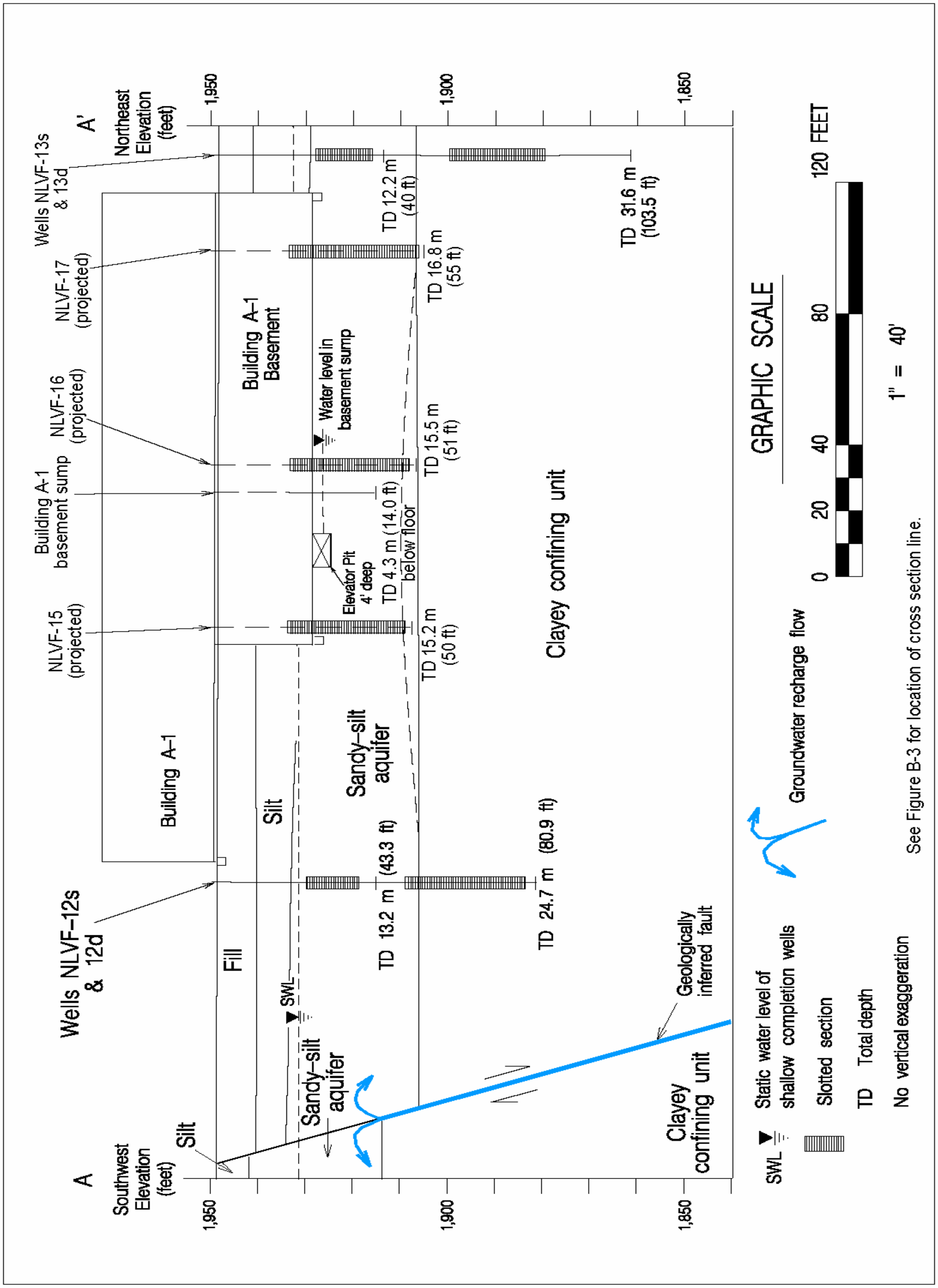

Figure A-3. Southwest-northeast hydrogeologic cross section A-A' through wells NLVF-12, -15, -16, -17, and -13, Basement Sump, NLVF-16, -17, and -13

On May, 18, 2004, two shallow hydrologic characterization wells, proximal to Building A-1, NLVF-12s and NLVF-13s (Figures A-2 and A-4), were converted into dewatering wells to remediate the rising groundwater below Building A-1. The objective of this dewatering effort was to lower the water level 1.2 m (4 ft) (or 1 ft below the lowest building footing) within two years.

Depth-to-water in the A-1 Basement Sump is plotted versus time (date) in Figure A-5. The low water levels depicted on the far left side of Figure A-5 reflect continued pumping of the A-1 Basement Sump well. The A-1 Basement Sump pump was turned off on May 22, 2004 several days after the two dewatering wells came on-line. At this point, the A-1 Basement Sump well could be used to monitor progress of the dewatering operation. Figure A-5 shows a steady decrease in the water level at the A-1 Basement Sump well due to pumping at Wells NLVF-12s and NLVF-13s up to about December 20, 2004. After this date, the water level at the A-1 Basement Sump well has been gradually rising, possibly due to recharge associated with the higher than normal precipitation for the July 2003 to April 2005 period (http://www.wrcc.dri.edu). It is interesting to note that the static water level at a majority of the NLVF monitoring wells (Figure A-2) has been gradually rising since the network was installed.

Plans to add at least two new wells to the remedial dewatering system and the resumption of pumping at the Building A-1 Basement Sump well were initiated at this time. While waiting for an appropriate long-term discharge permit, options for on-site water disposal, as required under the provisions of the Temporary Discharge Permits issued by NDEP, were studied, and several were put in place. The interim disposal methods are watering for dust control, irrigation of landscape, and evaporation of the Building A-1 Basement Sump well water. Since data gathered to date suggests that dewatering (pumping) may need to be continued indefinitely, permanent options for on-site use or disposal of produced water are being considered (BN, 2005c).

A.1.2.2 Work Conducted in 2005

Based on recommendations using data collected from the NLVF Groundwater Control Program (BN, 2003; 2004b; 2005b), three new shallow dewatering wells were drilled in July and August, 2005. The three new wells, designated NLVF-15, NLVF-16, and NLVF-17, are located along the north side of Building A-1 (Figures A-2 and A-4). The three wells were drilled with a 34.3-centimeter (cm) (13 ½-inch [in.]) auger bit to a total depth of between 15.2 to 16.8 m (50 to 55 ft) and completed with 10.2-cm (4-in.) inside diameter polyvinyl chloride casing.

All three wells have a single 9.1-m (30-ft) long slotted section and are completed in the same, shallow, clayey, sandy-silty aquifer as the two existing dewatering wells, NLVF-12s and NLVF-13s (Figure A-3). Preliminary results from short-term step drawdown aquifer tests conducted in the three new wells suggest that discharge rates from 2.6 to 3.8 lpm (0.7 to 1.0 gpm) may be sustained. BN Construction personnel performed the drilling and well construction activities; BN Geotechnical Sciences personnel conducted geologic and hydrologic data collection and analysis.

