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HEALTH AND SAFETY

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Abstract

This document provides information on the possible human exposure to environmental media potentially contaminated with radiological materials and chemical constituents from operations at Sandia National Laboratories/New Mexico (SNL/NM). This report is based on the best available information for Calendar Year (CY) 2008, and was prepared in support of future analyses, including those that may be performed as part of the SNL/NM Site-Wide Environmental Impact Statement.

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ACRONYMS AND ABBREVIATIONS

ABCWUA	Albuquerque Bernalillo County Water Utility Authority
ACRR	Annular Core Research Reactor
BMP	Best Management Practice
CAA	Clean Air Act
CAP88	Clean Air Act Assessment Package-1988
Ci/yr	curies per year
CFR	Code of Federal Regulations
CPMS	Criteria Pollutant Monitoring Station
CWL	Chemical Waste Landfill
CY	Calendar Year
DCG	Derived Concentration Guideline
DOE	Department of Energy
ECF	Explosive Components Facility
EDE	Effective Dose Equivalent
EPA	Environmental Protection Agency
ER	Environmental Restoration
ES&H	Environment, Safety, and Health
GWPP	Groundwater Protection Program
HCF	Hot Cell Facility
HERMES	High Energy Radiation Megavolt Electron Source
IH	Industrial Hygiene
KAFB	Kirtland Air Force Base
LECS	Liquid Effluent Control System
MCL	Maximum Contaminant Level
MDA	Minimum Detectable Activity
MDL	Microelectronics Development Laboratory
MEI	Maximally Exposed Individual
mg/l	milligrams per liter
mrem/yr	millirem per year
mSv/yr	millisievert per year
MTSLL	Metal Tritide Shelf-Life Laboratory
MWL	Mixed Waste Landfill
µCi/ml	microcuries per milliliter
µg/l	micrograms per liter
NESHAP	National Emission Standards for Hazardous Air Pollutants
NGF	Neutron Generator Facility
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
OSHA	Occupational Safety and Health Administration
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pCi/m3	picocuries per cubic meter
PM	particulate matter
RMWMF	Radioactive and Mixed Waste Management Facility

RPICL	Radiation Protection Instrument Calibration Laboratory
RPSD	Radiation Protection Sample Diagnostics
SITS	Safety Incident Tracking System
SNL/NM	Sandia National Laboratories/New Mexico
SSO	Sandia Site Office
START	Sandia Tomography and Radionuclide Transport Laboratory
SVOC	semi-volatile organic compound
TA	Technical Area
TCE	trichloroethene
TEDE	Total Effective Dose Equivalent
TLD	Thermoluminescent Dosimeter
U.S.	United States
VOC	volatile organic compound

1. INTRODUCTION

This document provides information on the possible human exposure to environmental media potentially contaminated with radiological materials and chemical constituents from operations at Sandia National Laboratories/New Mexico (SNL/NM). Sandia Corporation (Sandia) reporting is based on the previous calendar year. This report is based on the best available information for Calendar Year (CY) 2008, and was prepared in support of future analyses, including those that may be performed as part of the SNL/NM Site-Wide Environmental Impact Statement.

Sandia maintains key programs designed to detect the presence of radiological and non-radiological constituents that would serve as indications that releases from their operations could pose a human health risk. These programs include the following:

- Air Quality Programs – Air Quality Compliance, Clean Air Network (CAN) Program (surveillance and monitoring), and National Emission Standards for Hazardous Air Pollutants (NESHAP) Program (Radiological)
- Terrestrial Surveillance Program (soils, sediment, vegetation, Thermoluminescent Dosimeter [TLD])
- Water Programs – Wastewater, Surface Discharge, Storm Water, and Groundwater Protection Programs

Each of these programs produce plans, reports, and individual monitoring data. The *CY 2008 Annual Site Environmental Report, Sandia National Laboratories, New Mexico* (SNL/NM, 2009), serves as the primary reference for the information provided. Air analyses are supplemented by the NESHAP Annual Report (SNL/NM, 2009). The sections that follow provide a discussion of exposure pathways and monitoring results.

Pathways to Exposure

Radionuclide and chemical constituents may be transferred to environmental media by way of routine air emissions, transportation of radiological materials, or accidental releases. Human contact with affected media takes place through exposure pathways. Air is an example of a complete exposure pathway because of its potential to transport materials directly from a hazardous activity to locations where human receptors may be exposed through inhalation. Constituents can also enter the environment through the discharge of effluents, storm water run-off, and migration in groundwater. Secondary exposure pathways include ingestion of crops due to the deposition of airborne materials, ingestion of animal by-products (i.e., result of animals ingesting crops with subsequent introduction into the human food chain as humans ingest the animal by-product), and contact with soils, sediments, and water.

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2. EXPOSURE POTENTIAL FOR ON-SITE AND OFF-SITE RECEPTORS

This section discusses radiological and non-radiological exposure pathways and summarizes CY 2008 monitoring efforts for determining levels of contamination.

2.1 Radiological Pathways

2.1.1 Air

The release of radionuclides from a specific facility into the air can result in radiation exposure to people in the vicinity of the facility. Sandia calculates radiation dose annually based on facility monitoring data. Annual emissions data are used to estimate radioactive air emissions available to a hypothetical member of the public while on site at Kirtland Air Force Base (KAFB). This hypothetical individual is referred to as the maximally exposed individual (MEI).

Potential Dose

In general, the dose received by a person is dependent on the distance from the source, the available pathways in the environment (food chain, air, and water), radionuclide quantities and properties, and meteorological conditions. Historically, radioactive releases from SNL/NM have resulted in doses to the public that are several orders of magnitude below the Environmental Protection Agency's (EPA) standard of 10 millirem per year (mrem/yr). Department of Energy (DOE) Order 5400.5 limits the total annual effective dose equivalent (EDE) of all potential exposure pathways to the public (including air, water, and the food chain) to100 mrem/yr. The Order lists the Derived Concentration Guides (DCG) for radionuclides in water and air that could be continuously consumed or inhaled (365 days/year). This is a conservative approach that assumes that a member of the public resides at the location continuously. Table 2-1 lists the DCGs relevant to activities at SNL/NM (SNL/NM, 2008).

Table 2-1. Derived Concentration Guidelines for Selected Radionuclides[a]

Radionuclide	Ingested Water		Inhaled Air	
	DCG (µCi/ml)	f1 Value[b]	DCG (µCi/ml)	Solubility Class[c]
Tritium (water)	2×10^{-3}	--	1×10^{-7}	W
Cesium-137	3×10^{-6}	1	4×10^{-10}	D
Uranium, total (Utot)	6×10^{-6}	--	1×10^{-13}	Y

Source: SNL/NM 2009, Table 9-5.

[a]From Figure III-1, DOE Order 5400.5, Change 2, January 7, 1993 (DOE 1993); DCG for tritium in air is adjusted for skin absorption.

[b]F1 value is the gastrointestinal absorption factor; Listed DCGs for Uranium (TOTAL) are based on U (NATURAL) listing in DOE O 5400.5 (DOE 1993).

[c]The classes D, W, and Y have been established to describe the clearance of inhaled radionuclides from the lung. This classification refers to the approximate length of retention in the pulmonary region. Removal half-times assigned to the compounds with lung retention classes D, W, and Y are 0.5, 50, and 500 days, respectively (DOE 1993).

µCi/ml = Micro-curies per milliliter.

Emissions Sources as Input to NESHAP Dose Assessment

To assess compliance, all NESHAP facilities at SNL/NM must submit annual facility emission data to the NESHAP program administrator. The emissions from six "primary" sources (Annular Core Research Reactor [ACRR], Hot Cell Facility [HCF], Z Facility, Neutron Generator Facility [NGF], Radioactive and Mixed Waste Management Facility [RMWMF], and Mixed Waste Landfill [MWL]) are modeled using the EPA's Clean Air Act (CAA) Assessment Package-1988 (CAP88) (EPA 2006), to estimate the annual dose to each identified public receptor. Primary sources are those that determine their emissions by direct measurements or by calculations based on measured operational parameters.

The NESHAP regulation requires DOE to continuously monitor any radionuclide air emission source that has the potential to produce a dose of 0.1 mrem/yr to the MEI; however, there are no facilities at SNL/NM that exceed this criterion. As a best management practice (BMP), some SNL/NM facilities perform continuous stack monitoring. Other facilities base their emission estimates on periodic confirmatory measurements or engineering calculations.

Currently, there are 15 potential NESHAP facilities that may be defined as either point or diffuse emission sources at SNL/NM, including the six primary facilities identified above, and nine additional secondary sources (SNL/NM, 2009). Figure 2-1 provides the locations of these facilities.

Point sources are produced from an exhaust stack or vent, while diffuse sources emanate from broad areas of contamination, such as radionuclide-contaminated soils present at some environmental restoration sites.

Table 2-2 provides CY 2008 information on radionuclides and the total reported emissions from specific SNL/NM monitored facilities.

Off-Site and On-Site Receptors

A total of 35 receptor locations (24 on-site at KAFB, and 11 off-site) at or in the vicinity of SNL/NM have been identified as potential locations of maximum exposure to a member of the public. Figures 2-2 and 2-3 provide the locations of the off-site and on-site receptor locations used in the NESHAP Program. Off-site receptor locations extend to the Isleta Casino at the Isleta Pueblo Indian Reservation, the Four Hills subdivision north of KAFB, the Manzanita Mountains (with east mountain residents), and areas near the Albuquerque International Sunport west of KAFB. On-site receptors include U.S. Air Force facilities, offices, and housing areas, as well as other non-DOE and non-U.S. Department of Defense facilities on KAFB.

Table 2-3 provides the 2008 Annual Source Specific EDE to Off-Site Receptors. Table 2-4 provides the 2008 Annual Source Specific EDE to On-Site Receptors. Table 2-5 provides the EDE at the MEI locations for both the off-site and on-site receptors, and regional and KAFB collective populations. Dose is measured in mrem/yr and is calculated as EDE. The EDE is defined as the sum of the products of absorbed dose and appropriate factors to account for differences in biological effectiveness due to the quality of radiation and its distribution in the body. EDE combines both internal and external dose, and EDE limits have replaced the concept of maximum permissible dose for occupational exposures.

Table 2-2. Summary of Radionuclide Emissions for Monitored Facilities

Source Name and Location	Description	Source Type	Monitoring Method[a]	Radionuclide Emitted	Reported Release (Ci/yr)
ACRR - TA-V	Reactor used to perform in-pile experiments for severe reactor accident research project	Point	Periodic	^{41}Ar	3.90
HCF - TA-V	Facility provides full capability to handle and analyze radioactive materials	Point	Periodic	N/A[b]	N/A[b]
ECF - TA-II	Facility used for testing neutron generators	Point	Calculation	^{3}H	8.4E-04
HERMES III - TA-IV	Gamma simulator used primarily for simulating effects of prompt radiation from a nuclear burst on electronics and complete military systems	Point	Periodic	^{13}N ^{15}O	6.15E-04 6.15E-05
MTSLL - TA-I	Research and development using tritium	Point	N/A	N/A[c]	N/A[c]
MWL – TA-III	Environmental restoration site that acts as a diffuse source of tritium emissions into the atmosphere.	Diffuse	Periodic	^{3}H	9.0E-02
NGF - TA-I	Principal production facility for neutron generators – Tritium Envelope North Wing	Point	Continuous	^{3}H	3.99E+01
PRD Laboratory - TA-I	Research and development using tritium	Point	Calculation	N/A[b]	N/A[b]
Radiation Laboratory - TA-I	Laboratory that performs small-scale experiments	Point	Calculation	^{3}H ^{13}N ^{16}N ^{41}Ar	1.0E-05 2.0E-07 2.0E-07 1.0E-09
RMWMF - TA-III	Facility that handles radioactive and mixed waste products	Point	Continuous	^{3}H (oxide) ^{3}H (elemental) ^{241}Am ^{90}Sr ^{137}Cs	3.55E+01 4.84E+01 1.04E-05 4.18E-07 5.16E-08
RPICL - TA-I	Laboratory that performs radiation detection equipment calibration	Point	Calculation	^{3}H	4.1E-05
RPSD-TA-II	Small-scale laboratory analyses, as needed	Point	Calculation	N/A[d]	N/A[d]
START - TA-I	Small-scale laboratory operation	Point	Calculation	^{239}Pu	2.4E-07
IBL Tandem Accelerator - TA-I	Ion solid interaction and defect physics accelerator facilities	Point	Calculation	^{3}H	1.0E-05
Z Facility - TA-IV	Experimental facility for research on light-ion inertial confinement fusion. Technology involves storing large amounts of electrical energy over a period of minutes and then releasing this energy in an intense concentrated burst.	Point	Calculation	^{3}H	1.16E-03

Source: SNL/NM 2009a, Table 1.

[a]Monitoring Methods – Periodic = Based on periodic measurements; Calculation = Calculated from known parameters; Continuous= Based on continuous air monitoring results.

[b]The HCF and PRD did not operate in 2008, consequently there were no radionuclide emissions.

[c]There are no longer any tritium operations occurring at the MTSLL.

[d]An evaluation of the RPSD Laboratory determined that due to the sources being sealed, electroplated, or of very low activity used in the calibration of instruments there was little or no potential for measurable emissions.

ACRR = Annular Core Research Reactor.

Ci/yr = Curies per year.

ECF = Explosive Components Facility.

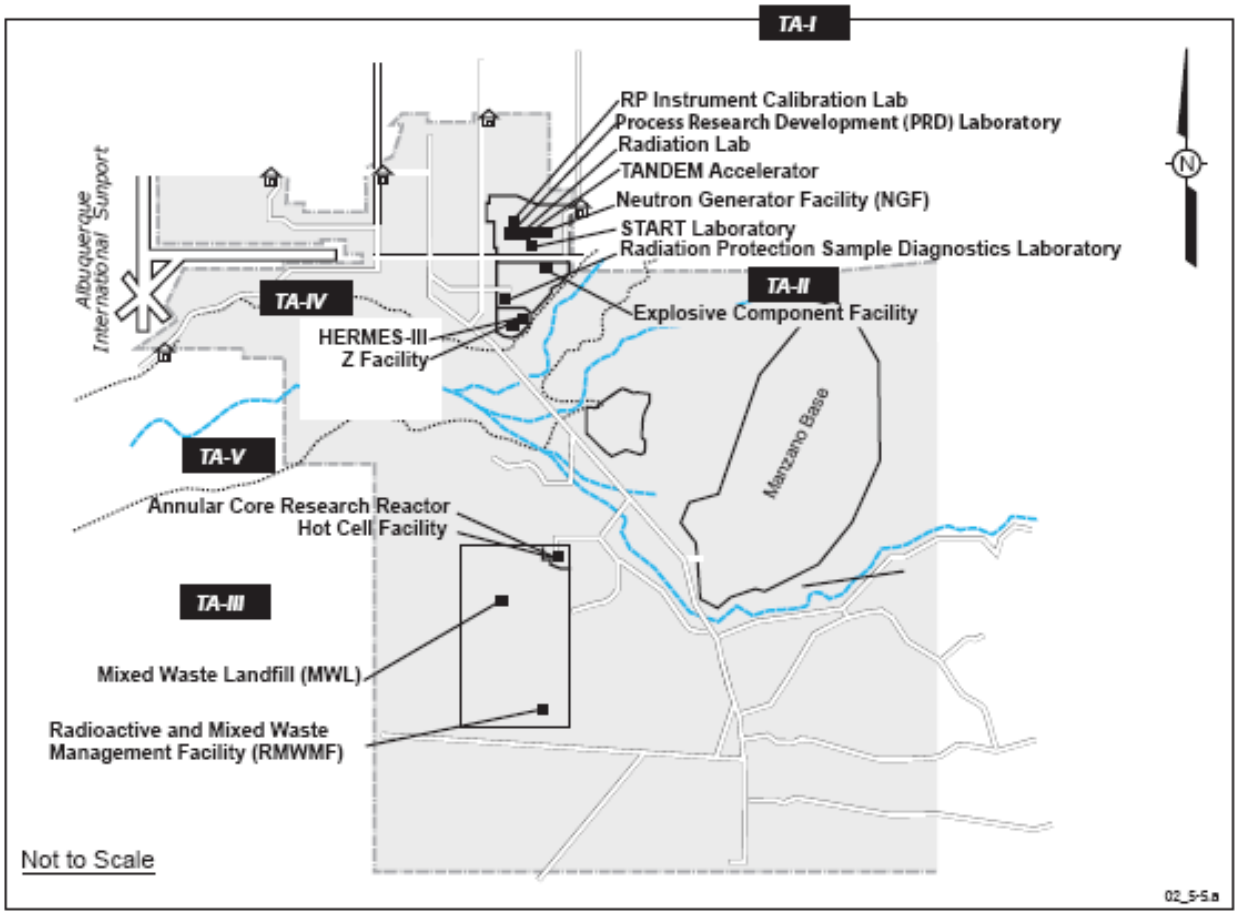
HCF = Hot Cell Facility.

HERMES III = High Energy Radiation Megavolt Electron Source-III.

MTSLL = Metal Tritide Shelf-Life Laboratory.

Table 2-2. Summary of Radionuclide Emissions for Monitored Facilities (Concluded)

MWL = *Mixed Waste Landfill.*
N/A = *Not available.*
NGF = *Neutron Generator Facility.*
PRD = *Process Research Development.*
RMWMF = *Radioactive and Mixed Waste Management Facility.*
RPICL = *Radiation Protection Instrument Calibration Laboratory.*
RPSD = *Radiation Protection Sample Diagnostics.*
START = *Sandia Tomography and Radionuclide Transport Laboratory.*
TA = *Technical Area.*



Source: SNL/NM 2009, Figure 5.5.

Figure 2-1. Locations of the 15 Facilities at SNL/NM that Provided Radionuclide Release Inventories for 2008

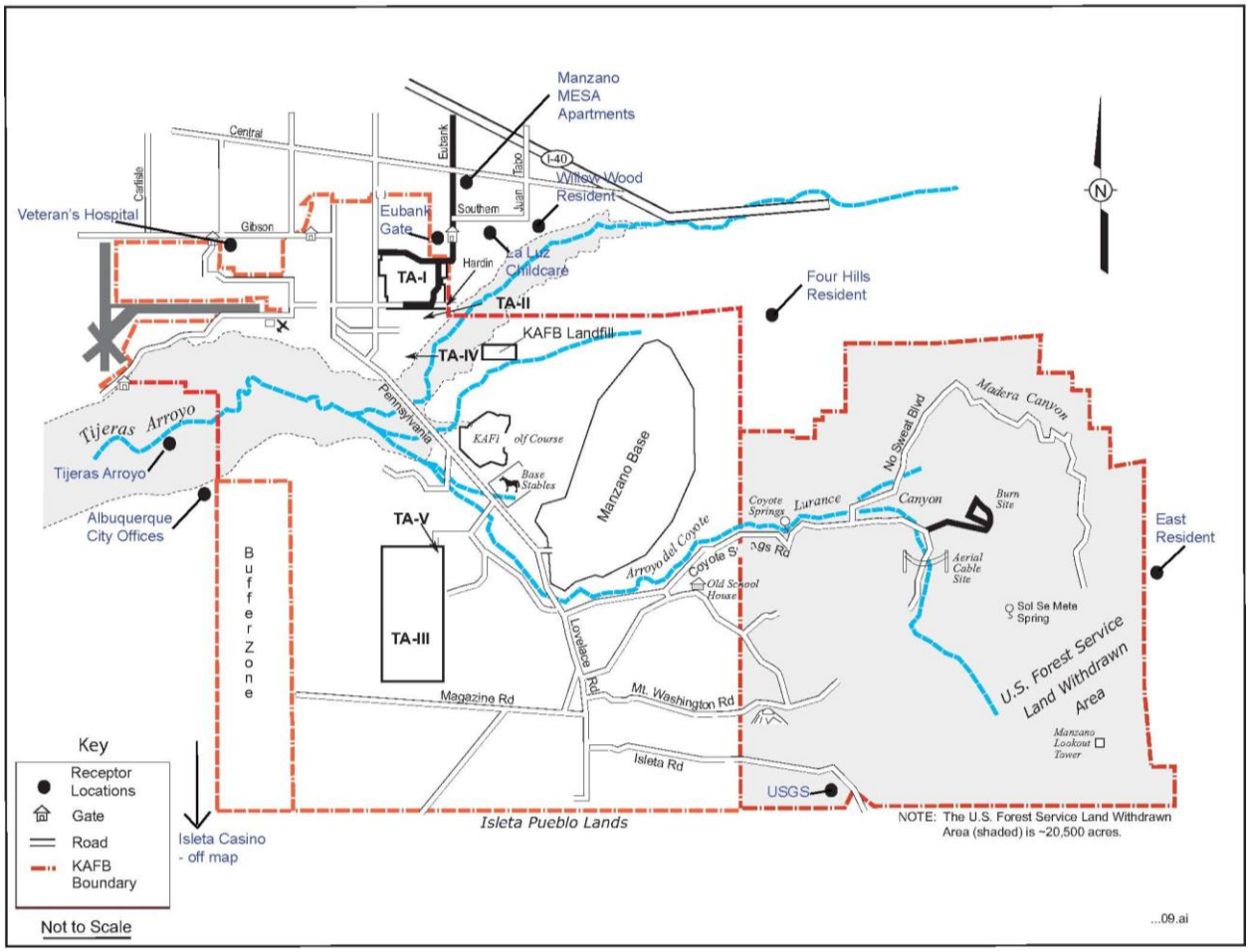
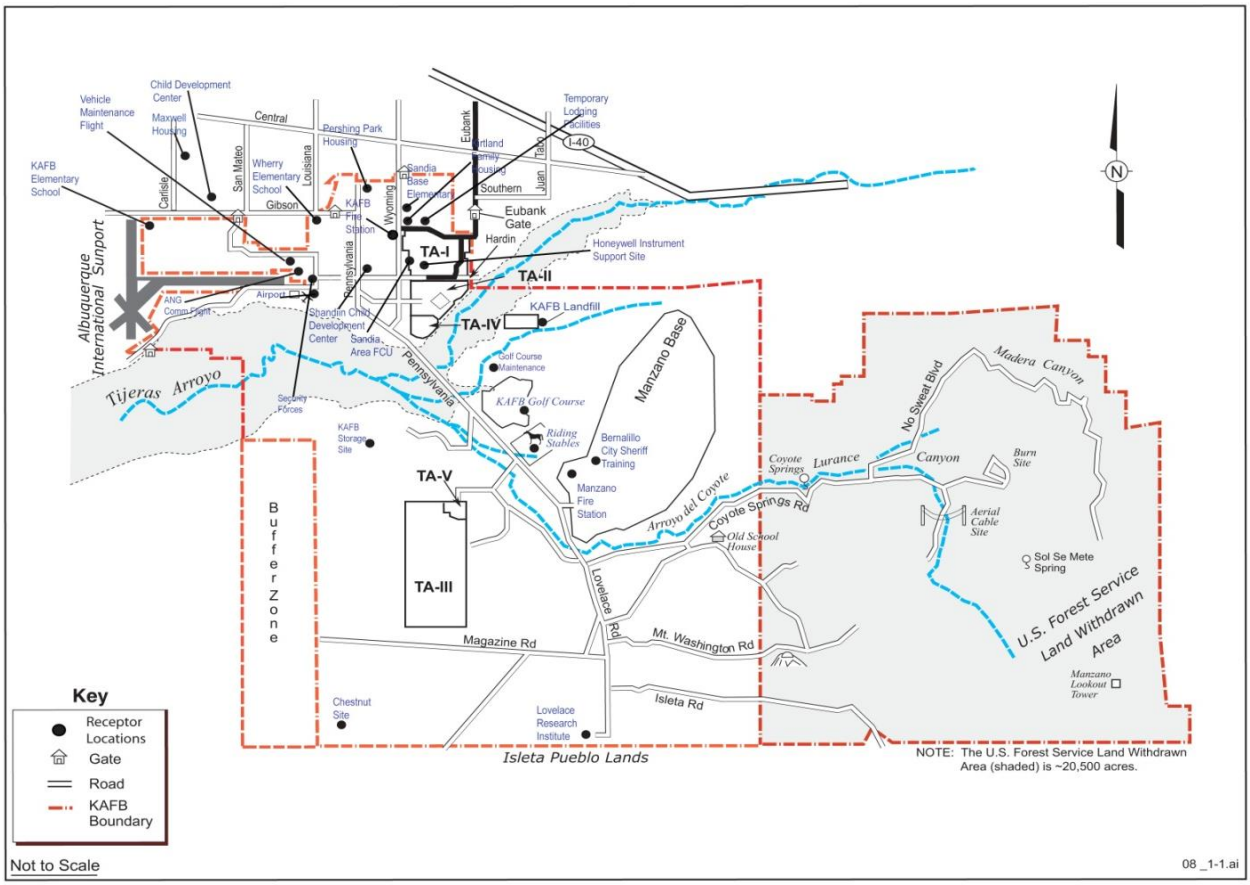