Groundwater monitoring activities for the dewatering project include periodic water-level measurements at all accessible wells at NLVF (including continuous measurements at the A-1 Basement Sump well), total discharge volume, and specific groundwater chemistry analyses conducted quarterly and annually at the active dewatering wells. The quarterly water samples are analyzed for tritium and for the standard field parameters pH, conductivity, temperature, and turbidity.

In addition to the quarterly sampling, water samples from selected wells were collected and analyzed in 2005 for a full-suite analysis. The parameters analyzed included metals, ions, alkalinity, TDS, tritium, volatile organic carbon (VOC) (including trihalomethanes), total organic carbon (TOC), coliform, turbidity, and field parameters pH, temperature, and specific conductance. This information was used to help characterize the groundwater and are reported in the 2006 dewatering initiative report (BN, 2006e). The presence or absence of particular constituents, or overall chemical signature, could suggest or confirm source(s) of the rising near-surface groundwater. Analytical results from the sampled wells meet the Safe Drinking Water Standards. These analyses were as expected and compare well with previous sampling events. Water analysis results are maintained in the Bechtel Environmental Integrated Data Management System database.

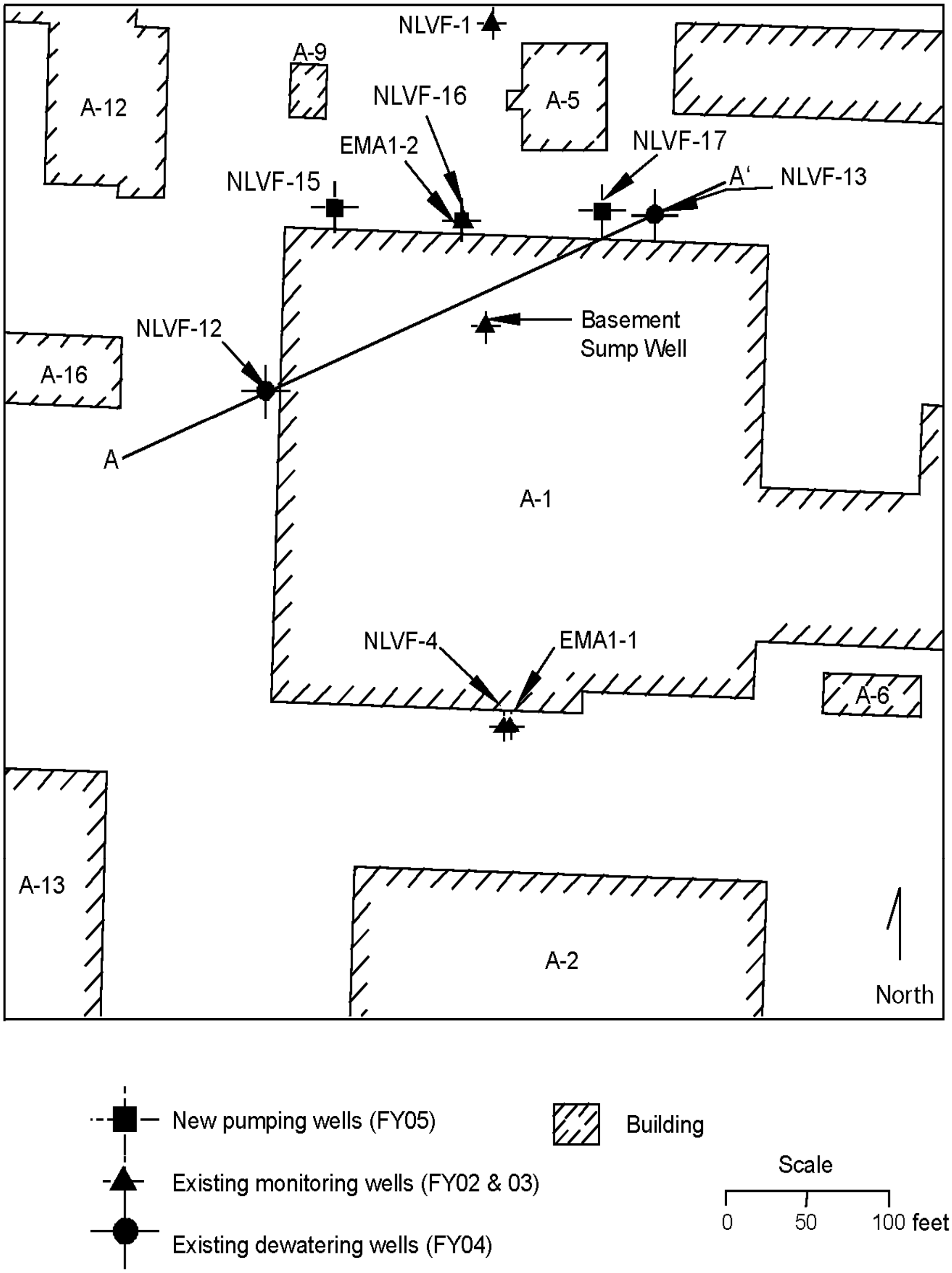

Figure A-4. Location of existing and new (2005) dewatering wells around Building A-1

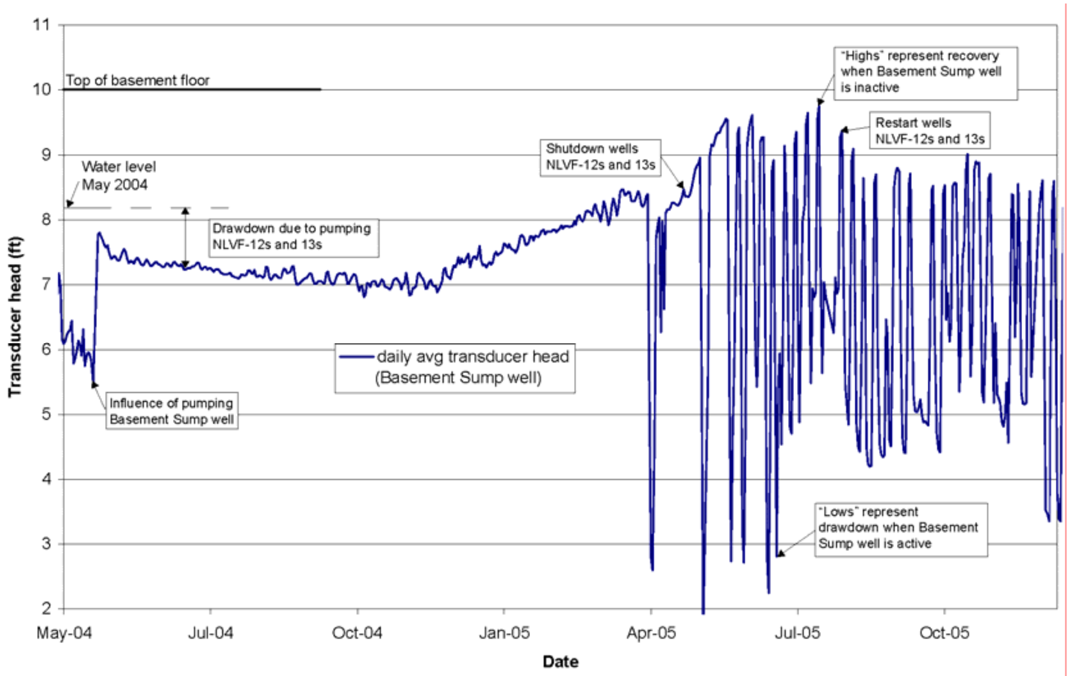

Figure A-5. A-1 Basement Sump well transducer data

The total quantity of water produced/discharged is reported monthly to the NDEP, Bureau of Water Pollution Control in Carson City, Nevada in accordance with the governing discharge permits. Well NLVF-12s has been pumping approximately 31,605 liters (L) (8,350 gallons [gal]) per month in the year since it was installed, and Well NLVF-13s has pumped about 141,559 L (37,400 gal) per month. The average combined discharge from both dewatering wells is about 173,164 L (45,750 gal) per month.

A.1.2.3 Future Work

Project work plans include the installation of electric submersible pumps in the new dewatering wells, construction of a permanent water distribution system, and the acquisition of a long-term discharge permit. The long-range plan is to use the pumped water onsite for landscape irrigation, dust control, and possibly in existing cooling towers. To bring the expanded dewatering operation on-line quickly, some portion of the produced water may be disposed directly into the existing storm-water conveyance system or the sanitary sewer, but this action will be dependent on the terms or the final discharge permit. Continued monitoring of water levels and water chemistry at selected wells is also planned.

A.1.3 Compliance with Air Quality Permits

The NLVF is regulated for the emission of criteria pollutants (see Glossary, Appendix B) and hazardous air pollutants (HAPs). They include sulfur dioxide (SO_2), nitrous oxides (NO_X), carbon monoxide (CO), particulate matter (PM), VOCs, and any of 189 defined HAPs. Air quality operating permits are maintained for a variety of equipment that includes boilers, emergency generators, and a paint spray booth. There are no monitoring requirements associated with these permits. The air permits for NLVF were issued in the mid 1980s and early 1990s through the Clark County Department of Air Quality and Environmental Management (DAQEM), formerly the Clark County Health District. Separate permits were maintained for equipment located at the NLVF. In 2005, during a modification to add a diesel generator to the Losee Road permit, all three permits were combined into a single site-wide NLVF permit ("Facility 657"). This was done in order to bring the permits up to date with Clark County's new permitting format. The Facility 657 permit was modified once during 2005 to change the operating status of most of the diesel generators from emergency to primary use so that the generators could be used during planned power outages. The new permit has no expiration date and will be renewed automatically each year upon payment of permit fees. It is revised only if the situation under which the permit was issued changes. The DAQEM requires submittal of an annual emissions inventory. The estimated quantities of criteria air pollutants and HAPs emitted in 2005 are shown in Table A-3. The emissions inventory for 2005 was reported to DAQEM on March 22, 2006.

Table A-4. Tons of criteria air pollutant and HAPs emissions estimated for NLVF in 2005

Facility at NLVF	Criteria Pollutant (Tons/yr)[a]					HAPs (Tons/yr)
	CO	NO_x	PM10[b]	SO_2	VOC	
Atlas Facility	0.067	0.252	0.001	0.004	0.007	0.00011
Losee Facility	0.179	0.611	0.107	0.040	0.050	0.0009
Nevada Support Facility	0.014	0.053	0.002	0.001	0.002	0.00007
Total by Pollutant	**0.260**	**0.916**	**0.110**	**0.045**	**0.059**	**0.00108**
Total Emissions			**1.391**			

(a) 1 ton equals 0.91 metric tons
(b) Particulate matter equal to or less than 10 microns in diameter

A.1.4 Compliance with Hazardous Materials Regulations

In 2005, the chemical inventory at NLVF was updated and submitted to the state in the Nevada Combined Agency (NCA) Report on February 23, 2006, as per the requirements of the Hazardous Materials Permit 2287-5144 (see Section 2.5, Emergency Planning and Community Right-to-Know Act for description of content, purpose, and federal regulatory driver behind the NCA Report). No accidental or unplanned release of an extremely hazardous substance (EHS) occurred at NLVF in 2005. Also, no annual usage quantities of toxic chemicals kept at NLVF exceeded specified thresholds (see Section 2.5 concerning Toxic Chemical Release Inventory, Form R).

A.1.5 Compliance with Radiation Protection Regulations

A.1.5.1 National Emission Standards for Hazardous Air Pollutants (NESHAP)

The Clean Air Act, Title 40 Code of Federal Regulations (CFR) 61, Subpart H (NESHAP) requires managers of DOE facilities to perform an assessment of all radionuclide air emissions caused by their operations and to estimate the radiation dose that a member of the public could receive from them. NESHAP establishes a dose limit for the general public to be no greater than 10 millirems per year (mrem/yr). Building A-1's basement was contaminated with tritium in 1995 when a container of tritium foils was opened, emitting about 1 Curie of tritium (DOE, 1996b). Complete cleanup of the tritium was unsuccessful due to the tritium being absorbed into the building materials. This has resulted in a continuous but decreasing release of tritium into the basement air space, which is ventilated to the outdoors. Since 1995, a dose assessment has been performed every year for this building. Two air samples were collected from the basement in 2005 (from April 4 to April 18 and from September 13 to September 21). As in previous years, the calculated radiation dose to the nearest member of the general public, located 100 m northwest of the building vent pipe, was less than 2 microrems/yr.

A.1.5.2 DOE Order 5400.5

DOE Order 5400.5, *Radiation Protection of the Public and the Environment* specifies that the radiological dose to a member of the public from radiation from all pathways must not exceed the 100 mrem/yr as a result of DOE activities. This dose limit does not include the dose contribution from natural background radiation. The facilities at NLVF where radioactive sources are used or where radiation-producing operations are conducted which have the potential to expose the general population or non-project personnel to direct radiation are the Atlas A-1 Source Range Laboratory and the Building C-3 High Intensity Source Building. BN's Environmental Technical Services (ETS) conducted direct radiation monitoring at the site. ETS utilized thermoluminescent dosimeters (TLDs) to monitor external gamma radiation exposure near the boundaries of these NLVF facilities. The methods of TLD use and data analyses are described in Section 5.0 of this report.

In 2005, two TLD stations were placed along the perimeter fence and one was placed in a control location. The annual exposure rates estimated from measurements at those NLVF locations are summarized in Table B-5. These exposures were all less than the 100 mrem/yr dose limit.

Table A-5. Results of 2005 direct radiation exposure monitoring at NLVF

Location	Number of Samples	Gamma Exposure (mR/yr) Mean	Median	Minimum	Maximum
Control	4	66	62	60	81
North Fence of A-1	4	67	63	60	83
North Fence of Bldg C-3	3	74	70	64	86

A.2 Cheyenne Las Vegas Facility

The CLVF Facility is located at the Flynn Gallagher Corporate Center on West Cheyenne Avenue in northwest Las Vegas. It is comprised of five buildings which house engineering, procurement, and administrative functions. Access to the facility requires proper identification, badging, and a security access card. Facility and infrastructure maintenance is provided by the facility owner. No environmental monitoring or compliance activities are conducted at or for this facility.