Figure 2-2. Location of Off-Site Receptors Used in the NESHAP Program



Source: SNL/NM 2009a, Figure 2.

Figure 2-3. Location of On-Site Receptors Used in the NESHAP Program

Table 2-3. Annual Source-Specific EDE from Primary Receptors to Off-Site Receptors – 2008

Receptor Location	ACRR Emissions (mrem/yr)	MWL Emissions (mrem/yr)	NGF Emissions (mrem/yr)	RMWMF Emissions (mrem/yr)	Z-Facility Emissions (mrem/yr)	Total from Primary Sources (mrem/yr)
Albuquerque City Offices	1.30E-05	7.40E-07	8.90E-04	4.20E-04	1.80E-08	1.32E-03
East Resident	9.90E-06	7.00E-07	8.80E-04	4.10E-04	1.80E-08	1.30E-03
Eubank Gate Area (Building 8895)	8.10E-05	9.40E-07	1.70E-03	5.00E-04	3.10E-08	2.28E-03
Four Hills Resident	7.70E-06	7.00E-07	8.80E-04	4.10E-04	1.80E-08	1.30E-03
Isleta Resident	1.20E-05	7.30E-07	8.90E-04	4.20E-04	1.90E-08	1.32E-03
La Luz Childcare	3.90E-05	7.80E-07	9.20E-04	4.60E-04	2.00E-08	1.42E-03
Manzano Mesa Apartments	1.60E-05	7.30E-07	9.00E-04	4.20E-04	1.90E-08	1.34E-03
Tijeras Arroyo (West)	1.30E-05	7.40E-07	8.90E-04	4.20E-04	1.80E-08	1.32E-03
U.S. Geological Survey	3.20E-05	7.60E-07	9.00E-04	4.80E-04	1.90E-08	1.41E-03
Veteran's Hospital	2.70E-05	8.00E-07	9.00E-04	4.50E-04	1.90E-08	1.38E-03
Willow Wood Resident	2.00E-05	7.40E-07	8.90E-04	4.30E-04	1.90E-08	1.34E-03
Totals	2.71E-04	8.36E-06	1.06E-02	4.82E-03	2.18E-07	1.57E-02

Source: SNL/NM 2009, Table 5-8.

mrem/yr = millirem per year

ACRR = Annular Core Research Reactor.

MWL = Mixed Waste Landfill.

NGF = Neutron Generator Facility.

RMWMF = Radioactive and Mixed Waste Management Facility.

Table 2-4. 2008 Annual Source Specific EDE from Primary Sources to On-Site Receptors

Facility	ACRR Emissions (mrem/yr)	MWL Emissions (mrem/yr)	NGF Emissions (mrem/yr)	RMWMF Emissions (mrem/yr)	Z-Facility Emissions (mrem/yr)	Total (mrem/yr)
Airport Building 761	1.50E-04	3.20E-07	4.40E-04	1.00E-04	1.40E-08	6.90E-04
Air Natl. Guard Comm. Flight	8.70E-05	2.60E-07	3.40E-04	8.60E-05	1.20E-08	5.13E-04
Bernalillo County Sheriff Training	1.40E-04	2.70E-07	8.90E-05	1.50E-04	2.60E-09	3.79E-04
Capeheart West	1.90E-05	6.40E-08	2.30E-05	3.40E-05	8.30E-10	7.61E-05
Chestnut Site	1.70E-04	6.20E-07	5.60E-05	1.30E-03	2.60E-09	1.53E-03
Child Development Center	1.90E-05	6.60E-05	2.00E-05	2.90E-05	7.10E-10	6.81E-05
Golf Course Club House	3.80E-04	5.70E-07	1.50E-04	1.70E-04	1.30E-08	7.01E-04
Golf Course Maintenance Area	2.40E-04	4.40E-07	2.10E-04	1.40E-04	1.40E-08	5.90E-04
Honeywell Systems Support Site	9.30E-05	2.20E-07	1.90E-03	8.30E-05	3.60E-08	2.08E-03
Lovelace Respiratory Research	6.70E-05	1.70E-07	3.60E-05	1.30E-04	1.50E-09	2.33E-04
KAFB Fire Station	8.80E-05	1.80E-07	6.80E-04	7.20E-05	1.70E-08	8.40E-04
Kirtland Landfill	4.60E-05	1.00E-07	4.90E-05	6.50E-05	2.10E-09	1.60E-04
Kirtland Elementary	1.80E-05	6.20E-08	1.90E-05	2.70E-05	6.60E-10	6.41E-05
Kirtland Storage Site	7.50E-04	1.20E-06	1.50E-04	2.00E-04	1.20E-08	1.10E-03
Manzano Offices (Fire Station)	1.70-04	2.80E-07	8.60E-05	1.60E-04	2.50E-09	4.16E-04
Maxwell Housing	2.00E-05	6.70E-08	2.00E-05	2.90E-05	7.20E-10	6.91E-05
Kirtland Family Housing	6.70E-05	1.60E-07	3.90E-04	6.50E-05	6.30E-09	5.22E-04
Pershing Park Housing	7.00E-05	1.50E-07	3.20E-04	6.20E-05	9.50E-09	4.52E-04
Riding Club	3.80E-04	5.30E-07	1.10E-04	2.10E-04	3.70E-09	7.01E-04
Sandia Area Credit Union	1.00E-04	2.10E-07	1.30E-03	7.90E-05	2.70E-08	1.48E-03
Sandia Elementary School	6.60E-05	1.60E-07	4.90E-04	6.50E-05	1.20E-08	6.21E-04
Sháńdíín Childcare	9.60E-05	2.10E-07	6.30E-04	7.90E-05	2.10E-08	8.05E-04
Vehicle Maintenance Flight	8.60E-05	2.60E-07	3.20E-04	8.60E-05	1.10E-08	4.92E-04
Wherry Elementary	3.90E-05	1.30E-07	4.50E-05	5.70E-05	1.60E-09	1.41E-04
Total	3.36E-03	6.70E-06	7.87E-03	3.48E-03	2.24E-07	1.47E-02

Source: SNL/NM 2009, Table 5-9.

mrem/yr = millirem per year

ACRR = Annular Core Research Reactor.

MWL = Mixed Waste Landfill.

NGF = Neutron Generator Facility.

RMWMF = Radioactive and Mixed Waste Management Facility.

Table 2-5. 2008 Calculated Dose Assessment Results for On-Site and Off-Site Receptors and for Collective Populations

Dose to Receptor	Location	2008 Calculated Dose	NESHAP Standard
Individual Dose			
On-Site Receptor EDE to the MEI	Honeywell Systems Support Site	2.25E-03 mrem/yr (2.25E-05 mSv/yr)	10 mrem/yr (0.1 mSv/yr)
Off-Site Receptor EDE to the MEI	Eubank Gate Area	2.29 E-03 mrem/yr (2.29E-05 mSv/yr)	10 mrem/yr (0.1 mSv/yr)
Collective Dose			
Collective Regional Population[a]	Residents within an 80-kilometer (50-mile) radius	1.92E-01 mrem/yr (1.92E-03 mSv/yr)	No standard available
Collective Kirtland Population[b]	KAFB Housing	1.81E-03 mrem/yr (1.81E-05 mSv/yr)	No standard available

Source: SNL/NM 2009, Table 5-10.

[a]Based on a population of 793,740 people estimated to be living within an 80-km (50-mi) radius.

[b]Based on a population of 4,021 people estimated to be living in permanent on-base housing.

mrem/yr = millirem per year

mSv/yr = milliSievert per year.

Demographic data are factored into exposure assessment and include the resident population, the number of beef and dairy cattle, and the utilized food crop area fraction for a 50-mile (mi) radius study area. The densities for resident population, cattle, and food crops are calculated as the quotient of the most recent county data and the county land area (e.g., cows per acre). In 2008, the NESHAP calculation for resident population was based on the State's 2000 to 2001 estimated urban and county population data and U.S. Census Bureau data. The beef and dairy cattle numbers and food crop area fraction were calculated using 1998 agricultural statistics. The statistics were supplied by the New Mexico Department of Agriculture (SNL/NM, 2009).

Monitoring for Radiological Particulates

Particulates are monitored at SNL/NM as a part of the Ambient Air Monitoring Program. This includes sampling for 23 metals and radiologically screening using gross alpha, gross beta, and gamma spectroscopy. In 2008, monthly composites varied from three to six filters per month, depending on the sampling schedule and sampler power problems. In an attempt to provide better analytical information, results are included in averages only when they are actually higher than the radiological decision levels or instrument detection limits. Table 2-6 lists the averaged results of the PM_{10} (particulate matter less than 10 micrometers) radionuclide analysis. Many of the averages for monitored radionuclides in 2008 were based on the results of one or two samples in the year identifying small concentrations of constituents. Discussion of non-radiological particulate monitoring is provided in Section 2.4.