A.3 Remote Sensing Laboratory - Nellis

RSL-Nellis is approximately 13.7 kilometers (km) (8.5 miles [mi]) northeast of the Las Vegas city center, and approximately 11.3 km (7 mi) northeast of NLVF. It occupies six facilities on approximately 14 secured hectares (35 acres) at the Nellis Air Force Base. The six NNSA/NSO facilities were constructed on property owned by the U.S. Air Force (USAF). There is a Memorandum of Agreement between the U.S. Air Force and the NNSA/NSO whereby the land belongs to the USAF, but is under lease to the NNSA/NSO for 25 years (as of 1989) with an option for a 25-year extension. The facilities are owned by NNSA/NSO. RSL-Nellis provides emergency response resources for weapons-of-mass-destruction incidents. The laboratory also designs and field tests counter-terrorism/intelligence technologies and has the capability to assess environmental and facility conditions using complex radiation measurements and multi-spectral imaging technologies.

Environmental compliance and monitoring activities at RSL-Nellis in 2005 included maintenance of a wastewater contribution permit, an air quality permit, and a hazardous materials permit (Table A-5). Sealed radiation sources are used for calibration at RSL-Nellis, but the public has no access to any area which may have elevated gamma radiation emitted by the sources. Therefore, no environmental TLD monitoring is conducted. However, dosimetry monitoring to ensure protection of personnel who work within the facility is performed.

Table A-6. Environmental permits for RSL-Nellis in 2005

Permit Number	Description	Expiration Date	Reporting
Wastewater Discharge			
CCWRD-080	Industrial Wastewater Discharge Permit	June 30, 2006	March, May, September, December
Air Quality			
Facility 348, Mod. 1	Clark County Authority to Construct/Operating Permit for a Testing Laboratory	None	March
Hazardous Materials			
2287-5145	RSL-Nellis Hazardous Materials Permit	February 28, 2006	Annually

A.3.1 Compliance with Wastewater Contribution Permit CCWRD-080

Discharges of wastewater from RSL - Nellis are required to meet permit limits set by the Clark County Water Reclamation District (CCWRD). These limits support the permit limits for the POTW operated by Clark County. The wastewater permit for this facility requires quarterly monitoring and reporting. Table A-6 presents the mean concentration of outfall measurements collected once per quarter in 2005. All contaminants in the outfall samples fell below permit limits. Quarterly reports were submitted on March 14, May 10, September 7, and December 7, 2005 to the CCWRD. The CCWRD also conducted two inspections of RSL-Nellis in 2005. The inspections resulted in no findings or corrective actions for the facility.

Table A-7. Mean concentration of outfall measurements at RSL-Nellis in 2005

Contaminant/Measure	Permit Limit	Outfall
	mg/L	
Ammonia	NL[(a)]	12.18
Cadmium	0.35	0.0007
Chromium (Total)	1.7	0.0013
Copper	3.36	0.237
Cyanide (Total)	1	< 0.02
Lead	0.99	0.0036
Nickel	10.08	0.0036
Phosphorus	NL	6.0
Silver	6.3	0.0252
TDS	NL	1293
TSS	NL	69.55
Zinc	23.06	0.482
	Standard Units	
pH	5.0 – 11.0	5.0 – 11.0
	Degrees Fahrenheit	
Temperature	140	140

(a) No limit listed on permit

A.3.2 Compliance with Air Quality Permits

RSL-Nellis is regulated for the emission of criteria pollutants and HAPs. Air quality operating permits are maintained for a variety of equipment. There are no monitoring requirements associated with these permits. The air permits for RSL-Nellis were issued in the mid 1980s and early 1990s through the DAQEM. Separate permits were maintained for each piece of equipment at the RSL. In 2005, following a request by NNSA/NSO to cancel the air permit for the Excimer Laser because it is no longer used, Clark County mistakenly cancelled all of the RSL permits, which included a water heater, generators, and other equipment. The County then reinstated the permits (except for the Excimer

Laser) and took the opportunity to combine all of them into a single combined permit "Facility 348") using the newer format. The Facility 348 permit was modified once during 2005 due to the addition of a vapor degreaser at the RSL. The permit has no expiration date and is renewed automatically each year upon payment of permit fees. It is revised only if the situation under which the permit was issued changes. The DAQEM requires submittal of the annual emissions inventory. The estimated quantities of criteria air pollutants and HAPs emitted at RSL-Nellis in 2005 are presented in Table A-7. Natural gas consumption is also reported as per the requirements of the new consolidated air permit issued for the RSL. The emissions inventory for 2005 was reported to DAQEM on March 22, 2006.

Table A-8. Summary of air emissions for RSL - Nellis in 2005

	Criteria Pollutant (Tons/yr)[a]					HAPs (Tons/yr)	Natural Gas Consumption (ft^3) [c]
	CO	NO_x	PM10[b]	SO_2	VOC		
	0.375	0.718	0.039	0.013	0.044	0.008	6,567,300
Total Emissions of Pollutants	**1.197**						

(a) 1 ton equals 0.91 metric tons
(b) Particulate matter equal to or less than 10 microns in diameter
(c) Cubic feet

A.3.3 Compliance with Hazardous Materials Regulations

In 2005, the chemical inventory at RSL-Nellis was updated and submitted to the state in the NCA Report on February 23, 2006, as per the requirements of the Hazardous Materials Permit 2287-5145 (see Section 2.5 of this report for description of content, purpose, and federal regulatory driver behind the NCA Report). No accidental or unplanned release of an EHS occurred at RSL-Nellis in 2005. Also, no annual usage quantities of toxic chemicals kept at RSL-Nellis exceeded specified thresholds (see Section 2.5 concerning Toxic Chemical Release Inventory, Form R).

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Appendix B: Glossary

A **Absorbed dose:** the amount of energy imparted to matter by ionizing radiation per unit mass of irradiated material, in which the absorbed dose is expressed in units of rad or gray (l rad equals 0.01 gray).

Accuracy: the closeness of the result of a measurement to the true value of the quantity measured.

Action level: defined by regulatory agencies, the level of pollutants which, if exceeded, requires regulatory action.

Aerosol: a gaseous suspension of very small particles of liquid or solid.

Alluvium: sediment deposited by flowing water.

Alpha particle: a positively charged particle emitted from the nucleus of an atom, having mass and charge equal to those of a helium nucleus (two protons and two neutrons), usually emitted by transuranic elements.

Ambient air: the surrounding atmosphere, usually the outside air, as it exists around people, plants, and structures; not considered in monitoring purposes when immediately adjacent to emission sources.

Analyte: the specific component measured in a chemical analysis.

Anion: a negatively charged ion, such as Cl^-.

Aquifer: a saturated layer of rock or soil below the ground surface that can supply usable quantities of ground water to wells and springs, and be a source of water for domestic, agricultural, and industrial uses.

Aquitard: a low-permeability geologic formation that bounds an aquifer.

Atom: the smallest particle of an element capable of entering into a chemical reaction.

B **Background:** as used in this report, background is the term for the amounts of chemical constituents or radioactivity in the environment which are not caused by NTS operations.

Becquerel (Bq): the SI unit of activity of a radionuclide, equal to the activity of a radionuclide having one spontaneous nuclear transition per second.

Beta particle: a negatively charged particle emitted from the nucleus of an atom, having charge, mass, and other properties of an electron, emitted from fission products such as ^{137}Cs.

Biochemical (biological) oxygen demand (BOD): a measure of the amount of dissolved oxygen that microorganisms need to break down organic matter in water; used as an indicator of water quality.

C **CAP88-PC:** computer code required by the EPA for modeling air emissions of radionuclides.

Chain-of-custody: a method for documenting the history and possession of a sample from the time of its collection, through its analysis and data reporting, to its final disposition.

Code of Federal Regulations (CFR): a codification of all regulations promulgated by federal government agencies.

Collective population dose: the sum of the total effective dose equivalents of all individuals within a defined population. The unit of collective population dose is person-rem or person-sievert. Collective population dose may also be referred to as "collective effective dose equivalent" or simply "population dose."

Committed dose equivalent: the dose equivalent to a tissue or organ over a 50-year period after an intake of a radionuclide into the body. Committed dose equivalent is expressed in units of rem or sievert.

Committed effective dose equivalent: the sum of the committed dose equivalents to various tissues in the body, each multiplied by an appropriate weighting factor representing the relative vulnerability of different parts of the body to radiation. Committed effective dose equivalent is expressed in units of rem or sievert.

Compliance Level (CL): stands for the Clean Air Act National Emission Standards for Hazardous Air Pollutants Concentration Level for Environmental Compliance. The CL value represents the annual average concentration which would result in a dose of 10 mrem/yr, which is the federal dose limit to the public from all radioactive air emissions.

Cosmic radiation: radiation with very high energies originating outside the earth's atmosphere; it is one source contributing to natural background radiation.

Criteria pollutants: those air pollutants designated by the U.S. Environmental Protection Agency as potentially harmful and for which National Ambient Air Quality Standards under the Clean Air Act have been established to protect the public health and welfare. These pollutants include sulfur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO), ozone, lead, and particulate matter equal to or less than 10 microns in diameter (PM10). The state of Nevada, through an air quality permit, establishes emission limits on the NTS for SO_2, NO_X, CO, PM10, and volatile organic compounds (VOCs). Ozone is not regulated by the permit as an emission as it is formed in part from NO_X and VOCs. Lead is considered a hazardous air pollutant (HAP) as well as a criteria pollutant, and lead emissions on the NTS are reported as part of the total HAP emissions. Lead emissions above a specified threshold are also reported under Section 313 of the Emergency Planning and Community Right-to-Know Act.

Curie (Ci): a unit of measurement of radioactivity, defined as the amount of radioactive material in which the decay rate is 3.7×10^{10} disintegrations per second or 2.22×10^{12} disintegrations per minute; one Ci is approximately equal to the decay rate of one gram of pure radium.

D **Daughter nuclide:** a nuclide formed by the radioactive decay of another nuclide, which is called the parent.

Decision level: the counts of radioactivity (or concentration level of a radionuclide) in a sample that must be exceeded before there is a specified level of confidence (typically 95 or 99 percent) that the sample contains radioactive material above the background; also known as the Critical Level (L_C).

Depleted uranium: uranium having a lower proportion of the isotope ^{235}U than is found in naturally occurring uranium. The masses of the three uranium isotopes with atomic weights 238, 235, and 234 occur in depleted uranium in the weight-percentages 99.8, 0.2, and 5×10^{-4}, respectively; see Table 3-7 and related discussion.

Derived Concentration Guide (DCG): concentrations of radionuclides in water and air that could be continuously consumed or inhaled for one year and not exceed the DOE primary radiation dose limit to the public of 100 mrem/yr effective dose equivalent.

Dose: the energy imparted to matter by ionizing radiation; the unit of absorbed dose is the rad, equal to 0.01 joules per kilogram for irradiated material in any medium.

Dose commitment: the dose that an organ or tissue would receive during a specified period of time (typically 50 or 70 years) as a result of one year's intake of one or more radionuclides.

Dose equivalent: the product of absorbed dose in rad (or gray) in tissue and a quality factor representing the relative damage caused to living tissue by different kinds of radiation, and perhaps other modifying factors representing the distribution of radiation, etc., expressed in units of rem or sievert.

Dosimeter: a portable detection device for measuring the total accumulated exposure to ionizing radiation.

Dosimetry: the theory and application of the principles and techniques of measuring and recording radiation doses.

Downgradient: in the direction of groundwater flow from a designated area; analogous to downstream.

E **Effective dose equivalent (EDE):** an estimate of the total risk of potential effects from radiation exposure, it is the summation of the products of the dose equivalent and weighting factor for each tissue. The weighting factor is the decimal fraction of the risk arising from irradiation of a selected tissue to the total risk when the whole body is irradiated uniformly to the same dose equivalent. These factors permit dose equivalents from non-uniform exposure of the body to be expressed in terms of an effective dose equivalent that is numerically equal to the dose from a uniform exposure of the whole body that entails the same risk as the internal exposure. The effective dose equivalent includes the committed effective dose equivalent from internal deposition of radionuclides and the effective dose equivalent caused by penetrating radiation from sources external to the body, and is expressed in units of rem or sievert.

Effluent: used in this report to refer to a liquid discharged to the environment.

Emission: used in this report to refer to a vapor, gas, airborne particulate, or radiation discharged to the environment via the air.

Environmental Impact Statement (EIS): a detailed report, required by the National Environmental Policy Act, on the environmental impacts from a federally-approved or funded project. An EIS must be prepared by a federal agency when a "major" federal action that will have "significant" environmental impacts is planned.

F **Federal facility:** a facility that is owned or operated by the federal government, subject to the same requirements as other responsible parties when placed on the Superfund National Priorities List.

Federal Facility Agreement (FFA): a negotiated agreement that specifies required actions at a federal facility as agreed upon by various agencies (e.g., EPA, DOE, DoD).

Federal Register: a document published daily by the federal government containing notification of government agency actions, including notification of EPA and DOE decisions concerning permit applications and rule-making.

Fiscal year: NNSA/NSO's fiscal year is from October 1 through September 30.

G **Gamma ray:** high-energy, short-wavelength, electromagnetic radiation emitted from the nucleus of an atom, frequently accompanying the emission of alpha or beta particles.

Gray (Gy): the SI unit of measure for absorbed dose; the quantity of energy imparted by ionizing radiation to a unit mass of matter, such as tissue. One gray equals 100 rads, or 1 joule per kilogram.

Gross alpha: the measure of radioactivity caused by all radionuclides present in a sample which emit alpha particles. Gross alpha measurements reflect alpha activity from all sources, including those that occur naturally. Gross measurements are used as a method to screen samples for relative levels of radioactivity.

Gross beta: the measure of radioactivity caused by all radionuclides present in a sample which emit beta particles. Gross beta measurements reflect beta activity from all sources, including those that occur naturally. Gross measurements are used as a method to screen samples for relative levels of radioactivity.

Groundwater: all subsurface water.

H **Half-life:** the time required for one-half the radioactive atoms in a given amount of material to decay; for example, after one half-life, half of the atoms will have decayed; after two half-lives, three-fourths; after three half-lives, seven-eighths; and so on, exponentially.