2.1.2 Water

Environmental sampling programs for wastewater discharges, surface discharge, and storm water monitoring provide additional information used to evaluate potential public exposure to radiological constituents from SNL/NM operations. The primary function of the radiological component of SNL/NM's groundwater program is to conduct groundwater surveillance to detect possible contamination from current operations and possible undiscovered legacy contamination.

Table 2-6. 2008 Averaged Results of PM_{10} Radionuclide Analysis (Air)

Analyte	Units	A2PM[a]	CPMS[a]	CWPM[a]	A3PM[a]	TLV[b]
Gross Alpha	pCi/m^3	4.05E-03	3.12E-03	2.09E-03	2.84E-03	
Gross Beta	pCi/m^3	1.80E-02	1.74E-02	1.80E-02	1.78E-02	
Actinium-228	pCi/m^3	6.81E-03	4.77E-03	1.78E-03	3.31E-03	100
Beryllium-7	pCi/m^3	1.71E-01	1.39E-01	1.72E-01	1.69E-01	40,000
Bismuth-212	pCi/m^3	6.31E-03	5.57E-03	6.84E-03	3.34E-03	700
Bismuth-214	pCi/m^3	1.39E-03	2.02E-03	3.91E-03	ND	2,000
Cesium-137	pCi/m^3	ND	ND	9.74E-04	3.62E-04	400
Cobalt-60	pCi/m^3	6.56E-04	1.26E-03	1.35E-03	1.58E-03	80
Lead-212	pCi/m^3	1.44E-03	1.58E-03	ND	1.34E-03	80
Lead-214	pCi/m^3	3.29E-03	3.92E-03	3.30E-03	3.45E-03	2,000
Potassium-40	pCi/m^3	2.71E-02	1.46E-02	2.20E-02	2.54E-02	900
Radium-224	pCi/m^3	ND	1.92E-03	6.00E-02	ND	4
Radium-226	pCi/m^3	6.81E-03	4.77E-03	1.78E-03	3.31E-03	1
Radium-228	pCi/m^3	ND	ND	ND	1.01E-03	3
Thorium-234	pCi/m^3	1.23E-02	ND	1.39E-01	1.59E-02	400
Uranium-235	pCi/m^3	1.79E-03	ND	7.17E-03	1.17E-03	0.1
Uranium-238	pCi/m^3	1.22E-02	ND	1.39E-01	1.59E-02	0.1

Source: SNL/NM 2009, Table 5-5.

[a]A2PM, CPMS, CWPM, and A3PM are designations for PM_{10} monitoring stations, see Figure 2-6 of this document for map.

[b]TLVs are guidelines and not legal standards; TLV guidelines assist in the control of health hazards. The TLVs listed for radionuclides are derived from DOE Order 5400.5 derived concentration guide values defined for 100 mrem.

ND = Not detected.

pCi/m^3 = Picocuries per cubic meter.

TLV = Threshold limit value.

Wastewater

SNL/NM personnel maintain research and engineering reactors in Technical Area V (TA-V). These reactors and support facilities have the potential to produce radioactive process wastewater that includes liquids from floor drains, laboratory sinks, and other drains located in buildings that use, process, or store radioactive materials. To ensure that all wastewater from these facilities meets regulatory standards, liquid effluent is separated into two process streams defined as reactor and non-reactor wastewater. Non-reactor wastewater is water from restrooms and non-radioactive laboratory activities. Reactor process wastewater from areas that use, process, or store radioactive materials is channeled to holding tanks where it can be screened for radiological contaminants within the Liquid Effluent Control System (LECS).

Water samples are analyzed for tritium, gross alpha, gross beta, and gamma spectroscopy to ensure radiological levels meet regulatory standards before the water is released to the public sewer system. If radioactivity levels are detected above regulatory limits, the water will not be released to the sanitary sewer system and an alternative disposal path will be found. If the contamination is due to short-lived medical radioisotopes, another alternative is to allow the radionuclides to decay in place over a matter of days or weeks. Once the activity is at or below regulatory levels, the water can be safely discharged to the public sewer system (SNL/NM, 2009). All water discharged from the LECS in 2008 met federal regulatory standards and DOE Orders for radiological levels in wastewater. All analytical results from sampling conducted in 2008 are available in *Appendix A* to the Calendar Year 2008 Annual Site Environmental Report (SNL/NM, 2009).

Surface Discharges
Surface discharges are releases of water and water-based compounds made to roads, open areas, or impoundments. Surface discharges are only made with the approval of the Surface Discharge Program. Proposed discharges are evaluated for potential contaminants and concentration levels to determine if the discharge complies with water quality guidelines for surface releases. Discharges of uncontaminated water must also be approved, since large volumes of water discharged in areas of prior contamination (such as Environmental Restoration [ER] sites) could increase infiltration rates and move contaminants deeper into the soil column.

Storm Water
Storm water runoff flowing over the ground surface has the potential to pick up and transport contaminants. The Storm Water Program works in coordination with the Pollution Prevention Group, the Surface Discharge Program, Facilities Engineering, and the ER Project to implement measures and BMPs to prevent potential radiological contaminants from Solid Waste Management Units from being transported in storm water runoff. This is done by diverting runoff to catchment basins where water evaporates. If evaporation is inadequate, the water is sampled, approvals are obtained, and the water is discharged in accordance with the approvals and regulatory requirements. Additional discussion of storm water management program activities is provided in the CY 2008 Annual Site Environmental Report (SNL/NM, 2009).

Groundwater
The Groundwater Protection Program (GWPP) and the ER Project collect groundwater data. Both programs monitor wells throughout SNL/NM operational areas and ER sites. The wells include ER monitoring wells, GWPP surveillance wells, Albuquerque Bernalillo County Water Utility Authority (ABCWUA) production wells, KAFB production wells, U.S. Geological Survey monitoring wells, and KAFB Installation Restoration Program wells. In CY 2008, 70 wells and one spring were sampled at the SNL/NM site.

Radionuclides in Groundwater. In CY 2008, analyses for radioisotopes were conducted on all samples. Specific analyses included gamma spectroscopy, gross alpha/beta, radium-226 and -228, uranium-233/234, and uranium-235 and -238. Gamma spectroscopic analysis was limited to the following key radioisotopes: americium-241, cesium-137, cobalt-60, and potassium-40. Only potassium-40 was reported above the associated minimum detectable activity (MDA) as identified in samples from Coyote Springs, CTF-MW2, Greystone MW2, and SWTA3-MW3. No specific Maximum Contaminant Levels (MCL) or Maximum Allowable Concentrations are established for these isotopes; however, EPA drinking water standards limit the effective dose for drinking water to 4 mrem/yr. The calculated maximum activity level using this standard is 1.2 picocuries per liter (pCi/L) for americium-241, 120 pCi/L for cesium-137, 200 pCi/L for cobalt-60, and 280 pCi/L for potassium-40. None of the activity levels from the groundwater samples was found to exceed these values in 2008 within the uncertainty level reported.

Uncorrected gross alpha activities for samples from CTF-MW1, CTF-MW2, CTF-MW3, SFR-2S, and TRE-1 exceeded the MCL of 15 pCi/L. In this region, groundwater contacts bedrock, which contains minerals that are high in naturally occurring uranium. After applying a correction for uranium, the alpha results for CTF-MW3 dropped below the MCL. The nominal (without uncertainty range) corrected gross alpha for the other wells, CTF-MW1, CTF-MW2, SFR-2S, and TRE-1, were 24.1 pC/L, 88.5 pCi/L, 15.4 pCi/L, and 18.3 pCi/L, respectively.

Radium-226/228 was detected in levels exceeding the MCL of 5.00 pCi/L. Additional discussion of these and other results, including 2008 exceedances overall, is provided in Section 7 of the Calendar Year 2008 Annual Site Environmental Report (SNL/NM, 2009).

Environmental Restoration Project Groundwater Sampling
MWL Monitoring. Groundwater samples from the MWL monitoring wells were analyzed for gamma-emitting radionuclides, gross alpha/beta activity, and tritium and compared with the established EPA MCLs (no MCLs have been established for tritium). Gross alpha/beta activity levels were detected above laboratory reporting limits in all environmental samples. However, when the gross alpha data are corrected for the uranium activity contribution, none of the samples analyzed exceeded the MCL of 15 pCi/L. Neither tritium, nor gamma-emitting isotopes were detected above the MDA in any of the groundwater samples.

TA-V Monitoring. Quarterly groundwater sampling takes place in TA-V where SNL/NM's nuclear facilities are located. Gamma spectroscopy, gross alpha/beta, and tritium analyses were conducted on all wells during the August/September 2008 sampling event. All radionuclide activities were below MCLs, where established. Tritium, analyzed by EPA Method 906.0M, was not detected above the MDA in any of the samples.

Tijeras Area Groundwater Monitoring (i.e., groundwater beneath TA-I, TA-II, and Tijeras Arroyo). Gamma spectroscopy, gross alpha/beta, and tritium analyses were conducted on 21 wells during the July/August 2008 sampling event. All radionuclide activities were below MCLs, where established. Tritium, analyzed by EPA Method 906.0M, was not detected above the MDA in any of the samples (SNL/NM, 2009).

Burn Site. Groundwater samples were analyzed for gross alpha/beta, tritium, and gamma spectroscopy. All radionuclide activities were below MCLs, except for some gross alpha. However, gross alpha results are consistent with historical results in Burn Site monitoring wells and are reported as uncorrected gross alpha activities (not corrected by subtracting naturally occurring uranium or radium activities). Gamma spectroscopy analysis did not detect any isotopes above associated MDAs. Tritium also was not detected above the MDA in any of the samples.

2.1.3 Terrestrial Surveillance

Terrestrial surveillance is conducted at SNL/NM to detect possible deposition or migration of contaminants to off-site locations and to determine the impact, if any, of SNL/NM's operations on human health or the environment. Sandia conducts sampling of surface soils, arroyo and river sediments, and vegetation from various on-site, perimeter, and off-site locations.

The Terrestrial Surveillance Program then conducts statistical analyses to compare the results from on-site and perimeter samples to off-site results, and to establish trends in order to identify possible pollutants and their potential impact on human health or the environment. If anomalies are observed, various documents are used as guidance with risk assessment, including DOE Order 5400.5, Radiation Protection of the Public and the Environment (DOE 1993).

The results of the statistical analyses also allow Sandia to prioritize sample locations for possible follow-up action. Table 2-7 provides this decision matrix. Figure 2-4 identifies the Terrestrial Surveillance Program onsite and perimeter sampling locations, and Figure 2-5 provides the off-site sampling locations.

Table 2-7. Decision Matrix for Determining Priority Action Levels

Priority	Are results higher than off-site?[a]	Is there an increasing trend?	Priority for further investigation
1	Yes	Yes	Immediate attention needed. Specific investigation planned and/or notifications made to responsible parties.
2	Yes	No	Some concern based on the level of contaminant present. Further investigation and/or notifications as necessary.
3	No	Yes	A minor concern since contaminants present are not higher than off-site averages. Further investigation and/or notifications as necessary.
4	No	No	No concern. No investigation required.