Hazardous waste: hazardous wastes exhibit any of the following characteristics: ignitability, corrosivity, reactivity, or EP-toxicity (yielding excessive levels of toxic constituents in a leaching test), but other wastes that do not necessarily exhibit these characteristics have been determined to be hazardous by the U.S. Environmental Protection Agency (EPA). Although the legal definition of hazardous waste is complex, according to EPA, the term generally refers to any waste that, if managed improperly, could pose a threat to human health and the environment.

High-efficiency particulate air filter (HEPA): a throwaway, extended-media, dry-type filter used to capture particulates in an air stream; HEPA collection efficiencies are at least 99.97 percent for 0.3 micrometer diameter particles.

Hydraulic gradient: in an aquifer, the rate of change of total head (water-level elevation) per unit distance of flow at a given point and in a given direction.

Hydrology: the science dealing with the properties, distribution, and circulation of natural water systems.

I **Inorganic compounds:** compounds that either do not contain carbon or do not contain hydrogen along with carbon, including metals, salts, various carbon oxides (e.g., carbon monoxide and carbon dioxide), and cyanide.

In situ: in the natural or original position. Generally refers to measurements taken in the environment or to the treatment of contaminated areas in place without excavation or removal.

Interim status: a legal classification allowing hazardous waste incinerators or other hazardous waste management facilities to operate while EPA considers their permit applications, provided that they were under construction or in operation by November 19, 1980 and can meet other interim status requirements.

Isotopes: forms of an element having the same number of protons in their nuclei, but differing numbers of neutrons.

L **Less than detection limits:** a phrase indicating that a chemical constituent or radionuclide was either not present in a sample, or is present in such a small concentration that it cannot be measured as significantly different from zero by a laboratory's analytical procedure and, therefore, is not identified at the lowest level of sensitivity.

Low level radioactive waste (LLW): waste defined by DOE Order 5820.2A, which contains transuranic nuclide concentrations less than 100 nCi/g.

Lower limit of detection: the smallest concentration or amount of analyte that can be detected in a sample at a 95 percent confidence level.

Lysimeter: an instrument for measuring the water percolating through soils and determining the dissolved materials.

M **Maximally exposed individual (MEI):** a hypothetical member of the public at a fixed location who, over an entire year, receives the maximum effective dose equivalent (summed over all pathways) from a given source of radionuclide releases to air. Generally, the MEI is different for each source at a site.

Maximum contaminant level (MCL): the highest level of a contaminant in drinking water that is allowed by U.S. Environmental Protection Agency regulation.

Minimum detectable concentration (MDC): also known as the lower limit of detection, the smallest amount of radioactive material in a sample that can be quantitatively distinguished from background radiation in the sample with 95 percent confidence.

Metric units: Metric system and U.S. customary units and their respective equivalents are shown in Table C-6. Except for temperature for which specific equations apply, U.S. customary units can be determined from metric units by multiplying the metric units by the U.S. customary equivalent. Similarly, metric units can be determined from U.S. customary equivalent units by multiplying the U.S. customary units by the metric equivalent.

Mixed waste (MW): waste that has the properties of both hazardous and radioactive waste.

N **National Emission Standards for Hazardous Air Pollutants (NESHAPs):** standards found in the Clean Air Act that set limits for hazardous air pollutants.

National Pollutant Discharge Elimination System (NPDES): federal regulation under the Clean Water Act that requires permits for discharges into surface waterways.

Non-point source: any nonconfined area from which pollutants are discharged into a body of water (e.g., agricultural runoff, construction runoff, and parking lot drainage), or into air (e.g., a pile of uranium tailings).

O **Offsite:** for effluent releases or in the nuclear testing area, offsite is any place outside the NTS and adjacent NTTR.

Onsite: for effluent releases or in the nuclear testing area, onsite is any place inside the NTS and adjacent NTTR.

P **Part B Permit:** the second, narrative section submitted by generators in the RCRA permitting process that covers in detail the procedures followed at a facility to protect human health and the environment.

Parts per billion (ppb): a unit of measure for the concentration of a substance in its surrounding medium; for example, one billion grams of water containing one gram of salt has a salt concentration of 1 ppb.

Parts per million (ppm): a unit of measure for the concentration of a substance in its surrounding medium; for example, one million grams of water containing one gram of salt has a salt concentration of 1 ppm.

Perched aquifer: an aquifer that is separated from another water-bearing stratum by an impermeable layer.

Performance standards (incinerators): specific regulatory requirements established by the U.S. Environmental Protection Agency limiting the concentrations of designated organic compounds, particulate matter, and hydrogen chloride in incinerator emissions.

pH: a measure of hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH from 0 to 7; basic solutions have a pH greater than 7; and neutral solutions have a pH of 7.

Pliocene: a geological epoch of the Tertiary period, starting about 12 million years ago.

PM-10: fine particulate matter with an aerodynamic diameter equal to or less than 10 microns.

Point source: any confined and discrete conveyance (e.g., pipe, ditch, well, or stack).

Q **Quality assurance (QA):** a system of activities whose purpose is to provide the assurance that standards of quality are attained with a stated level of confidence.

Quality control (QC): procedures used to verify that prescribed standards of performance are attained.

Quality factor: the factor by which the absorbed dose (rad) is multiplied to obtain a quantity that expresses (on a common scale for all ionizing radiation) the biological damage to exposed persons, usually used because some types of radiation, such as alpha particles, are biologically more damaging than others. Quality factors for alpha, beta, and gamma radiation are in the ratio 20:1:1.

Quaternary: the geologic era encompassing the last 2–3 million years.

R **Rad:** the unit of absorbed dose and the quantity of energy imparted by ionizing radiation to a unit mass of matter such as tissue; equal to 0.01 joule per kilogram, or 0.01 gray.

Radioactive decay: the spontaneous transformation of one radionuclide into a different nuclide (which may or may not be radioactive), or de-excitation to a lower energy state of the nucleus by emission of nuclear radiation, primarily alpha or beta particles, or gamma rays (photons).

Radioactivity: the spontaneous emission of nuclear radiation, generally alpha or beta particles, or gamma rays, from the nucleus of an unstable isotope.

Radionuclide: an unstable nuclide. See nuclide and radioactivity.

Rem: a unit of radiation dose equivalent and effective dose equivalent describing the effectiveness of a type of radiation to produce biological effects; coined from the phrase "roentgen equivalent man," and the product of the absorbed dose (rad), a quality factor (Q), a distribution factor, and other necessary modifying factors. One rem equals 0.01 sievert.

Risk assessment: the use of established methods to measure the risks posed by an activity or exposure by evaluating the relationship between exposure to radioactive substances and the subsequent occurrence of health effects and the likelihood for that exposure to occur.

Roentgen (R): a unit of measurement used to express radiation exposure in terms of the amount of ionization produced in a volume of air.

S **Sanitary waste:** most simply, waste generated by routine operations that is not regulated as hazardous or radioactive by state or federal agencies.

Saturated zone: a subsurface zone below which all rock pore-space is filled with water; also called the phreatic zone.

Sensitivity: the capability of methodology or instrumentation to discriminate between samples having differing concentrations or containing varying amounts of analyte.