Source: SNL/NM 2009, Table 4-1.

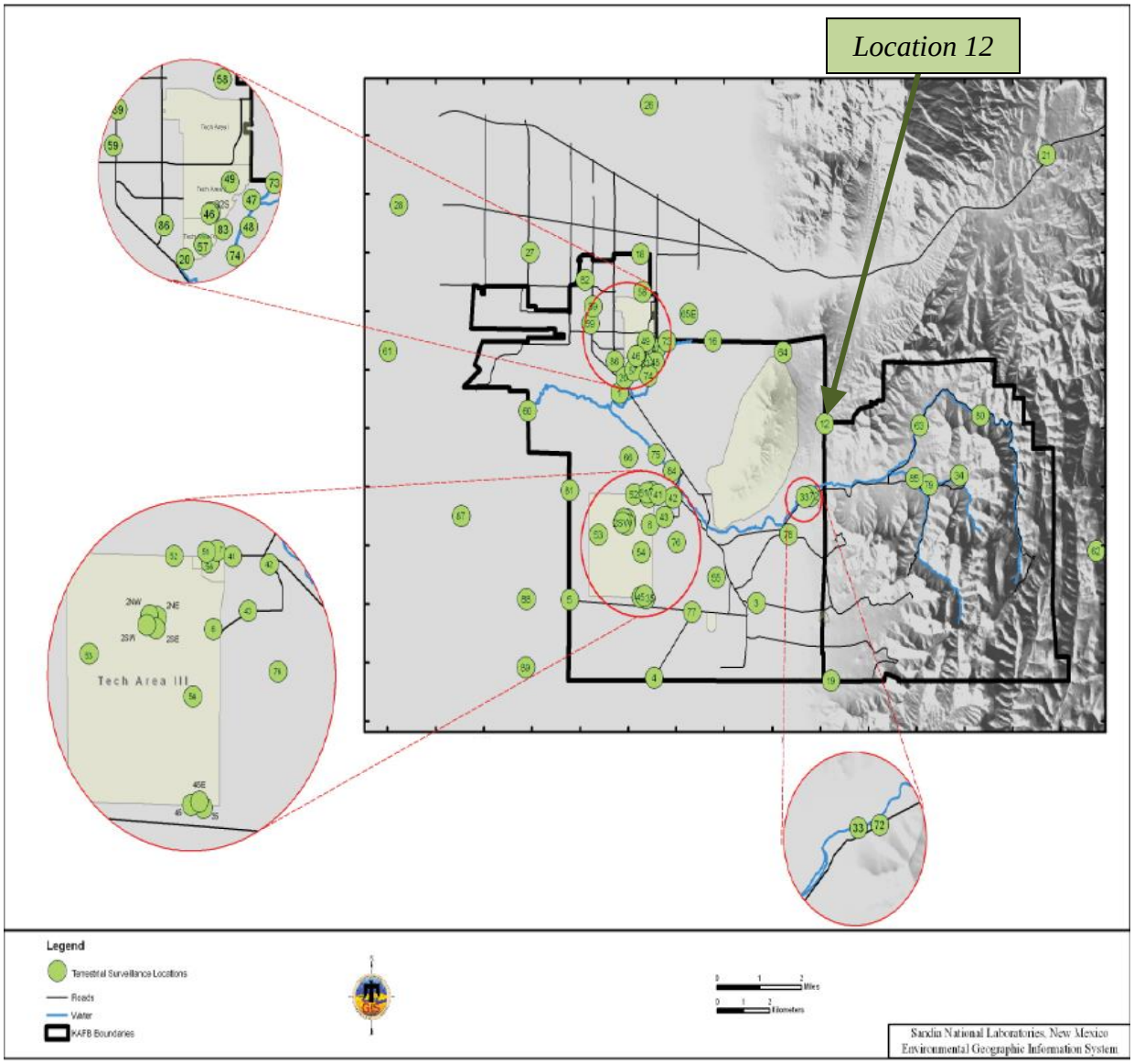
Based on Statistical Analysis Prioritization Methodology (Shyr, Herrera, and Haaker 1998).

[a]*Some sites may appear higher than off-site; however, there may not be a statistically significant difference.*

Radiological analyses are performed on all soil, sediment, and vegetation samples and are summarized in this section. The 2008 radiological parameters and analytical results are found in Appendix D of the CY 2008 Annual Site Environmental Report (SNL/NM, 2009).

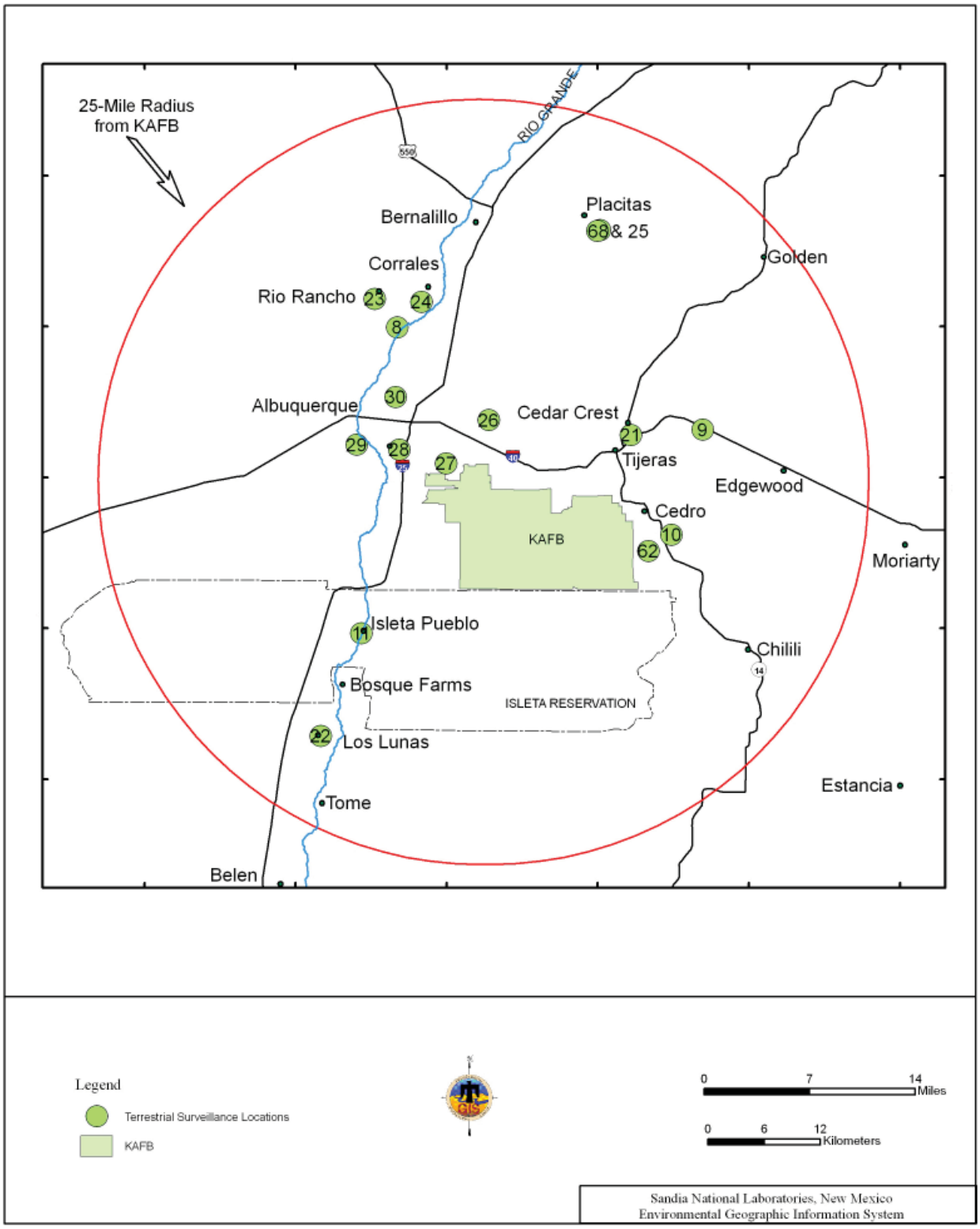
The results of the statistical analysis for CY 2008 showed no on-site or perimeter soil or sediment locations that were Priority-1 (both higher than off-site and with an increasing trend). One location was identified as Priority-2 (higher than off-site) for cesium-137. The Priority-2 location (Location 12) is discussed in the following paragraph on cesium-137, and the parameters are listed in Table 4-5 of the CY 2008 Annual Site Environmental Report (SNL/NM, 2009). There were no Priority-3 locations identified.

Cesium-137. The only perimeter location identified as Priority-2 for cesium-137 in surface soils was Location 12, which is located on the U.S. Forest Service land withdrawn area. This location is at a slightly higher elevation, which receives greater precipitation and results in slightly higher cesium-137 levels from fallout. Cesium-137 is prevalent in surface soils worldwide as a result of historical nuclear weapons testing. Over the past nine years, the values for cesium-137 at these perimeter locations ranged from 0.49 to 1.82 picocuries per gram (pCi/g). All sediment sample locations were identified as Priority-4 for cesium-137, which is consistent with off-site results -- no increasing trends; therefore, no additional investigation required (SNL/NM, 2009).



Source: SNL/NM 2009, Figure 4-1.

Figure 2-4. Terrestrial Surveillance Program On-Site and Perimeter Sampling Locations



Source: SNL/NM 2009, Figure 4-2.

Figure 2-5. Terrestrial Surveillance Program Off-Site Sampling Locations

Tritium. Tritium is not a significant radionuclide indicator for operations at SNL/NM, and the low soil moisture in the area will always make low-activity assay difficult. There were no unusual tritium concentrations noted for any of the soil or sediment samples collected in 2008.

Total Uranium. No sediment locations were identified as Priority-1, Priority-2, or Priority-3 for Total Uranium.

Thermoluminescent dosimeter. Gamma radiation levels are measured using TLDs to determine the impact, if any, of SNL/NM's operations on ambient radiation levels. TLD exposure by quarter and the exposure rate for each location class (on-site, perimeter, or community) for 2008 is shown in Appendix D of the CY 2008 Annual Site Environmental Report along with the exposure rate summary statistics for each location class (SNL/NM, 2009). In 2008, all TLDs were collected every quarter. If a TLD is not collected for a quarter, it is deleted from the statistical analysis. Data for 2000 through 2008 were analyzed to determine if any statistical differences were observed for either location class (on-site, perimeter, or community) or year (see Table 2-8). If a TLD was missing a quarter's sample in any year of interest, it was deleted from the analysis. Operational locations were also excluded from the statistical analysis. There was no statistical difference identified between on-site, perimeter, and off-site (community) locations.

Table 2-8. Summary Statistics for TLD Exposure Rates, 2000-2008

Location Class	No. Obs.	Units	Mean	Median	Std. dev.	Minimum	Maximum
On-Site	121	mR/hr	95.6	93.6	9.3	80.9	119.7
Perimeter	69	mR/hr	96.4	95	11.3	78.5	132.2
Community	103	mR/hr	94.9	91.6	14.1	73.2	147.6

Source: SNL/NM 2009, Table 4-6.

mR/hr = Milliroentgen per hour (10^{-3} milliroentgen per hour).