Sievert (Sv): the SI unit of radiation dose equivalent and effective dose equivalent, that is the product of the absorbed dose (gray), quality factor (Q), distribution factor, and other necessary modifying factors; 1 Sv equals 100 rem.

Source term: the amount of a specific pollutant emitted or discharged to a particular medium, such as the air or water, from a particular source.

Specific conductance: the measure of the ability of a material to conduct electricity; also called conductivity.

Subcritical experiment: an experiment using high explosives and nuclear weapon materials (including special nuclear materials like plutonium) to gain data used to maintain the nuclear stockpile without conducting nuclear explosions banned by the Comprehensive Test Ban Treaty.

Surface impoundment: a facility or part of a facility that is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials, although it may be lined with man-made materials. The impoundment is designed to hold an accumulation of liquid wastes, or wastes containing free liquids, and is not an injection well. Examples of surface impoundments are holding, storage, settling and aeration pits, ponds, and lagoons.

Système International d'Unités (SI): an international system of physical units which include meter (length), kilogram (mass), kelvin (temperature), becquerel (radioactivity), gray (radioactive dose), and sievert (dose equivalent).

T **Thermoluminescent dosimeter (TLD):** a device used to measure external beta or gamma radiation levels, and which contains a material that, after exposure to beta or gamma radiation, emits light when processed and heated.

Total dissolved solids (TDS): the portion of solid material in a waste stream that is dissolved and passed through a filter.

Total organic carbon (TOC): the sum of the organic material present in a sample.

Total organic halides (TOX): the sum of the organic halides present in a sample.

Total suspended solids (TSS): the total mass of particulate matter per unit volume suspended in water and wastewater discharges that is large enough to be collected by a 0.45 micron filter.

Transpiration: a process by which water is transferred from the soil to the air by plants that take the water up through their roots and release it through their leaves and other aboveground tissue.

Tritium: a radioactive isotope of hydrogen, containing one proton and two neutrons in its nucleus, which decays at a half-life of 12.3 years by emitting a low-energy beta particle.

Transuranic waste (TRU): material contaminated with alpha-emitting transuranium nuclides which have an atomic number greater than 92 (e.g., ^{239}Pu), half-lives longer than 20 years, and are present in concentrations greater than 100 nCi/g of waste.

U **Uncertainty:** the parameter associated with a sample measurement that characterizes the range of the measurement that could reasonably be attributed to the sample. Used in this report, the uncertainty value is established at ± 2 standard deviations.

Unsaturated zone: that portion of the subsurface in which the pores are only partially filled with water and the direction of water flow is vertical; is also referred to as the vadose zone.

V **Vadose zone:** the partially saturated or unsaturated region above the water table that does not yield water to wells.

Volatile organic compound (VOC): liquid or solid organic compounds that have a high vapor pressure at normal pressures and temperatures and thus tend to spontaneously pass into the vapor state.

W **Waste accumulation area (WAA):** an officially designated area that meets current environmental standards and guidelines for temporary (less than 90 days) storage of hazardous waste before off-site disposal.

Wastewater treatment system: a collection of treatment processes and facilities designed and built to reduce the amount of suspended solids, bacteria, oxygen-demanding materials, and chemical constituents in wastewater.

Water table: the water-level surface below the ground at which the unsaturated zone ends and the saturated zone begins, and the level to which a well that is screened in the unconfined aquifer would fill with water.

Weighting factor: a tissue-specific value used to calculate dose equivalents which represents the fraction of the total health risk resulting from uniform, whole-body irradiation that could be contributed to that particular tissue. The weighting factors used in this report are recommended by the International Commission on Radiological Protection.

Wind rose: a diagram that shows the frequency and intensity of wind from different directions at a specific location.

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Appendix C: Acronyms and Abbreviations

AA	alluvial aquifer
ac	acres
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
^{241}Am	americium-241
ARL	Air Resources Laboratory
ASER	Annual Site Environmental Report
ARPA	Archeological Resources Protection Act
ASA	Auditable Safety Analysis
ASN	Air Surveillance Network
ASTM	American Standard for Testing and Materials
ATM	Atomic Testing Museum
BCG	Biota Concentration Guide
Be	beryllium
BEEF	Big Explosives Experimental Facility
BEIDMS	Bechtel Environmental Integrated Data Management System
bgs	below ground surface
BHPS	Bureau of Health Protection Services
BLM	Bureau of Land Management
BN	Bechtel Nevada
BOD	biological oxygen demand
BP	before present
BREN	Bare Reactor Experiment Nevada
Bq	Becquerel
Bq/m^3	Becquerels per cubic meter
°C	degree Celsius

ca.	*circa*, meaning "approximately"
CA	Composite Analysis
CAA	Clean Air Act
CAB	Community Advisory Board
CADD	Corrective Action Decision Document
CAI	corrective action investigation
CAIP	Corrective Action Investigation Plan
CAP	Corrective Action Plan
CAPP	Chemical Accident Prevention Program
CAP88-PC	Clean Air Package 1988 (EPA software program for estimating doses)
CAS	Corrective Action Site
CAU	Corrective Action Unit
CCHD	Clark County Health District
cc/min	cubic centimeters per minute
CCWRD	Clark County Water Reclamation District
CEDE	committed effective dose equivalent
CEM	Community Environmental Monitor
CEMP	Community Environmental Monitoring Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CG	cloud-to-ground
CGTO	Consolidated Group of Tribes and Organizations
Ci	curie
Ci/yr	curies per year
cm	centimeter(s)
CL	Compliance Level (used in text for the Clean Air Act National Emission Standards for Hazardous Pollutants Concentration Level for Environmental Compliance)
CLVF	Cheyenne Las Vegas Facility (BN)
CNLV	City of North Las Vegas

Co	cobalt
CO	carbon monoxide
CP	Control Point
cpm	counts per minute
CRM	Cultural Resources Management
Cs	cesium
CWA	Clean Water Act
CX	categorical exclusion
CY	calendar year
d	day
DAF	Device Assembly Facility
DAQEM	Department of Air Quality and Environmental Management (Clark County)
DAS	Disposal Authorization Statement
DCG	Derived Concentration Guide
D&D	Deactivation and Disposal
DNWR	Desert National Wildlife Refuge
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE/HQ	DOE Headquarters
DQA	Data Quality Assessment
DQO	Data Quality Objectives
DRI	Desert Research Institute
DTRA	Defense Threat Reduction Agency
EA	Environmental Assessment
EDE	effective dose equivalent
EHS	extremely hazardous substances
EIS	Environmental Impact Statement
ELU	Ecological Landform Unit
EM	environmental monitor

EMAC	Ecological Monitoring and Compliance Program
E-MAD	Engine Maintenance, Assembly, and Disassembly
EML	Environmental Measurements Laboratory
EMS	Environmental Management System
EO	Executive Order
EODU	Explosive Ordnance Disposal Unit
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Reporting and Community Right-to-Know Act
ER	Environmental Restoration
ERP	Environmental Restoration Project
ES	Environmental Services (BN)
ES&H	Environment, Safety, and Health
ESA	Endangered Species Act
ET	evapotranspiration
ETS	Environmental Technical Services (BN)
°F	degree Fahrenheit
FD	field duplicate
FFACO	Federal Facilities Agreement and Consent Order
FFCA	Federal Facilities Compliance Act
FIFRA	Federal Insecticide, Fungicide, Rodenticide Act
ft	foot or feet
ft^2	square feet
ft^3	cubic feet
ft^3/hr	cubic feet per hour
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
g	gram(s)
gal	gallon(s)
gal/d	gallons per day