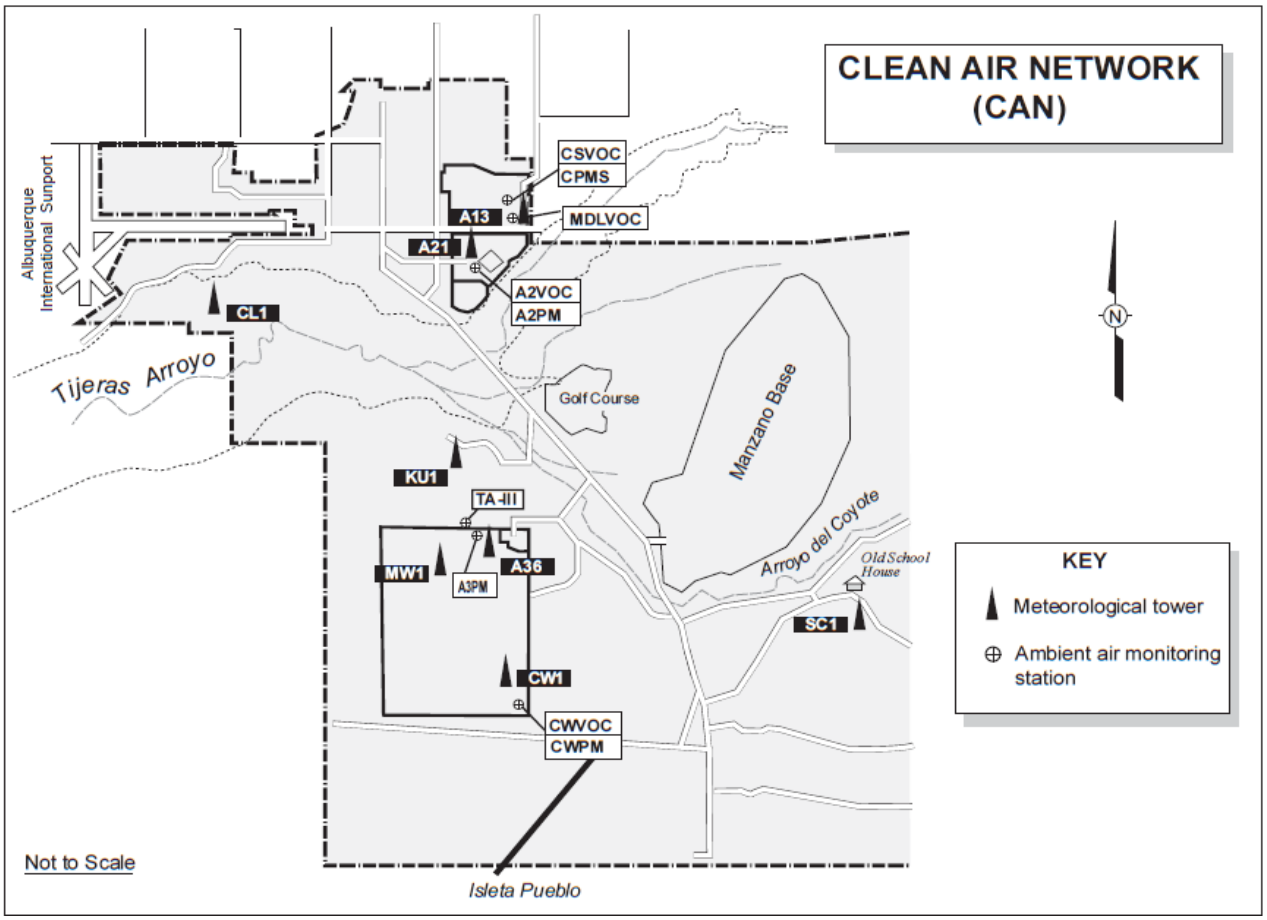
Std Dev = Standard deviation.

2.2 Non-radiological Pathways

2.2.1 Air

Non-radiological chemical air pollutants may be released from SNL/NM facilities that house laboratories or chemical operations. SNL/NM personnel conduct ambient air surveillance to show compliance with the National Ambient Air Quality Standards (40 Code of Federal Regulations [CFR] 50), and New Mexico Ambient Air Quality Standards (20.2.3 New Mexico Administrative Code).

Ambient air surveillance is also important to establish background concentration levels for pollutants of concern. Ambient air surveillance is performed at six locations (illustrated in Figure 2-6).



Source: SNL/NM 2009, Figure 5-1.

Figure 2-6. The Clean Air Network (CAN) of Meteorological Towers and Ambient Air Monitoring Stations

Air Monitoring Stations and CY 2008 Results

There is one Criteria Pollutant Monitoring Station (CPMS) at SNL/NM, located in the northeast corner of TA-I. The CPMS is used to perform continuous monitoring for sulfur dioxide, carbon monoxide, nitrogen oxides, and ozone. Data are compiled into hourly averages. There were no exceedances of the criteria pollutant standards in 2008. The results of 2008 criteria pollutant monitoring in comparison to Regulatory Standards is available in Table 5-2 of the CY 2008 Annual Site Environmental Report (SNL/NM, 2009).

A Particulate Matter (PM) monitor is also part of the CPMS. Lead (Pb), a criteria pollutant, is one of 23 metals analyzed from PM samples at this station.

PM_{10} Stations. PM with a diameter equal to or less than 10 microns are measured at four monitoring locations (CPMS, A2PM, A3PM, and CWPM). Data recovery for PM_{10} was 98 percent in 2008. Concentrations of selenium seen at the CPMS station were statistically different and slightly higher than other sites. This metal is commonly used in industrial applications and

could be expected to be higher due to the type of operations that take place in the area of the CPMS including operations associated with the Microsystems Fabrication Facility (MicroFab), Advanced Manufacturing Processes Laboratory, and Microelectronics Development Laboratory (MDL) (SNL/NM, 2009). The monthly and annual monitored averages for PM_{10} are provided in Table 5-3 of the CY 2008 Annual Site Environmental Report (SNL/NM, 2009).

$PM_{2.5}$ Stations. PM with a diameter equal to or less than 2.5 microns ($PM_{2.5}$) are known as "fine particulates" and are measured at two locations (CPMS and TA-III). $PM_{2.5}$ is measured continuously and recorded in hourly concentrations 24 hours per day, 365 days per year. Data recovery for $PM_{2.5}$ in 2008 was 99 percent. In 2008, the highest concentrations were found in the beginning of the summer and were most likely the result of wildland fire smoke transported from areas outside of SNL/NM. Concentrations in the SNL/NM area dropped quickly with the onset of rains in late June to early July. The monthly and annual monitored averages for $PM_{2.5}$ are provided in Table 5-4 of the CY 2008 Annual Site Environmental Report (SNL/NM, 2009).

Volatile Organic Compound (VOC) Stations. There are four VOC monitoring stations at SNL/NM. VOC samples are collected once per month over a 24-hour period. The VOCs generally observed at SNL/NM are products or by-products of fossil fuels or from laboratory operations. In 2008, the data recovery for VOC monitoring was 98 percent. Monthly VOC samples were analyzed for 23 VOC species plus total non-methane hydrocarbon. Although there was no one site with higher concentrations than the others for all analytes, the greatest number of contaminants were found at the CPMS VOC site.

A variance analysis was performed between monitoring stations to determine statistical differences between locations for the VOCs; three statistically valid differences were identified. The concentrations of n-butane, n-pentane, and acetone measured at the CPMS were higher than at least one other sampling site. These chemicals are commonly used in industrial applications and could be expected to be higher due to the type of operations that take place in the area of the CPMS monitoring station. The concentrations of these chemicals at the CPMS were only slightly higher than the concentrations at the other three sampling sites – though still very low overall. The average concentrations of VOCs for 2008 are provided in Table 5-6 of the CY 2008 Annual Site Environmental Report (SNL/NM, 2009).

2.2.2 Water

SNL/NM's water programs are focused on identifying contamination from ongoing operations and potential legacy contamination. This section provides a summary of non-radiological information on 2008 monitoring efforts.

Wastewater. SNL/NM has six outfall monitoring stations permitted by the ABCWUA. Non-radiological wastewater parameters include metals and general chemistry. A complete listing of monitored parameters is available in Section 6.1.3 of the CY 2008 Annual Site Environmental Report (SNL/NM, 2009). There were no reportable events (i.e., ABCWUA permit violations) in 2008 (SNL/NM, 2009).

Septic Systems. Sandia maintains four active septic tank systems in remote areas on KAFB, which are used only for domestic sanitary sewage collection. Since these tanks receive only

domestic sewage and no industrial discharges, they do not require sampling prior to pumping and discharge to the public sewer. However, as a BMP, SNL/NM personnel periodically obtain samples from the active septic tank systems prior to pumping and discharging (SNL/NM, 2009).

Surface Discharges. Surface discharge requests are generally made when access to a sanitary sewer line is not available, such as in remote locations on KAFB where no sewer lines exist. Typical surface discharge requests include discharges made by the GWPP to dispose of well purge water from groundwater monitoring wells. Wells are purged before a representative groundwater sample can be taken. Other surface discharges are requested as a result of fire training activities, the need to flush eyewash stations, and the cleaning of building exteriors. In 2008, 23 individual surface discharge requests were made; all met state standards and were approved.

The Surface Discharge Program must also be contacted in the event of an accidental release. In 2008, SNL/NM personnel investigated two environmental releases that met New Mexico Environment Department (NMED) reporting requirements. Additional discussion of these releases is available in Section 6.2.2 of the CY 2008 Annual Site Environmental Report (SNL/NM, 2009).

Pulsed Power Evaporation Lagoons. SNL/NM personnel maintain two evaporation lagoons in TA-IV which are permitted by NMED. The TA-IV lagoons are used to contain and evaporate accumulated storm water pumped from the secondary containment areas around seven oil tanks that support the pulsed power accelerators. All permit conditions for the TA-IV permitted lagoons were met in 2008.

Storm Water. Storm water runoff has the potential to pick up and transport contaminants. The Storm Water Program works in coordination with the Pollution Prevention Group, the Surface Discharge Program, Facilities Engineering, and the ER Project to implement measures and BMPs to prevent or reduce potential contaminants from being transported in storm water runoff. SNL/NM personnel control any potential contaminants that may be picked up by storm water runoff by routing all industrial wastewater to the sanitary sewer and storing most chemicals indoors. Storm water runoff is limited in areas where wastes, chemicals, and oils are stored or handled.

Secondary containment for outdoor oil storage tanks and chemical containers also prevents potential pollutants from being transported in storm water. Some facilities, including the Hazardous Waste Management Facility and the RMWMF, are designed to divert all runoff from the facility to lined catchment basins. Water that accumulates in these basins evaporates. If evaporation is not adequate due to meteorological conditions, the accumulated water is evaluated and pumped to either the storm drain system or to the sanitary sewer for disposal. Appropriate approvals must be granted by the state for discharges to the storm drain system or by the ABCWUA for discharges to the sanitary sewer. Required approvals from outside agencies are obtained through the DOE / National Nuclear Security Administration / Sandia Site Office (SSO).

Groundwater. Non-radiological monitoring for the SNL/NM groundwater program includes VOCs, dissolved metals (except for mercury), major ions (including nitrate), alkalinity/total phenols, total halogenated organics, and High Explosives (at selected wells). Exceedances of regulatory criteria for 2008 SNL/NM sampling activities are listed in Table 2-9 and are summarized in this section.

Arsenic concentrations from multiple water samples from CTF-MW2 were in a range from 0.0483 to 0.0507 mg/L. All values exceeded the MCL of 0.010 mg/L for arsenic.

Beryllium was detected above the MCL of 0.004 mg/L in Coyote Springs at a concentration of 0.00721 mg/L. Elevated beryllium has been consistently detected in the water from Coyote Springs and is deemed to be of natural origin as a consequence of groundwater in contact with the bedrock in this highly faulted location. Additional discussion of these and other results, including 2008 exceedances, is provided in Section 7 in the CY 2008 Annual Site Environmental Report (SNL/NM, 2009).

Other analytes provided as 2008 exceedances – chromium, nitrates (as nitrogen), nitrate plus nitrite (as nitrogen), and trichloroethene - were sampled at Environmental Restoration Project sites, and are discussed briefly in the following section.

Environmental Restoration Project Sampling Locations

Chemical Waste Landfill. No VOCs, semi-volatile organic compounds (SVOC), chlorinated herbicides, or polychlorinated biphenyls were detected above established MCLs during the period from October 2007 through December 2008. Total cyanide was not detected above the laboratory MDL in any groundwater sample. Sulfides were detected in four samples at concentrations ranging from 0.810 mg/L to 1.87 mg/L. No metals parameters were detected above established MCLs, except for chromium. Chromium was detected above the MCL of 0.10 mg/L from a monitoring well in November 2007.

MWL Monitoring. Analysis of groundwater samples from the MWL monitoring wells detected acetone and toluene. Toluene was detected well below the MCL, and no MCL exists for acetone. Neither compound is a contaminant of concern at the MWL, though historically, toluene has been detected in MWL groundwater samples. No metal concentrations were detected in excess of established MCLs in any of the wells sampled. There was also no perchlorate detected in the environmental samples from new wells where perchlorate sampling is conducted.

TA-V Monitoring. Trichloroethene (TCE) concentrations in excess of the MCL of 5 µg/L were detected in samples from TA-V monitoring wells. No other VOCs were detected above MCLs in any other TA-V monitoring wells. Among the anion analytes, Nitrate Plus Nitrite (reported as nitrogen) concentrations exceeded the MCL of 10 mg/L at one monitoring well during all sampling events. No metal concentrations were detected in excess of established MCLs in any of the wells sampled. Additional discussion of these results is provided in Section 7 of the CY 2008 Sandia Annual Site Environmental Report (SNL/NM, 2009).

Table 2-9. Summary of Non-radiological Exceedances at Sampling Wells – October 2007 through December 2008

Analyte	Well	Exceedance	Date
ARSENIC MCL = 0.010 mg/L	CTF-MW2	0.0507 mg/L	March 2008
	CTF-MW2 (unpreserved)	0.0495 mg/L	March 2008
	CTF-MW2 (dup)	0.0483 mg/L	March 2008
	CTF-MW2 (dup unpreserved)	0.0488 mg/L	March 2008
BERYLLIUM MCL = 0.004 mg/L	Coyote Springs	0.00721 mg/L	March 2008
CHROMIUM MCL = 0.10 mg/L	CWL-MW2BU	0.218 mg/L	November 2007
NITRATE (AS NITROGEN) MCL = 10.0 mg/L	TA2-SW1-320	21.6 mg/L	January 2008
	TJA-4	25.0 mg/L	January 2008
	TJA-7	22.0 mg/L	January 2008
NITRATE PLUS NITRITE (AS NITROGEN) MCL = 10.0 mg/L	TA2-SW1-320	22.2 mg/L	October 2007
	TA2-SW1-320 (dup)	22.2 mg/L	October 2007
	TA2-SW1-320	21.9 mg/L	April 2008
	TA2-SW1-320	23.4 mg/L	August 2008
	TA2-SW1-320	24.0 mg/L	November 2008
	TA2-W-19	10.4 mg/L	November 2008
	TJA-2	10.3 mg/L	April 2008
	TJA-2	10.9 mg/L	November 2008
	TJA-2 (dup)	10.6 mg/L	November 2008
	TJA-4	27.5 mg/L	October 2007
	TJA-4	27.8 mg/L	April 2008
	TJA-4	27.4 mg/L	August 2008
	TJA-4	29.8 mg/L	November 2008
	TJA-4 (dup)	29.6 mg/L	November 2008
	TJA-7	24.3 mg/L	October 2007
	TJA-7	24.4 mg/L	May 2008
	TJA-7	23.7 mg/L	August 2008
	TJA-7	25.6 mg/L	November 2008
	LWDS-MW1	12.6 mg/L	December 2007
	LWDS-MW1	11.9 mg/L	February 2008
	LWDS-MW1	11.6 mg/L	May 2008
	LWDS-MW1	11.5 mg/L	September 2008
	LWDS-MW1	11.7 mg/L	December 2008
	LWDS-MW1 (dup)	11.6 mg/L	December 2008
	TAV-MW10	10.3 mg/L	September 2008
	TAV-MW10	10.1 mg/L	December 2008
	TAV-MW10 (dup)	10.1 mg/L	December 2008
	CYN-MW1D	21.3 mg/L	March 2008
	CYN-MW1D (reanalysis)	15.5 mg/L	March 2008
	CYN-MW1D (dup)	15.1 mg/L	March 2008
	CYN-MW1D (dup reanalysis)	15.6 mg/L	March 2008
	CYN-MW1D	10.9 mg/L	September 2008
	CYN-MW1D (dup)	11.3 mg/L	September 2008
	CYN-MW3	10.9 mg/L	March 2008
	CYN-MW3	13.8 mg/L	September 2008
	CYN-MW3 (dup)	12.9 mg/L	September 2008
	CYN-MW6	27.7 mg/L	December 2007
	CYN-MW6 (dup)	29.3 mg/L	December 2007
	CYN-MW6	27.0 mg/L	March 2008
	CYN-MW6	27.9 mg/L	June 2008
	CYN-MW6	33.0 mg/L	September 2008

Table 2-9. Summary of Non-radiological Exceedances at Sampling Wells – October 2007 through December 2008 (Concluded)

Analyte	Well	Exceedance	Date
TRICHLOROETHENE MCL = 5.0 µg/L	TA2-W-19	6.23 µg/L	October 2007
	TA2-W-19	5.79 µg/L	January 2008
	TA2-W-19 (dup)	5.16 µg/L	May 2008
	WYO-4	6.94 µg/L	October 2007
	WYO-4	9.15 µg/L	January 2008
	WYO-4	6.69 µg/L	August 2008
	WYO-4 (dup)	6.44 µg/L	August 2008
	WYO-4	6.87 µg/L	November 2008
	LWDS-MW1	12.8 µg/L	December 2007
	LWDS-MW1	12.4 µg/L	February 2008
	LWDS-MW1	13.8 µg/L	May 2008
	LWDS-MW1	12.7 µg/L	September 2008
	LWDS-MW1	15.9 µg/L	December 2008
	LWDS-MW1 (dup)	16.2 µg/L	December 2008
	TAV-MW6	7.39 µg/L	November 2007
	TAV-MW6	10.2 µg/L	February 2008
	TAV-MW6	8.71 µg/L	May 2008
	TAV-MW6 (dup)	8.13 µg/L	May 2008
	TAV-MW6	9.81 µg/L	September 2008
	TAV-MW6	9.97 µg/L	December 2008
	TAV-MW10	9.80 µg/L	April 2008
	TAV-MW10	12.6 µg/L	December 2008
	TAV-MW10 (dup)	14.1 µg/L	December 2008

Source: SNL/NM 2009, Table 7-4.

Gross alpha results reported as corrected values (by subtracting the uranium activity).

dup = Duplicate.

µg/L = Micrograms per liter.

mg/L = Milligrams per liter.

pCi/L = Picocuries per liter.

Tijeras Area Groundwater Monitoring (i.e., groundwater beneath TA-I, TA-II, and Tijeras Arroyo). TCE concentrations above the MCL of 5 µg/L were detected in groundwater samples from two perched groundwater system wells. Nitrates exceeded the MCL in three wells during all sampling events. No metal concentrations were detected in excess of established MCLs in any of the wells sampled.

Burn Site Groundwater. No VOCs or SVOCs were detected above MCLs. Nitrates exceeded the MCL in some wells. Perchlorate concentrations exceeded the established screening level in one well. No metal concentrations were detected in excess of established MCLs in any of the wells sampled.

2.2.3 Terrestrial Surveillance

SNL/NM's Terrestrial Surveillance Program also monitors non-radiological contamination. Soil and sediment samples are collected to determine the presence or buildup of pollutants that may have been transported by air or water and deposited on the ground surface, or deposited by

surface water. Sampling locations include various established on-site, perimeter, and off-site locations; however, in some instances, special "sampling campaigns" may be conducted near operations of interest (SNL/NM, 2009). Vegetation is generally only sampled for uptake of radioactive pollutants, and because of a drought, no vegetation samples were collected in 2008.

Samples of surface soils, arroyo and river sediments, and vegetation are collected as part of the Terrestrial Surveillance Program and analyzed for radiological and non-radiological constituents. Locations that were sampled in 2008 are listed in Tables 2-10, 2-11, and 2-12, and are shown previously in Figures 2-4 and 2-5.

Soil. Soil samples are collected to ascertain the presence or buildup of pollutants that may have been transported by air or water and deposited on the ground surface. Approximately 1,500 grams (g) of sample is collected from the top two inches of soil. In 2008, soil samples were collected from locations indicated in Tables 2-10, 2-11, and 2-12.

Sediment. Sediment samples are collected from arroyo beds and from the banks of rivers and creeks to ascertain the presence, or buildup, of pollutants deposited from surface waters. Approximately 1,500 g of sample is collected from the top two inches of soil. Sediment samples were collected from locations listed in Tables 2-10, 2-11, and 2-12.

Gamma Radiation Levels. Gamma radiation levels are measured using TLDs to determine the impact, if any, of SNL/NM's operations on ambient radiation levels. The TLDs are changed out on a quarterly basis and processed at an on-site laboratory. TLDs were collected from locations listed in Tables 2-10, 2-11, and 2-12.