GCD	Greater Confinement Disposal
GIS	Geographic Information System
gpm	gallons per minute
GPS	global positioning satellite
Gy	gray
Gy/d	gray per day
ha	hectare
^{3}H	tritium
HAP	hazardous air pollutant
HC	hard copy
HDP	heat dissipation probe
HENRE	High Energy Neutron Reactions Experiment
HEPA	high efficiency particulate air
hr	hour
HRMP	Hydrologic Resources Management Program
HTO	tritiated water
HW	hazardous waste
HWSU	hazardous waste storage unit
ICMP	Integrated Closure and Monitoring Plan
IL	investigation level
in.	inch(es)
INL	Idaho National Laboratory
ISMS	Integrated Safety Management System
IT	International Technology Corporation
JASPER	Joint Actinide Shock Physics Experimental Research
K	potassium
kg	kilogram(s)
kg/d	kilograms per day
km	kilometer(s)

km^2	square kilometer(s)
kmh	kilometer(s) per hour
L	liter
L/d	liters per day
LANL	Los Alamos National Laboratory
LAO	Los Alamos Operations (BN)
lb	pound
L_C	Critical Level (synonymous with Decision Level)
LCS	laboratory control samples
L/d	liters per day
LLMW	low-level mixed waste
LLNL	Lawrence Livermore National Laboratory
LLW	low level radioactive waste
L/min	liters per minute
LO	Livermore Operations (BN)
lpm	liters per minute
LQAP	Laboratory Quality Assurance Plan
$\mu Bq/m^3$	microbecquerels per cubic meter
$\mu Ci/mL$	microcurie per milliliter
m	meter(s)
m^3	cubic meter(s)
Ma	million years ago
MAPEP	Mixed Analyte Performance Evaluation Program
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
MDC	minimum detectable concentration
MEDA	meteorological data acquisition
MEI	maximally exposed individual
mGy/d	milligray per day

mg/L	milligrams per liter
mi	miles
mi^2	square miles
mm	millimeter(s)
M&O	Management and Operations
MQO	Measurement Quality Objectives
mR	milliroentgen
mR/d	milliroentgen per day
mrad	millirad
mrad/yr	millirads per year
mrem	millirem
mrem/yr	millirem per year
MSA	Management Self-Assessments
MSDS	Material Safety Data Sheet
mSv	millisievert
mSv/yr	millisievert per day
mton	metric ton
NAAQS	National Ambient Air Quality Standards
NAC	Nevada Administrative Code
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NCA	Nevada Combined Agency
NCRP	National Council on Radiation Protection
NDEP	Nevada Division of Environmental Protection
NDOA	Nevada Department of Agriculture
NDWS	Nevada Drinking Water Standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NLV	North Las Vegas

NLVF	North Las Vegas Facility (BN)
NNHP	Nevada Natural Heritage Program
NNSA/NSO	U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office
NNSA/NV	U.S. Department of Energy, National Nuclear Security Administration Nevada Operations Office
NOx	nitrous oxides
NPDES	National Pollution Discharge Elimination System
NPTEC	Non-Proliferation Test and Evaluation Complex
NRC	Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NRS	Nevada Revised Statues
NSDO	Nevada State Demographer Office
NSPS	New Source Performance Standards
NTS	Nevada Test Site
NTSER	Nevada Test Site Environmental Report
NTSWAC	Nevada Test Site Waste Acceptance Criteria
NTTR	Nevada Test and Training Range
NVLAP	National Voluntary Laboratory Accreditation Program
ODS	ozone-depleting substances
OI	operating instruction (DRI) or organization instruction (BN)
P2	pollution prevention
P2/WM	pollution prevention/waste minimization
PA	Performance Assessment
PAAA	Price-Anderson Amendments Act
Pb	lead
PCB	polychlorinated biphenyl
pCi	picocuries
pCi/L	picocuries per liter
pCi/mL	picocuries per milliliter
PHS	Public Health Service

PI	prediction interval
PIC	pressurized ion chamber
PM	particulate matter
POTW	Publicly Owned Treatment Works
ppb	parts per billion
ppm	parts per million
PST	Pacific Standard Time
PT	proficiency testing
PTE	potential to emit
Pu	plutonium
PWS	public water systems
QA	quality assurance
QAP	Quality Assurance Program
QAPP	Quality Assurance Program Plan
QC	quality control
R	roentgen
rad	radiation absorbed dose (a unit of measure)
rad/d	rads per day
Rad/NucCTEC	Radiological/Nuclear Countermeasures Test and Evaluation Complex
RCD	Radiological Control Department
RCRA	Resource Conservation and Recovery Act
rem	roentgen equivalent man (a unit of measure)
RER	Relative Error Ratio
RIDP	Radionuclide Inventory and Distribution Program
R-MAD	Reactor Maintenance, Assembly, and Disassembly
RPD	Relative Percent Difference
RREMP	Routine Radiological Environmental Monitoring Plan
RSL	Remote Sensing Laboratory
RWMC	Radioactive Waste Management Complex

RWMS	Radioactive Waste Management Site
SA	Supplement Analysis
SAFER	Streamlined Approach for Environmental Restoration
SARA	Superfund Amendments and Reauthorization Act
SCP	Salinity Control Plan
SD	standard deviation
SDWA	Safe Drinking Water Act
SE	standard error of the mean
SHPO	Nevada State Historic Preservation Office
SI	International System of Units
SNL	Sandia National Laboratories
SNJV	Stoller-Navarro Joint Venture
SOP	standard operating procedure
SORD	Special Operations and Research Division
SOW	statement of work
SO_2	sulfur dioxide
SSC	Structures, Systems, and Components
STL	Special Technologies Laboratory
STP	standard temperature and pressure
S.U.	standard unit (for measuring pH)
SUV	sport utility vehicle
Sv	sievert
SWL	static water level
SWNVF	Southwest Nevada Volcanic Field
SWO	Solid Waste Operations
TaDD	Tactical Demilitarization Development Project
TCP	thermocouple psychrometer
TCU	tuff confining unit
TDR	time domain reflectometry

TDS	total dissolved solids
TLD	thermoluminescent dosimeter
TON	threshold odor number
TPCB	Transuranic Pad Cover Building
TRI	Toxic Release Inventory
TRU	transuranic
TSCA	Toxic Substances Control Act
TSS	total suspended solids
TTR	Tonopah Test Range
UGTA	Underground Test Area
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	United States Code
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compounds
VZM	vadose zone monitoring
WEF	Waste Examination Facility
WGS	Waste Generation Services
WIPP	Waste Isolation Pilot Plant
WMO	World Meteorological Organization
WSI	Wackenhut Services, Inc.
WSS	Work Smart Standards
WW	water well
yd	yard
yd^3	cubic yards
YMP	Yucca Mountain Project
yr	year

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