Table 2-10. On-Site Terrestrial Surveillance Locations and Sample Types

Location Number	Sampling Location	Soil	Sediment	Vegetation	TLD
1	Pennsylvania Ave.	X			X
2NW	Mixed Waste Landfill (MWL) (northwest)	X			X
2NE[a]	MWL (northeast)	X			
2SE	MWL (southeast)	X			
2SW	MWL (southwest)	X			
3	Coyote Canyon Control	X			X
6	Technical Area (TA) III (east of water tower)	X			X
7[a]	Unnamed Arroyo (north of TA-V)	X			X
27	Albuquerque Fire Station 11, Southern SE				X
31	TA-II Guard Gate				X
33	Coyote Springs	X		X	
34	Lurance Canyon Burn Site	X			
35	Chemical Waste Landfill (CWL)	X			
41	TA-V (northeast fence)	X			X
42	TA-V (east fence)	X			X
43	TA-V (southeast fence)	X		X	X
45	Radioactive and Mixed Waste Management Facility (RMWMF), TA-III (northwest corner)	X			X
45E	RMWMF, TA-III (east fence)				X
46	TA-II (south corner)	X			X
47	Tijeras Arroyo (east of TA-IV)				X
48	Tijeras Arroyo (east of TA-II)				X
49	Near the Explosive Components Facility (ECF)	X			
51	TA-V (north of culvert)	X			
52	TA-III, northeast of Buildings 6716 and 6717	X			
53[a]	TA-III south of long sled track	X			
54	TA-III, Building 6630	X			
55	Large Melt Facility, Building 9939	X		X	
56	TA-V, Building 6588 (west corner)	X			
57	TA-IV, Building 970 (northeast corner)	X			
66	KAFB Facility	X			X
72	Arroyo del Coyote (midstream)		X		
74N	TA-IV, Tijeras Arroyo (midstream)		X		
75	Arroyo del Coyote (down-gradient)		X		
76	Thunder Range (north)	X			
77	Thunder Range (south)	X			
78	School House Mesa	X			
79	Arroyo del Coyote (up-gradient)	X	X		
83	Tijeras Arroyo Ground Water Well		X		
84	Storm Water Monitoring Point (SWMP)-10		X		
85	Arroyo del Coyote Cable Site		X		
86	Corner of Wyoming and S Street	X			X

Source: SNL/NM 2009, Table 4-2.

[a]Replicate sampling locations: In addition to single samples taken for each medium, two replicate samples are collected for internal checks on comparability of sampling and analysis.

TLD = Thermoluminescent dosimeter.

Table 2-11. Perimeter Terrestrial Surveillance Locations and Sample Types

Location Number	Sampling Location	Soil	Sediment	Vegetation[a]	TLD
4	Isleta Reservation Gate	X			X
5	McCormick Gate	X			X
12	Northeast Perimeter	X			
16	Four Hills	X			X
18	North Perimeter Road				X
19	USGS Seismic Center Gate	X			X
39	Northwest DOE Complex				X
40	TA I, northeast (by Bldg. 852)				X
58	North KAFB Housing	X			
59	Zia Park (southeast)	X			
60	Tijeras Arroyo (down-gradient)	X	X		
61	Albuquerque International Sunport (west)	X			
63	No Sweat Boulevard	X			
64[b]	North Manzano Base	X			
73[b]	Tijeras Arroyo (up-gradient)		X		
80	Madera Canyon	X			
81	KAFB West Fence	X			X
82	Commissary	X			
87	Mesa del Sol (North)	X			
88	Mesa del Sol (Middle)	X			
89	Mesa del Sol (South)	X			

Source: SNL/NM 2009, Table 4-3.

TLD = Thermoluminescent dosimeter.

[a]No vegetation samples were collected due to the ongoing drought.

[b]Replicate sampling locations: In addition to single samples taken for each medium, two replicate samples are collected for internal checks on comparability of sampling analysis.

Table 2-12. Off-Site Terrestrial Surveillance Locations and Sample Types

Location Number	Sampling Location	Soil	Sediment	Vegetation[a]	TLD
8	Rio Grande, Corrales Bridge (up-gradient)	X	X		
9	Sedillo Hill, I-40 (east of Albuquerque)	X			
10	Oak Flats	X			X
11[b]	Rio Grande, Isleta Pueblo (down-gradient)	X	X		X
21	Bernalillo Fire Station 10, Tijeras				X
22	Los Lunas Fire Station				X
23	Rio Rancho Fire Station, 19th Ave.				X
24	Corrales Fire Station				X
25	Placitas Fire Station	X			X
26	Albuquerque Fire Station 9, Menaul NE				X
27	Albuquerque Fire Station 11, Southern SE				X
28	Albuquerque Fire Station 2, High SE				X
29	Albuquerque Fire Station 7, 47th NW				X
30	Albuquerque Fire Station 6, Griegos NW				X
62	East resident	X			
68	Las Huertas Creek		X		

Source: SNL/NM 2009, Table 4-4.

TLD = Thermoluminescent dosimeter.

[a]No vegetation samples were collected due to the ongoing drought.

[b]Replicate sampling locations: In addition to single samples taken for each medium, two replicate samples are collected for internal checks on comparability of sampling analysis.

The following provides a summary of non-radiological sample results for 2008. Sampling locations were shown previously in Figures 2-4 and 2-5.

In 2008, SNL/NM's Terrestrial Surveillance Program sampled for the following metals:

- Aluminum
- Arsenic
- Beryllium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Nickel
- Potassium
- Vanadium
- Zinc

Baseline samples were also taken for explosive compounds, and perchlorate in areas of Thunder Range scheduled for new explosives testing. These are discussed below.

Thunder Range. In the summer of 2008, several areas on SNL/NM's Thunder Range, where future explosives testing is planned, were sampled as part of baseline characterization. The sampling was conducted to document pre-existing contaminants that may remain from past operations. The baseline monitoring data, collected from soils in the study area, indicated that no unusual contamination from target analyte listed metals, high explosives compounds, or perchlorate was present. Arsenic concentrations did not exceed the NMED Soil Screening Levels for industrial/occupational land use in any of the 2008 samples. In all but 36 out of 166 samples, the arsenic concentrations (4.9 to 8.8 milligram per kilogram [mg/kg]) did not exceed the NMED residential soil screening levels. Based on knowledge of site activities in the sample area, arsenic concentrations are most likely naturally occurring. *Table 4-7* in the CY 2008 Annual Site Environmental Report provides the complete sample results from the 2008 Thunder Range sample event (SNL/NM, 2009). Thunder Range activities are discussed in the Operational Area Environmental Evaluation #7 Source Document for Coyote Test Field - West.

SNL/NM Other On-Site and Perimeter Sampling. In 2008, no sampling location was determined to be Priority-1 (i.e., both higher than off-site and with an increasing trend); see Table 2-7 of this document for an overview of priority levels. Fifteen locations were identified as Priority-2 and Priority-3 (i.e., higher than off-site or increasing trend). Priority-2 and Priority-3 2008 sample results for metals in soils are provided in Tables 4-9 and 4-10 in the CY 2008 Annual Site Environmental Report (SNL/NM, 2009). All results were orders of magnitude below NMED Soil Screening Levels. All metals were listed as Priority 4 (no concern, no investigation required) for all sediment samples.

3. WORKER SAFETY

SNL/NM operations are required to be compliant with DOE requirements for worker health and safety. This compliance is to ensure a safe work environment and minimize the potential for work-related exposures, illnesses, or injuries. This section discusses radiological and non-radiological hazardous impacts to workers and provides a summary of relevant SNL/NM data for CY 2008.

3.1 Potential Radiological Exposure to Workers

SNL/NM's Occupational Radiation Protection Program complies with 10 CFR 835, Occupational Radiation Protection.

SNL/NM's Radiation Protection Dosimetry Project tracks dose that individuals may have obtained from exposure to external radiation fields. Radiation monitoring devices called TLDs, or dosimetry badges, are used to monitor an individual's external dose. External dosimetry information is processed using a web-based dosimetry processing system called WebDose. A summary of this information is then provided to DOE's Radiation Exposure Monitoring System database. The WebDose database is discussed further in the Other Data Sources Source Document.

The Radiation Protection Dosimetry Project also tracks exposure and dose that individuals on-site at SNL/NM may have obtained from radioactive material they have taken internally. This is accomplished by the use of personnel air samplers or bioassay which includes analysis of urine or other excreta and whole-body counting.

Worker radiation dose information is tracked as total effective dose equivalent (TEDE). The TEDE is the sum of external and internal radiation dose. Annually, information from TLDs and bioassays is totaled and provided as a TEDE to individual workers.

3.2 Potential Hazardous/Non-radiological Exposure to Workers

3.2.1 Chemical Exposure

Hazardous chemicals may be used on a daily basis by SNL/NM workers. Engineered and administrative controls prevent and minimize personnel exposure to these chemicals. Table 3-1 provides details of the Occupational Safety and Health Administration (OSHA) recordable incidents from personal chemical exposures (tracked as "exposure to caustic, noxious, or allergenic substances") for SNL/NM employees and contractors for CY 2008. Data were obtained through the Safety Incident Tracking System (SITS) database maintained by the SNL/NM Environment, Safety, and Health (ES&H) Performance Assurance Department. The SITS application is discussed further in the Other Data Sources Source Document.

Table 3-1. Reported Personal Chemical Exposures at SNL/NM for CY 2008

OSHA101 Date	Contractor	Body Part	Nature	OSHA Work Related	Days Away	Days Restricted
2/5/2008	Y	Nose	Respiratory	Y	0	33
5/6/2008	N	Nose	Allergic Reaction	Y	0	0
4/30/2008	N	Eye	Irritation	Y	0	0
4/16/2008	Y	Neck	Notification of Potential Injury/Illness	Y	0	0
4/16/2008	Y	Leg(s)	Notification of Potential Injury/Illness	Y	0	0
5/4/2008	N	Chest	Respiratory	Y	0	0
2/20/2008	N	Hand	Dermatitis	Y	0	0
8/21/2008	N	Finger(s)	Allergic Reaction	Y	0	0
10/29/2008	Y	Skin	Respiratory	Y	0	0

Source: Safety Incident Tracking System (SITS) database.

Other sources of exposure data include Industrial Hygiene exposure assessments, conducted by the SNL/NM Industrial Hygiene (IH) Department. These exposure assessments take place in response to worker complaints, scheduled monitoring, worker risk assessments, changes in operations, and other ES&H-related assessments. All exposure assessments are documented using the Open Range™ IH software application. The Open Range™ IH software application is discussed further in the Other Data Sources Source Document.

3.2.2 Accidents, Injuries, and Illness

OSHA has identified important risks to workers' health as common industrial accidents involving slips, trips, and falls, contact with objects, and other accidents; and that result in sprains, cuts, abrasions, fractures, and other injuries. Sandia must comply with Federal requirements for the tracking and reporting of occupational illnesses and injuries as required in the following:

- 29 CFR 1904, Occupational Injuries and Illness Recording and Reporting, July 2004
- DOE-O-231.1A, Environment, Safety, and Health Reporting, June 2004
- DOE-M-231.1-2, Occurrence Reporting and Processing of Operations Information, August 2003
- OSHA CPL 02-00-135, Recordkeeping Policies and Procedures Manual, December 2004

Table 3-2 provides a summary of Injury/Illness Rates for CY 2008.

Table 3-2. SNL/NM CY 2008 Injury/Illness Rates

Parameter	CY 2008
Total SNL/NM employees, including staff augmentation	10,462
Total hours worked by all employees, including staff augmentation	17,021,726
Fatal Occupational Injuries/Illness	
SNL/NM	1[a]
Contractors including staff augmentation	0
Nonfatal Occupational Injury/Illness Rates (per 100 workers/year [per X hours])	
SNL/NM	1.74
Contractors including staff augmentation	1.6
Lost Work Day Case Rates (per 100 workers/year (per 100 workers/year [per X hours])	
SNL/NM	0.22
Contractors including staff augmentation	0.31

Source: Safety Incident Tracking System database.

[a]*According to the Final Occurrence Report (NA--SS-SNL-NMFAC-2008-0017): in 2008, a Facilities Management and Operations Center (FMOC) millwright craftsperson died of complications associated with mesothelioma while being hospitalized for pneumonia.*

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